U.S. Army Corps
of Engineers ®
Alaska District

Donlin Gold Project

Draft Supplemental Environmental Impact Statement

Village of Crooked Creek

Native Village of Napaimute

Native Village of Chuathbaluk

Knik Tribal Council

Akiak Native Community

CEPOA-RD

P.O. Box 6898

JBER, AK 99506-0898

September 2026

DONLIN GOLD PROJECT

DRAFT SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

U.S. Army Corps of Engineers CEPOA-RD

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EXECUTIVE SUMMARY

BACKGROUND

This Draft Supplemental Environmental Impact Statement (SEIS) for the Donlin Gold Project is a supplement to the original 2018 EIS that the U.S. Army Corps of Engineers (Corps) prepared to evaluate the environmental effects of the Donlin Gold Mine, and upon which the record of decision for Permit POA-1995-00120 is based. The Corps is preparing this SEIS to address a narrow issue identified by the U.S. District Court for the District of Alaska in *Orutsararmiut Native Council, et al. vs. U.S. Army Corps of Engineers, et al.* Although the Corps previously evaluated the potential for a tailings release from Donlin's proposed tailings storage facility (TSF), the court held that the 2018 EIS should have considered the potential for a larger tailings spill. The court found that "the FEIS failed to adequately consider one aspect of a complex mining project." The court emphasized that "[t]he issue on remand is narrow and a matter of degree, as the agencies already modeled and considered a tailings spill, albeit only a spill of 0.5 percent of the total tailings volume." Thus, the Corps has scoped this SEIS to evaluate the narrow issue on which court found the 2018 EIS lacking: the possible effects of a larger tailings spill. Although this SEIS evaluates the potential for larger spill events, a tailings dam failure and spill of any magnitude remains extremely unlikely.

The SEIS analysis centers on the proposed TSF Main Dam associated with the Donlin Gold Mine, a large-scale, open-pit gold mining project located approximately 10 miles north of the Village of Crooked Creek within the Kuskokwim River watershed. The Donlin Gold Project includes an open-pit gold mine, processing facilities, a natural gas-fired power plant, a 316-mile natural gas pipeline, transportation infrastructure, and a large TSF. The TSF Main Dam is designed to store approximately 568 million tons of tailings behind a 471-foot-high rockfill dam constructed using the downstream method and founded on competent bedrock. The facility includes a geomembrane liner, underdrain systems, freshwater diversion dams, and seepage recovery infrastructure.

The Project was approved through a joint record of decision issued in 2018 after completion of the 2018 EIS, which evaluated a partial tailings dam failure that released 0.5 percent of the TSF contents, and extensive public review. The original purpose of the Project remains unchanged: to develop and produce gold from the Donlin deposit using infrastructure and technologies suitable for remote western Alaska.

Six tribes challenged the 2018 EIS, joint record of decision, and the Corps' and Bureau of Land Management's (BLM's) authorizations in U.S. District Court (Alaska), arguing that a larger volume tailings spill should be evaluated. In September 2024, the District Court found in favor of the plaintiffs on the tailings spill claim, finding that the 2018 EIS and the BLM's Alaska Native Interests Land Conservation Act (ANILCA) Section 810 analysis should have evaluated a larger tailings spill. The court did not reject the original failure-mode analysis or the environmental evaluation itself, but concluded that the rationale for selecting only the 0.5 percent spill scenario was insufficient. In June 2025, the Court remanded the issue to the Corps and BLM for supplemental analysis without vacating existing Project authorizations.

The SEIS is intentionally limited in scope. Its purpose is to evaluate the social, environmental, economic, and subsistence consequences of larger hypothetical tailings releases. The agencies are not reevaluating Project alternatives, Project design, mining operations, or the permit application itself. Instead, the SEIS focuses solely on the effects of larger spill scenarios and the measures already incorporated into the Project to reduce spill risk.

The Corps will use this information when deciding whether to modify, reaffirm, or rescind its existing permits, while BLM will use the analysis for its ANILCA Section 810 review and in determining whether to modify, reaffirm, or rescind its right-of-way authorization.

TAILINGS MANAGEMENT AND SPILL SCENARIOS

To respond to the Court's concerns, the Corps reviewed global failure databases, engineering literature, empirical release-volume models, and Project-specific design information. This review found that the proposed Donlin TSF possesses several characteristics associated with the lowest observed failure frequencies worldwide, and that no known tailings dam sharing all of these design characteristics has failed. Historical analyses also show that downstream-constructed rockfill dams have substantially lower failure rates than upstream-constructed facilities.

The original 2014 failure modes and effects analysis identified several hypothetical failure pathways. For purposes of the SEIS, the selected catastrophic scenario assumes an initial piping failure that eventually causes dam overtopping and a larger breach. The Corps concluded this represented a credible, conservative mechanism for evaluating the effects of a larger tailings spill.

The Corps selected three larger release scenarios based on statistical models developed from historical tailings dam failures and overall historical averages.

Scenario	Volume Released
5.4% Release	27,640 acre-feet
13.3% Release	54,080 acre-feet
27% Release	109,730 acre-feet

The previously analyzed 0.5 percent release scenario (1,620 acre-feet) is retained as a baseline comparison. The 27 percent scenario was also modeled during a concurrent 100-year flood event to assess impacts across a range of hydrologic conditions.

Tables ES-1 shows a summary of modeled inundation areas, Table ES-2 lists the arrival times of the flow fronts, Table ES-3 lists the change in stream flow from the various release scenarios, and Table ES-4 presents the tailings deposition volumes released, deposited in Crooked Creek, and discharged into the Kuskokwim River.

Table ES-1: Summary of Modeled Inundation Areas

Tailings Release Scenario	Flood Induced	Crooked Creek Inundation Area (acres)	Kuskokwim River Inundation Area (acres)
5.4	Sunny Day	4,507	937[1]
13.3	Sunny Day	5,110	1,460[1]
27	Sunny Day	5,902	2,421[1]
27	Flood Stage	5,902	4,574[1]
-	100-Year Flood (Q_{100})	n/a	159,898

Note:
[1] Expressed as the area flooded outside the extent of the Kuskokwim River for the baseflow conditions.

Table ES-2: Modeled Front and Peak Arrival Times

Location	Tailings Release Scenario			
	Normal Conditions	Normal Conditions	Normal Conditions	Flood Conditions
	5.4%	13.3%	27%	27%
Front Arrival Time (hours:minutes after event)				
Crooked Creek	2:10	1:55	1:30[1]	
Chuathbaluk	11:20	10:55	9:30	6:45
Aniak	18:40	18:45	14:40	10:00
Kalskag	25:30	25:25	22:10	25:10
Peak Arrival Time (hours:minutes after event)				
Crooked Creek	2:30	2:15	1:50[1]	
Chuathbaluk	20:25	19:05	18:50	17:00
Aniak	23:35	23:45	22:25	19:55
Kalskag	40:45	40:30	41:10	39:30

Notes:
[1] Front and peak arrival times for the 27% scenarios are the same for Crooked Creek. The arrival times were modeled along Crooked Creek upstream of the confluence with the Kuskokwim River.

Table ES-3: Modeled Peak Flow, Incremental Peak Flow, and Incremental Increase in Flow Depth

Location and Tailings Release Scenario	Peak Flow (cfs)	Incremental Peak Flow (cfs) [1]	Incremental Increase in Flow Depth (feet)[2]
Village of Crooked Creek Upstream from Kuskokwim River Confluence[3]			
Normal Conditions (5.4%)	130,600	–	–
Normal Conditions (13.3%)	166,080	–	–
Normal Conditions (27%)	430,730	–	–
Flood Conditions (27%)	430,730	–	–
Village of Crooked Creek Immediately Below Crooked Creek and Kuskokwim River Confluence			
Normal Conditions (5.4%)	136,200	67,300	4.9
Normal Conditions (13.3%)	149,100	80,200	5.5
Normal Conditions (27%)	276,800	207,900	11.1
Flood Conditions (27%)	546,240	226,940	5.9
Chuathbaluk			
Normal Conditions (5.4%)	80,600	11,700	1.1
Normal Conditions (13.3%)	79,400	10,500	1.0
Normal Conditions (27%)	91,930	23,030	2.1
Flood Conditions (27%)	340,160	6,160	0.7
Aniak[4]			
Normal Conditions (5.4%)	72,900	7,900	1.0
Normal Conditions (13.3%)	72,100	7,100	0.9

Location and Tailings Release Scenario	Peak Flow (cfs)	Incremental Peak Flow (cfs) [1]	Incremental Increase in Flow Depth (feet)[2]
Normal Conditions (27%)	81,120	16,120	1.8
Flood Conditions (27%)	213,210	6,300	0.3
Kalskag[4]			
Normal Conditions (5.4%)	53,200	4,000	0.6
Normal Conditions (13.3%)	52,800	3,600	0.6
Normal Conditions (27%)	57,140	7,940	1.1
Flood Conditions (27%)	176,670	2,580	0.2

Notes:
[1] The incremental peak flow is the difference between the modeled peak flow and the base flow in the Kuskokwim River.
[2] The incremental increase in flow depth is the difference between the modeled peak flow depth and the base flow depth in the Kuskokwim River.
[3] Incremental peaks and depths are not applicable to Crooked Creek upstream of the confluence with the Kuskokwim River.
[4] The base flows at Aniak and Kalskag are reduced compared to other sites due to a segment of the flow being conveyed through a side channel.

Table ES-4 presents the tailings deposition volumes released, deposited in Crooked Creek, and discharged to the Kuskokwim River.

Table ES-4: Summary of Tailings Deposition in Crooked Creek and Discharged into the Kuskokwim River (Table 3-5 from BGC 2026c)

Tailings Release Scenario (%)	Volume of Tailings Released (acre-ft)	Tailings Deposition in Crooked Creek (acre-ft)	Deposition in Crooked Creek (%)[1]	Discharged to Kuskokwim River (acre-ft)[2]
5.4	17,910	11,877	66%	15,763
13.3	44,350	41,558	93%	12,702
27	100,000	69,588	70%	40,142

Notes:
[1] Expressed as a percentage of the volume of tailings released, and not the total release volume including the pond.
[2] Includes both tailings and 9,730 acre-feet of pond water.

TAILINGS SPILL SCENARIO IMPACTS

The baseline environmental conditions remain the same as presented in the 2018 EIS. This SEIS analyzes the potential effects of larger spill scenarios on the same physical, biological, and social resources analyzed in the 2018 EIS. Several of these resources would only be marginally affected by a larger spill scenario, including geology, geohazards and seismic conditions, climate and meteorology, air quality, and noise and vibration. Brief summaries of effects on the remainder of the resources analyzed in Chapter 4 of the SEIS are included below. In general, impacts become more extensive as spill size increases.

SOILS

Larger spills would cause greater erosion of Anaconda and Crooked Creeks, extensive burial of soils by tailings, and long-term contamination risks from metals and potential acid generation. Impacts would be more extensive and prolonged, especially under the 27 percent scenario. Successful cleanup efforts could reduce the scope, magnitude, and duration of impacts.

SURFACE WATER HYDROLOGY

Larger spills would generate much larger flood waves, inundate thousands of acres, flood portions of the Village of Crooked Creek, alter stream channels, and deposit large volumes of tailings throughout the drainage. Impacts to the Kuskokwim River would generally be attenuated by dilution, although water levels and turbidity would temporarily increase downstream.

GROUNDWATER HYDROLOGY

Impacts would be most acute along the Crooked Creek drainage. Floodwaters and tailings deposits could infiltrate shallow aquifers, elevate local water tables, and create groundwater mounding. The Crooked Creek drinking water source protection area becomes increasingly vulnerable as spill size increases, particularly under the 27 percent scenario.

WATER AND SEDIMENT QUALITY

Acute exceedances of water-quality criteria would occur from dissolved metals and other constituents, while deposited tailings could continue leaching contaminants for years to decades. Turbidity, suspended sediments, and contamination risks increase with spill size and would be most prevalent along the Crooked Creek drainage. The much larger volume of water in the Kuskokwim River is expected to dilute contaminants and limit downstream effects.

VEGETATION

Large areas of vegetation would be buried, scoured, or permanently altered by tailings deposition along the Crooked Creek drainage below the dam. The larger the release the greater the amount of scouring, burial, and associated impacts. Recovery would be slow, potentially taking decades, with some areas remaining unvegetated or transitioning to different plant communities. Successful cleanup efforts could reduce the scope, magnitude, and duration of impacts.

WETLANDS

Thousands of acres of wetlands and many stream miles would be buried, eroded, or converted to uplands, resulting in long-term losses of wetland functions. Recovery may take decades to more than a century and would depend on the success of remediation efforts.

WILDLIFE

Habitat loss, direct mortality, displacement, and contaminant exposure would increase with spill size and be most acute along the Crooked Creek drainage. Impacts would be greatest for aquatic, riparian, and small-bodied species, while broader wildlife-community changes could persist for decades in the Crooked Creek drainage.

FISH AND AQUATIC RESOURCES

Fish habitat, stream connectivity, spawning areas, and aquatic productivity would be severely affected, particularly in Crooked Creek. Larger spills could cause population-level impacts lasting years to decades in Crooked Creek, with the 27 percent scenario potentially causing generational effects.

THREATENED AND ENDANGERED BIRD SPECIES

Effects would primarily occur through sedimentation and potential contaminant exposure in Kuskokwim Bay. Population-level impacts are not expected, even under the largest scenario, due to the dilution of contaminants and wide disbursement of sediments.

LAND OWNERSHIP, MANAGEMENT, AND USE

Ownership would not change, but land use and management could be significantly disrupted by evacuations, access restrictions, and response activities. Impacts become more extensive as spill size increases.

RECREATION

Recreation opportunities, particularly fishing-related activities, could be reduced because of impacts to fish populations and perceptions of contamination. Effects would be localized but longer lasting under larger spills.

VISUAL RESOURCES

Tailings deposits, vegetation loss, flooding, and cleanup activities would create strong and long-lasting visual contrasts on the landscape. Effects would be most pronounced in Crooked Creek and along affected waterways.

SOCIOCULTURAL (CASH AND SUBSISTENCE ECONOMY)

Larger spills could disrupt subsistence harvests, reduce confidence in food resources, damage local economies, damage infrastructure and housing, and displace residents. Economic losses, real and perceived contamination, and effects on subsistence resources increase with spill magnitude.

CULTURAL RESOURCES

Tailings deposition and cleanup-related ground disturbance could damage cultural or historic sites along affected corridors. Risk increases as the impacted area expands.

HUMAN HEALTH

Risks include contaminant exposure, drinking-water concerns, psychosocial stress, displacement, and potential loss of life in heavily affected areas. The 27 percent scenario could render parts of the Village of Crooked Creek uninhabitable and create significant public-safety challenges.

TRANSPORTATION

Larger spills could inundate roads, bridges, airstrips, river travel routes, and port infrastructure, disrupting evacuation, access, and transportation networks. Impacts become increasingly severe and widespread as spill volume increases, especially at Crooked Creek where the airport would be inundated under the 27 percent scenario.

MITIGATION

The proposed Donlin TSF Main Dam possesses several design characteristics associated with the lowest observed failure frequencies worldwide, such as a bedrock foundation, rockfill embankment, and a downstream constructed design. No known tailings dam sharing all of these design characteristics has failed. Historical analyses show that downstream-constructed rockfill dams have substantially lower failure rates than upstream-constructed facilities. The TSF Main Dam is subject to robust oversight and regulation by Alaska Department of Natural Resources (ADNR) through the Alaska Dam Safety Program, which reduces the likelihood of dam failure and associated releases through enforceable design standards, independent technical review, and lifecycle oversight. ADNR approval is required for each stage of dam management: construction, operation, modification, and closure. A detailed explanation of that regulatory framework is provided in Chapter 3.24.1.5 of the 2018 EIS.

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ACRONYMS AND ABBREVATIONS

2018 EIS	*Donlin Gold Project Final Environmental Impact Statement*
ADNR	Alaska Department of Natural Resources
ADSP	Alaska Dam Safety Program
ANILCA	Alaska Native Interests Land Conservation Act
AWQC	Applicable Water Quality Criteria
BLM	Bureau of Land Management
cfs	cubic feet per second
Corps	United States Army Corps of Engineers
CRMP	Cultural Resource Management Plan
CSP^2	Center for Science in Public Participation
cy	cubic yards
Donlin Gold	Donlin Gold LLC
EAP	Emergency Action Plan
EIS	environmental impact statement
ESA	Endangered Species Act of 1973
FAST-41	Title 41 of the Fixing America's Surface Transportation Act
FMEA	failure mode and effects analysis
FWDD	freshwater diversion dam
GHG	greenhouse gas
ICOLD	International Commission on Large Dams
ITRB	Independent Tailings Review Board
LLDPE	linear low-density polyethylene
NAG	non-acid-generating
NEPA	National Environmental Policy Act
PAG	potentially acid-generating
SEIS	supplemental environmental impact statement
SRS	seepage recovery system
TSF	tailings storage facility
TSS	total suspended solids
WRF	Waste Rock Facility
Y-K	Yukon-Kuskokwim

CHAPTER 1 BACKGROUND AND PROJECT PURPOSE OF SUPPLEMENTAL EIS

1.1 PROJECT DESCRIPTION

The Donlin Gold Project is located in the Kuskokwim River watershed, 277 miles west of Anchorage, 145 miles northeast of Bethel, and 10 miles north of the community of Crooked Creek.

Donlin Gold LLC (Donlin Gold) is owned by NovaGold Resources Alaska Inc., a wholly owned subsidiary of NovaGold Resources Inc., and Donlin Gold Holdings LLC, a subsidiary of Paulson Advantage Plus Master Ltd. and Paulson Advisers LLC (together, "Paulson"). Donlin Gold has proposed the development of a gold mine in southwest Alaska. The mine resource area is located on lands owned by Calista Corporation and The Kuskokwim Corporation, which were conveyed to those Alaska Native corporations under a provision of the Alaska Native Claims Settlement Act.

The Project encompasses the construction of an open-pit mine, a tailings storage facility (TSF), a 316-mile natural gas pipeline originating at the western side of Cook Inlet, a natural-gas-fired power plant, advanced processing facilities, designated waste management areas, and the necessary transportation infrastructure to support year-round operations. The primary transportation components include a port facility at Angyaruaq (Jungjuk), a 30-mile mine access road from the port (west of Crooked Creek), a 5,000-foot airstrip, an airstrip spur road, and material sites. The natural gas pipeline will cross portions of federal lands managed by the Bureau of Land Management (BLM), for which BLM has issued a right-of-way.

The TSF would consist of a main, lined dam embankment; two temporary, lined, freshwater diversion dams (FWDDs); a fully lined impoundment; a reclaim water system; and a seepage recovery system (SRS). Built in phases, the facility would have the capacity to store 568 million tons, or 335,000 acre-feet of tailings. The height of the tailings dam at completion would be 471 feet, and the TSF would have a maximum capacity of 366,000 acre-feet. The tailings dam footprint would be excavated to bedrock, constructed using compacted rockfill, a prepared underlayer, and lined with a 60-mil (0.06-inch) linear low-density polyethylene (LLDPE) composite liner on the upstream face. The tailings impoundment footprint would be lined with a 60-mil (0.06-inch) textured LLDPE liner.

During construction, the FWDDs would minimize runoff to the impoundment and facilitate construction of the facility’s starter dam and placement of the liner. During operations, the FWDDs would limit the amount of fresh water entering the TSF and provide control of the volume of water in the impoundment for the first 3 years of operation. At the end of the third year, the FWDDs would be decommissioned.

Runoff to the TSF would be controlled with staged diversion channels built on both sides of the facility, in addition to the two temporary upstream FWDDs. An SRS consisting of a pond, diversion ditches, and monitoring/seepage collection wells would be constructed immediately downstream of the dam. During operations, water from the SRS would be used as process water, pumped back into the impoundment, or treated and discharged. Evaporators would be used to reduce pond size and, secondarily, to control beach dust.

The construction of all Project components that were previously permitted will result in the discharge of 4,368,300 cubic yards (cy) of fill material, permanently impacting 2,877 acres of wetlands, 3 acres of fill below the ordinary high-water mark of the Kuskokwim River, and 172,844 linear feet of stream, and temporarily impacting 538 acres of wetlands and 53,346 linear feet of stream.

1.2 PERMITTING HISTORY AND PROJECT PURPOSE

In July 2012, Donlin Gold sought a Section 10/404 permit from the U.S. Army Corps of Engineers (Corps) to allow for the discharge of fill within waters of the U.S. and construction in navigable waters. The Corps was the lead agency on the original EIS that was prepared under the National Environmental Policy Act (NEPA). A notice of intent was issued in December 2012 and a draft EIS in November 2015. Public scoping meetings were held in early 2013, and the draft EIS public meetings and Alaska Native Interests Land Conservation Act (ANILCA) Section 810 subsistence hearings were held in early 2016. In April 2018, the final EIS (2018 EIS) was published. A joint record of decision between the Corps and the BLM was issued in August 2018, and it selected Alternative 2, Donlin Gold's proposed action.

The overall purpose of the Donlin Gold Project, as defined by the Corps in the EIS, is to produce gold from the Donlin deposit ore reserves using mining processes, infrastructure, logistics, and an energy supply(s) practicable for application in remote western Alaska. The Purpose and Need statement remains the same as presented in the 2018 EIS.

1.3 ORDER MANDATING SUPPLEMENTAL ANALYSIS

The 2018 EIS analyzed six alternatives and evaluated the potential impacts of a variety of spill risks, including a hypothetical failure of the TSF Main Dam. The hypothetical failure considered was a partial dam breach which released approximately 0.5 percent of the facility's total capacity. This assessment was informed by an early-stage Failure Modes and Effects Analysis Workshop, in which a team of experts evaluated potential causes of failures at the TSF Main Dam (SRK 2015). Six tribes—Chevak Native Village, Native Village of Eek, Native Village of Kwigillingok, Organized Village of Kwethluk, Orutsararmiut Native Council, and Tuluksak Native Community—challenged the 2018 EIS, joint record of decision, and the Corps' and BLM's authorizations in U.S. District Court (Alaska), arguing, among others, that a larger volume tailings spill should be evaluated. In September 2024, the District Court found in favor of the plaintiffs on the tailings spill claim, finding that the 2018 EIS and the BLM's ANILCA Section 810 analyses should have evaluated a larger tailings spill. The court specifically took issue with the 2018 EIS's rationale for selecting the chosen spill volume for analysis. The court identified evidence in the record, including evidence of failures at other dams, that it determined justified evaluation of a larger tailings spill. The court did not criticize the use of a failure mode and effects analysis (FMEA), nor did it take issue with the Corps' environmental analysis of the 0.5 percent release. In June 2025, the court issued an order remanding the 2018 EIS to the Corps and BLM to supplement the 2018 EIS with the evaluation of a larger tailings spill without vacating the Corps' and BLM's authorizations for the Project.

The Corps and BLM published a special public notice on January 26, 2026, to inform the public of the intent to prepare a supplemental EIS (SEIS) (Corps 2026). The special public notice comment period began on January 26, 2026, and expired on February 24, 2026. The Corps received a total of 14 submissions during the special public notice comment period. A summary of the submissions received relevant to the analysis of a larger tailings spill is included in Appendix A.

1.4 PURPOSE AND SCOPE (OF THE SEIS)

This SEIS is a supplement to the original 2018 EIS the Corps prepared to evaluate the environmental effects of the Donlin Gold mine, and upon which the record of decision for Permit POA-1995-00120 is based. The Corps is preparing this SEIS to address a narrow issue identified by the U.S. District Court for the District of Alaska in *Orutsararmiut Native Council, et al. vs. U.S. Army Corps of Engineers, et al*. Although the Corps previously evaluated the potential for a tailings release from Donlin's proposed TSF, the court held that the 2018 EIS should have considered the potential for a larger tailings release. The court found that "the FEIS failed to adequately consider one aspect of a complex mining project." The court emphasized that "[t]he issue on remand is narrow and a matter of degree, as the agencies already modeled and considered a tailings spill, albeit only a spill of 0.5 percent of the total tailings volume." Thus, the Corps has scoped this SEIS to evaluate the narrow issue on which court found the 2018 EIS lacking: the possible effects of a larger tailings spill. Although this SEIS evaluates the potential for larger spill events, tailings dam failure and tailings spills of any magnitude remain extremely unlikely.

The Corps is preparing an SEIS to analyze such a spill prior to deciding whether to modify, reaffirm, or rescind the existing permit issued under Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act (Section 10/404 permit) for the Project based on the SEIS analysis. BLM will use the SEIS analysis for its ANILCA Section 810 review and consider both to assess whether to modify, reaffirm, or rescind the right-of-way authorization.

As discussed in Chapter 2, a tailings dam failure of any size is extremely unlikely to occur at the Donlin TSF Main Dam. Multiple spill values were chosen due to the uncertainty inherent in determining an appropriate larger spill release size and the availability of multiple models and methods. The SEIS primarily relies on the baseline information from the 2018 EIS. The SEIS analyzes the resulting social, economic, physical, chemical, and biological impacts from a larger tailings spill on the affected areas, including an analysis of subsistence impacts under ANILCA Section 810. The SEIS also identifies measures that will reduce the potential for a larger tailings spill, ensuring that a dam failure of any size or intensity is extremely unlikely to occur in the first place. Neither additional alternatives nor other sources of impacts from the Project are evaluated.

The permittee has not proposed any changes to the activities the Corps evaluated in the 2018 EIS and authorized in a permit issued on August 13, 2018. Thus, the scope of the authorized activities has not changed. The Corps' permit authorizes proposed discharges of dredged or fill material into waters of the United States, pursuant to Section 404 of the Clean Water Act, and structures or work in navigable waters pursuant to Section 10 of the Rivers and Harbors Act of 1899. Tailings spills are not intended as part of the Project, are extremely unlikely, and are not proposed discharges. Accordingly, the Corps' permit does not authorize tailings spills. Although the Corps is preparing this SEIS to evaluate tailings spills in accordance with the court order, tailings spills are a remote possibility and not an effect caused by the Corps' permit decision.

1.5 COOPERATING AGENCIES

The Corps is the lead federal agency for this SEIS. Four agencies and six Alaska Native tribal councils with federally recognized tribal government status were identified to have jurisdiction by law or special knowledge or expertise, and on this basis serve as cooperating agencies under NEPA. The cooperating agencies are:

- BLM
- U.S. Environmental Protection Agency
- U.S. Fish and Wildlife Service
- State of Alaska
- Village of Crooked Creek
- Native Village of Chuathbaluk
- Knik Tribal Council
- Native Village of Napaimute
- Native Village of Akiak

These are the same cooperating agencies as for the EIS except for the Pipeline Hazardous Materials Safety Administration, which was involved with the EIS. The Pipeline Hazardous Materials Safety Administration issued a Special Permit to Donlin Gold to allow Strain-Based Design, and this authorization was not affected by the litigation.

CHAPTER 2 TAILINGS MANAGEMENT AND SPILL SCENARIOS

2.1 SELECTION OF TAILINGS SPILL SCENARIOS FOR ANALYSIS

The U.S. District Court of Alaska instructed the Corps to evaluate a larger tailings spill scenario, but the court did not specify how to determine the spill size or what size should be analyzed. In response, the Corps reviewed information from the 2018 EIS, published literature on tailings dam failures, published predictive models on spill volumes, historical statistics on failure rates and spill volumes, an analysis of international tailings dam failures prepared by BGC Engineering Alaska Inc (BGC 2026b), and the primary design characteristics of the Donlin TSF Main Dam. Based on this review, the Corps concluded that a catastrophic tailings dam failure at the Donlin Mine is extremely unlikely due to the dam's design, regulatory oversight, and mitigation measures. To estimate potential spill volumes, the Corps evaluated several peer-reviewed empirical models and statistics on historical tailings dam failures, including work by Rico et al. (2008), Larrauri and Lall (2018), Piciullo et al. (2022), and Stark et al. (2022). Multiple spill release scenarios were chosen due to the uncertainty inherent in determining an appropriate larger spill release size and the availability of multiple models and methods, rather than relying on a single spill estimate.

2.1.1 REVIEW OF STATISTICS ON TAILINGS DAM FAILURES

Currently, information on tailings dam failures is commonly obtained from the International Commission on Large Dams (ICOLD), the United Nations Environment Programme, the World Energy Information Service, and the Center for Science in Public Participation (CSP^2 2025).

ICOLD issued an update in 2019 to Bulletin 99, Statistical Analysis of Dam Failures (ICOLD 2019). The update includes extending the inventory of previously known failures and updating the total number of existing dams. The update documents a total of 322 dam failures worldwide from 39,071 existing dams of multiple sizes and designs.

The number of tailings dam failures remained low until the 1950s. The number of failures increased after the 1950s due to the worldwide demand for metals. About 64 percent of the number of failures occurred from 1960 to 1999 (Azam and Li 2010). Magnitude-recurrence statistics indicate that tailings dam breaches have produced mass flows with volumes of more than 1 million cubic meters once every 2 to 3 years from 1965 to 2020 (Rana et al. 2021).

Many factors can affect the probability of a tailings dam failure. The foundation of a dam significantly affects the stability of the embankment, with a bedrock foundation being the most robust foundation design. The type of embankment fill material is also an important factor. Types of embankment fill materials include compacted soil, processed tailings, and rockfill. A rockfill embankment would be considered a more robust design because it is not susceptible to liquefaction. Based on ICOLD statistical data for dam failures, HydroCoop (2013) noted that far fewer failures have occurred worldwide for rockfill dams compared to earthfill dams. In a benchmarking study of British Columbia tailings dam failure frequency, Independent Expert Evaluation and Investigation Review Panel (IEEIRP 2015) noted that there were no failures of rockfill dams out of 525 dam-years of active operation for U.S. water dams.

Tailings dams are raised through three different construction methods: upstream, centerline, and downstream. The upstream construction method is found to be more prone to failure and more susceptible to static and dynamic liquefaction, compared to the centerline and downstream construction methods (Chambers and Higman 2011; Piciullo et al. 2022). In their analysis, Piciullo et al. (2022) found that the upstream construction method had a higher frequency (relative to total) of failure (0.13), followed by the centerline construction method (0.11), and the downstream construction method (0.07). Similarly, Franks et al. (2021) noted that active upstream constructed facilities are more prone to stability problems than those built using other methods. Of the 94 U.S. failures between 1940 and 2018, only 10 involved downstream construction, none were rockfill dams, and the last recorded failure of a downstream raised tailings dam in the USA was in 1989 (Stark et al. 2022; CSP² 2025). Other important factors that influence failure probability include the adequacy of the hydrologic capacity of the impoundment, drainage and seepage control, construction quality, and how seismically active the location is. The Donlin TSF Main Dam would be constructed using the downstream method and would not be susceptible to liquefaction because it would have a bedrock foundation and a rockfill embankment, which are not liquefiable.

Historical data indicate that tailings dams over 328 feet (100 meters) in height have the lowest failure rates (Stark et al. 2022). This finding can be attributed to the fact that taller dams require more regulatory oversight, including additional design, analysis, inspection, monitoring, and instrumentation (Stark et al. 2022). The Donlin Gold TSF Main Dam would be constructed to a height of 471 feet (144 meters), which puts it in the category of dams associated with the lowest historical failure rates. For comparison, the existing Fort Knox Gold Mine tailings dam near Fairbanks is about 350 feet in height and the Pogo Mine Dry Stack Tailing Facility has a height of about 490 feet. ICOLD (2019) reports that to date, no earth fill dam higher than 328 feet has failed. Reported tailings dam heights in failure incidents of gold mine TSFs have ranged from about 16 to 308 feet, averaging about 82 feet (Lin et al. 2022).

Efforts have been made to evaluate statistical relationships to estimate spill volumes for tailings dams. One of the first empirical methods to estimate tailings volume releases was developed by Rico et al. (2008), who analyzed 29 tailings releases around the world by plotting tailings release volume versus tailings storage volume. However, this developed model included data from four water retention dams that behave differently when failing (i.e., almost the entire storage volume is released) compared to tailings dams. Larrauri and Lall (2018) adopted the same dataset of Rico et al. (2008), but they extended it with an additional seven cases. Most recently, Piciullo et al. (2022) used 70 failure cases from the Center for Science in Public Participation (CSP² 2025) database to develop a single regression model that related spill volume to stored volume, and a multiple regression model that also factored in dam height. None of these models consider detailed design factors such as foundation type, fill material, or construction raise method. Therefore, it is difficult to determine what exact spill volume to analyze for a breach analysis given that the models do not factor in detailed design factors, and each model produces a different release percentage estimate.

To date, no known tailings dam with the design characteristics proposed for Donlin's TSF Main Dam has failed. The TSF Main Dam would be built on a bedrock foundation, the embankment would be of rockfill material, and it would be constructed using the downstream method. The proposed first (starter) TSF Main Dam construction prior to mine start-up will be a 198-foot-high embankment, which would be raised in the downstream direction in seven construction campaigns. Dam raises are planned about every 4 years throughout the life of the mine. The final (ultimate) dam height is 471 feet. The TSF Main Dam foundation would be excavated to expose competent bedrock, with the embankment constructed using compacted rockfill, engineered filtered zones, and a prepared underlayer for the geomembrane. The TSF Main Dam would be lined on its upstream face with 60-mil (0.06-inch-thick) single-sided textured LLDPE liner as the low-permeability barrier to seepage. Liner bedding and filter/transition layers would separate the liner from the rockfill. A network of underdrains below the geomembrane liner within the impoundment is designed to convey average upslope surface runoff, groundwater, and possible liner leakage across the base of the TSF Main Dam to the SRS downstream of the dam. The dam has been designed at a feasibility level to meet or exceed State of Alaska and industry standards for stability under both static and seismic conditions. A cross-section of the proposed dam at its ultimate height is provided on Figure 2-1 of the BGC (2026a) report. See Section 4.22 for a detailed description of design features and mitigation measures to be implemented that reduce the likelihood of a tailings dam failure and resulting spill.

2.1.2 FAILURE MODE AND EFFECTS ANALYSIS AND SELECTION OF FAILURE MECHANISM

An early-stage FMEA workshop was performed for the Project in December 2014 to inform the NEPA process. The purpose of the FMEA workshop was to identify and evaluate significant risks and "credible failure modes" associated with the TSF Main Dam during current and future design stages (the dam design was not "final," and was not yet in the approval process with Alaska Department of Natural Resources [ADNR], Dam Safety and Construction Unit). A "credible failure mode" refers to failure mechanisms that are technically feasible given the materials present in the facility and its foundation, the properties of those materials, the configuration of the facility, and drainage conditions and surface water control at the TSF throughout the lifecycle under static and transient loading conditions that the TSF may be subject to over its lifecycle. A "credible failure mode" refers solely to the possible mechanism by which a release could occur, and not the likelihood or probability. The "credible failure modes" identified in the workshop are summarized in Table 2.1-1 below.

Table 2.1-1: Credible TSF Main Dam Failure Modes Identified in the 2014 FMEA Workshop

Scenario	Full or Partial Beach	Consequence Severity	Likelihood	Risk Rating
1. Downstream failure of dam due to material variability results in partial breach that reaches Crooked Creek*	Partial	Major	Unlikely	Moderately High
2. Poor Quality Assurance/Quality Control during construction of filter/liner materials results in a leak and ultimately a piping failure and catastrophic release	Full	Critical	Very Unlikely	Moderately High
4. Liner rupture directly above the underdrain leads to sinkhole and outflow of tailings through underdrain*	Partial	Critical	Unlikely	Moderately High
11. Spillway blockage by ice and snow leads to overtopping and breach of dam	Full	Critical	Very Unlikely	Moderately High

Scenario	Full or Partial Beach	Consequence Severity	Likelihood	Risk Rating
20. Liner rupture leads to piping of native materials into the underdrain and release of tailings and formation of a sinkhole	Partial	Moderate	Very Unlikely	Low
24. Mass wasting failure at the abutment (landslide) occurs following construction results in catastrophic dam failure	Full	Critical	Very Unlikely	Moderately High
37. Deep-seated failure of dam foundation due to undiscovered conditions leads to catastrophic dam failure	Full	Critical	Very Unlikely	Moderately High

*Modeled as part of the 2018 EIS
Source: BGC 2026a (Appendix B)

BGC was ultimately requested to model releases from two hypothetical failure modes: (1) a piping failure leading to partial breach, and (2) a liner rupture leading to a sinkhole and outflow of tailings through the underdrain system. Both failures were modeled as a release of 0.5 percent of the facility's total capacity. These two failure modes reflect Scenarios #1 and #4 from the FMEA. Subsequent modeling showed that the partial dam breach release from a piping failure was more severe than the liner rupture release. Therefore, the liner rupture release scenario was dismissed from further analysis in the 2018 EIS because its impacts were lower. Scenarios #1, #4, and #20 from the FMEA represent smaller partial breaches of the TSF and, therefore, were not considered further in this supplemental analysis. The most plausible cause of a larger release based on the credible failure modes identified in the 2014 FMEA was assessed to be Scenario #2, where poor quality assurance and control leads to a piping failure that causes overtopping and a catastrophic release. This selected approach aligns with ADNR Dam Safety Program guidance, which recommends considering piping failures for embankment dams.

The other larger release FMEA scenarios were not considered further in the analysis for several reasons. Scenario #11 could only occur during the closure/post-closure period. The risk for Scenario #11 is highly improbable because the TSF pond will be routed to the southeast, toward the closure spillway and away from the dam structure. An overtopping failure during this period would require extreme, prolonged maintenance neglect that allows a spillway blockage to back up water enough to overtop the dam. Scenario #24 assumes a failure occurs immediately after (or during) the initial starter dam phase. Because this scenario lacks the massive stored volume of the ultimate, full-height TSF Main Dam, it was considered non-conservative and not considered further. Scenario #37 was assessed to have a similar breach progression, hydrograph, and resulting impacts compared with the selected Scenario #2. Specifically, the failure mechanism and resulting breach hydrograph would follow a similar progression: geotechnical failure of the downstream slope, lowering of the dam crest, subsequent overtopping, and a catastrophic breach.

The U.S. District Court of Alaska did not opine upon the failure modes selected in the FMEA. The SEIS continues to rely on the 2014 FMEA because of its validity for evaluating potential dam failure modes. Although the FMEA was completed at an early stage of design, the dam's fundamental configuration has not materially changed, and the credible failure mechanisms identified in the analysis remain applicable to the proposed design. The FMEA was conducted by independent, qualified experts and followed established practice for identifying plausible failure mechanisms at the feasibility stage of design.

The early-stage FMEA conducted in 2014 does not replace the need for an FMEA during the final design and dam safety approval process for which the ADNR is responsible. Prior to construction of the dam, Donlin Gold would provide a proposed fully engineered design that would then be the subject of an FMEA to assess potential weakness in the design. Any design weaknesses identified in the FMEA would be addressed, and the design revised prior to approval by ADNR.

2.1.3 SELECTED SPILL SCENARIOS AND RATIONALE

Multiple larger catastrophic spill percentages were chosen to model for the breach analysis of the Donlin TSF Main Dam based on review of historical tailings dam spill data (BGC 2026b; Piciullo et al. 2022; Stark et al. 2022). Multiple spill values were chosen due to the uncertainty inherent in determining an appropriate larger spill release size and the availability of multiple models and methods. The tailings dam spill scenarios selected for analysis in the SEIS include releases of 5.4 percent, 13.3 percent, and 27 percent of the total tailings volume (334,300 acre-feet consisting of 153,800 acre-feet of solids and 180,500 acre-feet of interstitial water), plus the supernatant pond volume of 9,760 acre-feet, which is the 50th percentile pond volume at the end of operations (BGC 2015a) and represents normal operating conditions. These scenarios were modeled assuming the ultimate dam height of 471 feet. Additionally, the analysis of the 2018 EIS scenario of 0.5 percent is summarized here-in for comparison to the new, larger volume release scenarios.

Various empirical methodologies and spill estimates were considered when determining the spill release volumes to model. This included 5.4 percent and 13.3 percent estimates derived from the empirical models developed by Piciullo et al. (2022), a 24.6 percent estimate using the model developed by Larrauri and Lall (2018), a 36 percent estimate using the method described by Adria et al. (2023) and the 3 degrees backscarp angle method, and a 38 percent estimate using the model developed by Rico et al. (2008). The models developed by Piciullo et al. (2022) were selected because they are based on a much larger and more diverse dataset (71 case studies) than those used by Larrauri and Lall (2018) (28 cases) and Rico et al. (2008) (21 cases), making them more representative of real-world tailings dam failures. Additionally, Rico et al. (2008) used four water retention dams in their dataset that behave differently when failing (i.e., almost the entire storage volume is released) compared to tailings dams, making their model not properly representative. The 36 percent estimate, derived partly from Adria et al. (2023) and the 3 degrees backscarp angle method, was also considered less applicable because it is largely based on the Wahl (2014) dataset, which primarily includes earthen dams. Earthen dams are generally more erodible and tend to experience larger releases during failures. In contrast, the Donlin TSF Main Dam will be a rockfill dam, which has much lower erodibility. Supporting this distinction, analysis of the CSP² dataset in the BGC (2026b) report found that only 5 percent of documented tailings dam failures involved rockfill or waste-rock-fill dams.

Release volumes were calculated using the methods described in Piciullo et al. (2022), and technical details can be found in the BGC (2026c) report. The 5.4 percent spill release was determined by using a single regression statistical model developed by Piciullo et al. (2022) that related stored volume to observed historical spill volumes. The 13.3 percent spill release was determined by using a multiple regression statistical model developed by Piciullo et al. (2022) that related stored volume and dam height to observed historical spill volumes. Data on average historical spill volumes was also reviewed in choosing spill volumes to model. The 27 percent spill release was determined by using the historical average tailings dam spill volume based on the analysis of the CSP² dataset by Piciullo et al. (2022). The historical average and the statistical models developed by Piciullo et al. (2022) do not factor in the more robust design features of the TSF Main Dam, such as its bedrock foundation, compacted rockfill embankment, and the downstream construction raise method. Instead, the models and historical average rely on data from tailings dams of all types and designs. Therefore, the spill percentages selected for modeling are conservative given the robust design features of the Donlin TSF Main Dam. Table 2.1-2 outlines the selected scenarios, volumes released, modes of failure, and material released. These selected catastrophic failure scenarios would be extremely unlikely given the robust design characteristics of the dam.

Table 2.1-2: Tailings Dam Spill Scenarios Selected for Analysis in the SEIS

Scenario/ Percentage of Contents Released[1]	Volume Released (acre-feet)	Source	Material Released	Failure Mode	Hydrologic Regime
0.5 Percent (Summary of 2018 EIS)	1,620	2015 early-stage FMEA workshop	The 2018 EIS analyzed two hypothetical releases; a water-only scenario and a slurry of tailings and water	Two failure modes: Piping and liner rupture leading to sinkhole and outflow through the underdrain	Sunny day
5.4 Percent	27,640	Piciullo et al. (2022) single regression[2,3]	Slurry	Initial piping failure leading to overtopping	Sunny day
13.3 Percent	54,080	Piciullo et al. (2022) multiple regression[2,4]	Slurry	Initial piping failure leading to overtopping	Sunny day
27 Percent	109,730	Piciullo et al. (2022) historical average[2,5]	Slurry	Initial piping failure leading to overtopping	Sunny day and 100-year flood stage

Notes:

[1] All spill percentages are based on a tailings volume of 334,300 acre-feet consisting of 153,800 acre-feet of solids and 180,500 acre-feet of interstitial water, plus a supernatant pond volume of 9,760 acre-feet, which is the 50th percentile pond volume at the end of operations (BGC 2015a) and represents normal operating conditions.

[2] Piciullo, L., E.B. Storrøsten, Z. Liu, F. Nadim, and S. Lacasse. (2022). A new look at the statistics of tailings dam failures. Engineering Geology, 303, 106657. https://doi.org/10.1016/j.enggeo.2022.106657.

[3] 71 historical tailings dam failure cases with linear regression of release volume versus storage volume.

[4] 71 historical tailings dam failure cases with multiple regression of release volume versus storage volume and dam height.

[5] Historical average volume released during the tailings failures events as published by Piciullo et al. 2022.

2.2 TAILINGS SPILL SCENARIO MODELING

2.2.1 GENERAL BEHAVIOR OF A TAILINGS DAM RELEASE

When a tailings dam fails, the stored material—typically a slurry of finely ground rock, process water, and residual chemicals—rapidly transitions from a semi-contained or weakly consolidated state into a highly mobile, gravity-driven flow. The behavior of tailings flows are highly dependent on the solid-to-water concentration level and particle size, which determines whether the flow behaves as a Newtonian or non-Newtonian fluid for modeling. Newtonian flows, such as clean water, have a constant viscosity regardless of flow conditions, meaning the relationship between shear stress and strain rate is linear and predictable. In contrast, non-Newtonian flows, such as tailings slurries composed of fine-grained solids and water, exhibit viscosity that changes with shear rate, solids concentration, and stress history. These materials may behave more like a viscous or plastic mass, requiring a threshold force before movement begins and displaying greater resistance to flow than water alone. As a result, non-Newtonian tailings flows can travel as dense, slow-moving flood waves that deposit large volumes of material near the release area, whereas Newtonian flows tend to spread, dilute, and behave predictably within natural channels. Correctly characterizing these flow regimes is important for the accurate modeling of inundation extent, velocities, and deposition patterns following a tailings dam breach (See the full TSF Main Dam Breach Assessment modeling report in Appendix B for discussion on variations in flow properties with varied water and sediment content.).

Physically, a tailings flow often behaves like a debris flow or mudflow, depending on the water content and grain-size distribution. The leading surge can scour riverbeds, strip topsoil, and destabilize slopes, widening channels and altering drainage patterns. Behind the surge, sediment-laden water spreads across floodplains, depositing layers of fine sediment that can bury ecosystems and infrastructure. These deposits may later dry and consolidate, forming hard, compacted surfaces that change soil permeability and inhibit vegetation regrowth. Secondary remobilization is also common: rain events or rising river levels can re-erode deposited tailings, extending contamination and sediment transport farther downstream over time.

Hydrologically, the influx of tailings dramatically changes water characteristics. Suspended solids increase turbidity, reducing light penetration and affecting aquatic photosynthesis. The altered sediment load can clog fish gills, bury spawning habitats, and disrupt benthic ecosystems. Over time, the deposited material may continue to interact with surface and groundwater, influencing flow regimes and potentially creating perched water tables or altering infiltration rates. Residual pore water trapped in the tailings can continue to drain slowly, sustaining the release of fine particles and dissolved constituents long after the initial failure event.

Finally, the physical behavior of tailings has long-term geomorphic implications. Deposits may remain unstable for years, especially if they retain high moisture or are on slopes, posing ongoing risks of smaller landslides or flows. Rivers may adjust to the sudden influx of sediment by aggrading (raising their beds) or by cutting new channels, which can shift flood risks to new areas. The landscape, therefore, undergoes both immediate and evolving change, driven by the interaction between the deposited tailings, weather processes, and the local hydrologic system.

2.2.2 SUMMARY OF 2018 EIS SCENARIO

An inundation study was conducted for the 2018 EIS release scenario of up to 2.6 million cy (0.5 percent of the ultimate storage volume at end of operations) to estimate the potential downstream consequences of two failure modes: a partial dam breach due to piping, and a liner rupture leading to a sinkhole and outflow of stored material (BGC 2015b). For both of these potential failure modes, BGC modeled a release of a mixture of process-affected water and tailings, and a release of process-affected water only, to evaluate a range of possible spill scenarios.

The potential spill scenarios were modeled in these ways to bracket the range of flow distances, velocities, and depths for the range of possible materials that could spill. Modeling was conducted using FLO-2D, a Federal Emergency Management Agency–approved, two-dimensional hydraulic model. This model was selected because of its ability to model both tailings (slurry) and "clear water" flow inundation processes. The tailings slurry was modeled as a non-Newtonian fluid, while the process water release was modeled as a Newtonian fluid (BGC 2015b).

Modeling showed that the partial dam breach release from a piping failure (internal erosion) would be more severe than the liner rupture release (BGC 2015b). Therefore, the inundation results analyzed in the 2018 EIS were for the partial dam breach release from the piping failure, and the liner rupture release was dismissed from further analysis.

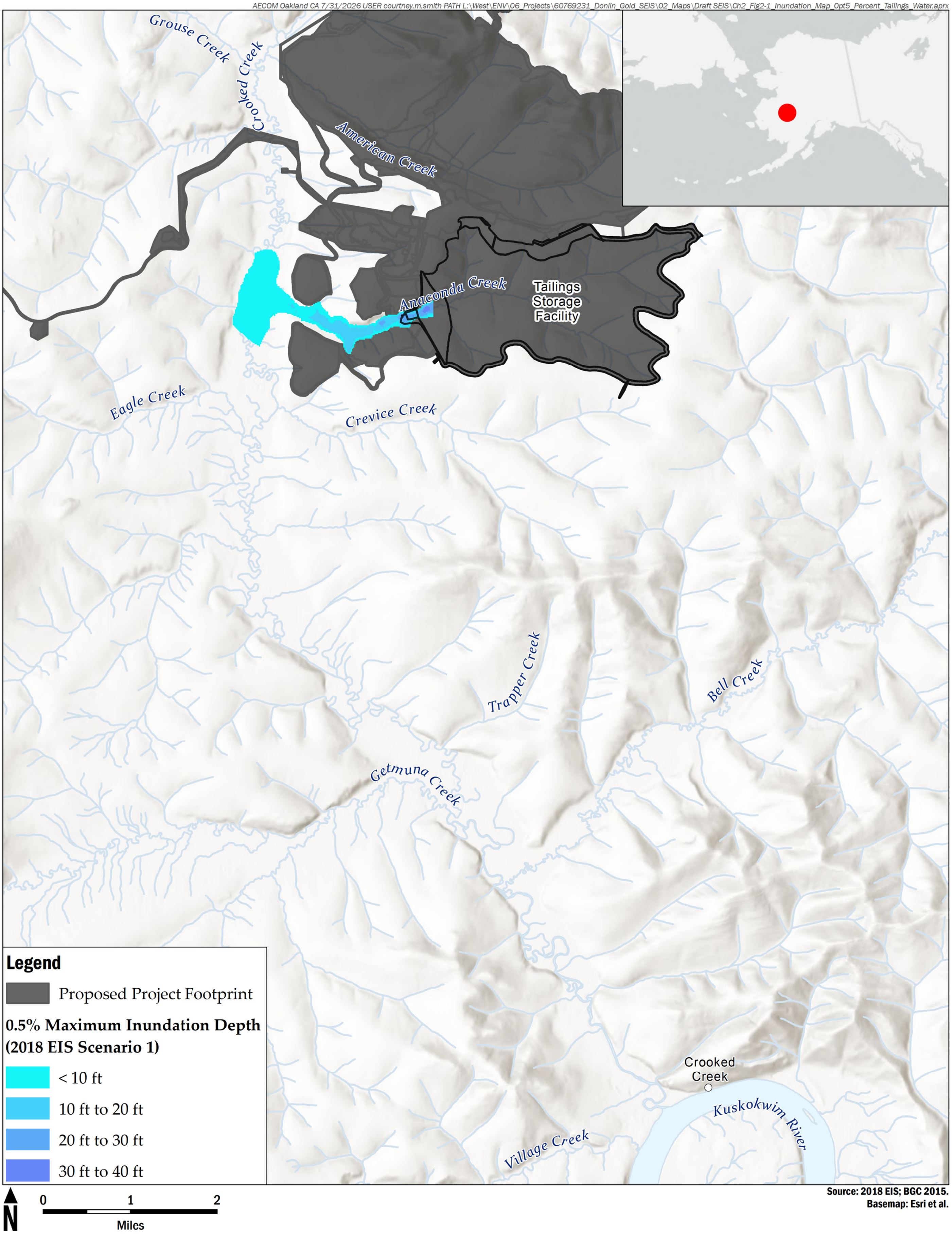
The modeling produced inundation extent limits and deposition depth predictions from the dam breach to a short distance up Crooked Creek. It was determined through modeling that the tailings would not flow further downstream into the Kuskokwim River. Figure 2-1 depicts the inundation extent for the tailings and water release and Figure 2-2 depicts the deposition of tailings for the tailings and water release. Figure 3.24-4 in the 2018 EIS depicts the inundation extent for the water-only release but the water-only release is not carried forward into the SEIS (as explained below).

In the modeled tailings-and-water release scenario, tailings deposits greater than approximately 1 to 2 feet deep would extend from the TSF dam downstream to the Anaconda Creek–Crooked Creek confluence, and approximately 0.5 mile upstream and downstream. Water and suspended solids would continue to flow down Crooked Creek to the Kuskokwim River and beyond.

Modeled tailings deposition depths along Anaconda Creek ranged from less than 2 feet to 8 feet, with an estimated 1,300 acre-feet of tailings potentially deposited in Crooked Creek. Predictions of deposition less than 1 to 2 feet are uncertain because of limitations in modeling accuracy and available topographic data. If the release occurred during summer, deposited tailings could temporarily block Crooked Creek, with some material later remobilized and carried downstream. Cleanup would be challenging because of creek flows and limited equipment access. In a winter release scenario, the cone-shaped tailings deposit could be excavated and returned to the tailings facility before spring thaw, reducing subsequent impacts.

Modeling of the water-only release scenario indicated that the release would reach the Crooked Creek–Kuskokwim River confluence in approximately 24 to 25 hours, with a maximum flow rate of approximately 600 cubic feet per second (cfs). The release would significantly affect flow depths and velocities in Anaconda Creek but would have little effect in Crooked Creek due to its broad floodplain (about 0.5 mile wide) and gentle gradient (about 0.3 percent), which dissipate and attenuate floodwaters before they reach the Kuskokwim River. Even at peak discharge, the water-only release would be relatively small compared to flow rates in the Kuskokwim River, representing about 4.0 percent of winter flow and 1.8 percent of summer flow (BGC 2015b). The release is expected to have limited influence on water levels and velocities by the time it reaches the Kuskokwim River.

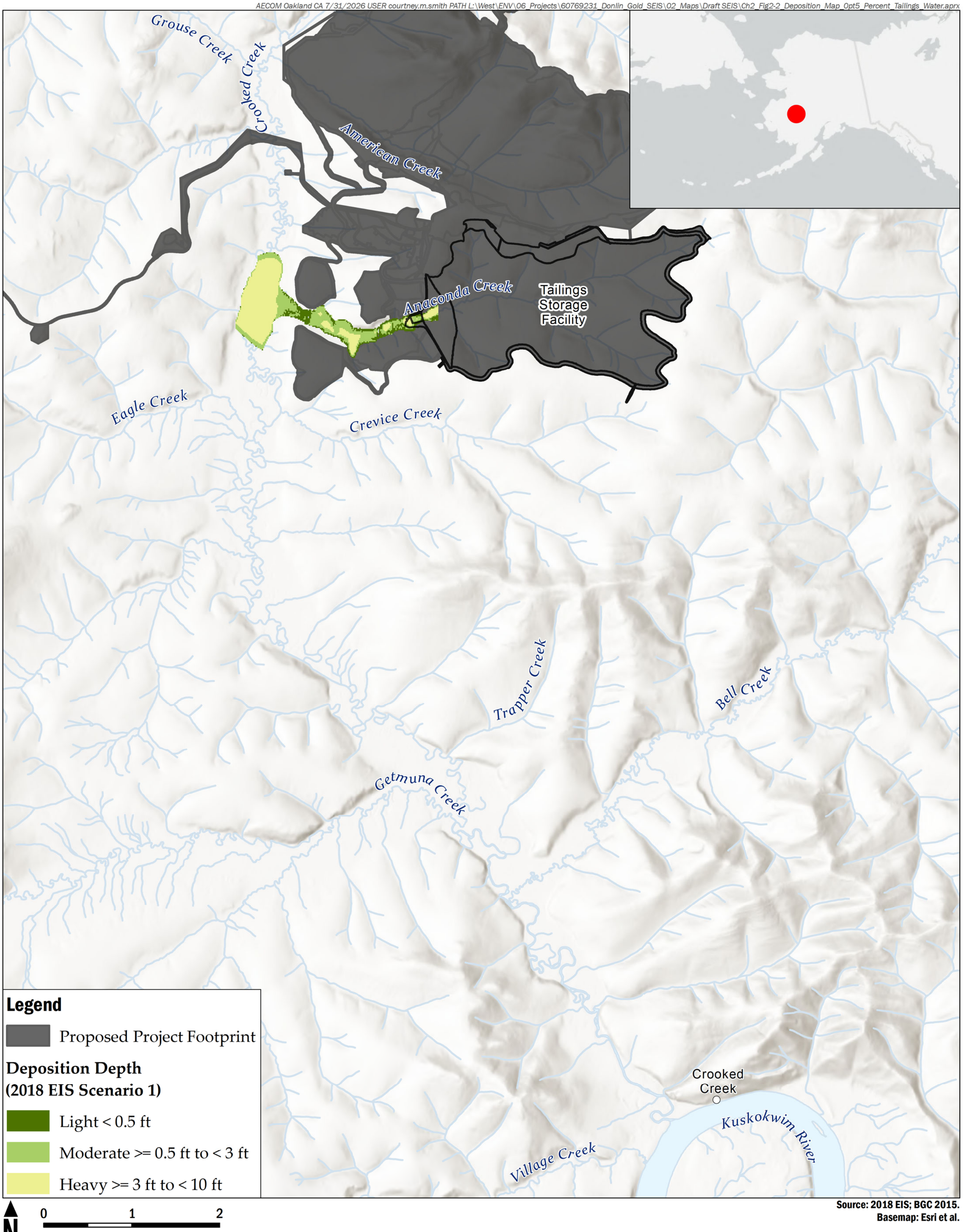
The water-only release scenario analyzed in the 2018 EIS is not carried forward into the SEIS for several reasons. First, it is inapplicable because it was tied to the partial breach failure modes evaluated in 2018; the larger overtopping failures now analyzed would necessarily mobilize tailings with process water, making a water-only release implausible. Second, it is unnecessary because, in the 2018 EIS, the water-only case served as a conservative upper bound on inundation, whereas the larger slurry releases in this SEIS exceed that footprint. Finally, it is unhelpful because a water-only scenario would not aid in comparing impacts across the larger slurry release volumes evaluated here.



Source: 2018 EIS; BGC 2015.
Basemap: Esri et al.

AECOM
U.S. Army Corps of Engineers
Donlin Gold Supplemental EIS
DRAFT

FIGURE 2-1
0.5 Percent Inundation Map (Tailings and Water)



Source: 2018 EIS; BGC 2015.
Basemap: Esri et al.

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U.S. Army Corps of Engineers
Donlin Gold Supplemental EIS
DRAFT

FIGURE 2-2
0.5 Percent Deposition Map (Tailings and Water)

2.2.3 SUMMARY OF THE 2026 SEIS SCENARIOS: LARGER TAILINGS DAM SPILLS

This SEIS evaluates a range of volumes of releases of slurries of tailings and water. There are no water-only scenarios because they are implausible based on the modeled failure mechanism and volumes of releases. The assumed failure mechanism is an initial piping failure that leads to overtopping of the TSF Main Dam at a supernatant pond volume of 9,760 acre-feet , which is the 50th percentile pond volume at the end of operations (BGC 2015a) and represents normal operating conditions.

The scenarios were modeled by BGC Engineering using a HEC-RAS software package (Version 6.6) developed by the Corps (BGC 2026c). The HEC-HMS breach module allows for simulation of breach formation under overtopping and piping failure conditions. Each scenario was modeled under "sunny day" conditions, which assume the failure happens during fair weather and normal inflow and water levels. Although a sunny day breach could occur at any time during the year, BGC modeled average flow conditions during the summer, which roughly represent median hydrologic conditions. Sunny day dam breaches typically have greater incremental impacts than rainy day (flood-induced) breaches because they occur without warning during normal conditions, often resulting in a higher, faster, and more unexpected surge of water. The 27 percent release scenario was also evaluated under a conservative 100-year flood condition The 100-year flood scenario was selected to evaluate impacts from a wide range of hydrologic conditions.

The behavior of the spill releases were characterized initially as non-Newtonian from the dam breach down to the confluence with the Kuskokwim River. From the confluence farther downstream, the tailings flows were characterized as Newtonian. The flood waves generated by a breach of the Donlin TSF are considered non-Newtonian as they move down Crooked Creek. The volume of tailings released is significantly greater than the creek's base flow, and the influence of the creek's base flow on the properties of the tailings is regarded as negligible. However, once these non-Newtonian breach flood waves discharge into the Kuskokwim River, BGC (2026c) assumed that the flows from the upstream Kuskokwim River would mix and dilute the non-Newtonian fluid from Crooked Creek, converting the flow to Newtonian fluid behavior. To capture both the non-Newtonian and Newtonian flow regimes, two hydraulic models were developed. This division was necessary because HEC-RAS cannot simulate non-Newtonian and Newtonian fluids concurrently due to its computational framework, which is designed for single rheological behavior (i.e., constant sediment concentration and constant rheological parameters) per simulation run. Therefore, one model was configured to simulate the non-Newtonian flows along Crooked Creek, while the other model was set up for Newtonian flow conditions along the Kuskokwim River. The flood wave extracted from the non-Newtonian model at the confluence of Crooked Creek and the Kuskokwim River was applied as an inflow boundary condition to the Newtonian model.

The modeling produced inundation extent limits and deposition depth predictions for the different release scenarios (see Tables 2.2-1, 2.2-2, and 2.2-3 below). The 5.4 percent release scenario would inundate 4,507 acres in the Crooked Creek drainage and 937 acres in the Kuskokwim River. The release front would reach Crooked Creek village in approximately 2 hours. The 13.3 percent release scenario would inundate 5,110 acres in the Crooked Creek drainage and 1,460 acres in the Kuskokwim River. The release front would reach Crooked Creek village in approximately 2 hours. The 27.7 percent sunny day release scenario would inundate 5,902 acres in the Crooked Creek drainage and 2,421 aces in the Kuskokwim River. The release front would reach Crooked Creek village in approximately 90 minutes. The 27.7 percent 100-year flood stage release scenario would inundate 5,902 acres in the Crooked Creek drainage and 4,574 aces in the Kuskokwim River. The release front would also reach Crooked Creek village in approximately 90 minutes.

Figures 2-3 through 2-5 depict the inundation extents for each scenario under normal hydrologic conditions. Figure 2-6 depicts the inundation extent under a flood event, and Figure 2-7 depicts the inundation extent of the 27 percent scenario occurring during flood conditions. Figures 2-8 through 2-11 depict net inundation during 100-year flood conditions, river elevation for flood conditions at Crooked Creek, river elevation for flood conditions at Aniak, and river elevation for flood conditions at Lower Kalskag. Figures 2-12 through 2-14 depict the deposition of tailings for each scenario (the deposition is the same for the 27 percent normal conditions and flood conditions scenarios because the magnitude of the breach hydrograph was so much greater than the flood baseflow).

Chapter 4 describes the impacts to the area and downstream communities, including Section 4.5, Surface Water Hydrology, which describes the flood wave and tailings deposition from the larger spill scenarios.

Table 2.2-1 summarizes the areas that would be inundated under the various scenarios (Table 3-3 from BGC 2026c).

Table 2.2-1: Summary of Modeled Inundation Areas

Tailings Release Scenario	Flood Induced	Crooked Creek Inundation Area (acres)	Kuskokwim River Inundation Area (acres)
5.4	Sunny Day	4,507	937[1]
13.3	Sunny Day	5,110	1,460[1]
27	Sunny Day	5,902	2,421[1]
27	Flood Stage	5,902	4,574[1]
-	100-Year Flood (Q_{100})	n/a	159,898

Note:
[1] Expressed as the area flooded outside the extent of the Kuskokwim River for the baseflow conditions.

Table 2.2-2 lists the arrival times of the flow fronts and Table 2.2-3 lists the change in stream flow from the various release scenarios (Table 3-4 from BGC 2026c).

Table 2.2-2: Modeled Front and Peak Arrival Times

Location	Tailings Release Scenario			
	Normal Conditions	Normal Conditions	Normal Conditions	Flood Conditions
	5.4%	13.3%	27%	27%
Front Arrival Time (hours:minutes after event)				
Crooked Creek	2:10	1:55	1:30[1]	
Chuathbaluk	11:20	10:55	9:30	6:45
Aniak	18:40	18:45	14:40	10:00
Kalskag	25:30	25:25	22:10	25:10
Peak Arrival Time (hours:minutes after event)				
Crooked Creek	2:30	2:15	1:50[1]	

Location	Tailings Release Scenario			
	Normal Conditions	Normal Conditions	Normal Conditions	Flood Conditions
	5.4%	13.3%	27%	27%
Chuathbaluk	20:25	19:05	18:50	17:00
Aniak	23:35	23:45	22:25	19:55
Kalskag	40:45	40:30	41:10	39:30

Notes:
[1] Front and peak arrival times for the 27% scenarios are the same for Crooked Creek. The arrival times were modeled along Crooked Creek upstream of the confluence with the Kuskokwim River.

Table 2.2-3: Modeled Peak Flow, Incremental Peak Flow, and Incremental Increase in Flow Depth

Location and Tailings Release Scenario	Peak Flow (cfs)	Incremental Peak Flow (cfs) [1]	Incremental Increase in Flow Depth (feet)[2]
Village of Crooked Creek Upstream from Kuskokwim River Confluence[3]			
Normal Conditions (5.4%)	130,600	–	–
Normal Conditions (13.3%)	166,080	–	–
Normal Conditions (27%)	430,730	–	–
Flood Conditions (27%)	430,730	–	–
Village of Crooked Creek Immediately Below Crooked Creek and Kuskokwim River Confluence			
Normal Conditions (5.4%)	136,200	67,300	4.9
Normal Conditions (13.3%)	149,100	80,200	5.5
Normal Conditions (27%)	276,800	207,900	11.1
Flood Conditions (27%)	546,240	226,940	5.9
Chuathbaluk			
Normal Conditions (5.4%)	80,600	11,700	1.1
Normal Conditions (13.3%)	79,400	10,500	1.0
Normal Conditions (27%)	91,930	23,030	2.1
Flood Conditions (27%)	340,160	6,160	0.7
Aniak[4]			
Normal Conditions (5.4%)	72,900	7,900	1.0
Normal Conditions (13.3%)	72,100	7,100	0.9
Normal Conditions (27%)	81,120	16,120	1.8
Flood Conditions (27%)	213,210	6,300	0.3
Kalskag[4]			
Normal Conditions (5.4%)	53,200	4,000	0.6
Normal Conditions (13.3%)	52,800	3,600	0.6
Normal Conditions (27%)	57,140	7,940	1.1
Flood Conditions (27%)	176,670	2,580	0.2

Notes:
[1] The incremental peak flow is the difference between the modeled peak flow and the base flow in the Kuskokwim River.

[2] The incremental increase in flow depth is the difference between the modeled peak flow depth and the base flow depth in the Kuskokwim River.
[3] Incremental peaks and depths are not applicable to Crooked Creek upstream of the confluence with the Kuskokwim River.
[4] The base flows at Aniak and Kalskag are reduced compared to other sites due to a segment of the flow being conveyed through a side channel.

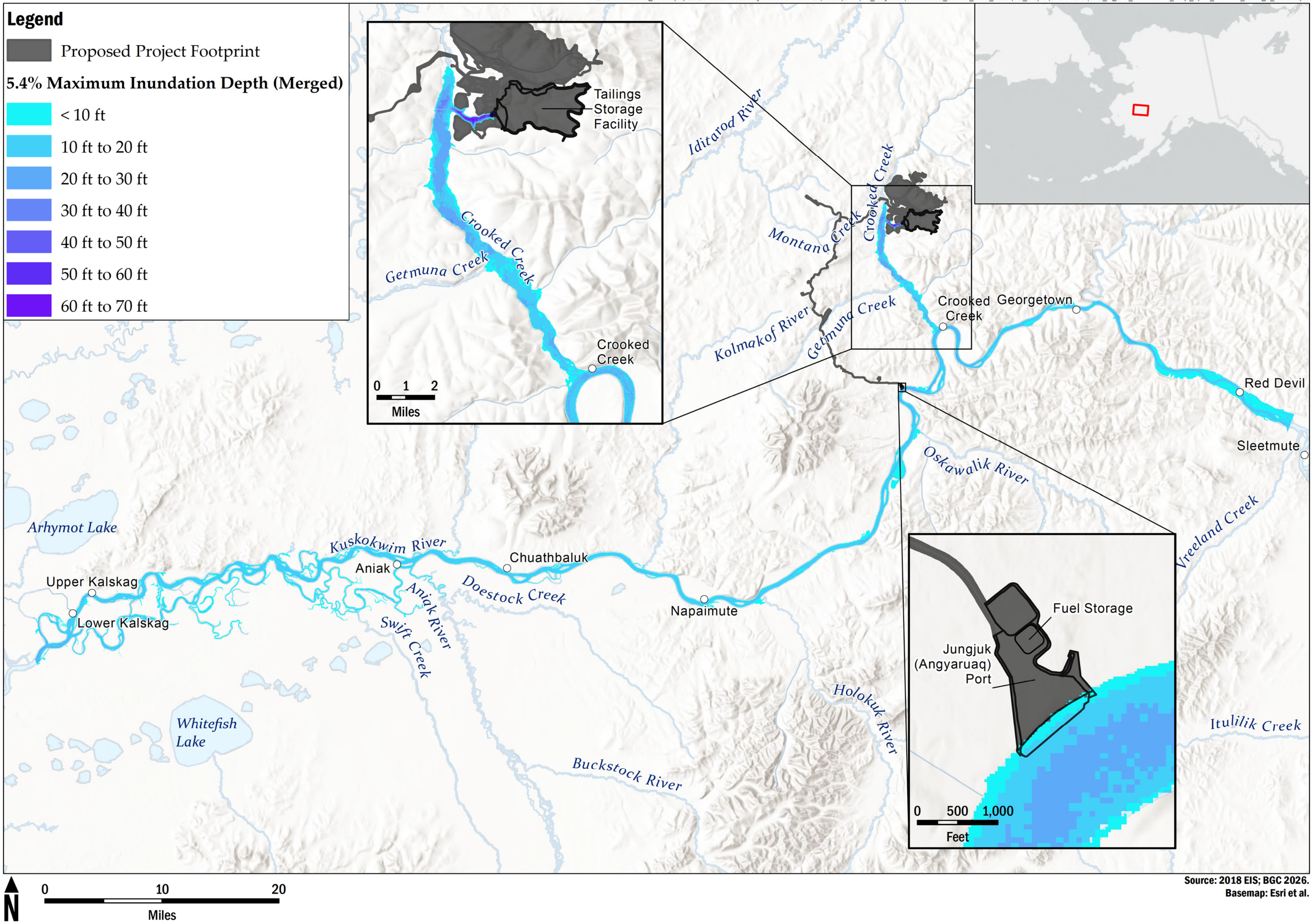
Table 2.2-4 presents the tailings deposition volumes released, deposited in Crooked Creek, and discharged to the Kuskokwim River.

Table 2.2-4: Summary of Tailings Deposition in Crooked Creek and Discharged into the Kuskokwim River (Table 3-5 from BGC 2026c)

Tailings Release Scenario (%)	Volume of Tailings Released (acre-ft)	Tailings Deposition in Crooked Creek (acre-ft)	Deposition in Crooked Creek (%)[1]	Discharged to Kuskokwim River (acre-ft)[2]
5.4	17,910	11,877	66%	15,763
13.3	44,350	41,558	93%	12,702
27	100,000	69,588	70%	40,142

Notes:
[1] Expressed as a percentage of the volume of tailings released, and not the total release volume including the pond.
[2] Includes both tailings and 9,730 acre-feet of pond water.

AECOM Anchorage AK 8/6/2026 USER courtney.m.smith PATH L:\West\ENV\06_Projects\60769231_Donlin_Gold_SEIS\02_Maps\Draft SEIS\Ch2_Fig2-3_Inundation_Map_5pt4_Percent_Tailings_Water.aprx



Source: 2018 EIS; BGC 2026.
Basemap: Esri et al.

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U.S. Army Corps of Engineers
Donlin Gold Supplemental EIS
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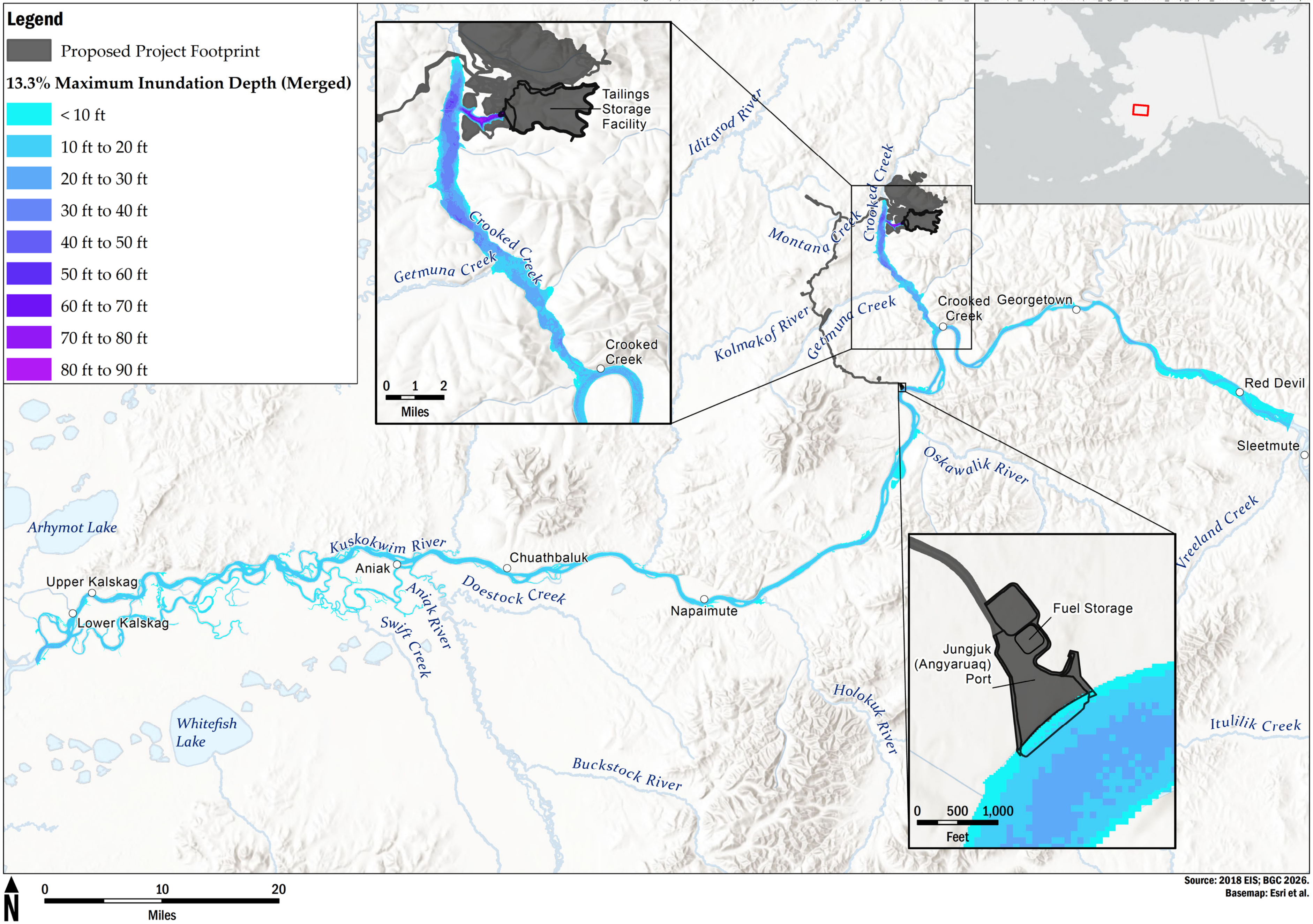
FIGURE 2-3
5.4 Percent Inundation Map (Tailings and Water)



Source: 2018 EIS; BGC 2026.
Basemap: Esri et al.

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U.S. Army Corps of Engineers
Donlin Gold Supplemental EIS
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FIGURE 2-4
13.3 Percent Inundation Map (Tailings and Water)

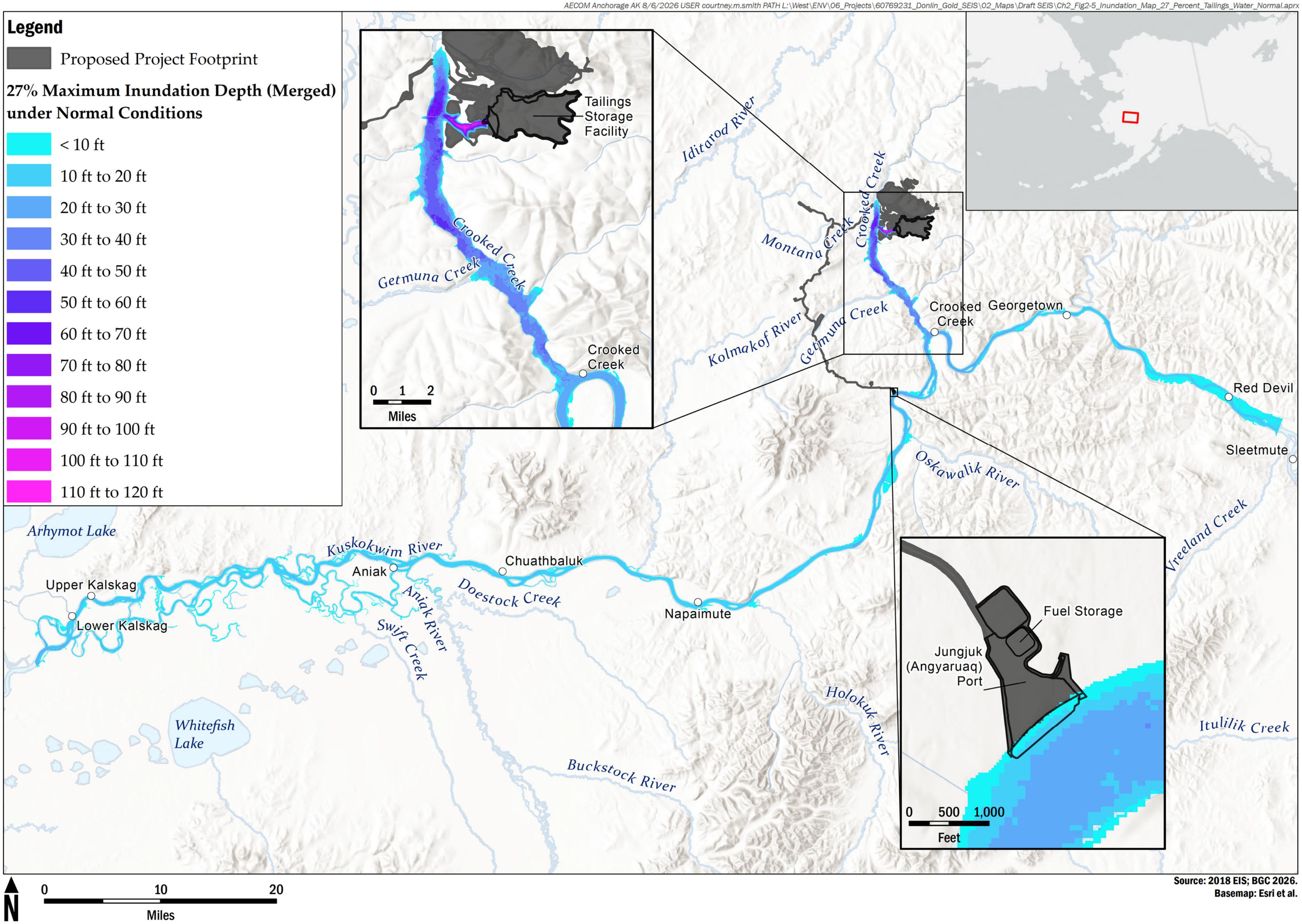
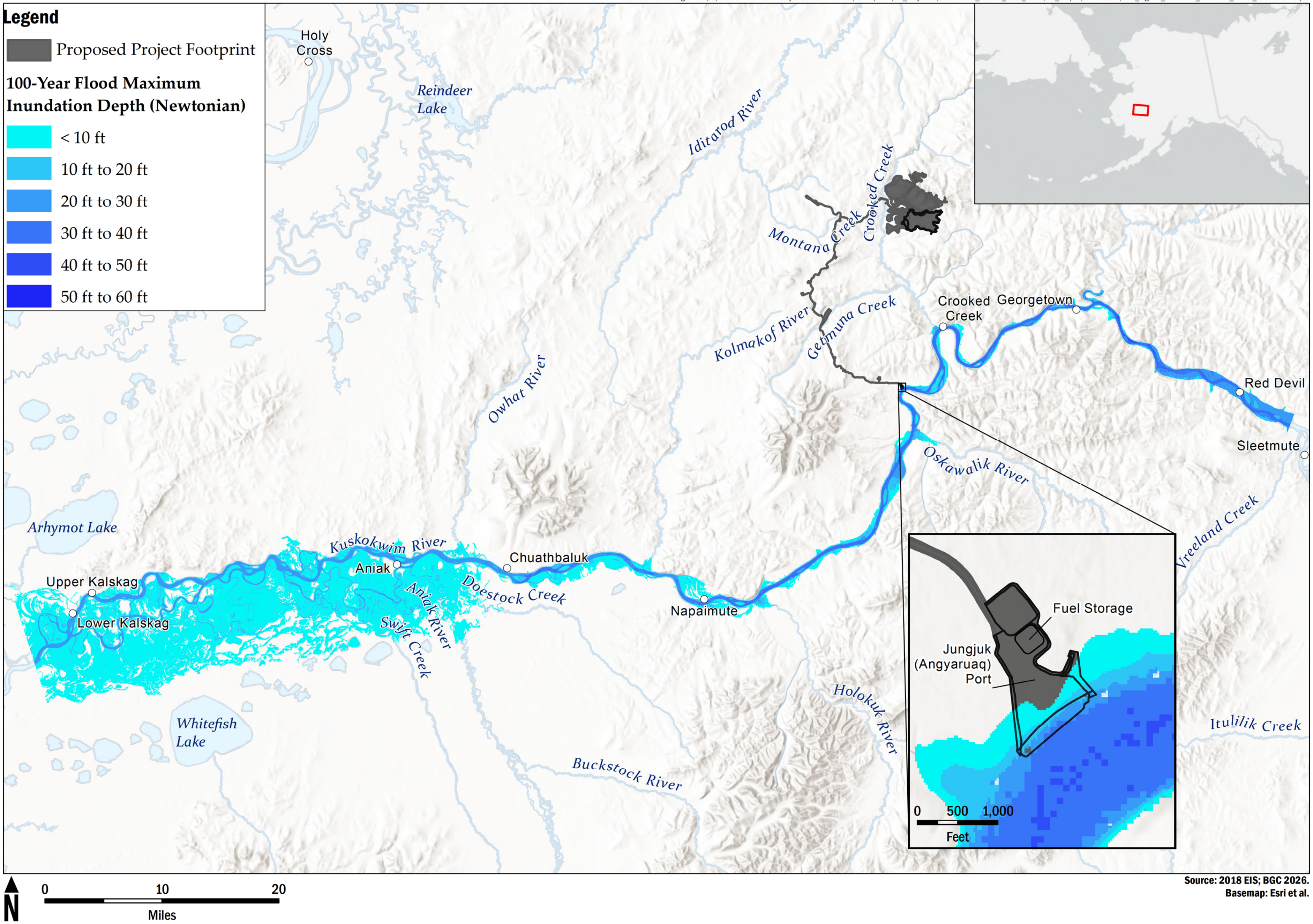


FIGURE 2-5

27 Percent Inundation Map (Tailings and Water) for Normal Conditions

AECOM Anchorage AK 8/6/2026 USER courtney.m.smith PATH L:\West\ENV\06_Projects\60769231_Donlin_Gold_SEIS\02_Maps\Draft SEIS\Ch2_Fig2-6_100-Year_Baseline_Flood_Inundation.aprx



Source: 2018 EIS; BGC 2026.
Basemap: Esri et al.

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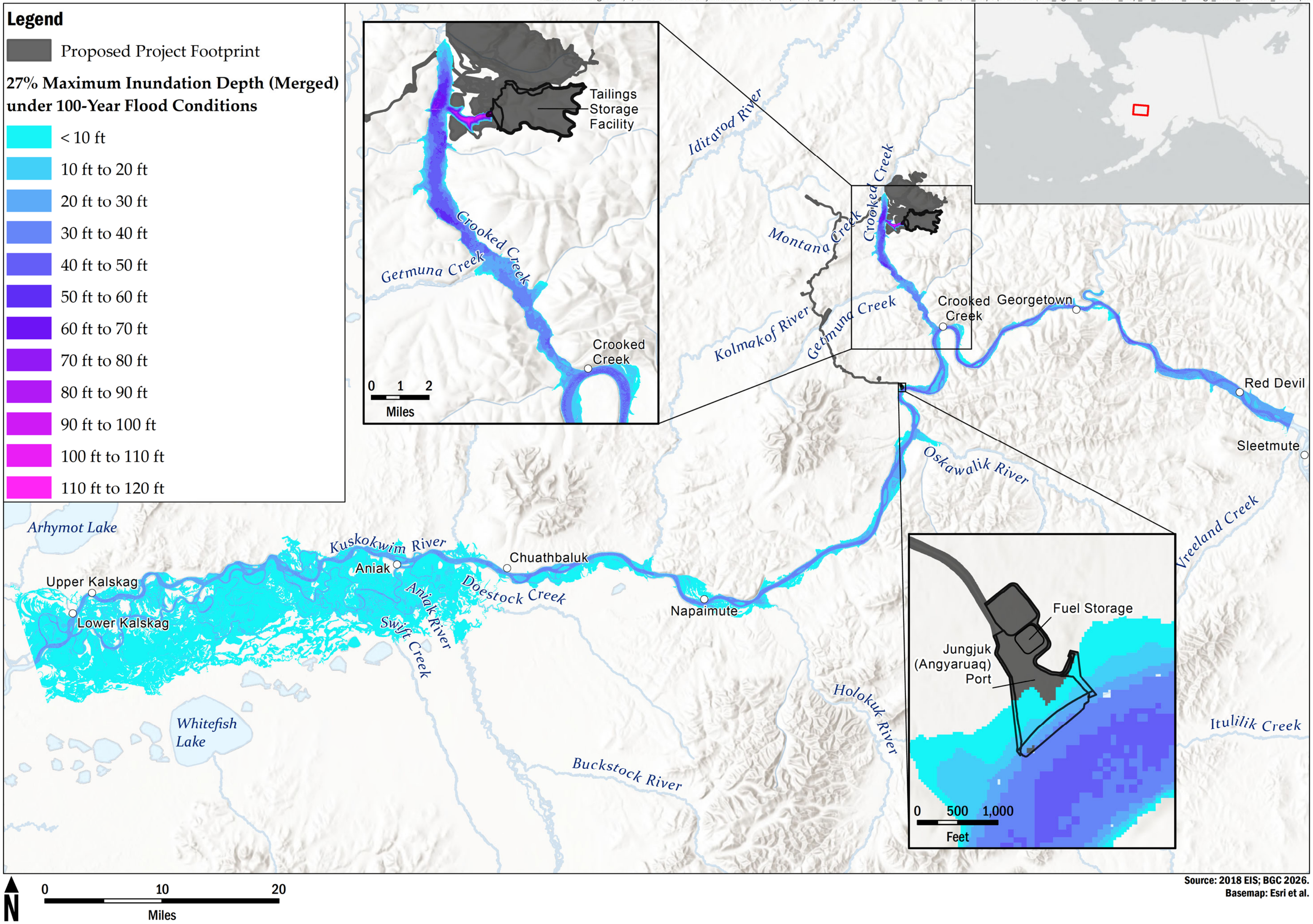
FIGURE 2-6
100-Year Baseline Flood Inundation



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U.S. Army Corps of Engineers

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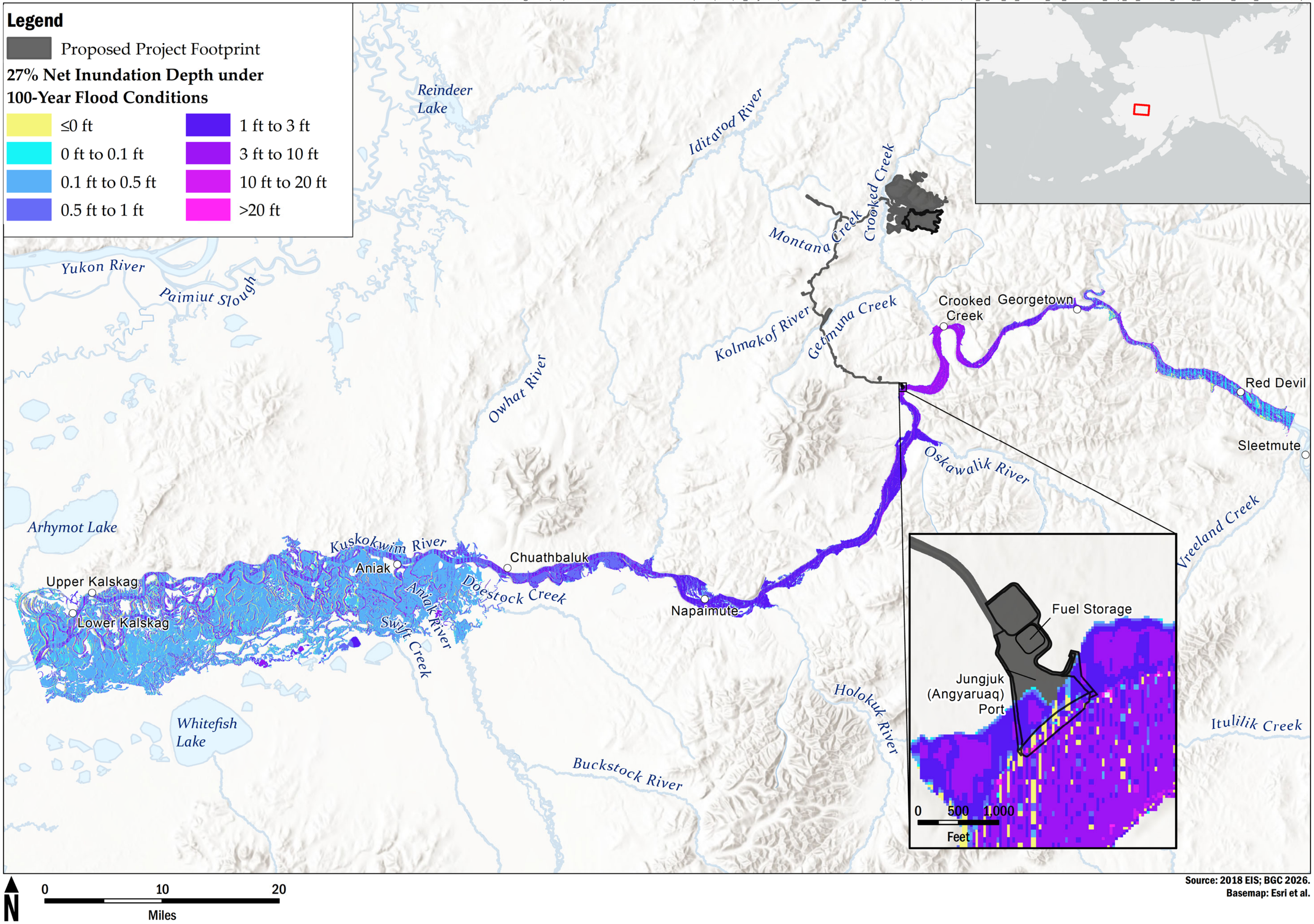
FIGURE 2-7

27 Percent Inundation Map (Tailings and Water) for 100-Year Flood Conditions

AECOM Anchorage AK 9/18/2026 USER thomas.schultz PATH L:\West\ENV\06_Projects\60769231_Donlin_Gold_SEIS\02_Maps\Draft SEIS\Ch2_Fig2-8_27_Percent_Net_Inundation_Map_for_Scenario_during_100-Year_Flood_Conditions.aprx



Source: 2018 EIS; BGC 2026.
Basemap: Esri et al.

AECOM

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FIGURE 2-8

27 Percent Net Inundation Map for Scenario during 100-Year Flood Conditions

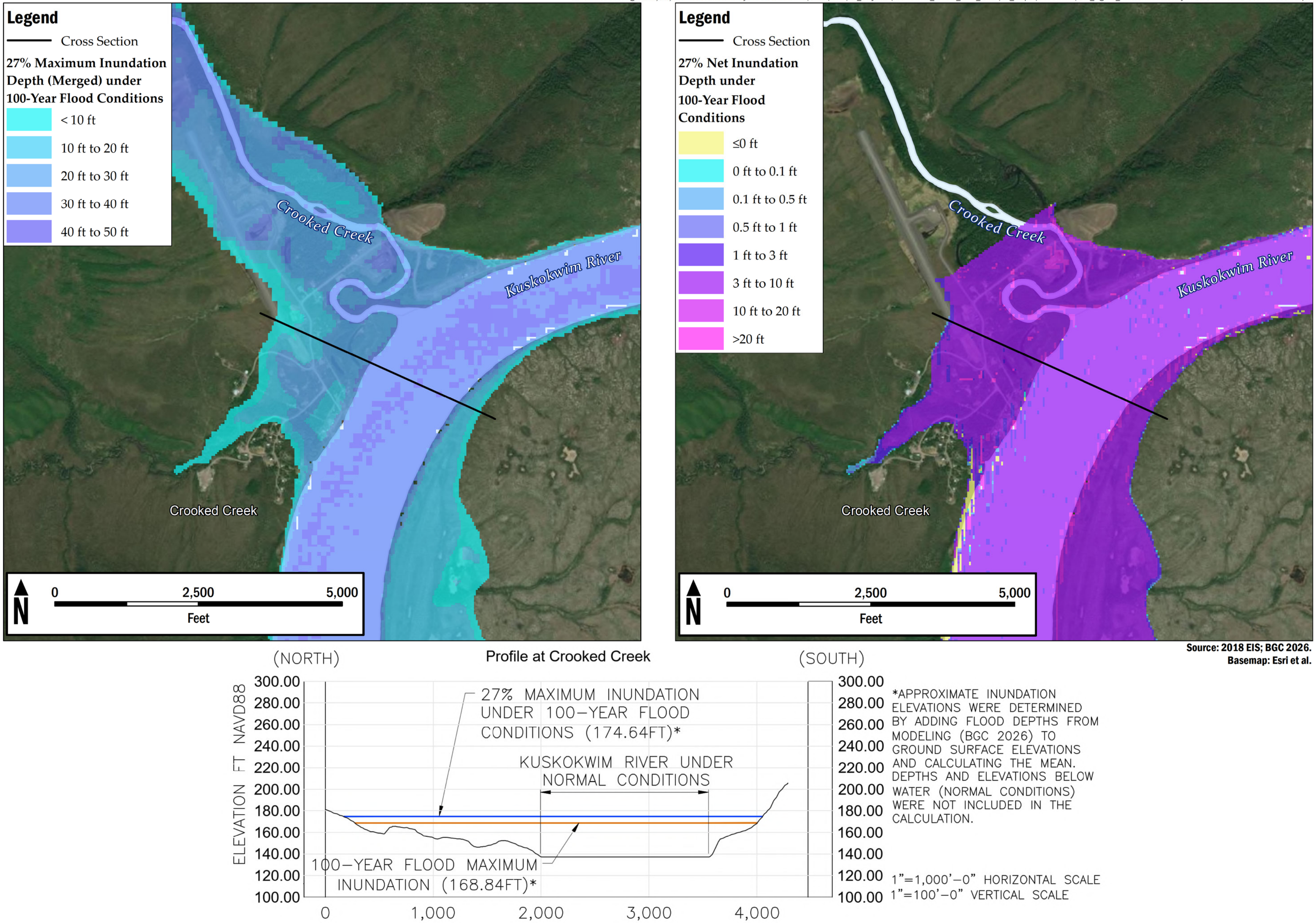

FIGURE 2-9

River Elevation for 27 Percent Scenario during Flood Conditions at Crooked Creek

AECOM Anchorage AK 9/10/2026 USER courtney.m.smith PATH L:\West\ENV\06_Projects\60769231_Donlin_Gold_SEIS\02_Maps\Draft SEIS\Ch2_Fig2-10_Aniak 27yr Flood Conditions Cross Section.aprx

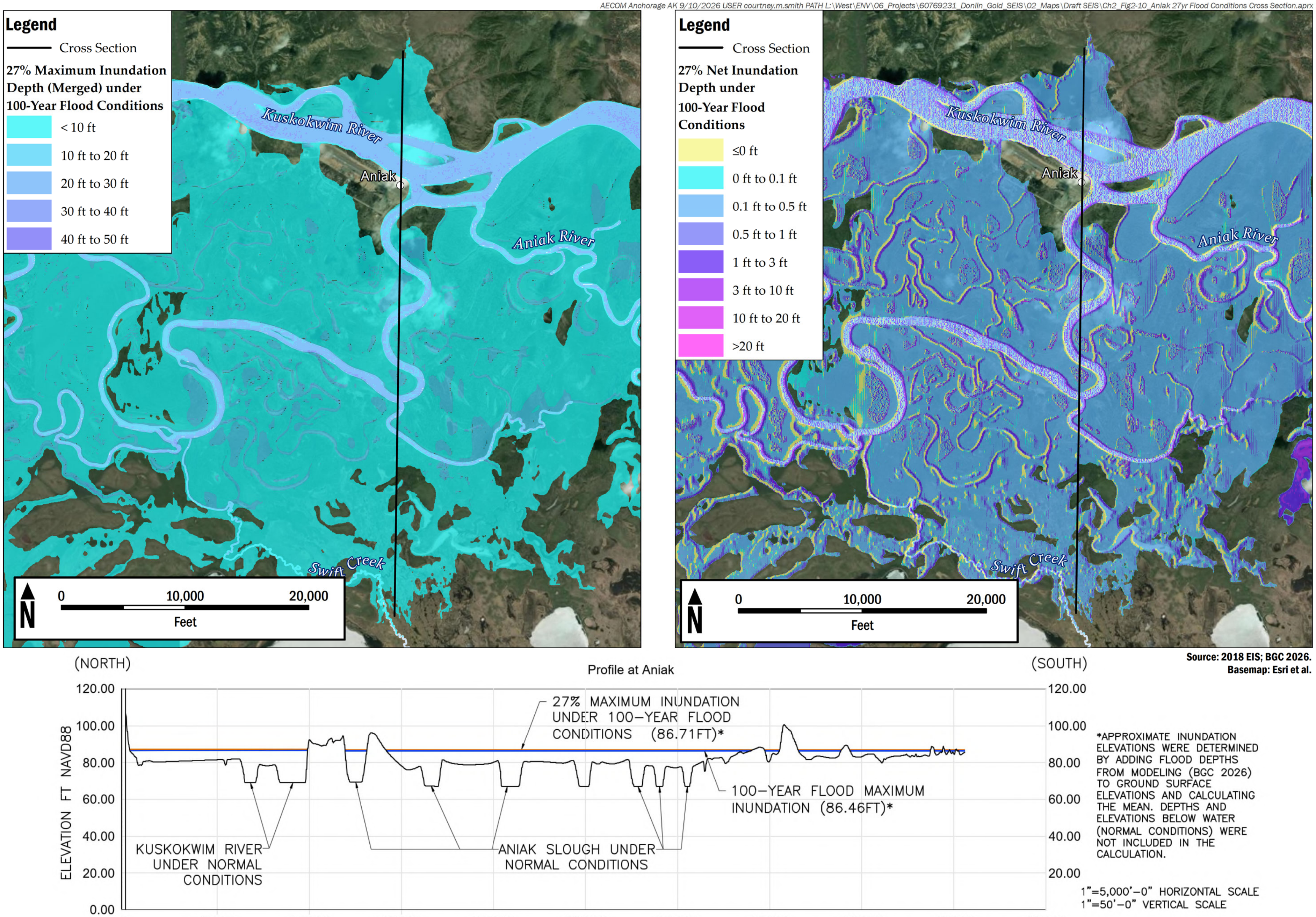

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FIGURE 2-10

River Elevation for 27 Percent Scenario during Flood Conditions at Aniak

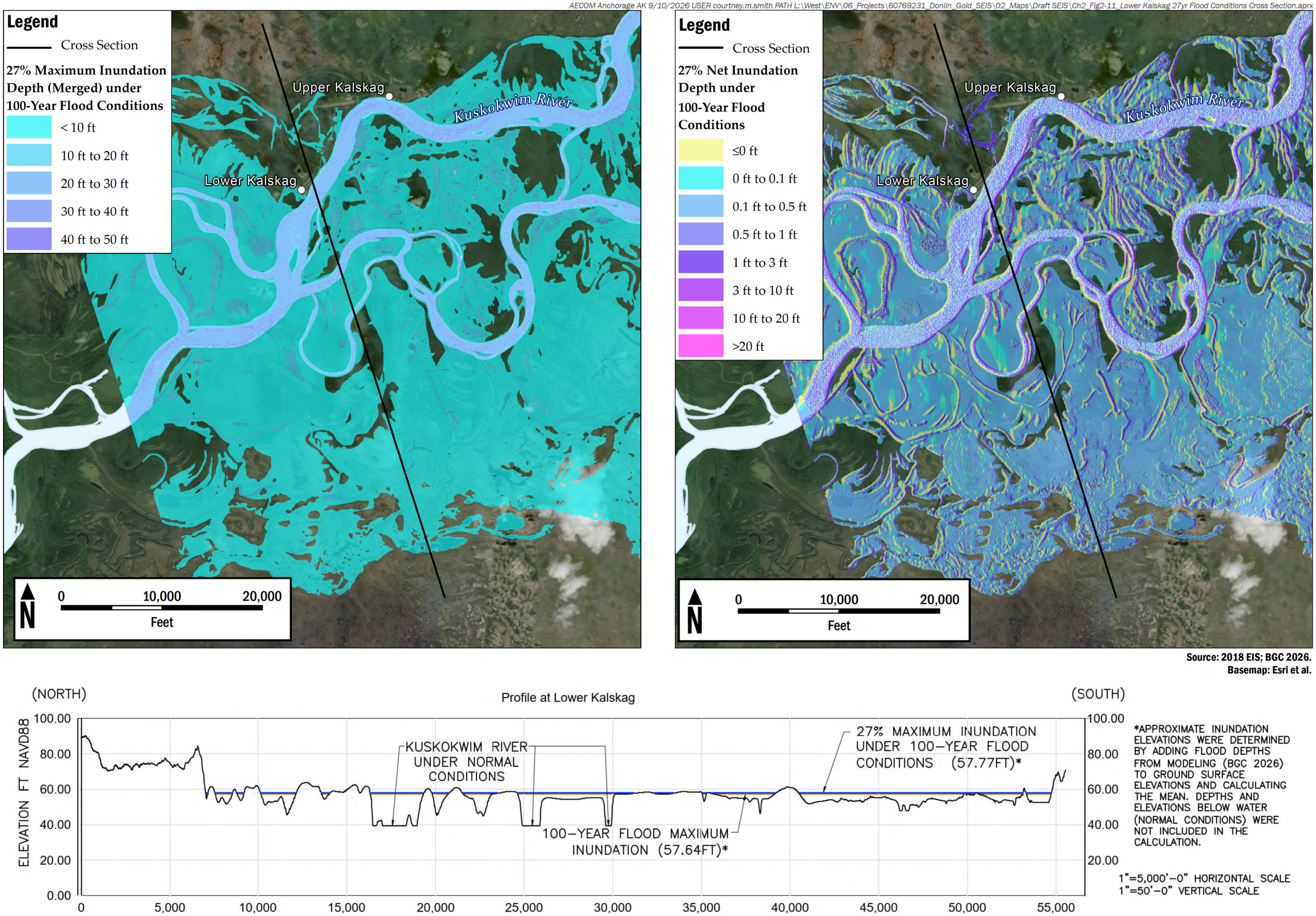

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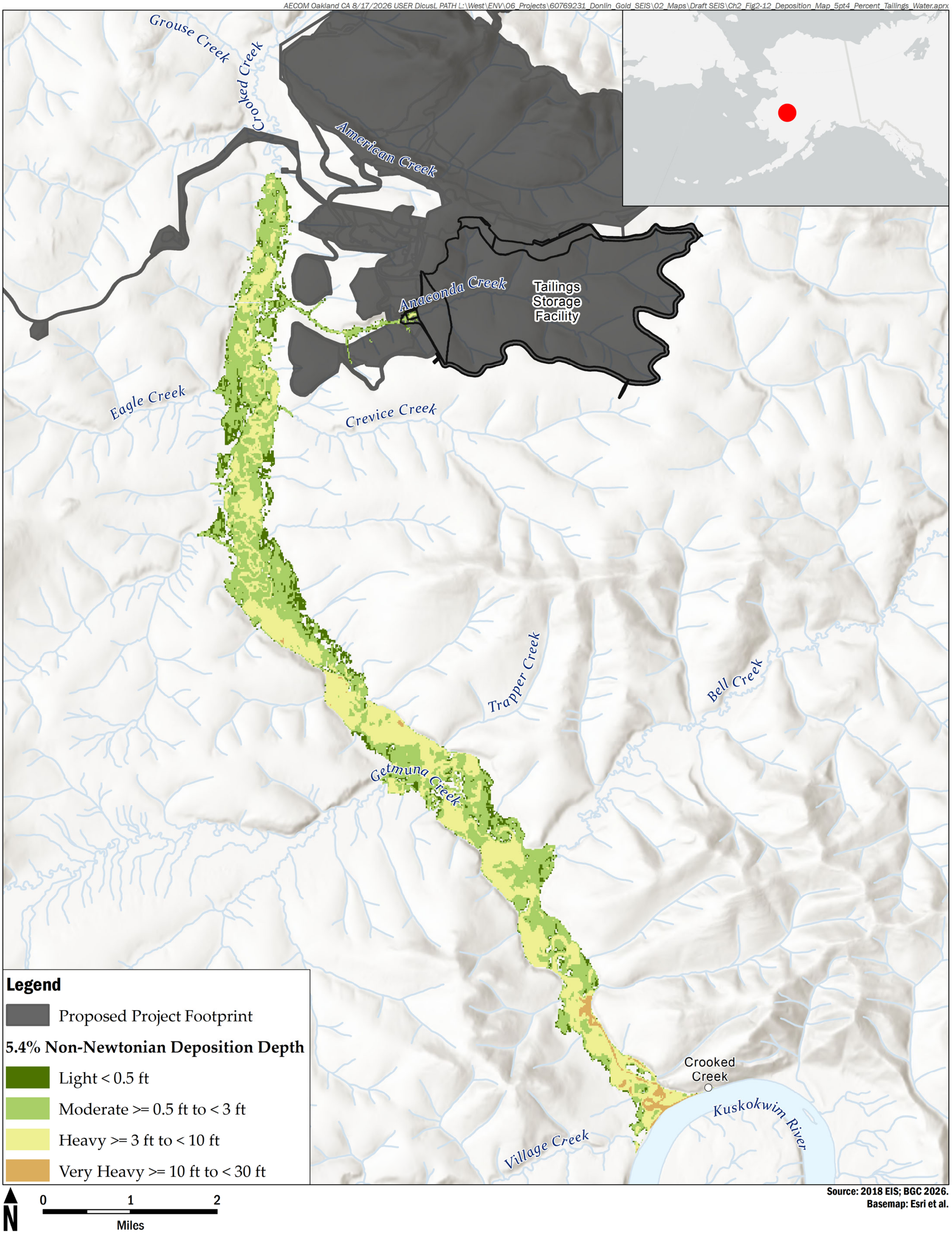
FIGURE 2-11

River Elevation for 27 Percent Scenario during Flood Conditions at Lower Kalskag

AECOM Oakland CA 8/17/2026 USER DicusL PATH L:\West\ENV\06_Projects\60769231_Donlin_Gold_SEIS\02_Maps\Draft SEIS\Ch2_Fig2-12_Deposition_Map_5pt4_Percent_Tailings_Water.aprx



Source: 2018 EIS; BGC 2026.
Basemap: Esri et al.

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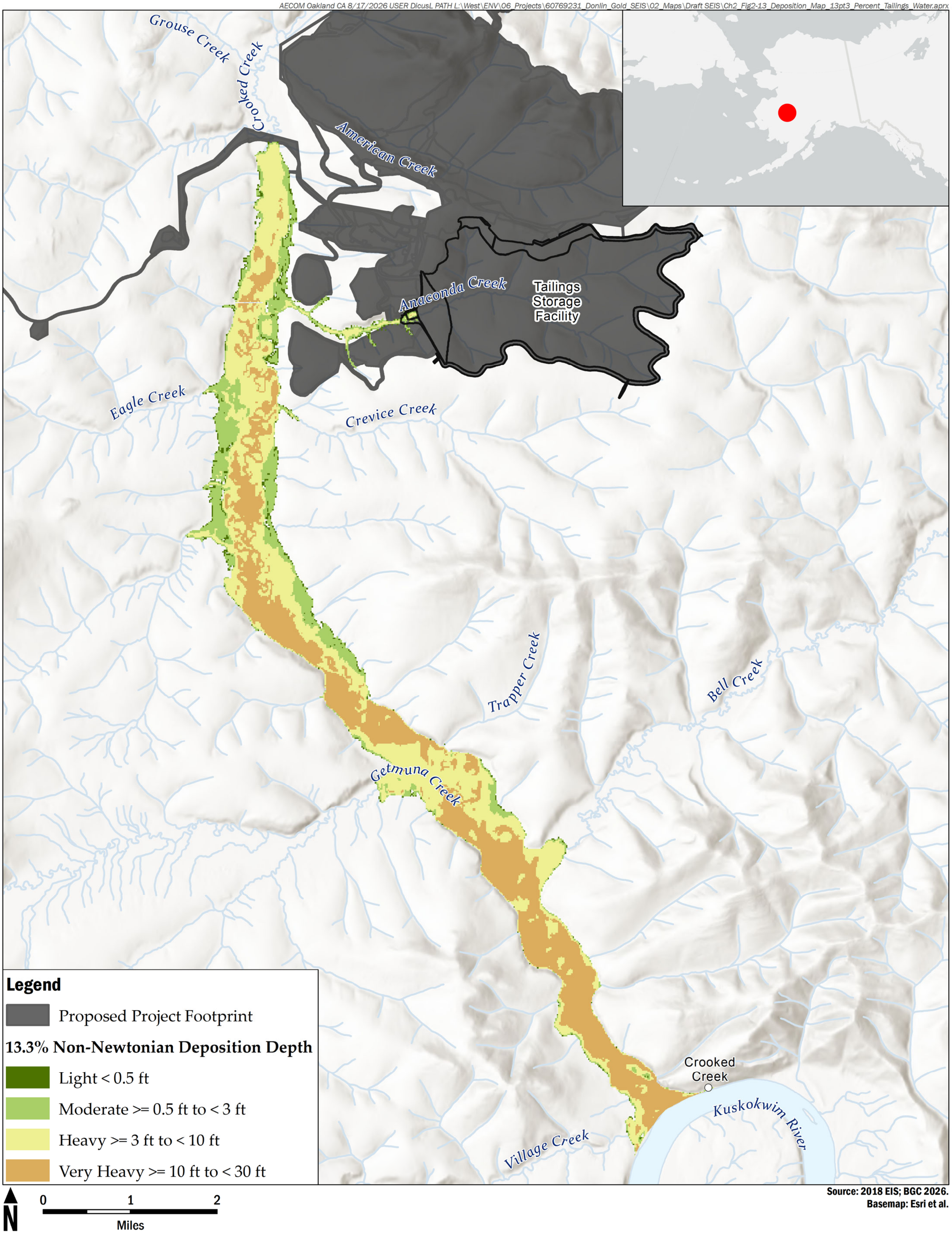
FIGURE 2-12

5.4 Percent Deposition Map (Tailings and Water)



Source: 2018 EIS; BGC 2026.
Basemap: Esri et al.

AECOM

U.S. Army Corps of Engineers

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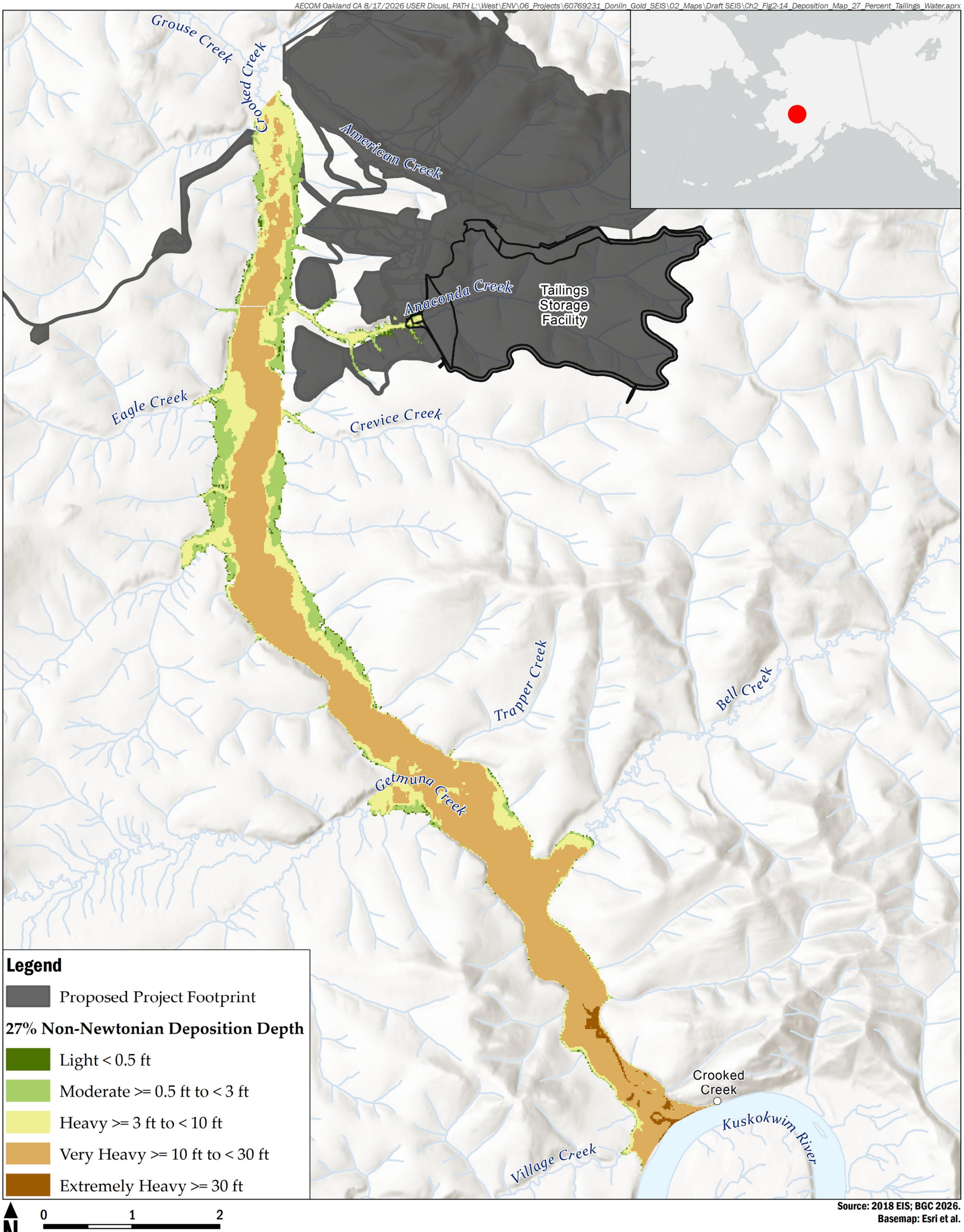
FIGURE 2-13

13.3 Percent Deposition Map (Tailings and Water)



Source: 2018 EIS; BGC 2026.
Basemap: Esri et al.

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FIGURE 2-14
27 Percent Deposition Map (Tailings and Water)

2.2.4 RESPONSE TO A TAILINGS DAM RELEASE

Plans and response capacities would be required and detailed in the Emergency Action Plan (EAP) required under ADNR Dam Safety certification and are further described in Section 4.23. Response to an emergency would involve the extensive use of excavation and earthmoving equipment, which could be sourced from the mine itself. As described in BGC (2015), if a situation arises that requires immediate attention, Donlin Gold would have the equipment, material, labor, and engineering expertise already on site for mining operations that could be deployed to respond to an emergency immediately.

The specific equipment and supplies would be outlined in the EAP. For example, stockpiles of fine and coarse filter materials, as well as rockfill and transitional rockfill, would be placed in the vicinity of the dam to be readily available in an emergency to arrest or retard internal or external erosion of the dam, and plug any erosion channels that may have formed on the dam crest or downstream face. In addition, pumps would be on hand to lower the TSF pond level, using the reclaim system to divert water to the open pit for temporary storage (BGC 2015b). Response measures would include protecting the safety of mine employees and downstream residents, stabilizing the TSF breach, and implementing remedial actions to minimize impacts to affected resources. Remedial actions would include removing the tailings from the primary depositional area at the Crooked Creek confluence to the extent practicable. The volume of deposited tailings for the modeled scenarios would be extremely large, and it would take a significant amount of time to remove the material and restore the area along Crooked Creek. The tailings would be excavated using a combination of heavy equipment and hand tools, and would be transported back to the TSF or other designated temporary storage area. Access to cleanup areas in the summer would be difficult due to the lack of roads along Crooked Creek and would likely involve use of helicopters. Access in the winter could likely be accomplished on packed snow trails, and removal of deposited material may be more effective because the ground and creek would likely be frozen.

CHAPTER 3 AFFECTED ENVIRONMENT

The baseline information from the 2018 EIS was reviewed and evaluated in light of the new modeling conducted to evaluate the impacts of a larger tailings spill release of the Donlin TSF Main Dam. The baseline environmental conditions remain the same as described in the 2018 EIS. The updated modeling, results, and analysis do not create a need to update the affected environment information in the 2018 EIS. This document uses the 2018 EIS as its foundation, and the affected environment information from the 2018 EIS remains valid for the current supplemental analysis.

CHAPTER 4 TAILINGS SPILL SCENARIO IMPACTS

4.1 GEOLOGY

The analysis area has limited exposures of bedrock and fossils, as most surfaces are covered in soils and surficial deposits. The spill scenarios would result in erosion and scouring along the impacted streambeds, particularly in Anaconda Creek. It is possible that erosion could expose and damage fossils or remains of Pleistocene mammals, if present, in the downstream path of the spill.

Impacts on soils and surficial deposits are addressed in Section 4.2, Soils.

4.2 SOILS

4.2.1 SUMMARY OF IMPACTS FROM 2018 EIS SCENARIO – 0.5 PERCENT SCENARIO

The release of 1,620 acre-feet of tailings slurry under the 0.5 percent spill scenario would result in soil erosion and soil burial, as well as soil contamination from elevated metals, potential acid generation, and other residual toxins present in tailings fluid and solids. Each of these impacts would be minimized depending on the success of the cleanup effort.

The released tailings slurry would flow as a viscous fluid downstream from the TSF dam into Anaconda Creek. The flow down Anaconda Creek would be far greater than historical flood capacities, resulting in erosion and scouring along the channel, especially the area immediately below the TSF. The bed and bank materials along Anaconda Creek are composed primarily of sand and silt and would be very susceptible to erosion from the spill. Areas disturbed by erosion may remain susceptible to continued instability and sediment transport until re-establishment of vegetation and channel equilibrium conditions occurs. The high energy erosional processes would result in changes to the Anaconda Creek stream morphology, transforming the channel into a more linear (less sinuous), wider, and deeper channel. A TSF release during frozen winter months may result in comparatively less erosion; however, changes to stream morphology would still be anticipated.

Deposition of tailings solids would bury soils and sediments along the lower Anaconda Creek drainage and in the area surrounding the confluence of Anaconda Creek and Crooked Creek, extending for approximately 2 miles downgradient of the TSF (see Figure 3.24-2 in the 2018 EIS). Burial of soils would result in the loss of soil structure, organic matter, and microbial communities that support nutrient cycling and vegetation establishment. Recovery of soil ecological function would likely lag behind physical stabilization and would depend on the success of restoration efforts and natural soil-forming processes. Varying depths of tailings deposition would be anticipated throughout the entire flow inundation area, which ranges from 2 feet up to 10 feet deep in the area near the confluence of Anaconda and Crooked Creeks (see Figure 3.24-2 in the 2018 EIS). Around the confluence, 1,300 acre-feet of tailings are predicted to be deposited, which would modify the topography in this area.

The total areal extent of soil disturbance by inundation or deposition would be approximately 1,700 acres under this scenario.

Depending on the success of the cleanup, deposited tailings could be removed and the landscape could be returned to its baseline condition. Recovery of soil stability would also depend on the severity of damage to streambank vegetation, which plays a crucial role in stabilizing soils against further potential erosion.

Modeling results show that most tailings would not be transported farther down Crooked Creek during the release. Some tailings, however, would be remobilized by streamflow and precipitation, and would be carried downstream along Crooked Creek and into the Kuskokwim River. Under the 0.5 percent scenario, this would likely be a small amount of tailings that would then be diluted by streamflow and naturally flushed out of the drainages, and would be unlikely to have any further impacts on downstream soils.

Seasonal conditions at the time of the release could also influence the severity of physical soil impacts. Modeled inputs were based on mean summer flow conditions, a frozen riverbed, and a roughness value (Manning's n-value) representative of dense brush. Scouring and depositional impacts to soil may be appreciably reduced in winter months due to frozen soil, snow cover, and low annual flow conditions in Crooked Creek. Conversely, a release during peak flow conditions would result in a greater inundation area and distribution of remobilized tailings downstream of the Crooked Creek confluence.

Immediate impacts on soils could include contamination from elevated metals or processing chemicals such as reagents present in the tailings fluid. In the long term, any tailings that remain on the landscape could slowly leach metals and generate acid which can infiltrate into soils.

As the tailings slurry flows down Crooked Creek, initially, there would be limited mixing of the slurry and streamwater. The tailings pond water would be released immediately during the initial flooding and could infiltrate into soils along the streambank. If a spill were to occur during the winter, fluid from the tailings slurry would not readily penetrate frozen soils but may remain on the frozen surface longer, eventually to be carried downstream or infiltrate soils. Most of the pore water within the tailings is expected to remain entrained within the tailings slurry during transport such that deposited tailings would initially retain a high volume of pore water (BGC 2026c). After deposition of the tailings solids, the pore water would be slowly released from the deposited slurry, allowing the contaminated fluid to slowly infiltrate soils and sediments, as well as shallow groundwater, and release to surface water.

In areas with thin soils, shallow bedrock may impede infiltration of tailings fluid (pond water and/or pore water) such that the fluid may spread laterally and potentially impact a wider area. Fractures in bedrock may also allow fluid to infiltrate deeper within bedrock in some areas.

Spilled tailings would contain elevated metals and a small amount of potentially acid-generating (PAG) material. Some of the tailings are acid-neutralizing, such that the tailings as a whole are unlikely to generate substantial acid. Any acid that may be generated from PAG tailings remaining on the land would be generated very slowly over years and would be constantly diluted by precipitation, such that acid levels may not cause exceedances of soil contamination criteria.

Elevated levels of antimony, arsenic, and thallium in tailings solids and mercury in tailings water have the potential to contaminate soils inundated in the spill. (Mercury would not be present in tailings at levels exceeding soil cleanup guidelines, but it would have elevated concentrations in tailings pond water that could potentially affect downstream soils.) These constituents can migrate downward through the deposited tailings to contaminate the underlying soils. Metals leached from any unrecovered tailings solids could have a long-term impact on soils as the tailings solids would be an ongoing source material for leaching of these metals. Mercury and other potential toxins in tailings fluid may have a more acute but shorter-duration impact on soils because the fluids would be diluted and flushed out more readily. All other evaluated analytes and associated concentrations in TSF tailings or water were well below listed Alaska Department of Environmental Conservation soil cleanup levels. See Table 3.24-11 in the 2018 EIS for the data on concentration and soil and groundwater cleanup levels for these analytes of concern.

Certain metals may leach for years to decades or more from unrecovered tailings and could infiltrate soils. As with acid generation, however, this process would happen very slowly over a timescale of years, and the metals would be constantly diluted by precipitation. Any accumulation of elevated metals would be likely to happen only in isolated areas where pockets of tailings remain unrecovered. See Section 4.7, Water and Sediment Quality, for full details on the chemistry of tailings, acid generation, and metals leaching potential.

Following deposition and drying of fine-grained tailings, there is potential for wind erosion and generation of fugitive dust. Windblown tailings particles could be transported beyond the initial deposition area and result in secondary deposition onto surrounding soils. This would be most likely to happen during warm and dry conditions during the summer months. However, rain is common in the summer months in the area, which would keep any residual tailings moist and suppress the generation of dust.

Response to the spill would involve excavation and removal of tailings as practicable, which would reduce the long-term impact on soils. Cleanup would be facilitated in winter months because of the ability of heavy equipment to operate on frozen ground. Cleanup operations would be challenging in summer months as heavy equipment may not be able to operate on thawed soils.

No cleanup effort would ever be 100 percent effective, and a small amount of residual tailings would likely remain on the land. Over time, some of these tailings would naturally be rinsed downstream from streamwater and precipitation, while other tailings that are not recovered would eventually be covered by natural sedimentation and incorporated into soils. Any remaining tailings could continue to leach metals and other constituents that could contaminate soils. Any leachate generated from a small volume of residual tailings, however, would be constantly diluted by precipitation and/or streamwater.

Recovery efforts may disturb and mobilize tailings from the activity of heavy machinery, temporarily increasing downstream deposition of tailings and resulting in additional burial of soils. Erosion and sediment control would be employed to reduce downstream movement of tailings solids during cleanup efforts. Erosion and sediment control measures may include seeding of approved vegetation for stabilization of impacted soils, in addition to other stormwater pollution prevention plan countermeasures.

4.2.2 2026 SEIS SCENARIO – 5.4 PERCENT SCENARIO

The release of 27,640 acre-feet of tailings slurry under the 5.4 percent release scenario would cause soil erosion, burial, and contamination as described above for the 0.5 percent scenario, but impacts would be more extensive. Impacts would be minimized depending on the success of the cleanup effort.

The released tailings slurry made up of 30 percent solids and 70 percent liquid would flow downstream from the TSF and would cause substantial soil erosion along the streambank of Anaconda Creek. Depending on the velocity of the flow, erosion may continue around the confluence of Anaconda Creek and Crooked Creek.

Along Anaconda Creek, soils along the streambank would be buried by tailings from less than 1 foot thick to some 3 feet thick in most areas, with deposition of up to 10 feet thick at the base of the TSF dam (Figure 2-11). An estimated 11,877 acre-feet of tailings (66 percent of the total of released tailings) would be deposited in the Crooked Creek drainage, from upstream of the confluence with Anaconda Creek, to downstream as far as the confluence with the Kuskokwim River. Soils surrounding the confluence of Anaconda and Crooked Creeks would be buried by tailings ranging from less than 1 foot thick to some 15 feet thick. Soils along the streambank of Crooked Creek downstream of the confluence would be buried by tailings in thicknesses of less than 1 foot to up to 10 feet, with thicker deposits over 10 feet near the confluence with the Kuskokwim River. See Figure 2-11 for a map of tailings deposition across the impacted area.

Modeling results indicate that 66 percent of the tailings would not be transported downstream into the Kuskokwim River during the release. The remaining 34 percent of tailings, 6,033 acre-feet, would be mobilized downstream and discharged to the Kuskokwim River (BGC 2026c). The majority of tailings that reach the Kuskokwim River would be finer-grained particles that would be readily entrained and diluted by streamflow and naturally flushed out of the Kuskokwim River and would be unlikely to have any further impacts on downstream soils. Over time, some of the tailings initially deposited in Crooked Creek would also be remobilized by streamflow and precipitation and carried downstream into the Kuskokwim River.

Chemical impacts to soils would be as stated above and could include acute contamination from metals or processing chemicals from tailings fluid, as well long-term contamination from metals or acids leached from spilled tailings into soils.

Cleanup would be as outlined above for the smaller scenario, with additional activities for this and the larger scenarios.

Follow-up restoration work would be performed concurrently with stabilization, recovery, and remediation efforts. This would include drainage and channel reconstruction and restoration along Anaconda and Crooked Creeks.

Cleanup efforts may require construction of temporary roads to access spilled material, which would likely have additional soil disturbance impacts. Use of ice- or snow-packed roads in winter would reduce impacts compared to construction of summertime roads.

Cleanup in the Village of Crooked Creek would be extensive and would last multiple years due to the tailings deposition of 10 to 20 feet in some areas. Community members may be displaced in areas where buildings are uninhabitable due to damage by flooding and tailings deposition.

4.2.3 2026 SEIS SCENARIO – 13.3 PERCENT SCENARIO

The release of 54,080 acre-feet of tailings slurry under the 13.3 percent release scenario would cause soil erosion, burial, and contamination as described above, but impacts would be more extensive and longer in duration. Impacts would be minimized depending on the success of the cleanup effort.

The released tailings slurry made up of 38 percent solids and 62 percent liquid would flow as a viscous fluid downstream from the TSF and would cause substantial soil erosion along the streambank of Anaconda Creek and around the confluence of Anaconda Creek and Crooked Creek. Soil erosion would strip vegetation and destabilize streambanks, making them more susceptible to further erosion. The flow of tailings slurry through the Village of Crooked Creek would cause soil erosion and could result in scour around foundations beneath infrastructure, such as bridges, roads, and buildings. Infrastructure that is impacted by scour may need to be restabilized or rebuilt.

Along Anaconda Creek, soils along the streambank would be buried by tailings from less than 1 foot thick to up to 10 feet thick from the base of the TSF dam along much of the drainage (Figure 2-12). An estimated 41,558 acre-feet of tailings (93 percent of the total released) would be deposited in the Crooked Creek drainage under the 13.3 percent scenario. Soils surrounding the confluence of Anaconda and Crooked Creeks would be buried by thicknesses of tailings ranging from less than 1 foot to about 18 feet**.** Soils along the streambank of Crooked Creek downstream of the confluence would be buried by tailings from a few feet up to 30 feet, with thicker deposits up to 30 feet along the lower stretch near the confluence with the Kuskokwim River. Soils within the Village of Crooked Creek would be partially buried by tailings, between several feet and 30 feet in depth. See Figure 2-12 for a map of tailings deposition across the impacted area.

The remaining 7 percent of tailings, 2,792 acre-feet, would be mobilized downstream and discharged to the Kuskokwim River (BGC 2026c). The majority of tailings that reach the Kuskokwim River would be finer-grained particles that would be readily entrained and diluted by streamflow and naturally flushed out of the Kuskokwim River and would be unlikely to have any further impacts on downstream soils. Over time, some of the tailings initially deposited in Crooked Creek would also be remobilized by streamflow and precipitation and carried downstream into the Kuskokwim River.

Chemical impacts to soils would be as stated above and could include acute contamination from metals or processing chemicals from tailings fluid, as well long-term contamination from metals or acids leached from spilled tailings into soils.

Cleanup and restoration activities would be as described for the previous spill scenarios, with more extensive and longer-duration impacts from cleanup of the larger spill. Cleanup in the Village of Crooked Creek would be extensive and would last multiple years due to the extreme tailings deposition of up to 30 feet in some areas. Extensive damage to homes and infrastructure would occur in the Village of Crooked Creek. Community members would likely be displaced in areas where buildings are inhabitable due to damage by flooding and tailings deposition.

4.2.4 2026 SEIS SCENARIO – 27 PERCENT SCENARIO

The release of 109,730 acre-feet of tailings slurry under the 27 percent release scenario would cause soil erosion, burial, and contamination as described above, but impacts would be more extensive. Impacts would be minimized depending on the success of the cleanup effort.

For the 27 percent scenario, impacts were considered for two separate sets of conditions: the spill occurring during fair weather and normal inflow and water level conditions (referred to hereafter as normal hydrologic conditions), and the spill occurring during the 100-year flood stage of Crooked Creek/Kuskokwim River.

The released tailings slurry made up of 42 percent solids and 58 percent liquid would flow as a viscous fluid downstream from the TSF and would cause substantial soil erosion along the streambank of Anaconda Creek. Some areas could be permanently modified by soil erosion from the flow of tailings slurry. Soil erosion would strip vegetation and destabilize streambanks, making them more susceptible to further erosion. The flow of tailings slurry through the Village of Crooked Creek would cause soil erosion and could result in scour around foundations beneath infrastructure such as bridges, roads, and buildings. Infrastructure that is impacted by scour may need to be restabilized or rebuilt.

Soils along the streambanks would be buried to variable degrees along Anaconda Creek, along Crooked Creek upstream of the confluence with Anaconda Creek, and along Crooked Creek all the way downstream to the confluence with the Kuskokwim River. Along Anaconda Creek, soils along the streambank would be buried by tailings from less than 1 foot thick to some 13 feet thick at the base of the TSF dam, and nearly 10 feet along much of the drainage (Figure 2-13). Soils surrounding the confluence of Anaconda and Crooked Creeks would be buried by tailings ranging from less than 1 foot to nearly 30 feet. Soils along the streambank of Crooked Creek downstream of the confluence would be buried by tailings in thicknesses of less than 1 foot to up to nearly 30 feet, with thicker deposits over 30 feet near the confluence with the Kuskokwim River. Soils in and surrounding the Village of Crooked Creek would be partially buried by tailings, between several feet up to more than 30 feet in depth. See Figure 2-13 for a map of tailings deposition across the impacted area.

Under the 27 percent scenario, 11,877 acre-feet of tailings are predicted to be deposited along the Crooked Creek drainage during the initial release (70 percent of the total of released tailings). The remaining 30 percent of tailings, 30,412 acre-feet, would be mobilized downstream and discharged to the Kuskokwim River (BGC 2026c). The majority of tailings that reach the Kuskokwim River would be finer-grained particles that would be readily entrained and diluted by streamflow and naturally flushed out of the Kuskokwim River and would be unlikely to have any further impacts on downstream soils. Over time, some of the tailings initially deposited in Crooked Creek would also be remobilized by streamflow and precipitation and carried downstream into the Kuskokwim River. Chemical impacts to soils would be as stated above and could include acute contamination from metals or processing chemicals from tailings fluid, as well long-term contamination from metals or acids leached from spilled tailings into soils.

Impacts under normal hydrological conditions and 100-year flood stage conditions would differ in several ways but would be relatively similar. Under the flood stage conditions, erosion along Crooked Creek could be somewhat more severe due to the naturally elevated flood levels. Naturally elevated floodwaters along the Kuskokwim River and associated overbank flow may also allow tailings deposition to be more spread out across floodplain soils. However, the flood stage conditions scenario would also cause more dilution of the tailings fluids and contaminants compared to normal hydrological conditions.

Cleanup would be as described for the previous spill scenarios, with much longer duration and more geographically extensive impacts from cleanup of the larger spill. Cleanup in the Village of Crooked Creek would be extensive and would last many years due to the extreme tailings deposition of up to 30 feet in some areas. Extensive damage to homes and infrastructure would occur in the Village of Crooked Creek. Community members would likely be displaced in areas where buildings are uninhabitable due to damage by flooding and tailings deposition.

4.3 GEOHAZARDS AND SEISMIC CONDITIONS

The spills as described under the analyzed scenarios would have no impact on geohazards and seismic conditions. Flooding impacts as they pertain to streamflow are addressed in Section 4.5, Surface Water Hydrology, and impacts as they pertain to human health are addressed in Section 4.21, Human Health.

4.4 CLIMATE AND METEOROLOGY

The spills as described under the analyzed scenarios would have no impact on climate and meteorology. Cleanup and response activities would generate tailpipe emissions of criteria pollutants and greenhouse gas (GHG) emissions from excavation and earthmoving equipment, vehicles, river vessels, helicopters, and other aircraft. For the smaller spill scenarios, these emissions would last more than a year and would have de minimis impacts on air quality and GHG concentrations. For the 27 percent scenario, cleanup emissions would be more extensive, lasting multiple years, with some activities potentially continuing for up to a decade. However, these emissions would remain temporary and would not result in any measurable effect on regional or global climate.

4.5 SURFACE WATER HYDROLOGY

This section addresses impacts to the hydrology of surface water as a result of the four release scenarios. Impacts on water and sediment quality are presented in Section 4.7, Water and Sediment Quality.

4.5.1 SUMMARY OF IMPACTS FROM 2018 EIS SCENARIO – 0.5 PERCENT SCENARIO

The 0.5 percent release scenario would have impacts on surface water hydrology in Anaconda Creek and Crooked Creek, and to a lesser extent the Kuskokwim River confluence.

The 0.5 percent scenario would involve the release of 1,620 acre-feet of slurry consisting of 50 percent tailings solids and 50 percent fluid. The release would occur from the toe of the TSF over a 5-hour period.

Modeling results of maximum flow and tailings deposition depths are presented in Figure 2-1 and Figure 2-2. Flow depths would be greatest just below the TSF dam and would progressively decrease as the tailings spread out toward the confluence of Anaconda Creek and Crooked Creek.

Anaconda Creek is a small drainage located immediately downstream of the TSF dam, with average monthly discharges in the summer months ranging from 2.1 cfs to 21.6 cfs. A maximum daily discharge of 78 cfs was recorded in July 2003. Maximum flow depths from the spill are predicted to be greater than 20 feet within the Anaconda Creek drainage below the TSF (see Figure 2-1). Erosion and scour from the release of tailings slurry down Anaconda Creek would result in changes to the stream morphology and would transform the stream into a more linear (less sinuous), wider, and deeper channel.

As the flows approached the confluence with Crooked Creek, the flows would lower in velocity and spread out, and tailings and eroded materials would deposit in the Crooked Creek drainage. Crooked Creek has a wide, highly meandering floodplain (about 0.5 mile across), that would allow the tailings slurry to spread out and allow the solid tailings to settle out and deposit.

Average daily discharges in Crooked Creek seasonally range from approximately 100 cfs to 250 cfs near the confluence. A maximum average daily discharge of 880 cfs was recorded in late August 2006. Peak streamflow in early spring has averaged 1,600 cfs in recent years. The 100-year flood streamflow (Q100) of Crooked Creek at its mouth is estimated at 7,840 cfs (BGC 2026c). The additional influx of 1,620 acre-feet of slurry to the Crooked Creek drainage would remain within the active stream channel and wide, gentle sloping floodplain.

The total volume of tailings deposition at the confluence of Anaconda Creek and Crooked Creek is estimated to be approximately 1,300 acre-feet. The maximum deposition of tailings would be approximately 10 feet thick at the confluence and would progressively thin to 2 feet upstream and downstream of the confluence.

Streamflow in Crooked Creek would likely be blocked by deposited tailings at the confluence, causing water to be temporarily dammed up and accumulate upstream of the tailings (Figure 2-2). Upstream flow would eventually cut through the deposited tailings, and flow would likely resume (skirt) along the north side of the valley where tailings deposits are likely to be thinner and finer grained.

The blocked flow from deposited tailings at the confluence would temporarily reduce downstream dispersion of tailings. However, the deposited tailings would eventually be remobilized by streamflow and carried downstream, and tailings would subsequently be re-deposited farther downstream where stream velocity is reduced. Tailings would continue to be entrained in streamflow and mobilized downstream until deposited tailings were completely recovered from the initial release site.

Deposition of tailings downstream could result in channel instability and channel migration. Stream channel erosion and migration would continue to mobilize tailings downstream until equilibrium is eventually achieved through stream restoration measures and natural processes.

The breach hydrograph shows peak outflow of 197,000 cfs for the 0.5 percent scenario. The spilled tailings and fluid that are not recovered would slowly be discharged from Crooked Creek into the Kuskokwim River over a series of weeks to months or more. Much of the spilled fluid would infiltrate soils and sediments along Crooked Creek, such that only a fraction of the spilled fluid is likely to enter the Kuskokwim River under this scenario. Entrained tailings would be carried downstream as suspended solids, with some tailings settling out in low-energy areas along the stream channel and other tailings eventually flushed out into the Bering Sea.

Under normal hydrologic conditions, the average streamflow in the Kuskokwim River is 68,900 cfs. Due to this high rate of flow, compared to the small fraction of released fluids that would slowly enter the Kuskokwim River over weeks to months, the hydrologic impact of the tailings release to the Kuskokwim River flow would be considered negligible. Communities downstream of Crooked Creek would see increased turbidity in the Kuskokwim River as the tailings were flushed downstream.

Heavily diluted flows from the spill scenarios that eventually enter the marine waters of the Bering Sea would not have any hydrologic impact.

Spilled tailings would be excavated and transported to the TSF as much as practicable. If a release were to occur during winter months, flow conditions would be more favorable for initial response and recovery efforts. Follow-up restoration work would be performed concurrently with stabilization, recovery, and remediation efforts. This would include drainage and channel reconstruction and restoration along Anaconda and Crooked Creeks.

4.5.2 2026 SEIS SCENARIO – 5.4 PERCENT SCENARIO

Under the 5.4 percent scenario, 27,640 acre-feet of slurry would be released (17,910 acre-feet of tailings plus 9,730 acre-feet of fluid from the tailings pond) over approximately 1 hour and 40 minutes.

The 5.4 percent scenario would have both temporary and long-term impacts on the hydrology of Anaconda Creek and Crooked Creek but would not have substantial impacts on the hydrology of the Kuskokwim River. See Table 2.2-2 for flow arrival times and floodwater depths for the release scenarios.

As with the 0.5 percent scenario, the flow of the tailings slurry down Anaconda Creek would cause erosion and scouring, resulting in more widespread changes to the stream morphology and transforming the stream into a more linear (less sinuous), wider, and deeper channel. The floodwater would travel at a high speed with a wave between 40 and 70 feet high flowing down the entire length of Anaconda Creek. Upon entering the confluence with Crooked Creek, the floodwaters would spread out, and the wave would diminish in speed and height.

Floodwaters would likely flow in both upstream and downstream directions along Crooked Creek, with depths of 20 to 50 feet near the confluence, substantially overflowing the channel. The volume of slurry released would be significantly greater than the streamflow in Crooked Creek, which seasonally ranges from approximately 100 cfs to 250 cfs near the confluence, such that the streamflow would not influence the properties of the tailings slurry (BGC 2026c). The release would inundate 4,507 acres within the Crooked Creek drainage. Maximum water depths would range between 20 and 40 feet down most of the length of Crooked Creek to the confluence with the Kuskokwim River at the Village of Crooked Creek, overflowing the channel all the way downstream.

See Table 2.2-2 for a summary of flood front and peak arrival times and peak flows for various impacted communities. The peak flood wave of slurry is predicted to reach the Village of Crooked Creek after 2 hours and 10 minutes, with a peak flow of 130,600 cfs. (The 100-year flood streamflow (Q100) of Crooked Creek at its mouth is estimated at 7,840 cfs [BGC 2026c]). The maximum water level rise at the village would be on the order of 20 to 30 feet. See Table 2.2-2 for flow arrival times and floodwater depths for the release scenarios. Many of the main roads through the village and areas around the perimeter of the airport would be inundated by floodwaters. Most buildings in low-lying areas of the village would also be inundated (see Figure 2-3). See Section 4.6, Groundwater Hydrology, for impacts to the village drinking water well.

The floodwaters would stay elevated for a few hours before subsiding. As the floodwaters recede, tailings solids would drop out of suspension and be deposited all along the flow path, from Anaconda Creek below the TSF, all the way down the Crooked Creek drainage and across much of the Village of Crooked Creek. Most of the tailings (66 percent) or 11,877 acre-feet of tailings would be deposited in the Crooked Creek drainage. Deposited tailings could block streamflow and cause water to be temporarily dammed and accumulate upstream of the tailings. The dammed water upstream of the tailings blockage would eventually cut into the soft tailings and form new stream channels through the tailings mass. The initial release from the temporary dam of deposited tailings could result in a secondary flood pulse that would travel downstream. A secondary flood pulse would be smaller than the initial flood and would likely have minimal additional impact. The deposition of the tailings solids would modify the streambed morphology. Tailings would be constantly eroded by streamflow and carried downstream, while tailings from farther upstream may deposit in lower energy areas of the new stream system. Streambed morphology would be in flux for months to years or more, depending on the effectiveness and timing of cleanup activities.

In the Village of Crooked Creek, portions of the airport, most of the major roads, residences, and other infrastructure would be partially buried by tailings, in thicknesses of between several feet up to almost 30 feet in depth (refer to Figure 2-11).

Under this scenario, 15,763 acre-feet of slurry would be discharged to the Kuskokwim River, and the release would inundate 3,100 acres in the Kuskokwim watershed. See Table 2.2-1 for inundation areas for the release scenarios. Streamflow in the Kuskokwim River averages 68,900 cfs, with the 100-year flood levels (Q100) estimated at 319,300 cfs based on stream gage data from just upstream of the Crooked Creek confluence (BGC 2026c). Due to this high flow volume, the hydrologic impact of the tailings release to the Kuskokwim River flow would be minimal. See Table 2.2-2 for flow arrival times and floodwater depths for the release scenarios, and Table 2.2-3 for tailings deposition and discharge volumes to the Kuskokwim River for the release scenarios.

Most of the tailings that are flushed into the Kuskokwim River would be finer-grained silts and clays. Because of the strong flow in the Kuskokwim, these fine particles are likely to stay in suspension all the way downstream and be flushed into the Bering Sea. A small amount of the tailings may settle in lower energy side channels, but tailings deposition in the Kuskokwim River would be minimal and would not be sufficient to cause notable changes to stream morphology as it would in Crooked Creek.

Communities along the Kuskokwim River downstream of Crooked Creek (e.g., Napaimute, Chuathbaluk, Aniak, Kalskag) would experience elevated river levels on the order of 1 foot or less for 1 to 2 days. Increased turbidity in the river would be evident in these communities as the tailings are flushed downstream.

Heavily diluted flows from the spill scenarios that eventually enter the marine waters of the Bering Sea would not have any hydrologic impact.

Spilled tailings would be excavated and transported to the TSF as much as practicable. If a release were to occur during winter months, flow conditions would be more favorable for initial response and recovery efforts. Follow-up restoration work would be performed concurrently with stabilization, recovery, and remediation efforts. This would include drainage and channel reconstruction and restoration along Anaconda and Crooked Creeks.

4.5.3 2026 SEIS SCENARIO – 13.3 PERCENT SCENARIO

The 13.3 percent release scenario would have both temporary and long-term impacts on the hydrology of Anaconda Creek and Crooked Creek that would be more extensive than those of the smaller scenarios. Impacts on the hydrology of the Kuskokwim River would remain minimal (refer to Table 2.2-2).

Under the 13.3 percent scenario, 54,080 acre-feet of slurry would be released (44,350 acre-feet of tailings plus 9,730 acre-feet of fluid from the tailings pond) over approximately 1 hour and 45 minutes.

Impacts from the flood wave and inundation of floodwaters on the downstream environment would be more extensive than the 5.4 percent scenario. Floodwater would maintain high speed, and a wave between 50 and 80 feet would flow down the entire length of Anaconda Creek. Floodwaters would flow in both upstream and downstream directions along Crooked Creek, with depths of 40 to 60 feet near the confluence, substantially overflowing the channel. The release would inundate 5,110 acres within the Crooked Creek drainage. Maximum water depths would be 30 to 40 feet along upper Crooked Creek, and 20 to 30 feet farther downstream and at the confluence with the Kuskokwim River at the Village of Crooked Creek. The floodwaters would overflow the Crooked Creek channel all the way downstream to the Kuskokwim River (Figure 2-4).

The peak flood wave of slurry is predicted to reach the Village of Crooked Creek after 1 hour and 55 minutes, with a peak flow of 166,080 cfs. (The 100-year flood streamflow (Q100) of Crooked Creek at its mouth is estimated at 7,840 cfs [BGC 2026c]). See Table 2.2-2 for a summary of flood front and peak arrival times and peak flows for various impacted communities. Flooding in the Village of Crooked Creek would be similar to that described for the 5.4 percent scenario. The maximum water level rise at the village would be on the order of 20 to 30 feet. Many of the main roads through the village and areas around the perimeter of the airport would be inundated. Most buildings in low-lying areas of the village would also be inundated (see Figure 2-4). See Section 4.6, Groundwater Hydrology, for impacts to the village drinking water well.

The majority of the tailings (93 percent), or 41,558 acre-feet, would be deposited in the Crooked Creek drainage under the 13.3 percent spill scenario. As noted for the 5.4 percent scenario, deposited tailings could block streamflow and cause water to be temporarily dammed and accumulate upstream of the tailings. The dammed water upstream of the tailings blockage would eventually cut into the soft tailings and form new stream channels through the tailings mass. The initial release from the temporary dam of deposited tailings could result in a secondary flood pulse that would travel downstream. A secondary flood pulse would be smaller than the initial flood and would have similar but minor additional impacts. Changes to stream morphology would be extensive, and even after successful cleanup, stream morphology would take years to decades to reach a new equilibrium. Tailings solids would be re-mobilized and distributed throughout the Crooked Creek drainage from stream channel re-establishment (down cutting, erosion, and channel migration) through the unconsolidated tailings mixture. This process would continue until equilibrium is eventually achieved through stream restoration measures, natural processes, or other mitigation activities.

In the Village of Crooked Creek, portions of the airport, most of the major roads, residences, and other infrastructure would be partially buried by tailings, mostly by thicknesses between 10 and 30 feet in depth.

Kuskokwim River flow averages 68,900 cfs. Due to the high flow volume in the Kuskokwim River, the hydrologic impact of the tailings release to the river flow would be considered minimal. A small amount of the tailings may settle in lower energy side channels along the Kuskokwim River, but tailings deposition would not be sufficient to cause notable changes to stream morphology as it would in Crooked Creek.

Communities along the Kuskokwim River downstream of Crooked Creek (e.g., Napaimute, Chuathbaluk, Aniak, Kalskag) as well as the proposed Angyaruaq (Jungjuk) port site would experience elevated river levels on the order of 1 foot or less for 1 to 2 days, but flooding is expected to remain confined to the channel, limiting overbank erosion potential. Residents of downstream communities would see increased turbidity in the river as the tailings are flushed downstream.

Heavily diluted flows from the spill scenarios that eventually enter the marine waters of the Bering Sea would not have any hydrologic impact.

Spilled tailings would be excavated and transported to the TSF as much as practicable. If a release were to occur during winter months, flow conditions would be more favorable for initial response and recovery efforts. Follow-up restoration work would be performed concurrently with stabilization, recovery, and remediation efforts. This would include drainage and channel reconstruction and restoration along Anaconda and Crooked Creeks.

4.5.4 2026 SEIS SCENARIO – 27 PERCENT SCENARIO

The 27 percent scenario would have both temporary and long-term impacts on the hydrology of Anaconda Creek and Crooked Creek, and minimal to minor impacts on the hydrology of the Kuskokwim River.

Under the 27 percent scenario, 109,730 acre-feet of slurry would be released (100,000 acre-feet of tailings plus 9,730 acre-feet of fluid from the tailings pond) over approximately 1 hour and 50 minutes.

For the 27 percent scenario, impacts were considered for two separate sets of conditions: the spill occurring during normal hydrologic conditions, and the spill occurring during the 100-year flood stage of Crooked Creek/Kuskokwim River. This section describes impacts from a naturally occurring 100-year flood alone; impacts from the spill under flood conditions are considered to be the additional hydrologic impacts beyond baseline flood conditions.

Inundation modeling results predict an initial wave as high as 111.5 feet directly below the TSF dam under both normal hydrologic conditions and the flood stage scenario. Extreme erosion from the flow of the tailings slurry and pond fluid down Anaconda Creek would eliminate existing stream morphology and transform the channel into a linear, wider, and deeper channel. Floodwater would maintain high speed and a wave between 90 and 100 feet down the entire length of Anaconda Creek. Upon entering the confluence with Crooked Creek, the floodwaters would spread out and the wave would diminish in speed and height.

Floodwaters would flow in both upstream and downstream directions along Crooked Creek, with depths of 60-80 feet near the confluence, substantially overflowing the channel. The release would inundate 5,902 acres within the Crooked Creek drainage. Maximum water depths would range between 30 and 50 feet down most of the length of Crooked Creek to the confluence with the Kuskokwim River at the Village of Crooked Creek, overflowing the entire length of the Crooked Crook channel from Anaconda Creek to the Kuskokwim River.

The peak flood wave of slurry is predicted to reach the Village of Crooked Creek after 1 hour and 30 minutes, with a peak flow of 430,730 cfs, some 55 times the volume of Crooked Creek during a hypothetical 100-year flood. (The 100-year flood streamflow (Q100) of Crooked Creek at its mouth is estimated at 7,840 cfs [BGC 2026c]). See Table 2.2-2 for a summary of flood front and peak arrival times and peak flows for various impacted communities. The maximum water level rise at the village would be on the order of 30–40 feet under both during normal hydrological conditions and 100-year flood stage conditions. The airport and all the main roads through the village would be inundated by floodwaters, and most buildings in low-lying areas of the village would be inundated under both normal hydrological conditions and 100-year flood stage conditions (see Figures 2-5 and 2-7). See Section 4.6, Groundwater Hydrology, for impacts to the village drinking water well.

If the 27 percent spill were to occur under normal hydrological conditions, water level rise would be 20 to 30 feet on the Kuskokwim River near the confluence with Crooked Creek. During a 100-year flood, the predicted baseline water level rise on this stretch of the Kuskokwim River would be 30 to 40 feet. If the spill were to occur under these flood conditions, the water rise would be an additional 10 feet above flood levels, with a maximum water level rise of 40 to 50 feet under this scenario. Floodwaters would stay elevated for 1 to 2 days before subsiding.

As the floodwaters recede, tailings solids would drop out of suspension and be deposited all along the flood path, from Anaconda Creek below the TSF, all the way down the Crooked Creek drainage and across much of the Village of Crooked Creek. An estimated 69,588 acre-feet of tailings would be deposited in the Crooked Creek drainage. As with the smaller failure scenarios, deposited tailings would block streamflow and cause surface water to be temporarily dammed and accumulate upstream of the tailings. The blockage of flow in the 27 percent scenario, however, would be much more extensive, and may stretch in the downstream direction nearly to the confluence with the Kuskokwim River. The massive amounts of tailings deposited would also result in longer-lasting impacts to stream morphology. The dammed water upstream of the tailings blockage would eventually cut into the soft tailings and form new stream channels through the tailings mass; this process could start within hours of the release, and new channels could be cut into the tailings for days to weeks until the dammed water is released and the flow is stabilized. The initial release from the temporary dam of deposited tailings could result in a secondary flood pulse that would travel downstream. A secondary flood pulse would be smaller than the initial flood and would have similar but less severe effects. Tailings would be constantly eroded by streamflow and carried downstream, while tailings from farther upstream may be redeposited in lower energy areas of the channel. Streambed morphology would likely be in flux for years or longer, depending on the effectiveness and timing of cleanup activities. Even after successful cleanup, stream morphology may require decades to reach a new equilibrium.

The majority of the tailings (70 percent), or 69,588 acre-feet, would be deposited within Crooked Creek. Deposited tailings within Crooked Creek would continue to be mobilized and carried downstream in suspension over time. Tailings solids would be re-mobilized and distributed throughout the Crooked Creek drainage from stream channel re-establishment (down cutting, erosion, and channel migration) through the unconsolidated tailings mixture. This process would continue until equilibrium is eventually achieved through stream restoration measures, natural processes, or other mitigation activities.

In the Village of Crooked Creek, portions of the airport, most of the major roads, residences, and other infrastructure would be partially buried by tailings, in thicknesses of between several feet up to greater than 30 feet in depth.

Kuskokwim River flow averages 68,900 cfs during normal hydrological conditions “sunny day" conditions, while the flow under 100-year flood conditions is 319,300 cfs. Due to the high volume of flow, most tailings that enter the Kuskokwim River would be carried downstream and not deposited. A small amount of the tailings may settle in lower energy side channels along the Kuskokwim River, but tailings deposition would not be sufficient to cause notable changes to stream morphology as it would in Crooked Creek.

Under this spill scenario during normal hydrologic condition, communities along the Kuskokwim River downstream of Crooked Creek (e.g., Napaimute, Chuathbaluk, Aniak, Kalskag) and the proposed Angyaruaq (Jungjuk) port site would experience elevated river levels on the order of 1 to 2 feet for 1 to 2 days while the initial flood wave passes, but flooding is expected to mostly remain confined to the channel, limiting overbank erosion potential and safety concerns. Residents of downstream communities would see increased turbidity in the river as the tailings are flushed downstream.

The increased flow during a naturally occurring 100-year flood, without the contribution from the release scenario, would raise the river level approximately 20 to 40 feet. Most of this flow would remain within the main channel; however, in areas where the braided channel widens, there would be significant overbank flooding. This would be most notable in the area between Aniak and Upper/Lower Kalskag, where natural flooding would cause up to 10 feet of streamflow to spread out in the surrounding braided channels. The Village of Napaimute would also see floodwaters rise some 10–30 feet in parts of the community (see Figure 2-6).

Under 100-year flood conditions with the 27 percent release, communities along the Kuskokwim River downstream of Crooked Creek (e.g., Napaimute, Chuathbaluk, Aniak, Kalskag) would experience additional elevated river levels of only 0.2 to 0.7 feet above baseline flood conditions (see Figure 2-7). The proposed Angyaruaq (Jungjuk) port site would be partially inundated during flood conditions, but the fuel tank location remains beyond the inundation extent. The 100-year flood condition greatly attenuates the effects of the spill wave downstream compared to normal hydrologic conditions. Under flood condition, tailings fluids are more likely to infiltrate soils, sediments, and shallow groundwater in these areas, and minor amounts of tailings solids are more likely to deposit.

Heavily diluted flows from any of the spill scenarios that eventually enter the marine waters of the Bering Sea would not have any hydrologic impact.

Spilled tailings would be excavated and transported to the TSF as much as practicable. If a release were to occur during winter months, flow conditions would be more favorable for initial response and recovery efforts. Follow-up restoration work would be performed concurrently with stabilization, recovery, and remediation efforts. This would include drainage and channel reconstruction and restoration along Anaconda and Crooked Creeks.

4.6 GROUNDWATER HYDROLOGY

This section addresses potential impacts to the hydrology of downstream groundwater systems from the spill scenarios. Effects on groundwater quality from metals leaching from the tailings and reaching the shallow water table are described in Section 4.7.2, Groundwater Quality.

4.6.1 SUMMARY OF IMPACTS FROM 2018 EIS SCENARIO – 0.5 PERCENT SCENARIO

A partial tailings dam failure could temporarily affect the physical hydrology of shallow groundwater in the Crooked Creek floodplain and Kuskokwim River shoreline areas. In locations where the flood elevation is substantially higher than normal water levels, floodwaters could infiltrate into shallow groundwater stored in the widespread surficial alluvial deposits across the extent of the spill area, from just upstream of the confluence to about 1 mile downstream along Crooked Creek (see Figure 2-1).

The thick deposition of tailings around the confluence could raise the water table along Crooked Creek. Groundwater mounding could occur within the thicker parts of the tailings deposit in Anaconda and Crooked Creeks, with localized groundwater flow directed radially away from the deposit. Pore water entrained within the deposited tailings could infiltrate into the shallow aquifer. This could last for the duration of cleanup activities.

The 0.5 percent scenario would not impact the drinking water supply well that serves the community of Crooked Creek. An increased flood elevation of 1 foot near the village would not affect flow in the aquifer tapped by the village drinking water supply well, as it is sited on a hill about 60 feet above Crooked Creek and the Kuskokwim River. The source water protection area for the well extends up the hill to the northwest and would not intersect the path of the tailings spill in the Crooked Creek floodplain.

Impacts on groundwater hydrology under this 0.5 percent scenario are mostly expected to last a few days and would then subside after creek levels return to normal. Groundwater mounding would last for the duration of tailings cleanup activities.

4.6.2 2026 SEIS SCENARIO – 5.4 PERCENT SCENARIO

Similar to the 0.5 percent scenario, groundwater hydrology would be impacted by the 5.4 percent scenario in areas where the flood elevation is substantially higher than normal water levels, resulting in floodwaters infiltrating shallow alluvial deposits. The maximum increase in surface water elevations under this scenario is predicted to be about 40 feet at the confluence of Anaconda and Crooked Creeks. Floodwaters would infiltrate alluvium within and along the streambank in this area (see Figure 2-3).

Water table mounding would likely occur within the thicker parts of the tailings deposit in Anaconda and Crooked Creeks, with localized groundwater flow directed radially away from the deposit, which could last for the duration of cleanup activities.

This scenario would likely impact the drinking water supply well that serves the community of Crooked Creek. Immediately after the tailings failure, the stream level is predicted to rise a maximum of about 30 feet near the village. The village drinking water supply well is sited on a hill about 60 feet above Crooked Creek and the Kuskokwim River. The source water protection area for the well extends up the hill to the northwest and could be impacted by the elevated floodwaters as well as the tailings deposited. Modeling of the 5.4 percent scenario indicates that the floodwaters would rise to within approximately 300 feet of the groundwater source protection area (ADEC 2026). The floodwaters would subside within 1 to 2 days, but the remaining tailings could cause groundwater mounding in the source water protection area until the tailings are cleaned up. The potential impact of the tailings pore water on groundwater quality is addressed in Section 4.7.2.

Impacts on groundwater hydrology under this 5.4 percent scenario may last approximately 1 week and would then subside after creek levels return to normal. Groundwater mounding would last for the duration of tailings cleanup activities.

The maximum rise in floodwater elevation in communities farther downstream along the Kuskokwim River would be up to about 1 foot. Groundwater protection areas for Aniak, Upper Kalskag, and Lower Kalskag are in alluvial deposits adjacent to the Kuskokwim River. The slightly elevated stream levels in the Kuskokwim could infiltrate these alluvial deposits for 1 to 2 days as the flood flow passes. This minor and temporary increase in water levels is unlikely to impact the groundwater hydrology in these downstream areas. For potential impacts to groundwater quality, refer to Section 4.7.2.

4.6.3 2026 SEIS SCENARIO – 13.3 PERCENT SCENARIO

Similar to the previous scenarios analyzed, groundwater hydrology would be impacted under the 13.3 percent scenario in areas where the flood elevation is substantially higher than normal water levels, resulting in floodwaters infiltrating shallow alluvial deposits.

The maximum increase in surface water elevations under this scenario is predicted to be about 60 feet at the confluence of Anaconda and Crooked Creeks (Figure 2-4). Water table mounding would likely occur within the thicker parts of the deposited tailings, with localized groundwater flow directed radially away from the deposit, which could last for the duration of cleanup activities.

This scenario would likely impact the drinking water supply well that serves the community of Crooked Creek, located at the confluence of Crooked Creek and the Kuskokwim River. After the tailings failure, the maximum increase in surface water elevation at the village is predicted to be about 30 feet (Figure 2-4). The village drinking water supply well is sited on a hill about 60 feet above Crooked Creek and the Kuskokwim River. The source water protection area for the well extends up the hill to the northwest and could be impacted by the elevated floodwaters and the tailings left behind in the Crooked Creek floodplain under this scenario. Modeling of the 13.3 percent scenario indicates that the floodwaters would rise to within approximately 300 feet of the groundwater source protection area (ADEC 2026). The floodwaters would subside within 1 to 2 days, but the remaining tailings could cause groundwater mounding in the source water protection area until the tailings are cleaned up. The potential impact of the tailings pore water on groundwater quality is addressed in Section 4.7.2.

Impacts on groundwater hydrology under this 13.3 percent scenario may last 1 to 2 weeks or more, depending on the area, and would then subside after creek levels return to normal. In areas such as oxbow lakes where floodwaters may remain backed up, the impact to groundwater hydrology would persist until the floodwaters completely drained. Groundwater mounding would last for the duration of tailings cleanup activities.

The maximum rise in floodwater elevation in communities farther downstream along the Kuskokwim River would be up to about 1 foot. Groundwater protection areas for Aniak, Upper Kalskag, and Lower Kalskag are in alluvial deposits adjacent to the Kuskokwim River. The slightly elevated stream levels in the Kuskokwim could infiltrate these alluvial deposits for 1 to 2 days as the flood flow passes. This minor and temporary increase in water levels is unlikely to impact the groundwater hydrology in these downstream areas. For potential impacts to groundwater quality, refer to Section 4.7.2.

4.6.4 2026 SEIS SCENARIO – 27 PERCENT SCENARIO

Similar to the previous scenarios analyzed, groundwater hydrology would be impacted by the 27 percent spill scenario in areas where the flood elevation is substantially higher than normal water levels. Floodwaters would likely infiltrate into shallow alluvial deposits. The maximum increase in surface water elevation under this scenario is predicted to be about 80 feet at the confluence of Anaconda and Crooked Creeks, under both normal hydrologic conditions and 100-year flood conditions (see Figures 2-5 and 2-7). Water table mounding would likely occur within the thicker parts of the deposited tailings, with localized groundwater flow directed radially away from the deposit, which could last for the duration of cleanup activities.

This scenario would likely impact the drinking water supply well that serves the community of Crooked Creek, located at the confluence of Crooked Creek and the Kuskokwim River. The maximum increase in water elevation at the village under this scenario is predicted to be about 40 feet, under both normal hydrological conditions and 100-year flood stage conditions (Figures 2-5 and 2-7). The village drinking water supply well is sited on a hill about 60 feet above Crooked Creek and the Kuskokwim River. The source water protection area for the well extends up the hill to the northwest and would be impacted by the elevated floodwaters and the tailings deposited in the Crooked Creek floodplain under this scenario. Modeling of the 27 percent scenario indicates that the floodwaters would enter the groundwater source protection area (ADEC 2026). The floodwaters would likely subside within a day, but the remaining tailings could cause groundwater mounding in the source water protection area until the tailings are cleaned up. The potential impact of the tailings pore water on groundwater quality is addressed in Section 4.7.2.

Impacts on groundwater hydrology under this 27 percent scenario may last for weeks or longer, and would then subside after creek levels return to normal. In areas such as oxbow lakes where floodwaters may remain backed up, the impact to groundwater hydrology would persist until the floodwaters completely drained. Groundwater mounding would last for the duration of tailings cleanup activities.

The maximum rise in floodwater elevation in communities farther downstream along the Kuskokwim River would be on the order of 1 to 2 feet. Groundwater protection areas for Aniak, Upper Kalskag, and Lower Kalskag are in alluvial deposits adjacent to the Kuskokwim River. The slightly elevated stream levels in the Kuskokwim could infiltrate these alluvial deposits for up to 2 days as the flood flow passes. This minor and temporary increase in water levels is unlikely to impact the groundwater hydrology in these downstream areas. For potential impacts to groundwater quality, see Section 4.7.2.

4.7 WATER AND SEDIMENT QUALITY

This section addresses impacts to surface water quality, groundwater quality, and sediment quality. The types of impacts expected to each resource are likely to be similar due to the interrelationship between surface water, groundwater, and streambed sediments. Water and sediment quality impacts are largely determined by the change in chemical composition of impacted waters compared to baseline water quality and Applicable Water Quality Criteria (AWQC). Exceedances of water quality criteria can result in adverse impacts to water and sediment quality. Refer to the 2018 EIS Section 3.7, Water Quality, for a discussion of the analysis methodology.

Physical impacts to water resources are addressed in Section 4.5, Surface Water Hydrology, and Section 4.6, Groundwater Hydrology. Impacts to soils are addressed in Section 4.2, Soils.

4.7.1 SURFACE WATER QUALITY

Several constituents and metals in the tailings fluid are expected to exceed AWQC. Any intentional discharge of TSF water under planned mine operations would require water treatment to comply with Alaska Pollutant Discharge Elimination System requirements. In the event of an unplanned release, however, TSF fluids would likely result in adverse effects to downstream water quality from release of these constituents.

4.7.1.1 Summary of Impacts from 2018 EIS Scenario – 0.5 Percent Scenario and Comparison with the Larger Spill Scenarios

The partial tailings dam failure scenario would result in adverse impacts to surface water quality downstream of the failure. Surface water impacts exceeding applicable water quality standards would extend from the Anaconda Creek and Crooked Creek drainages to the Kuskokwim confluence. Water quality impacts would result from both the spilled TSF fluid, including pond water and pore water, and the spilled tailings solids. Impacts would be acute, short-term and long-term, lasting for years to more than a decade under the 0.5 percent scenario, with more severe, extensive, and longer-lasting impacts in the larger scenarios. Impacts from the tailings fluid would generally be more acute and of shorter duration, while adverse impacts from deposited tailings would be prolonged for years to decades. Water quality would also vary over time due to seasonal changes in flow conditions and as spilled tailings are redistributed throughout the impacted drainages.

4.7.1.1.1 Turbidity/Total Suspended Solids

Increased turbidity and total suspended solids (TSS) in downstream waters would cause both an acute and a long-term water quality impact in all release scenarios. Turbidity and TSS would be elevated in tailings fluid. The solid tailings particles entrained in the slurry would also cause immediate increases in downstream turbidity and TSS in all of the release scenarios.

Tailings particles flushed into Crooked Creek would have immediate adverse impacts on the water quality throughout downstream stretches of the creek. The existing flow in Crooked Creek consists of relatively clear water, with naturally low levels of turbidity and TSS. The high levels of suspended particles that would result from a tailings spill may cause an increase in water temperature, reduced dissolved oxygen levels, and reduced penetration of sunlight through the water, which can result in reduced photosynthesis in underwater vegetation. Elevated turbidity and TSS would be both an acute impact during the initial release, and a long-term impact, as tailings would be constantly mobilized and flushed downstream for years following a spill. Loading of fine suspended tailings sediment during all seasonal flow conditions would progressively diminish over time as the stream re-establishes equilibrium with continued flow.

Tailings flushed into the Kuskokwim River would increase the turbidity and TSS of the streamwater to a degree; however, water in the Kuskokwim River is already naturally turbid, with high TSS. Suspended tailings particles would also be highly diluted by the streamflow in the Kuskokwim River, such that the increased turbidity and TSS would be less notable.

Increased turbidity of marine waters when tailings are flushed from the mouth of the Kuskokwim into the Bering Sea would be a negligible impact in the smaller spill scenarios.

4.7.1.1.2 Metals and Major Constituents

The release of tailings slurry with elevated metals and other constituents to downstream waters would be an acute impact from the release of pond water; a short-term impact from the release of tailings pore water; and a long-term impact from leaching of any tailings solids that remain on the land.

Concentrations of analytes expected to exceed the most stringent AWQC in TSF pond water and pore water in buried tailings are summarized in the 2018 EIS Table 3.24-12. A total of seven analytes in TSF water exceed the concentrations specified in the most stringent AWQC by an order of magnitude or greater. These include sulfate, antimony, arsenic, iron, manganese, molybdenum, and mercury. Analyte concentrations in TSF water that are the most elevated above the AWQC include mercury, arsenic, and potentially antimony. Mercury would not be used for ore processing but occurs naturally in some rock types as the mineral cinnabar and would thus be present in the tailings solids. High mercury levels would be addressed through process plant design that would include a dosage facility to allow chemical addition to precipitate mercury as a stable mercury sulfide compound that would remain with the tailings solids in the TSF (SRK 2017). Due to these measures, mercury would not be present in tailings solids at levels exceeding soil cleanup guidelines, but there would be elevated concentrations of mercury in tailings pond water.

Initial post-depositional flow in the Crooked Creek drainage would likely result in acute loading of dissolved TSF fluid constituents in surface water. Tailings pond water not held within the tailings slurry would be flushed downstream with the initial flood wave and would cause immediate, acute impacts to surface water. These impacts would likely diminish quickly, over timescales of weeks. The water would naturally drain from the Crooked Creek watershed to the Kuskokwim River, where it would be diluted with river water to the extent that the Kuskokwim River would be compliant with the most stringent AWQC.

Most of the tailings fluid would be retained interstitially during tailings deposition. Pore water entrained within the deposited tailings would be released more slowly during and after tailings deposition, causing more gradual impacts to surface water in the short term, over ensuing days to weeks.

Certain dissolved constituents in TSF water would likely temporarily exceed AWQC throughout the entire Crooked Creek drainage to the Kuskokwim River. These would include sulfate, antimony, arsenic, iron, manganese, molybdenum, mercury, and potentially selenium pending dilutional processes. See 2018 EIS Table 3.24-12 for concentrations of all the constituents that would exceed water quality criteria. The fluid would flush through the drainage relatively quickly and would be diluted by existing flow in the stream. The release of these constituents from the tailings water would progressively diminish with continued flushing from the natural streamflow. The adverse water quality impacts would therefore be short-term.

In a summertime spill, spilled tailings fluid would readily mix with surface water; infiltrate into soils, sediments, and shallow groundwater; and would be impossible to recover. If the spill were to occur during the winter while the ground is frozen, infiltration of the fluid would be delayed; a small amount of the tailings fluid could potentially be recovered with the solid tailings, but most fluid would likely be lost to the environment. Deposition of the tailings at the confluence of Anaconda and Crooked Creeks would impede flow of some of the tailings fluid initially, but the backed-up fluid would eventually mix with surface water and flow downstream, with the same outcomes.

4.7.1.1.3 Leaching of Metals and Major Constituents from Deposited Tailings

Tailings deposited within the spill impact area would serve as a long-term source of downstream contamination until the tailings are recovered. Dissolution of metals and other constituents in tailings solids would cause prolonged chemical impacts to surface water downstream of the spill. Surface water and meteoric water would continually leach constituents from the deposited tailings, which would be carried downstream and diluted by surface water flow.

The potential to leach metals from spilled tailings varies by constituent, as well as environmental conditions. Leaching rates are slower in cold environments. In order to predict the potential for leaching of harmful constituents, a series of tests were carried out on material representative of tailings that would be present in the Donlin Gold TSF. Kinetic cell testing was performed on the tailings to evaluate metal leaching potential. The tests involve subjecting the tailings to periodic leaching and collection of leachate for analysis. The meteoric water mobility procedure test was also applied, wherein tailings are subjected to a series of rinses to determine the nature and quantities of soluble constituents that may be washed from tailings materials under natural precipitation conditions (e.g., rainfall, snowmelt; Table 4.7-1).

With the exception of dissolved manganese, pre-existing analyte concentrations in Crooked Creek are in compliance with the most stringent AWQC (Table 3.7-4 of the 2018 EIS). Analyte concentrations from tailings dissolution in surface water would diminish with distance downstream of the tailings deposit; however, certain analytes would exist throughout the entire Crooked Creek drainage at concentrations above AWQC at any seasonal average flow condition. Concentrations of sulfate, arsenic, antimony, manganese, and potentially molybdenum in surface water could exceed their respective AWQC based on meteoric water mobility procedure test results.

Leaching of arsenic, antimony, and manganese from spilled tailings would likely cause exceedances for downstream water quality for years to decades or more, or until tailings are recovered. Sulfate leaching would result in exceedance of water quality standards for weeks to months but would be reduced in the long term compared to other metals. Leaching of fluoride, cadmium, molybdenum, and selenium would likely cause exceedances in water quality for months to years, and then levels of these constituents in the leachate would be reduced to within water quality standards. Table 4.7-2 provides the results of a mass balance assumption in which the total leachable constituent mass (on a milligrams per cubic foot of tailings, based on summing each meteoric water mobility procedure cycle) is released into Crooked Creek water yielding exceedance right at the AWQC, with estimation of the timeframe required to deplete the constituent mass based on the mean annual Crooked Creek flow.

Table 4.7-1: Tailings Pond Water Quality, Tailings Pore Water Quality, and 2007 Phase 2 Pilot Plant Transitional Tailings Solids MWMP Dissolved Constituent Results for Regulated Analytes of Concern

Parameter	Units	AWQC	Tailings Pond Water	Tailings Pore Water	MWMP Leachate	MWMP 1st DI Rinse	MWMP 2nd DI Rinse	MWMP 3rd DI Rinse	MWMP 4th DI Rinse
Major Constituents									
pH	s.u.	6.5-8.5 [1]	6.5	5.8	6.85	6.86	6.73	6.65	7.06
Fluoride	mg/L	1 [2d]	2	2	0.45	0.50	0.47	0.30	0.27
			2x	*2x*	--	--	--	--	--
Sulfate	mg/L	250 [1]	5,800	4,400	2,000	1,900	1,500	850	1,600
			23x	*18x*	*8x*	*7.6x*	*6x*	*3.4x*	*6.4x*
TDS	mg/L	500 [1]	--	7,779	2,900	2,820	2,370	1,160	1,440
			--	*16x*	*5.8x*	*5.6x*	*4.7x*	*2.3x*	*2.9x*
Metals									
Antimony	mg/L	0.006 [2c]	0.022	1.1	0.0393	0.0448	0.0431	0.0239	0.0222
			3.7x	*183.3x*	*6.6x*	*7.5x*	*7.2x*	*4x*	*3.7x*
Arsenic	mg/L	0.010 [2c]	3.3	15	0.463	0.506	0.5	0.412	0.402
			330x	*1500x*	*46x*	*51x*	*50x*	*41x*	*40x*
	mg/L	0.150 [2b]	3.3	15	0.463	0.506	0.5	0.412	0.402
			22x	*100x*	*3x*	*3x*	*3x*	*3x*	*3x*
Cadmium	mg/L	0.00064 [2a,b]	0.00073	0.00073	0.000083	0.000061	0.000043	0.000017	0.000045
			1.1x	*1.1x*	--	--	--	--	--
Iron	mg/L	1 2b	0.0044	98	0.03	0.05	0.02	<0.01	0.03
			--	*98x*	--	--	--	--	--
Manganese	mg/L	0.200 [2d]	2	2	3.27	3.14	2.06	0.870	0.966
			40x	*40x*	*65x*	*63x*	*41x*	*17x*	*19x*

Parameter	Units	AWQC	Tailings Pond Water	Tailings Pore Water	MWMP Leachate	MWMP 1st DI Rinse	MWMP 2nd DI Rinse	MWMP 3rd DI Rinse	MWMP 4th DI Rinse
Molybdenum	mg/L	0.010 [2d]	0.23	0.23	0.0368	0.0309	0.0115	0.00268	0.00477
			23x	*23x*	*4x*	*3x*	*1x*	--	--
Selenium	mg/L	0.0046 [2b]	0.042	0.042	0.004	0.003	<0.001	<0.001	<0.001
			9x	*9x*	--	--	--	--	--
Mercury	ng/L	12 [2b]	10,000	10,000	0.000010	0.000010	0.000007	0.000005	0.000003
			833x	*833x*	--	--	--	--	--

Source: Donlin Gold 2026a
Notes:
All tailings pond water and pore-water concentrations are “dissolved” and should be used as “average” annual.
AWQC = Alaska Water Quality Criteria; MWMP = meteoric water mobility procedure; TDS = total dissolved solids
AWQC values provided are the most stringent among values provided in 18 AAC 70 and the Alaska Water Quality Criteria Manual (considering drinking water, irrigation water, and freshwater aquatic life chronic standards), as noted below. Two values are provided for arsenic, since the freshwater aquatic life chronic standard is higher than the drinking water standard.
[1] 18 AAC 70. ADEC, Alaska Water Quality Standards. Amended as of August 9, 2025, maximum drinking water levels.
[2] Alaska Water Quality Criteria Manual for Toxic and Other Deleterious Organic and Inorganic Substances. Amended through September 8, 2022. Most stringent criteria used. Criteria are expressed in terms of dissolved metal in the water column, except for aluminum and mercury, which are in terms of total recoverable metal.
[2a] Aquatic life for fresh water hardness-dependent criteria. A hardness of >400 mg/L was used for all calculations. For aluminum, if pH≥7.0 and hardness ≥50, then 750 µg/L.
[2b] Aquatic life for fresh water (chronic) criteria. For selenium, the criterion is provided as total recoverable (0.005 mg/L), which was multiplied by 0.922 to convert to a dissolved basis per Note 64 in the Alaska Water Quality Criteria Manual.
[2c] Drinking water primary maximum contaminant levels. 2d Irrigation water criteria.
Yellow highlighting indicates values that exceed the AWQC. Italicized values beneath concentration values indicate factor by which concentration exceeds AWQC.

Table 4.7-2: Estimated Hypothetical Depletion Timeframe for Tailings Constituents in Crooked Creek

Release Scenario			0.5%	5%	13%	27%[1]
	AWQC	Solute Mass	Time to Dilute Below AWQC			
	mg/L	mg/cf tailings	years	years	years	years
Fluoride	1	132	0.03	0.2	0.7	1.2
Cadmium	0.00064	0.024	0.01	0.1	0.2	0.3
Molybdenum	0.01	7.91	0.2	1.2	4.2	7.2
Selenium	0.0046	0.997	0.05	0.3	1.2	2.0

Notes: AWQC = Applicable Water Quality Criteria; mg/L = milligrams per liter; mg/cf = milligrams per cubic foot
[1] The analysis was conducted on a 25% release scenario and the hypothetical depletion timeframe for the 27% scenario would be similar but longer.
Sources: Arcadis 2026; Donlin Gold 2026a

4.7.1.1.4 Acid Generation

PAG tailings have the ability to generate sulfuric acid mostly through oxidation of sulfide minerals. Release of sulfuric acid through both natural and mining-related processes results in acid rock drainage, which is harmful to downstream ecosystems. In addition, acidic environments promote higher rates of metal leaching, resulting in further potential impacts to water quality.

At the proposed Donlin Gold mine, most tailings stored in the TSF would be non-acid-generating (NAG), while only a small percentage would be PAG. Subaqueous tailings storage in the TSF would reduce exposure of PAG tailings to air, which limits the oxidation of sulfides and thus limits the generation of acid. Some NAG tailings may also serve to neutralize any acid generated by the PAG materials. The predicted pH of tailings pond water is neutral (6.5), while the tailings pore water would have a slightly more acidic pH of 5.8. See Section 3.7.2.4.1, Waste Rock, in the 2018 EIS for a full evaluation of the Donlin Gold ore chemistry, including acid generation potential.

Kinetic cell testing profiles of final tailings were performed to evaluate acid generation potential. The tests involved subjecting the tailings to periodic leaching and collection of leachate for analysis. Available data indicated no adverse acid generation trends (SRK 2017).

In spilled tailings deposited along streambanks that do not remain submerged underwater, tailings could be exposed to air, such that there would be potential for acid generation from PAG materials. In the absence of neutralizing NAG tailings, a small amount of acid could be generated from PAG tailings, which would occur slowly over months to years in the cold climate. As acid is generated, it would be diluted and flushed downstream by precipitation and streamflow, such that in most areas, it is unlikely that the generated acid would become concentrated enough to impede water quality.

4.7.1.1.5 Other Contaminants

Residual amounts of reagents would also be present in the TSF and would be carried downstream in the tailings slurry. Various reagents will be used to concentrate gold-bearing minerals to separate gold from the ore and from the water treatment processes. For a list of potential reagents that would be used at the Mine Site, see Table 2.3-3 from the 2018 EIS. Some key examples of these substances include the following:

- The tailings would contain residual amounts of the mercury suppressant UNR reagent, which will be used to precipitate the remaining mercury in solution, creating an insoluble sulfide-mercury particle.
- Residual amounts of cyanate, ammonium, and carbonate ions could be present in the tailings. Sodium cyanide would be used for ore processing and would then be converted to less toxic cyanate before discharging to the tailings pond. Cyanate naturally breaks down over time into common substances, including ammonium and carbonate, which are forms of nitrogen and carbon found naturally in the environment.

Residual amounts of these contaminants would be present in tailings pond water, tailings pore water, and may also adhere to solid tailings particles, and would be transported downstream with the tailings slurry. These contaminants range in toxicity and have not been quantified with respect to their potential concentration in the TSF but may be toxic to downstream ecosystems. Their release with the initial floodwaters may cause acute adverse water quality impacts downstream. These contaminants would be quickly diluted by surface water and/or precipitation, are likely to flush out of the impacted drainages within days to weeks of the spill, and are unlikely to have long-term water quality impacts.

4.7.1.1.6 Clean Water Act Regulation

Adverse water quality impacts in the Crooked Creek drainage would meet the criteria for a Category 5 impaired waterbody per Section 303 (d) of the Clean Water Act. The listing could potentially persist throughout mine closure, but this would largely depend on timing of the release relative to the period of mine operation. Depending on the success of remediation and restoration efforts, adverse physical and chemical impacts to water quality in the Crooked Creek drainage could potentially persist for decades.

4.7.1.1.7 Cleanup and Restoration Efforts

Cleanup of spilled tailings would greatly reduce the long-term adverse effects of the leaching from solid tailings. However, recovery efforts may disturb and mobilize tailings from the activity of heavy machinery, temporarily increasing downstream impacts, with subsequent temporary increases in turbidity and TSS. Erosion and sediment control measures such as sedimentation ponds and other best management practices would be employed to reduce downstream movement of tailings solids during cleanup efforts.

The degree of impacts to water quality would depend on the effectiveness of cleanup activities and the volume and spatial distribution of the released tailings solids material considered "non-recoverable." Successful cleanup would recover a portion of the spilled tailings, thereby limiting the longer-term potential effects of the leaching of constituents from tailings solids into downstream water. Cleanup during the winter months may be more successful, as there would be less streamflow to re-mobilize spilled tailings, and heavy equipment could operate more effectively on hard, frozen ground.

Even after successful cleanup, dispersed deposits of tailings would likely remain in and around the Crooked Creek channel for years. Over time, precipitation and river flow would naturally flush these tailings downstream. Entrained tailings would be carried downstream into the Kuskokwim River as suspended solids, with some tailings settling out in low-energy areas along the stream channel. Some of the tailings deposited along the Kuskokwim River may remain in oxbows and backwater sloughs for years before being flushed downstream or being buried by sedimentation.

Metals and other constituents would be leached from any tailings that remain in place. Due to the cold climate, the leaching of metals from tailings would be slow, and due to the high precipitation in the area, any metals released would be constantly diluted by rain and streamflow, such that metals concentrations in streamflow are unlikely to be high enough to exceed AWQC in most areas.

Lingering thin deposits of tailings may remain in isolated portions of the drainages, particularly in oxbows and backwater sloughs that are cut off from the main drainage channel. These tailings may remain in place for years to decades, depending on the success of cleanup efforts. These isolated deposits are less likely to be flushed downstream and diluted. Thus, any acid, metals, or other constituents leached from the tailings solids are more likely to accumulate in place, potentially causing localized water quality exceedances in these areas for years following a spill.

The Kuskokwim River mean monthly discharge is approximately 63 times greater than the flow of Crooked Creek in May, and approximately 295 times greater in February (Table 3.24-15 of the 2018 EIS). Dilution from Kuskokwim River flow is anticipated to limit the downstream extent of water quality exceedances. The extent of the AWQC exceedances downstream of the confluence would progressively diminish over time but would fluctuate with variations in Crooked Creek sediment transport and chemical loading and dilution from the Kuskokwim River. Under the 0.5 percent scenario, dissolved concentrations of analytes exceeding their respective water quality standard in Crooked Creek are anticipated to be within acceptable or near baseline levels within several hundred feet or less downstream of the Kuskokwim River confluence, as evidenced by the kinetic test results and U.S. Geological Survey river discharge data.

Most of the tailings that are flushed into the Kuskokwim River would be the finer-grained silts and clays. Because of the high volume flow in the Kuskokwim, most of these fine particles are likely to stay in suspension and be carried all the way downstream and flushed into the Bering Sea. These tailings would have the short-term impact of increasing the turbidity/TSS of the Kuskokwim River water but would have no notable long-term water quality impacts. A small amount of the tailings may settle in lower energy side channels, where they could slowly leach metals, particularly sulfate, antimony, arsenic, and manganese. However, with the slow rate of leaching in this cold climate, combined with ongoing dilution from precipitation and streamflow, it is unlikely that the remaining tailings would cause exceedance of AWQC beyond small, isolated side channels.

4.7.1.2 2026 SEIS Scenario – 5.4 Percent Scenario

Surface water quality impacts of the 5.4 percent spill scenario would be similar to those described above for the 0.5 percent scenario but would be geographically more extensive and longer in duration.

The release of tailings water would have acute, short-term impacts to water quality along the entire Crooked Creek drainage. The tailings fluid would cause exceedances of water quality standards for sulfate, arsenic, antimony, manganese, molybdenum, selenium, and mercury. The initial impact from the tailings pond water would be short-term, as the initial flood of tailings fluid would be diluted and carried downstream. Tailings pore water from deposited tailings would be slowly released over days to weeks, prolonging water quality exceedances to varying degrees.

In the long term, deposited tailings under the 5.4 percent spill scenario would continue to release leached metals to surface water receptors for years to decades, depending on the timing and success of tailings recovery. Leachate would be most elevated in arsenic, manganese, sulfate, and antimony, and would exceed AWQC for these constituents until tailings are recovered or washed downstream.

Acute impacts would be more severe during a winter release, as there would be less streamflow to dilute the spilled tailings water. However, reduced streamflow in a winter spill would also limit the spread of spilled tailings. A winter spill would likely facilitate more effective tailings recovery because of the ability of machinery to operate on frozen ground.

Depending on the success of remediation and restoration efforts, adverse physical and chemical impacts to water quality in the Crooked Creek drainage could potentially persist for decades.

Below the confluence of Crooked Creek and the Kuskokwim River, dilution from the high-volume Kuskokwim River flow is anticipated to limit the downstream extent of water quality exceedances. The extent of the AWQC exceedances downstream of the confluence would progressively diminish over time but would fluctuate with variations in Crooked Creek sediment transport and chemical loading and dilution from the Kuskokwim River.

4.7.1.3 2026 SEIS Scenario – 13.3 Percent Scenario

Surface water quality impacts of the 13.3 percent spill scenario would be similar to those described above for the 5.4 percent scenario but would be geographically more extensive and longer in duration.

The release of tailings water would have acute, short-term impacts to water quality along the entire Crooked Creek drainage, as described above for the 5.4 percent scenario. Initial impacts to water quality from the tailings fluid would be somewhat longer in duration, lasting a number of weeks while the fluid is flushed downstream.

In the long term, deposited tailings under the 13.3 percent spill scenario would continue to release leached metals to surface water receptors for years to decades, as described above for the 5.4 percent scenario, depending on the timing and success of tailings recovery. Adverse physical and chemical impacts to water quality in the Crooked Creek drainage could potentially persist for decades.

Dilution from the high-volume Kuskokwim River flow is anticipated to limit the downstream extent of AWQC exceedances, as described above.

4.7.1.4 2026 SEIS Scenario – 27 Percent Scenario

Surface water quality impacts of the 27 percent spill scenario would be similar to those described above for the smaller spill scenarios but would be geographically much more extensive and much longer in duration. The 27 percent scenario addresses impacts for two separate sets of conditions: the spill occurring during normal hydrological conditions, and the spill occurring during the 100-year flood stage of Crooked Creek and the Kuskokwim River.

The release of tailings water would have acute, short-term impacts to water quality along the entire Crooked Creek drainage. The tailings fluid would cause exceedances of water quality standards for sulfate, arsenic, antimony, manganese, molybdenum, selenium, and mercury. The initial impact from the tailings pond water would be short-term, as the initial flood of tailings fluid would be diluted and carried downstream. Tailings pore water from deposited tailings would be slowly released over days to weeks, prolonging water quality exceedances to varying degrees.

Deposited tailings solids under the 27 percent spill scenario could continue to release chemical constituents to surface water receptors for several decades, even with extensive cleanup efforts, and the duration would be longer compared with the 13.3 percent scenario. The leachate would be most elevated in arsenic, manganese, sulfate, and antimony, and would exceed AWQC for these constituents until tailings are recovered or washed downstream.

Impacts under normal hydrological conditions and 100-year flood stage conditions would differ in several ways but would be relatively similar. The higher flow and overbank flooding under the flood stage scenario would result in downstream floodplains on the Kuskokwim River being inundated, which may increase the spatial extent of water quality impact. However, flood stage conditions would allow for more dilution of contaminants, possibly reducing AWQC exceedances.

Depending on the success of remediation and restoration efforts, adverse physical and chemical impacts to water quality in the Crooked Creek drainage could potentially persist for several decades.

Kuskokwim River flow averages 68,900 cfs during normal hydrological conditions, while the flow under the 100-year flood conditions is 319,300 cfs. The Kuskokwim River mean monthly discharge is approximately 63 times greater than the flow of Crooked Creek in May, and approximately 295 times greater in February (Table 3.24-15 of the 2018 EIS). Thus, the high degree of dilution from the high-volume Kuskokwim River flow below the confluence with Crooked Creek is anticipated to limit the downstream extent of water quality exceedances. The extent of the AWQC exceedances downstream of the confluence would progressively diminish over time but would fluctuate with variations in Crooked Creek sediment transport and chemical loading and dilution from the Kuskokwim River.

4.7.2 GROUNDWATER QUALITY

4.7.2.1 Summary of Impacts from 2018 EIS Scenario – 0.5 Percent Scenario

The 0.5 percent scenario would cause minor impacts to groundwater quality due to contamination in floodwaters and subsequent tailings deposition. Analyte concentrations predicted for untreated TSF fluids were compared to Alaska Department of Environmental Conservation groundwater cleanup level guidelines. Identified analytes of concern in the fluid include antimony, arsenic, molybdenum, thallium, and mercury (Table 3.24-12 in the 2018 EIS). Elevated levels of these constituents and other contaminants from the tailings could infiltrate shallow groundwater along the entire downstream length of Crooked Creek, which is approximately 13 linear miles. The initial floodwaters may have an acute effect on shallow groundwater quality from infiltration of the floodwaters into the shallow aquifer. Subsequently, pore water entrained within the deposited tailings could slowly be released and infiltrate into the shallow aquifer along the impacted stretch of Crooked Creek. This condition could last for the duration of cleanup activities.

Groundwater contamination from the spill would initially follow the path of the spill along Anaconda and Crooked Creeks. The contamination could also extend farther downstream along the Crooked Creek drainage over time as contaminated groundwater migrates downgradient.

The drinking water supply in the Village of Crooked Creek is unlikely to be impacted by the 0.5 percent scenario, as floodwater levels would not rise enough to impact the groundwater protection area (ADEC 2026).

Groundwater quality along the Kuskokwim River drainage is unlikely to be impacted because the released material would be heavily diluted once it flows into the Kuskokwim and would pass downstream within a day. There would be limited time for released materials to infiltrate shallow groundwater, and any infiltrated material would likely be diluted to below groundwater cleanup levels. There would be no overbank flow on the Kuskokwim under the 0.5 percent spill scenario, so groundwater stored in alluvium along the streambank is unlikely to be impacted.

Initial impacts from the tailings fluid would be greater during summer months, when floodwaters could infiltrate shallow aquifers. In winter months, frozen ground would reduce infiltration of tailings fluid and floodwater into aquifers. Cleanup of spilled tailings would also be easier during winter months because heavy equipment can operate effectively on hard, frozen ground, compared to soft, thawed soils and sediments along the floodplain areas.

4.7.2.2 2026 SEIS Scenario – 5.4 Percent Scenario

Groundwater quality impacts of the 5.4 percent spill scenario would be similar to those described above for the 0.5 percent scenario but would be geographically more extensive and longer in duration.

This scenario would cause impacts to groundwater quality due to contamination from the initial floodwaters and the release of pore water from deposited tailings. Elevated levels of antimony, arsenic, molybdenum, thallium, mercury, and other contaminants from the pond water could infiltrate shallow groundwater along the path of the spill, causing acute impacts to groundwater quality in the initial flood. The release of pore water entrained in the deposited tailings would occur more slowly, over days to weeks, causing more gradual impacts to groundwater quality. Tailings solids that remain in place may further leach metals and acid that could infiltrate shallow groundwater.

The Village of Crooked Creek draws its drinking water from a well located on a hill some 60 feet above Crooked Creek. Modeling of the 5.4 percent scenario indicates that the floodwaters would rise to within approximately 300 feet of the groundwater source protection area (ADEC 2026). The aquifer that supplies this well could be impacted from the elevated floodwater levels and subsequent tailings deposition in the source water protection area for the well. Floodwater and pore water from the deposited tailings could infiltrate groundwater in the source water protection area, impacting drinking water supplies.

Groundwater quality along the Kuskokwim River drainage is unlikely to be impacted under the 5.4 percent scenario, because the released material would be heavily diluted once it flows into the

Kuskokwim and would no longer contain entrained pore water. The release would pass downstream within 1 to 2 days, so there would be limited time for released materials to infiltrate shallow groundwater. Any of the spilled material that could infiltrate into shallow groundwater would likely be diluted to below groundwater quality standards. The water level rise along the river would be minimal in this scenario, so groundwater stored in alluvium along the streambank is unlikely to be impacted.

4.7.2.3 2026 SEIS Scenario – 13.3 Percent Scenario

Groundwater quality impacts of the 13.3 percent spill scenario would be similar to those described above for the 5.4 percent scenario, but would be geographically more extensive and longer in duration.

This scenario would likely cause impacts to groundwater quality due to contamination from the initial floodwaters and the release of pore water from deposited tailings. Elevated levels of antimony, arsenic, molybdenum, thallium, mercury, and other contaminants from the tailings fluid could infiltrate shallow groundwater along the path of the spill. Tailings solids that remain in place may further leach metals and acid that could infiltrate shallow groundwater.

Groundwater contamination from the spill would extend along the path of the spill along Anaconda Creek and all along the Crooked Creek drainage down to the confluence with the Kuskokwim River.

Modeling of the 13.3 percent scenario indicates that the floodwaters would rise to within approximately 300 feet of the groundwater source protection area (ADEC 2026). As described above under the 5.4 percent scenario, the aquifer that supplies the Crooked Creek drinking water well may be impacted in this 13.3 percent scenario. Floodwater and pore water from the deposited tailings could infiltrate groundwater in the source water protection area, impacting drinking water supplies.

Under this scenario, water levels at the confluence of Crooked Creek and the Kuskokwim River are predicted to rise 20 to 30 feet. As described above, as the floodwater enters the Kuskokwim, the released material would be heavily diluted by the voluminous streamflow and would no longer contain entrained pore water. The release would pass downstream within 1 to 2 days, so there would be limited time for released materials to infiltrate shallow groundwater. There could be minor infiltration of the diluted flow into shallow groundwater, but this is not likely to result in exceedances of groundwater quality standards. Impacts to groundwater quality along the Kuskokwim would therefore be expected to be minimal.

The maximum rise in floodwater elevation in communities farther downstream along the Kuskokwim River would be on the order of less than 1 foot. Groundwater protection areas for Aniak, Upper Kalskag, and Lower Kalskag are located in alluvial deposits adjacent to the Kuskokwim River. The slightly elevated streamwater in the Kuskokwim could infiltrate these alluvial deposits for 1 to 2 days as the initial flow passes. Due to the high volume of streamflow in the Kuskokwim River and large amount of dilution of the spill release materials, it is unlikely that this release would cause exceedances of groundwater quality standards in these groundwater protection areas.

4.7.2.4 2026 SEIS Scenario – 27 Percent Scenario

Groundwater quality impacts of the 27 percent spill scenario under normal hydrologic conditions would be similar to those described above for the smaller spill scenarios but would be geographically much more extensive and much longer in duration. Impacts from the 27 percent spill under flood conditions would be greater due to overbank flooding.

This scenario would likely cause impacts to groundwater quality due to contamination from the initial floodwaters and the release of pore water from deposited tailings. Elevated levels of antimony, arsenic, molybdenum, thallium, mercury, and other contaminants from the tailings fluid could infiltrate shallow groundwater along the path of the spill, especially along Crooked Creek. Tailings solids that remain in place may further leach metals and acid that could infiltrate shallow groundwater.

The aquifer that supplies the Crooked Creek drinking water well would likely be impacted in this 27 percent scenario, under both normal hydrological conditions and 100-year flood stage conditions. Floodwater and pore water from the deposited tailings could infiltrate groundwater in the source water protection area, impacting drinking water supplies. Under the 100-year flood stage conditions, there would be more dilution of contaminants present in the tailings fluid.

Under normal hydrologic conditions for the 27 percent scenario, water levels at the confluence of Crooked Creek and the Kuskokwim River are predicted to rise a maximum of 30 to 40 feet; under the flood stage conditions, the water levels at the confluence would rise 40 to 50 feet. As described above, as the floodwater enters the Kuskokwim, the released material would be heavily diluted by the voluminous streamflow and would no longer contain entrained pore water. The release would pass downstream within 1 to 2 days, so there would be limited time for released materials to infiltrate shallow groundwater. There could be minor infiltration of the diluted flow into shallow groundwater, but this is not likely to result in exceedances of groundwater quality standards along much of the length of the Kuskokwim.

The maximum rise in floodwater elevation for most communities farther downstream along the Kuskokwim River would be on the order of 1 to 2.5 feet for normal hydrological conditions, and an additional 0.2 to 0.7 feet (incremental impact) above the 100-year flood stage baseline conditions for the 27 percent flood scenario. In areas where the braided channel widens—particularly between Aniak and Upper/Lower Kalskag—up to 10 feet of flow would spread out in the surrounding braided channels under flood conditions (refer to Figure 2-6). The flood stage conditions would distribute water and contaminants much more widely across the downstream floodplains, although the water and contaminants would be much more diluted compared to normal hydrologic conditions.

Groundwater protection areas for Chuathbaluk, Aniak, Upper Kalskag, and Lower Kalskag are in alluvial deposits adjacent to the Kuskokwim River. The elevated streamwater in the Kuskokwim could infiltrate these alluvial deposits for 1 to 2 days as the initial flow passes. During 100-year flood conditions, floodwaters would enter the groundwater protection areas in Aniak and Upper and Lower Kalskag, but not in Chuathbaluk (ADEC 2026;Groundwater protection area data is not available for Napaimute). Due to the high volume of streamflow in the Kuskokwim River and large amount of dilution of the spill release materials, it is unlikely that this release would cause exceedances of groundwater quality standards in these groundwater protection areas. Any tailings transported down the Kuskokwim River would have been diluted by the streamflow and would no longer contain entrained pore water, and the minimal volume of any deposited tailings is unlikely to impact groundwater quality under normal hydrologic conditions. Under flood conditions, in areas where the channel widens and allows for overbank flow, tailings solids are more likely to be deposited during the passing of floodwaters. Although deposition is likely to be minimal, these tailings could mix with streambed soils and sediments and remain in place. Cleanup of thin deposits of tailings would be challenging, because the small amount of tailings would visually blend in with surrounding sediments. Where small amounts of tailings may settle in lower energy side channels and slowly leach metals, it is possible that some of this leachate could infiltrate shallow groundwater. However, with the slow rate of leaching in the cold climate, combined with ongoing dilution from precipitation and streamflow, it is unlikely that the remaining tailings would cause exceedance of water quality criteria beyond small, isolated side channels.

4.7.3 SEDIMENT QUALITY

4.7.3.1 Summary of Impacts from 2018 EIS Scenario – 0.5 Percent Scenario

Impacts to sediment quality under the 0.5 percent scenario are linked to the impacts described above for surface water and groundwater quality.

Spilled tailings fluids would infiltrate sediments immediately during a spill, resulting in sediment contamination. (If the spill were to occur during winter months, the infiltration of spilled fluids would be delayed due to frozen ground.) These impacts would be both acute and potentially of long duration, as recovery of contaminated fluids would not be practicable. Identified analytes of concern for sediment contamination include antimony, arsenic, thallium, and mercury (Table 3.24-11 of the 2018 EIS).

Long-term impacts to sediment quality would result from the leachate of solid tailings that remain on the land. Leachate would infiltrate surficial sediments, resulting in contamination that would be difficult or impossible to remedy. As described above for water quality impacts, solid tailings would be likely to leach arsenic, antimony, manganese, sulfate, fluoride, cadmium, molybdenum, and selenium. Leaching of sulfate, fluoride, cadmium, molybdenum, and selenium would subside over months to years, while leaching of arsenic, antimony, and manganese would be ongoing until tailings are recovered or flushed downstream.

Contamination of sediments from the spill would initially extend along the path of the spill along Anaconda and Crooked Creeks. The contamination could migrate downgradient along Crooked Creek over time as contaminants are mobilized by surface and groundwater flow.

The severity of these impacts would be dependent on the timing and success of cleanup efforts. The duration of impacts to sediment quality resulting from released solids would potentially persist over years to decades.

If a spill were to occur during the winter, fluid from the tailings slurry would not readily penetrate frozen sediments along the stream channels, reducing impacts in the short term. Cleanup would be facilitated in winter months because of the ability of heavy equipment to operate on frozen ground. In contrast, in a spill during the summer months, fluid from the tailings slurry would readily infiltrate sediments, resulting in more impacts to the underlying sediments. Cleanup operations would also be challenging in summer months as heavy equipment may not be able to operate on soft wetland soils and streambank sediments.

4.7.3.2 2026 SEIS Scenario – 5.4 Percent Scenario

Impacts to sediment quality from the 5.4 percent spill scenario would be similar to those addressed above for the 0.5 percent scenario but more severe, more extensive, and of longer duration.

Under the 5.4 percent scenario, sediments in the path of the spill would be mostly buried by 1 to 10 feet of deposited tailings along the length of Anaconda Creek, and by 1 to 15 feet of tailings along the downstream extent of Crooked Creek to the confluence with the Kuskokwim River (refer to Figure 2-11). Entrained pore water from the tailings would infiltrate and contaminate underlying sediments in the days and weeks following the spill. In the long term, where tailings are not recovered, leachate from tailings may infiltrate underlying sediments.

The severity of these impacts would be dependent on the timing and success of cleanup efforts. The duration of impacts to sediment quality resulting from released solids would likely be over decades.

Most of the tailings that would be flushed into the Kuskokwim River would be finer-grained silts and clays. Because of the high-volume flow in the Kuskokwim, most of these fine particles are likely to stay in suspension and be carried all the way downstream and flushed into the Bering Sea (BGC 2026c). Likely only trace amounts of tailings solids would mix with sediments in the Kuskokwim drainage and are unlikely to result in sediment quality exceedances.

The small volume of tailings flushed out of the Kuskokwim River into the Bering Sea would be mixed with existing sediments and would eventually settle on the seafloor. Potential contaminants would be diluted to levels within water quality standards.

4.7.3.3 2026 SEIS Scenario – 13.3 Percent Scenario

Impacts to sediment quality from the 13.3 percent spill scenario would be similar to those described above for the 5.4 percent scenario but more severe, more extensive, and of longer duration.

Under the 13.3 percent scenario, sediments in the path of the spill would be buried by 1 to 18 feet of deposited tailings along the length of Anaconda Creek, and 3 to 30 feet of tailings along the downstream extent of Crooked Creek to the confluence with the Kuskokwim River (refer to Figure 2-12). Entrained pore water from the tailings would infiltrate and contaminate underlying sediments in the days and weeks following the spill. In the long term, where tailings are not recovered, leachate from tailings would infiltrate underlying sediments.

The severity of these impacts would be dependent on the timing and success of cleanup efforts. The duration of impacts to sediment quality resulting from released solids would likely persist for decades, similar to the 5.4 percent scenario.

Most of the tailings that would be flushed into the Kuskokwim River would be finer-grained silts and clays. Because of the high-volume flow in the Kuskokwim, most of these fine particles are likely to stay in suspension and be carried all the way downstream and flushed into the Bering Sea (BGC 2026c). Likely only trace amounts of tailings solids would mix with sediments in the Kuskokwim drainage and are unlikely to result in sediment quality exceedances.

Tailings flushed out of the Kuskokwim River into the Bering Sea would be mixed with existing sediments and would eventually settle on the seafloor. Potential contaminants would be diluted to levels within water quality standards.

4.7.3.4 2026 SEIS Scenario – 27 Percent Scenario

Impacts to sediment quality from the 27 percent spill scenario would be similar to those addressed above for the 13.3 percent scenario, but more severe, more extensive, and of longer duration.

Under the 27 percent scenario, sediments in the path of the spill would be buried by deposited tailings from less than 1 foot to greater than 30 feet in thickness along the length of Anaconda Creek and along the downstream extent of Crooked Creek to the confluence with the Kuskokwim River. Entrained pore water from the tailings would infiltrate and contaminate underlying sediments in the days and weeks following the spill. In the long term, where tailings are not recovered, leachate from tailings would infiltrate underlying sediments.

The severity of these impacts would be dependent on the timing and success of cleanup efforts. The duration of impacts to sediment quality resulting from released solids would likely persist for decades.

Most of the tailings that would be flushed into the Kuskokwim River would be finer-grained silts and clays. Because of the high-volume flow in the Kuskokwim, most of these fine particles are likely to stay in suspension and be flushed downstream (BGC 2026c). Under flood conditions, the high volume of streamflow would further dilute the TSS in the released material. In most stretches of the river, only trace amounts of tailings solids would mix with sediments in the Kuskokwim drainage and are unlikely to result in sediment quality exceedances.

Under flood conditions, in areas where there is significant overbank flow, such as the area between Aniak and Upper/Lower Kalskag where the braided channel widens (refer to Figure 2-6), tailings are more likely to be deposited and mixed with existing sediments across the floodplains. Some of these tailings may remain in place after floodwaters recede and could contaminate existing streambed sediments above sediment quality standards.

Tailings flushed out of the Kuskokwim River into the Bering Sea would be mixed with existing sediments and would eventually settle on the seafloor. Potential contaminants would be diluted to levels within water quality standards.

4.8 AIR QUALITY

4.8.1 SUMMARY OF IMPACTS FROM 2018 EIS SCENARIO – 0.5 PERCENT SCENARIO

Air quality impacts from the spill scenarios would include potential impacts from the spill itself, and a separate set of impacts from the cleanup efforts. Impacts to air quality from the 0.5 percent tailings release would be similar to those of the Mine Site during normal operations.

4.8.1.1 Fugitive Dust

Following a tailings spill, deposited tailings could potentially dry out and become resuspended in the air as airborne fugitive dust/particulate matter. This would be most likely to happen during warm and dry conditions during the summer months. Fugitive tailings dust could be carried by wind and deposited beyond the original deposition area. However, rain is common in the summer months in the area, which would keep any residual tailings moist and suppress the generation of dust. Control of fugitive dust during cleanup activities would likely include mitigation measures such as water trucks and dust suppressants as necessary (see 2018 EIS Section 3.2.3.2.4 for a more complete list of mitigation measures).

Dust generation is therefore likely to be minor, temporary, and intermittent. The duration of this impact would depend on the effectiveness of cleanup efforts, however, and any tailings that remain on the land could continue to generate dust for years following a spill. Again, the geographic extent of this impact would be dependent on the effectiveness of cleanup efforts.

Metals present in fugitive dust, including arsenic, antimony, and mercury, could be mobilized during remediation of the tailings deposit.

4.8.1.2 Mercury

The Project design includes the use of mercury abatement systems designed to comply with federal Clean Air Act maximum achievable control technology regulations (40 Code of Federal Regulations 63). High mercury levels would be addressed through process plant design that would include a dosage facility to allow chemical addition to precipitate mercury as a stable mercury sulfide compound that would remain with the tailings solids. Refer to impact-reducing measures M20 and M28 in Section 4.22, Impact-Reducing Measures, for more information. Therefore, naturally occurring mercury in the ore would largely be captured for proper disposal during ore processing; however, minor amounts of mercury may remain in the tailings. Any remaining mercury in the tailings could be released as a gaseous emission that could impact air quality.

During a 0.5 percent tailings spill, the amount of tailings exposed to air would expand by 1,300 acres, and the spill could temporarily double the amount of mercury emissions until remediation is complete.

Gaseous mercury emissions from the fluid portion of the slurry release are expected to be imperceptible due to rapid transport and dilution of the initial flood, as compared to the stationary TSF pond during normal operations.

The extent of mercury in air in both gaseous and particulate forms under the 0.5 percent scenario would be similar to that shown on Figure 3.8-5 of the 2018 EIS (Section 3.8, Air Quality) for the Mine Site during normal operations, with a slight bulge in contours to the southwest due to the expanded tailings deposit at the Anaconda Creek and Crooked Creek confluence.

With the exception of mercury, a tailings release would not discharge any other substances that could evaporate and cause direct or indirect impacts to air quality.

4.8.1.3 Tailpipe Emissions from Cleanup Equipment

Cleanup efforts would require the operation of excavation and earthmoving equipment, vehicles and river vessels transporting spill response personnel and equipment, and helicopters or other aircraft. Air quality impacts including GHG emissions would result from the tailpipe emissions of criteria pollutants from the spill response equipment. Impacts from these emissions would last for the duration of cleanup activities, which is likely to be more than a year.

4.8.2 2026 SEIS SCENARIO – 5.4 PERCENT SCENARIO

Air quality impacts from the 5.4 percent spill scenario would be similar to those described above for the 0.5 percent scenario, but more extensive because the greater volume of tailings would be deposited farther downstream.

Impacts from emissions of cleanup equipment would last for the duration of cleanup activities, which is likely to be multiple years.

4.8.3 2026 SEIS SCENARIO – 13.3 PERCENT SCENARIO

Air quality impacts from the 13.3 percent spill scenario would be similar to those described above for the smaller spill scenarios but more extensive.

Impacts from emissions of cleanup equipment would last for the duration of cleanup activities, which is likely to be multiple years to decades.

4.8.4 2026 SEIS SCENARIO – 27 PERCENT SCENARIO

Air quality impacts from the 27 percent spill scenario would be similar to those described above for the smaller spill scenarios, but more extensive.

Impacts from emissions of cleanup equipment would last for the duration of cleanup activities, which may last for several decades.

4.9 NOISE AND VIBRATION

4.9.1 SUMMARY OF IMPACTS FROM 2018 EIS SCENARIO – 0.5 PERCENT SCENARIO

The flow of the tailings slurry under the 0.5 percent release scenario would generate low-level, temporary, localized noise from the release of fluid immediately below the tailings dam and within Anaconda Creek. Noise impacts from the 0.5 percent scenario would primarily result from spill response activities, including noise from excavation and earthmoving equipment, vehicles and river vessels transporting spill response personnel and equipment, and helicopters or other aircraft.

The spill response effort from the 0.5 percent spill scenario would include the immediate area of the spill site, including the Mine Site, Anaconda Creek, lower Crooked Creek, and to a lesser extent, along the Kuskokwim River for monitoring activities.

Noise-sensitive receptors nearest to the spill site would be in the Village of Crooked Creek, located 9.15 miles from the Mine Site. Other noise-sensitive receptors are located in several communities in the impact area along the Kuskokwim River, including Georgetown, Napaimute, Chuathbaluk, Aniak, Crow Village, Upper Kalskag, Lower Kalskag, Tuluksak, Akiak, Akiachak, Kwethluk, Bethel, Oscarville, Napaskiak, and Napakiak. Some of these communities may be beyond the immediate cleanup area, but may be impacted by noise from helicopters or boats in transit to the cleanup sites.

Infrequent noise impacts generated from response activities would have little or no lasting effect at these noise-sensitive receptors. With the exception of increased air traffic, noise levels at the receptor locations from cleanup activities would be comparable to natural sounds.

These impacts would occur at the noise-sensitive receptors in the Village of Crooked Creek and would last for the duration of the response effort, which is likely to be more than a year.

4.9.2 2026 SEIS SCENARIO – 5.4 PERCENT SCENARIO

Noise impacts from the 5.4 percent scenario would likely be similar, but more extensive and longer-lasting, than those described above for the 0.5 percent scenario, due to more extensive cleanup efforts required for a larger spill.

The flow of the tailings slurry under this scenario would generate low-level, temporary, and localized noise from the release of fluid immediately below the tailings dam and within Anaconda Creek. Most noise from the 5.4 percent scenario would be infrequent impacts generated from response activities and would have only minor effects at noise-sensitive receptors in downstream communities, as described above. Some of the communities would likely be beyond the immediate cleanup area but may be impacted by noise from helicopters or boats in transit to the cleanup sites.

The impacts would last for the duration of the response effort, which is likely to last multiple years.

4.9.3 2026 SEIS SCENARIO – 13.3 PERCENT SCENARIO

Noise impacts from the 13.3 percent scenario would likely be more extensive and longer-lasting than those described above for the 5.4 percent scenario, due to more extensive cleanup efforts required for a larger spill.

The flow of the tailings slurry under this scenario would generate low-level, temporary, and localized noise from the release of fluid immediately below the tailings dam and within Anaconda Creek. Most noise from the 13.3 percent scenario would be infrequent impacts generated from response activities and would have only minor effects at noise-sensitive receptors in downstream communities, as described above. Some of the communities would likely be beyond the immediate cleanup area but may be impacted by noise from helicopters or boats in transit to the cleanup sites.

These impacts would last for the duration of the response effort, which is likely to last multiple years to decades.

4.9.4 2026 SEIS SCENARIO – 27 PERCENT SCENARIO

Noise impacts from the 27 percent scenario would likely be similar, but more extensive and longer-lasting, than those described above for the 13.3 percent scenario, due to more extensive cleanup efforts required for the larger spill. Noise impacts under normal hydrological conditions and 100-year flood stage conditions would be similar.

Under the 27 percent scenario, the flow of tailings slurry would cause substantial noise and vibration during the brief, initial rush of floodwaters which would likely be heard in the vicinity of the TSF. The rush of floodwaters would also cause some low-level noise and vibration when passing through the Village of Crooked Creek. Following the spill, noise and vibration impacts would be caused by the cleanup activities that would follow the spill and would be similar to those described above for the 13.3 percent scenario, but longer in duration.

Noise impacts generated from response activities would have ongoing moderate effects at the noise-sensitive receptors. The increase in air traffic and boat traffic would be frequently heard on a daily basis at some of the village sites, and the noise impacts would last for the duration of the response effort, which would likely last for decades.

4.10 VEGETATION

4.10.1 SUMMARY OF IMPACTS FROM 2018 EIS SCENARIO – 0.5 PERCENT SCENARIO

Under the 0.5 percent tailings dam release scenario, approximately 473 acres of vegetation would be impacted.

The impacts to vegetation would primarily be from deposition of tailings and eroded material, although riparian vegetation could also be removed by the flood of materials as it moves down Anaconda Creek. The intensity of impacts to vegetation would vary depending on the depth and type of materials spilled. In riparian areas, the intensity of impacts on vegetation would vary based on the rate of movement of spilled materials. The duration of impacts would be expected to be permanent, although some locations would experience regrowth of native vegetation in places. The extent of impacts would be limited to the area of the spill. No rare or sensitive plants are known to occur in the vicinity.

4.10.2 2026 SEIS SCENARIO – METHODS

In general, the vegetation impact analysis follows the approach used in the 2018 EIS. However, while the baseline environmental conditions remain the same as described in the 2018 EIS, the addition of larger tailings dam release scenarios required expanding the vegetation mapping that was conducted as part of the 2018 EIS. Vegetation types applied in the vegetation analysis were derived from the data used in the 2018 EIS. Under each of the larger tailings dam release scenarios, the area potentially impacted exceeds the extent of the vegetation mapping performed previously. Publicly available continuous foliar cover maps (Nawrocki et al. 2023) were used to prepare a vegetation map with classes corresponding to the 2018 EIS vegetation types following the definitions in Table 4.10-1. The individual foliar cover maps were combined using geographic information systems following the definitions below to create a standalone vegetation map that was used to supplement areas not covered in the data used in the 2018 EIS. For instance, the white and black spruce continuous cover maps were combined and the needleleaf ratio calculated using the broadleaf tree continuous cover map. Pixels meeting the tree cover and ratio criteria were assigned to the Forested – Evergreen vegetation type. Impacts to vegetation were quantified by calculating the area of each vegetation type inundated in the maximum flood depth model for each release scenario.

Vegetation types and their definitions are shown in Table 4.10-1.

Table 4.10-1: Definitions of Aggregated Vegetation Types.

Aggregated Type	Definition	Vegetation Types
Forested – Evergreen	Tree/sapling cover greater than or equal to 10%, where >75% of the total tree cover is contributed by needleleaf species	Black spruce woodland, closed black spruce forest, closed white spruce forest, open black spruce forest, open white spruce forest, white spruce woodland
Forested – Deciduous/Mixed	Tree/sapling cover greater than or equal to 10%, where less than or equal to 75% of the total tree cover is contributed by needleleaf species	Open deciduous forest, open mixed forest, closed deciduous forest, closed mixed forest, deciduous woodland, mixed woodland

Aggregated Type	Definition	Vegetation Types
Scrub Shrub	Shrub cover greater than 25% and tree cover less than 10%	Deciduous tree sapling regrowth, closed willow shrub, open willow shrub, closed alder shrub, open alder shrub, closed alder willow shrub, open alder willow shrub, closed and open alder-willow shrub, low shrub bog, ericaceous shrub bog-string bog, low shrub tundra, dwarf shrub tundra
Herbaceous	Tree cover less than 10%, shrub cover less than 25%, and total live vascular plant cover greater than or equal to 10%	Mesic herb, wet herbaceous, aquatic herbaceous, tussock sedge tundra
Other Land Cover	Less than 10% total live vascular cover	Alpine barrens, riverine barrens: disturbance-related barrens, open water: ponds/lakes, snow

Source: Michael Baker 2017

4.10.3 2026 SEIS SCENARIO – 5.4 PERCENT SCENARIO

Impacts to vegetation from the 5.4 percent tailings release scenario would be similar in type and distribution to those identified in the 0.5 percent release scenario, as they are derived from the same disturbance processes. However, due to the increased volume of material released and greater modeled flow depths, the extent and intensity of vegetation impacts would be greater under the larger scenario. The estimated acres of vegetation affected per aggregated vegetation type are summarized in Table 4.10-2. A large proportion of the impacts under the 5.4 percent scenario would occur on Other Land Cover, since the release would extend into the Kuskokwim River and other sparsely vegetated areas.

As with the 0.5 percent release, impacts to vegetation would primarily consist of burial by tailings and eroded materials, with localized removal of riparian vegetation along stream channels due to high flow velocities. Burial of vegetation would be expected in the Crooked Creek drainage but not in the Kuskokwim. Within the Crooked Creek drainage, impacts to vegetation would vary by landscape position and by the depth and type of materials deposited in an area (Figures 2-8 through 2-10).

The severity of impacts to vegetation under the larger release scenario would increase due to greater depths of tailings and sediment deposition that would result in expanded areas of altered soil chemistry and reduced nutrient availability. Deposited tailings lack soil structure, contain toxic metals, and can have extreme geochemical properties (e.g., highly alkaline/acidic, saline) that can inhibit vegetation growth. As with the 0.5 percent scenario, impacts would be expected to permanently impact the types of vegetation that recover in many locations due to the extreme change in soil conditions following the spill. For instance, previously forested areas buried by moderate to extremely heavy deposition may eventually recover as a mosaic of alder (*Alnus*)/willow (*Salix*) shrublands and bluejoint (*Calamagrostis canadensis*) meadows. However, vegetation recovery would be slow, taking place over the course of several decades, with much of the area remaining essentially unvegetated for at least the first decade following the spill. For instance, Young et al. (2012), working on 70-year-old mine tailings in boreal forests in southern Canada, found that natural vegetation recovery followed a predictable sequence, beginning with colonization by horsetail (*Equisetum*) and other early successional species, progressing through willows, balsam poplar (*Populus balsamifera*), tamarack (*Larix laricina*), and ultimately reaching a climax community dominated by black spruce (*Picea mariana*). Early establishment of pioneer species such as horsetail were determined to be critical, as they advance soil formation and improve soil structure and nutrient availability of the tailings, thereby facilitating subsequent stages of succession. Over time, vegetation development leads to increased surface litter, organic matter, and soil carbon, enhancing water retention and providing energy for soil microbes. While initial revegetation may be slow due to low nutrients, natural successional processes may eventually lead to vegetation recovery. However, in tailings depositional areas with high metal concentrations or extreme pH levels, the colonization of plants and vegetation recovery would be inhibited by such conditions, preventing or delaying vegetation establishment, growth, and recovery. Due to variation in environmental conditions, vegetation may recover better in some areas but not in other more contaminated areas. Active remediation and rehabilitation of tailings may likely be necessary for successful vegetation recovery in highly impacted areas.

In areas where burial depths are shallow and soils remain partially intact, and in limited areas that may be actively remediated, vegetation has a higher likelihood of recovering more quickly to pre-spill plant communities. Areas with naturally drier soil conditions and/or more exposed slope positions (for instance, on the tops of hills and ridges) may remain permanently as unvegetated tailings due to extreme conditions (e.g., dry soil, and desiccation from wind and cold). In depressions, wetland vegetation may eventually establish in the tailings over time and where new river/stream channels form in the tailings through natural erosion and sedimentation processes.

Vegetation may eventually recover in the tailings spill area; however, uncertainty exists around the extent and timeframe of recovery and the types of vegetation communities that would recover due to the extreme physical and chemical nature of the tailings. The increased severity of impacts under the 5.4 percent scenario would reduce the extent and likelihood of natural recovery and result in a greater proportion of the area remaining unvegetated over the long term.

The impacts on vegetation will have significant impacts on subsistence resources, such as berries and other edible plants, which are vital to local communities. Many subsistence plants, including blueberries (e.g., *Vaccinium uliginosum*), low-bush cranberries (*V. vitis-idaea*), and other edible species, thrive in specific soil and vegetation conditions that may be disrupted by tailings deposition. The burial of these plants and the alteration of soil chemistry could significantly reduce their availability in the short and long term, impacting traditional harvesting practices and food sources for local communities in the area. Additionally, the slow recovery of vegetation in heavily impacted areas may result in a prolonged loss of access to these critical resources, further affecting subsistence lifestyles.

Table 4.10-2: Acres of Vegetation Affected Based on Maximum Flood Depth in the 5.4, 13.3, and 27 Percent Release Scenarios

Aggregated Type	5.4% Scenario, Approximate Area (acres)	13.3% Scenario, Approximate Area (acres)	27% Normal Hydrological Conditions Scenario, Approximate Area (acres)	27% Release Under 100-Year Flood Scenario, Approximate Area (acres)[2]
Forested – Evergreen	2,224.1	2,540.7	3,189.5	3,492.1
Forested – Mixed/Deciduous	10,187.3	9,718.9[1]	11,314.5	3,847.1

Aggregated Type	5.4% Scenario, Approximate Area (acres)	13.3% Scenario, Approximate Area (acres)	27% Normal Hydrological Conditions Scenario, Approximate Area (acres)	27% Release Under 100-Year Flood Scenario, Approximate Area (acres)[2]
Scrub Shrub	3,834.4	3,779.2	4,351.5	2,131.5
Herbaceous	4,900.0	5,053.0	5,193.3	1,547.3
Other Land Cover	36,736.8	36,928.2	36,793.0	347.7
Total	**57,882.6**	**58,019.9**	**60,841.9**	**11,365.7**

Notes:

[1] The lower impact acres for certain vegetation classes under larger scenarios relative to smaller scenarios arises from hydrograph shape and downstream attenuation in the tailings spill models. For instance, the 5.4 percent scenario can show greater inundation area in some locations compared to the 13.3 percent scenario. This pattern also appears occasionally in the wetland impact tables (Section 4.11).

[2] Under 100-year baseline flood conditions, 213,743.8 acres of vegetation would already be impacted by the natural overbank flooding of the Kuskokwim River. The acres reported in this column represent the additional impacts to vegetation from a 27% tailings dam release during 100-year baseline flood conditions. The total impacts to vegetation from a 27% tailings dam release during 100-year baseline flood conditions would be approximately 225,109.5 acres.

Sources: 3PPI 2014; BGC 2026a

4.10.4 2026 SEIS SCENARIO – 13.3 PERCENT SCENARIO

Impacts to vegetation from the 13.3 percent tailings release scenario would be similar in type and overall distribution to those described for the 5.4 percent release scenario. However, because the 13.3 percent scenario represents a substantially larger spill volume, the extent, depth, and intensity of these effects would be greater, with higher modeled flow depths, broader inundation, and more expansive depositional footprints (Table 4.10-2, Figures 2-8 through 2-10). As with the 5.4 percent scenario, a large proportion of mapped impacts would be expected to occur in Other Land Cover where the release extends into the Kuskokwim River and other sparsely vegetated areas; under the 13.3 percent release, these impacts would likely encompass more acreage and exhibit more severe disturbance across affected land cover types.

As with the 5.4 percent release scenario, vegetation impacts under the 13.3 percent scenario primarily include burial by tailings and eroded materials, along with localized removal of riparian vegetation along stream channels where velocities are sufficient to scour banks and floodplain surfaces. The larger spill volume would increase the likelihood of moderate to heavy burial across a wider area, expand zones of altered soil chemistry and reduced nutrient availability, and increase the proportion of locations where the post-spill substrate conditions would be expected to permanently shift the vegetation community (e.g., from forest to shrubland/meadow mosaics) rather than returning to pre-spill conditions. In tailings depositional areas with high metal concentrations or extreme pH levels, the colonization of plants and vegetation recovery would be inhibited by such conditions, preventing or delaying vegetation establishment, growth, and recovery. Due to variation in environmental conditions, vegetation may recover better in some areas but not in other, more contaminated areas. Active remediation and rehabilitation of tailings would likely be necessary for successful vegetation recovery in highly impacted areas, which may not be practicable due to the increased size and scope of the impacted area.

Similar to the 5.4 percent scenario, recovery would be slow (decades) and many areas would remain essentially unvegetated for at least the first decade. The increased deposition depths and more widespread soil alteration would further reduce the extent and likelihood of natural recovery, increasing the amount of area that remains sparsely vegetated or unvegetated over the long term, particularly in locations with very deep tailings deposits, exposed slope positions, or drier substrates where tailings conditions could remain inhospitable longer.

4.10.5 2026 SEIS SCENARIO – 27 PERCENT SCENARIO

Impacts to vegetation from the 27 percent tailings release scenario would be similar in type and general distribution to those described for the 13.3 percent release scenario. However, the much larger spill volume would result in a broader footprint of inundation and deposition, resulting in vegetation effects that are substantially greater in extent and severity than under the smaller release scenarios (Table 4.10-2, Figures 2-8 through 2-10). As with the other scenarios, a large share of mapped impacts would likely occur within Other Land Cover where the release extends into the Kuskokwim River and other sparsely vegetated areas. These impacts would be expected to affect more acreage and include more extensive disturbance across vegetated floodplain and riparian settings where sediment deposition spreads laterally.

The primary mechanisms of vegetation impact under the 27 percent scenario would be burial by tailings and eroded materials—including a greater likelihood of moderate to extremely heavy burial—and localized removal of riparian vegetation along stream channels due to higher energy flows. The larger spill would expand the areas subject to extreme changes in soil conditions, including reduced nutrient availability and altered soil chemistry, increasing the likelihood that affected areas would experience a long-term or permanent shift in vegetation composition or be permanently unvegetated rather than recover to pre-spill communities. In tailings depositional areas with high metal concentrations or extreme pH levels, the colonization of plants and vegetation recovery would be inhibited by such conditions, preventing or delaying vegetation establishment, growth, and recovery. Due to variation in environmental conditions, vegetation may recover better in some areas but not in other, more contaminated areas. Active remediation and rehabilitation of tailings would likely be necessary for successful vegetation recovery in highly impacted areas, which may not be practicable due to the increased size and scope of the impacted area.

Similar to the recovery patterns described for the 5.4 percent scenario, recolonization would be expected to occur through slow natural succession (where possible), with many areas remaining essentially unvegetated for at least the first decade. The increased severity and expanded footprint would further reduce the probability and rate of natural recovery, increase the proportion of terrain that remains unvegetated over the long-term, and enlarge the areas where previously forested communities may ultimately recover only as shrubland/meadow mosaics (e.g., alder/willow and bluejoint) or persist as barren tailings in exposed or moisture-limited settings.

Under 100-year flood baseline conditions, floodwaters would inundate approximately 213,743.8 acres of vegetated areas within the Kuskokwim River floodplain. While this inundation represents the existing flood extent and is not the same type of effect as tailings deposition, it provides context for the area already subject to flooding during the 27 percent scenario during a 100-year flood. If the tailings dam were to release 27 percent of its contents during a 100-year flood, tailings would affect an additional 11,365.7 acres of vegetation beyond the baseline flood inundation footprint. In total, the combined area experiencing either baseline flood inundation and/or additional tailings-related effects would be approximately 225,109.5 acres.

In summary, in the event of a tailings spill, vegetation impacts are expected to be similar across the larger release scenarios, with effects driven primarily by burial by tailings/eroded material and localized riparian vegetation removal from higher flow velocities. The extent and severity increase with larger releases due to greater tailings volumes and deeper flow depths, potentially causing long-term changes in plant community composition and structure. Consequently, these changes could result in altered vegetation communities developing over time (decades to over a century) relative to pre-spill conditions, potentially broad areas of unvegetated tailings (especially in the near term), a reduction in the availability of subsistence plants (e.g., blueberries and cranberries) through burial and altered soil conditions, leading to short- and long-term impacts on traditional harvesting. Habitat shifts (e.g., forest to shrubland/meadow/wetland) may also alter wildlife habitat and affect subsistence hunting, trapping, and fishing, with some areas potentially remaining sparsely vegetated for extended periods; see Sections 4.12 and 4.18 for detailed wildlife and subsistence impacts analysis and discussion of consequences.

4.11 WETLANDS

4.11.1 SUMMARY OF IMPACTS FROM 2018 EIS SCENARIO – 0.5 PERCENT SCENARIO

Under the 0.5 percent release scenario, approximately 445.4 acres of wetlands would be disturbed by the slurry of tailings and water (Table 3.24-19 of the 2018 EIS). Potential impacts to wetlands could include:

- Removal or burial of native wetland soils;
- Removal or burial of wetland vegetation and propagules;
- Reduced soil nutrient availability resulting in delayed regrowth;
- Exposure to soil conditions (pH) or chemical contaminants that may reduce or prevent wetland vegetation growth; and
- Altered hydrologic flow patterns (Andrusiak et al. 2015).

For a more detailed description of the 0.5 percent release scenario and its effects, see 2018 EIS Section 3.24.6.8, Wetlands.

4.11.2 2026 SEIS SCENARIO – METHODS

In general, the wetland impact analysis follows the approach used in the 2018 EIS. However, while the baseline environmental conditions remain the same as described in the 2018 EIS, the addition of larger tailings dam release scenarios required expanding the wetland mapping that was conducted as part of the 2018 EIS. To evaluate potential impacts to wetlands, wetland mapping from the 2018 EIS was used, supplemented with National Wetlands Inventory data to fill any gaps in wetland mapping. In addition, the larger tailings dam releases have deeper flow and depositional depths than the 0.5 percent release scenario analyzed in the 2018 EIS. To allow for more effective analysis, 10 to 40 feet, 40 to 100 feet, and greater than 100 feet depth classes were added to the flow depth tables. In the deposition tables, 10 to less than 30 feet and greater than 30 feet classes were added to better illustrate potential burial depth. Note that the flow and burial depth classes of greater than 100 feet and greater than 30 feet (respectively) were only necessary for the 27 percent scenario and therefore do not appear in the 5.4 and 13.3 percent scenario tables.

4.11.3 2026 SEIS SCENARIO – 5.4 PERCENT SCENARIO

Impacts from a 5.4 percent release would be similar in type to those of the 0.5 percent scenario; however, the intensity, extent, spatial distribution, and severity of impacts would be greater due to increased release volume, higher flow depths, and expanded downstream inundation.

Approximately 12,876 acres of wetlands and 62.4 miles of streams would be impacted under the 5.4 percent release scenario (Table 4.11-1). As with the smaller release, wetland impacts would include erosion, combined erosion and burial, and burial-only disturbance. However, these impacts would occur over a greater geographic extent and be more severe due to greater erosion and deeper burial by tailings. Wetlands that are eroded during the initial flood would be permanently lost. The deposition of large amounts of tailings would fundamentally alter hydrology and convert many wetlands to barren upland areas, resulting in a permanent loss of wetland ecological services. In order for wetland vegetation to re-establish itself, hydrology would need to be re-established and hydric soils would need to be formed. In tailings depositional areas with high metal concentrations or extreme pH levels, the colonization of vegetation in areas would be inhibited by such conditions, preventing or delaying the formation of soils and re-establishment of wetland vegetation. Many areas that were formerly wetlands and that are buried deeply would likely not recover or re-establish wetland vegetation without active remediation and rehabilitation efforts. Wetlands that are inundated by the initial floodwaters but not eroded or buried would be exposed to toxins from the tailings pond water, which may result in vegetation die-off. However, wetland functions of these impacted areas would likely remain mostly intact, and these wetlands would serve as an important sink for sediments and provide flood attenuation in these areas. Due to variation in environmental conditions, wetland vegetation may recover better in some areas but not in other more contaminated and deeply buried areas. The recovery of wetland vegetation would not be uniform and there would be a great deal of uncertainty, with recovery taking on the order of one to several decades.

Table 4.11-1: Impacts to Wetlands under the 5.4 Percent Release Scenario: Calculation of Wetland Categories by Maximum Flow Depth

Type	Flow Depth (acres)				Approximate Impact Area (acres)	Area[1] (%)
	40–100 ft	10–40 ft	≥ 3 ft to < 10 ft	< 3 ft		
Deciduous Forested Wetlands	0.0	233.8	1,295.4	1,218.9	2,748.1	5%
Deciduous Scrub Shrub Wetlands	14.9	974.1	1,481.4	1,045.2	3,515.5	6%
Evergreen Forested Wetlands	24.1	390.5	115.4	67.4	597.5	1%
Evergreen Scrub Shrub Wetlands	3.4	45.9	269.8	194.2	513.3	1%
Herbaceous Wetlands	2.1	457.1	456.6	205.6	1,121.4	2%
Lakes	0.0	102.7	210.5	33.1	346.3	1%
Mixed Forested Wetlands	0.0	535.2	1,486.8	761.4	2,783.4	5%

Type	Flow Depth (acres)				Approximate Impact Area (acres)	Area[1] (%)
	40–100 ft	10–40 ft	≥ 3 ft to < 10 ft	< 3 ft		
Mixed Scrub Shrub Wetlands	59.7	783.0	477.9	275.9	1,596.5	3%
Moss-Lichen Wetlands	0.0	0.5	0.1	0	0.6	0%
Ponds	0.0	37.8	102.6	29.3	169.7	0%
Rivers	0.0	32,222.8	5,736.6	912.4	38,871.9	67%
Uplands	2.4	691.7	3,904.0	1,020.5	5,618.5	10%
Wetland Area[2]	104.1	3,420.1	5,583.5	3,768.6	12,876.3	22%
Total Area	106.5	36,475.1	15,537.2	5,763.8	57,882.6	100%
Streams[3] (Miles)						
Intermittent Streams (miles)	0.1	3.3	14.9	8.0	26.4	42%
Perennial Streams (miles)	2.4	13.0	14.8	5.8	36.0	58%
Total Stream Length	2.5	16.3	29.7	13.8	62.4	100%

Notes:
[1] Proportion of total study area by wetland category. Note that mosaic classes calculated as 100% wetlands overestimate the wetland area proportion.
[2] Proportion of total study area that is wetland, excluding lakes, ponds, rivers, and uplands.
[3] Stream impacts are measured in linear miles.
NA = Not Applicable 0 = None 0.0 = < 0.1
Sources: 3PPI 2014; BGC 2026a

Impacts to wetlands from the deposition of tailings are shown in Table 4.11-2. Deposition of tailings and eroded materials would be expected to increase where flow depths are lower or where flow is impeded, including at bends in water bodies or at the confluence of Anaconda and Crooked Creeks. Under this scenario, approximately 3,332.1 acres of wetlands would be subject to tailings burial, with 41 percent of impacted wetlands buried beneath greater than 3 feet of tailings (Table 4.11-2). The increased volume and energy of the 5.4 percent release would also result in a greater length of streams impacted by erosion and deposition. Approximately 19.8 miles of streams would be impacted, an increase of 16 miles compared to the 0.5 percent scenario.

Cleanup efforts would prioritize removing the tailings and returning them to the TSF. The burial or fill of wetlands and waters in the Anaconda Creek and Crooked Creek watersheds would alter or remove their capacity to provide hydrologic, biogeochemical, and biological functions. Much of the existing wetlands that are deeply buried would be converted to barren uplands where vegetation would not be expected to easily grow in the near term (one to several decades). Cleanup and remediation efforts may be able to restore wetland functions in some areas, but impacts would likely persist beyond cleanup. The success of cleanup efforts would determine the scope and severity of long-term impacts.

Table 4.11-2: Calculation of Wetland Categories by Burial Depth, 5.4 Percent Scenario

Wetland Type	Burial Depth (acres)				Approximate Impact Area (acres)	Area[1] (%)
	Light (< 0.5 ft)	Moderate (≥ 0.5 ft to < 3 ft)	Heavy (≥ 3 ft to < 10 ft)	Very Heavy (≥ 10 ft to < 30 ft)		
Deciduous Forested Wetlands	0.7	20.7	39.6	2.4	63.3	2%
Deciduous Scrub Shrub Wetlands	117.0	476.0	366.5	6.2	965.7	25%
Evergreen Forested Wetlands	28.8	215.3	170.2	0.2	414.4	11%
Evergreen Scrub Shrub Wetlands	4.3	12.4	6.5	0	23.2	1%
Herbaceous Wetlands	52.6	252.4	142.6	3.2	450.9	12%
Mixed Forested Wetlands	19.8	196.7	290.3	11.9	518.6	13%
Mixed Scrub Shrub Wetlands	173.6	556.7	162.8	2.4	895.5	23%
Moss-Lichen Wetlands	0.0	0.4	0	0	0.4	<1%
Ponds	0.4	4.1	23.9	0.4	28.8	1%
Rivers	1.4	33.1	200.8	32.8	268.0	7%
Uplands	11.2	115.1	121.3	13.4	261.1	7%
Wetland Area[2]	396.9	1,730.5	1,178.5	26.2	3,332.1	86%
Total Area	409.9	1,882.8	1,524.5	72.8	3,890.0	100%
Streams[3]						
Intermittent Streams (miles)	0.6	2.2	1.7	0.0	4.5	23%
Perennial Streams (miles)	1.9	9.8	3.4	0.2	15.3	77%
Total Stream Length	2.5	12.0	5.1	0.2	19.8	100%

Notes:

[1] Proportion of total study area by wetland category. Note that mosaic classes calculated as 100% wetlands overestimate the wetland area proportion.
[2] Proportion of total study area that is wetland, excluding ponds, rivers, and uplands.
[3] Stream impacts are measured in linear miles.
NA = Not Applicable 0 = None 0.0 = < 0.1
Sources: 3PPI 2014; BGC 2026a

The intensity of impacts would depend on burial depth, the type of materials spilled, and the rate of speed at which tailings and water moved through riparian locations. The spatial extent of wetland impacts would be confined to the area of the spill.

Much of the existing wetlands that are deeply buried would be converted to barren uplands. However, new wetlands and riparian areas will likely eventually form in areas of concave topography and along new stream channels created through tailings, with the timeframe of wetland and riparian area formation on the order of several decades. Studies of historical mine tailings sites have shown that wetland recovery is possible if disturbance is minimized and natural processes are allowed to proceed, but recovery is typically slow and may take several decades to a century or more (Wood 2021). During the first 5 to 10 years, erosion and sedimentation would mobilize deposited tailings across the landscape, flushing some material into streams and downstream while exposing steeper convex areas and concentrating deposits in lower-slope, concave, and depressional positions where deeper accumulations would be likely to persist. In these concave areas of the landscape, wetland vegetation would re-establish gradually from early successional species, and as new or modified stream channels form, riparian communities such as willow and balsam poplar (*Populus balsamifera*) would begin to colonize these corridors. Depressions that retain water would form ponds and wet areas, supporting the development of wetland vegetation, soils, and hydrology over time. Actively remediated and revegetated areas (tailings removal plus seeding/planting) would likely recover more quickly—on the order of years to a decade or two—than areas left to natural processes (several decades). Residual tailings would shift site conditions and drive state changes: thick deposits would infill existing wetlands, alter hydrologic conditions, and convert some existing wetland areas to uplands, while the fine texture of tailings in certain locations (e.g., concavities) may impede drainage and create new wetland conditions. These dynamics would produce a patchwork of wetland loss, wetland conversion, and new wetland formation, with recovery trajectories varying by geomorphic position, tailings thickness, level of contamination, and remediation intensity. While wetlands are anticipated to eventually recover in the tailings spill area, uncertainty exists around the extent and timeframe of wetland recovery and the degree to which wetland function would eventually be restored.

Wetlands serve as critical habitats for numerous plant and animal species, support high biodiversity, and provide essential ecosystem services such as water purification, flood attenuation, and carbon sequestration (Kossoff et al. 2014; Mitsch and Gosselink 2015). The burial or alteration of wetlands by mine tailings reduces these functions, often for extended periods, and in the case of deep burial, permanently.

Remediation efforts, such as tailings removal and active revegetation, could accelerate wetland recovery but are often limited by operational constraints and the risk of additional disturbance.

Across much of the spill area where active remediation is not possible, wetlands may eventually re-establish in concave areas and along new or modified stream channels, but the trajectory and timeline of recovery remain uncertain (Kossoff et al. 2014; Wood 2021). In addition, the immediate loss of deeply buried wetlands and the relatively long timeline for new wetland development would result in several decades of wetland function loss and impairment resulting in increased sedimentation downstream, reduced pollutant retention, little to no flood attenuation, and habitat degradation.

4.11.4 2026 SEIS SCENARIO – 13.3 PERCENT SCENARIO

Impacts from a 13.3 percent release would be similar in type to those of the 5.4 percent scenario; however, the intensity, extent, spatial distribution, and severity of impacts would likely be greater due to increased release volume, higher flow depths, and expanded downstream inundation.

Approximately 12,712.3 acres of wetlands would be impacted under the 13.3 percent release scenario (Table 4.11-3). As with the smaller release, wetland impacts would include erosion, combined erosion and burial, and burial-only disturbance. However, these impacts would be much more severe due to significantly greater erosion and deeper burial by tailings.

The increased volume and energy of the 13.3 percent release would also result in a greater length of streams impacted by erosion and deposition. Approximately 68 miles of streams would be impacted by inundation, an increase of approximately 6 miles compared to the 5.4 percent scenario.

Table 4.11-3: Impacts to Wetlands under the 13.3 Percent Release Scenario: Calculation of Wetland Categories by Maximum Flow Depth

Wetland Type	Flow Depth (acres)				Approximate Impact Area (acres)	Area[1] (%)
	40–100 ft	10–40 ft	≥ 3 ft to < 10 ft	< 3 ft		
Deciduous Forested Wetlands	0.1	208.7	1,066.3	1,180.0	2,455.0	4%
Deciduous Scrub Shrub Wetlands	43.2	1,219.4	1,201.4	991.0	3,455.0	6%
Evergreen Forested Wetlands	38.8	442.8	98.7	66.9	647.2	1%
Evergreen Scrub Shrub Wetlands	13.9	61.7	255.9	155.8	487.3	1%
Herbaceous Wetlands	12.5	560.4	385.3	206.8	1,165.0	2%
Lakes	0.0	101.3	212.5	36.8	350.6	1%
Mixed Forested Wetlands	18.6	562.1	1,353.4	754.1	2,688.3	5%
Mixed Scrub Shrub Wetlands	122.4	1,092.3	370.8	228.1	1,813.6	3%
Moss-Lichen Wetlands	0.0	0.8	0.1	0.0	0.9	0%
Ponds	1.6	38.1	99.9	33.2	172.8	0%
Rivers	17.9	32,033.8	5,890.7	1,175.9	39,118.3	67%
Uplands	51.1	736.5	3,855.6	1,022.7	5,665.9	10%
Wetland Area[2]	249.5	4,148.1	4,731.8	3,582.9	12,712.3[3]	22%
Total Area	320.0	37,057.8	14,790.6	5,851.5	58,019.9	100%
Streams[4]						
Intermittent Streams (miles)	0.2	5.3	14.1	8.5	28.2	41%
Perennial Streams (miles)	2.9	16.8	14.0	6.2	39.8	59%
Total Stream Length	3.1	22.1	28.1	14.7	68.0	100%

Notes:

[1] Proportion of total study area by wetland category. Note that mosaic classes calculated as 100% wetlands overestimate the wetland area proportion.
[2] Proportion of total study area that is wetland, excluding lakes, ponds, rivers, and uplands.
[3] The lower total impact acres for wetlands under larger scenarios relative to smaller scenarios arises from hydrograph shape and downstream attenuation in the tailings spill models. For instance, the 5.4 percent scenario can show greater inundation area in some locations compared to the 13.3 percent scenario. This pattern also appears occasionally in the vegetation impact tables (Section 4.10).
[4] Stream impacts are measured in linear miles.
NA = Not Applicable 0 = None 0.0 = < 0.1

Sources: 3PPI 2014; BGC 2026a

Impacts to wetlands from the deposition of tailings are shown in Table 4.11-4. Deposition of tailings and eroded materials would be expected to increase where flow depths are lower or where flow is impeded, including at bends in water bodies or at the confluence of Anaconda and Crooked Creeks. Under this scenario, approximately 4,185.7 acres of wetlands would be subject to tailings burial, with 82 percent of impacted wetlands buried beneath greater than 3 feet of tailings (Table 4.11-4). The increased volume and energy of the 13.3 percent release would also result in a greater length of streams impacted by erosion and deposition. Approximately 25.8 miles of streams would be impacted by deposition, an increase of 6 miles compared to the 5.4 percent scenario.

Table 4.11-4: Calculation of Wetland Categories by Burial Depth, 13.3 Percent Scenario

Wetland Type	Burial Depth (acres)				Approximate Impact Area (acres)	Area[1] (%)
	Light (< 0.5 ft)	Moderate (≥ 0.5 ft to < 3 ft)	Heavy (≥ 3 ft to < 10 ft)	Light (< 0.5 ft)		
Deciduous Forested Wetlands	0.5	1.6	16.7	51.8	70.6	1%
Deciduous Scrub Shrub Wetlands	29.8	215.7	548.0	456.0	1,249.4	26%
Evergreen Forested Wetlands	12.3	61.2	190.4	225.4	489.3	10%
Evergreen Scrub Shrub Wetlands	2.0	9.1	12.7	11.6	35.4	1%
Herbaceous Wetlands	11.8	127.6	234.3	163.7	537.4	11%
Mixed Forested Wetlands	1.0	6.4	147.5	395.2	550.0	11%
Mixed Scrub Shrub Wetlands	59.6	338.7	609.8	244.9	1,253.0	26%
Moss-Lichen Wetlands	0.0	0.0	0.5	0	0.5	<1%
Ponds	0	0.1	3.0	26.3	29.4	1%
Rivers	0.4	0.9	39.5	237.5	278.3	6%
Uplands	1.4	8.3	146.9	145.3	301.8	6%
Wetland Area[2]	117.0	760.3	1,759.9	1,548.5	4,185.7	87%
Total Area	118.8	769.6	1,949.2	1,957.6	4,795.2	100%
Streams[3]						
Intermittent Streams (miles)	0.2	1.3	3.5	1.3	6.3	24%
Perennial Streams (miles)	0.5	5.5	9.1	4.4	19.5	76%
Total Stream Length	0.7	6.8	12.6	5.7	25.8	100%

Notes:

[1] Proportion of total study area by wetland category. Note that mosaic classes calculated as 100% wetlands overestimate the wetland area proportion.
[2] Proportion of total study area that is wetland, excluding ponds, rivers, and uplands.
[3] Stream impacts are measured in linear miles.
NA = Not Applicable 0 = None 0.0 = < 0.1
Sources: 3PPI 2014; BGC 2026a

The intensity of impacts would depend on burial depth, the type of materials spilled, and the rate of speed at which tailings and water moved through riparian locations. The spatial extent of wetland impacts would be confined to the area of the spill.

The recovery timeframe and general pathways of wetland recovery are expected to be similar to those described for the 5.4 percent scenario, but with a larger spatial extent of impacts. The initial mobilization and deposition of tailings would infill and deeply bury existing wetlands, converting areas to barren uplands, and impeding drainage in concave positions, fundamentally altering wetland hydrology and function. This would result in the immediate and long-term loss or impairment of wetland extent, vegetation, and ecological services, including water purification, flood attenuation, carbon sequestration, and habitat provision (Kossoff et al. 2014; Mitsch and Gosselink 2015).

In the first 5 to 10 years, tailings erosion and sedimentation would redistribute material, with deeper deposits persisting in concave and low-lying areas. These areas would gradually support wetland re-establishment, starting with early successional vegetation. Stream channels altered by the spill could foster the growth of riparian vegetation, while depressions retaining water might evolve into new wetlands or ponds over decades to a century or more. Actively remediated areas, where tailings are removed and vegetation is restored, would recover more quickly—within years to a few decades—compared to areas left to natural processes, which may take several decades or more. Recovery would result in a mosaic of wetland loss, conversion, and formation, with timelines and outcomes varying based on level of burial, amount of contaminants, local conditions, and remediation efforts. Wetland function is expected to remain significantly impaired for several decades, with eventual recovery uncertain in terms of both extent and functionality.

Cleanup efforts would focus on the removal and return of tailings to the TSF. The burial or fill of wetlands and waters in the Anaconda Creek and Crooked Creek watersheds would alter or remove their capacity to provide hydrologic, biogeochemical, and biological functions. Much of the wetlands that are deeply buried would be converted to barren uplands where vegetation would not be expected to easily grow. Cleanup and remediation efforts may be able to restore wetland functions in areas, but the large scope and magnitude of impacts would make complete remediation and rehabilitation of the site likely not practicable. Impacts would likely persist beyond cleanup. The success of cleanup efforts would greatly determine the scope and severity of long-term impacts.

4.11.5 2026 SEIS SCENARIO – 27 PERCENT SCENARIO

4.11.5.1 27 Percent Scenario – Normal Hydrologic Conditions

Impacts from a 27 percent release under normal hydrologic conditions would be similar in type to those of the 13.3 percent scenario; however, the intensity, extent, spatial distribution, and severity of impacts would likely be greater due to increased release volume, higher flow depths, and expanded downstream inundation.

Approximately 15,603.1 acres of wetlands would be impacted by inundation under the 27 percent release scenario (Table 4.11-5). As with the smaller releases, wetland impacts would include erosion, combined erosion and burial, and burial-only disturbance. However, these impacts would be much more severe due to significantly greater erosion and deeper burial by tailings. Some areas may be inundated by 100 or more feet of water.

The increased volume and energy of the 27 percent release would also result in a greater length of streams impacted by erosion and deposition. Approximately 78.1 miles of streams would be impacted by inundation, an increase of 52.3 miles compared to the 13.3 percent scenario.

Table 4.11-5: Impacts to Wetlands under the 27 Percent Normal Hydrological Conditions Release: Calculation of Wetland Categories by Maximum Flow Depth

Wetland Type	Flow Depth (acres)					Approximate Impact Area (acres)	Area[1] (%)
	> 100 ft	40–100 ft	10–40 ft	≥ 3 ft to < 10 ft	< 3 ft		
Deciduous Forested Wetlands	0	18.6	313.0	1,521.2	1,323.2	3,176.0	5%
Deciduous Scrub Shrub Wetlands	4.9	322.9	1,371.3	1,503.4	1,119.5	4,322.0	7%
Evergreen Forested Wetlands	7.7	281.9	282.4	132.8	88.8	793.6	1%
Evergreen Scrub Shrub Wetlands	0.0	35.6	144.0	353.2	218.6	751.5	1%
Herbaceous Wetlands	0.5	220.5	460.8	430.3	242.9	1,355.0	2%
Lakes	0	0	115.5	208.6	25.3	349.4	1%
Mixed Forested Wetlands	0	196.8	468.9	1,744.1	647.4	3,057.2	5%
Mixed Scrub Shrub Wetlands	16.9	433.9	1,131.6	341.3	222.9	2,146.7	4%
Moss-Lichen Wetlands	0	0.6	0.5	0.1	0	1.2	0%
Ponds	0	22.4	22.4	115.5	23.5	183.9	0%
Rivers	0	132.1	33,123.2	4,974.0	756.2	38,985.5	64%
Uplands	0.0	181.0	684.1	3,856.3	998.6	5,720.0	9%
Area (acre) Wetland Area[2]	30.0	1,510.8	4,172.6	6,026.4	3,863.3	15,603.1	26%
Total Area	30.1	1,846.4	38,117.8	15,180.8	5,666.9	60,841.9	100%
Streams[3]							
Intermittent Streams (miles)	0	0.6	7.1	16.5	6.9	31.1	40%
Perennial Streams (miles)	1.1	6.5	18.5	16.2	4.6	47.0	60%
Total Stream Length	1.1	7.1	25.6	32.7	11.5	78.1	100%

Notes:

[1] Proportion of total study area by wetland category. Note that mosaic classes calculated as 100 percent wetlands overestimate the wetland area proportion.
[2] Proportion of total study area that is wetland, excluding lakes, ponds, rivers, and uplands.
[3] Stream impacts are measured in linear miles.
NA = Not Applicable 0 = None 0.0 = < 0.1
Sources: 3PPI 2014; BGC 2026a

Impacts to wetlands from the deposition of tailings are shown in Table 4.11-6. Deposition of tailings and eroded materials would be expected to increase where flow depths are lower or where flow is impeded, including at bends in water bodies or at the confluence of Anaconda and Crooked Creeks. Under this scenario, approximately 4,811.8 acres of wetlands would be subject to tailings burial, with 85 percent of impacted wetlands buried beneath greater than 3 feet of tailings (Table 4.11-4). The increased volume and energy of the 27 percent release would also result in a greater length of streams impacted by erosion and deposition. Approximately 32.3 miles of streams would be impacted by deposition, an increase of 6.5 miles compared to the 5.4 percent scenario.

Cleanup efforts would focus on the removal and return of tailings to the TSF. The burial or fill of wetlands and waters in the Anaconda Creek and Crooked Creek watersheds would alter or remove their capacity to provide hydrologic, biogeochemical, and biological functions. Much of the wetlands that are deeply buried would be converted to barren uplands where vegetation would not be expected to easily grow. Cleanup and remediation efforts may not be feasible or effective due to the magnitude and scope of the impacts. Impacts would be expected to persist beyond cleanup efforts. The success of cleanup efforts would determine the scope and severity of long-term impacts.

Table 4.11-6: Calculation of Wetland Categories by Burial Depth, 27 Percent Normal Hydrological Conditions Release

Wetland Type	Burial Depth (acres)					Approximate Impact Area (acres)	Area[3] (%)
	Light (< 0.5ft)	Moderate (≥ 0.5ft to < 3ft)	Heavy (≥ 3 ft to < 10 ft)	Very Heavy (≥ 10 ft to < 30 ft)	Extremely Heavy (≥ 30 ft)		
Deciduous Forested Wetlands	0.1	0.5	1.1	67.9	2.3	71.8	1%
Deciduous Scrub Shrub Wetlands	22.2	213.8	340.4	897.4	5.0	1,478.7	27%
Evergreen Forested Wetlands	13.2	89.8	87.7	375.4	0.1	566.2	10%
Evergreen Scrub Shrub Wetlands	2.0	11.0	14.4	23	0	50.2	1%
Herbaceous Wetlands	6.7	79.8	156.3	335.2	3.0	581.1	11%
Mixed Forested Wetlands	0.4	2.5	35.0	514.7	11.3	564.0	10%
Mixed Scrub Shrub Wetlands	47.5	310.4	426.7	711.9	2.5	1,499.0	27%
Moss-Lichen Wetlands	0	0.2	0.1	0.4	0	0.7	<1%
Ponds	0	0	1.9	29.2	0.2	31.4	1%
Rivers	0.1	0.4	8.3	249.0	28.0	285.7	5%
Uplands	2.0	8.0	68.8	265.3	9.7	353.7	6%
Wetland Area [2]	92.1	707.9	1,061.8	2,925.8	24.2	4,811.8	88%

Wetland Type	Burial Depth (acres)					Approximate Impact Area (acres)	Area[3] (%)
	Light (< 0.5ft)	Moderate (≥ 0.5ft to < 3ft)	Heavy (≥ 3 ft to < 10 ft)	Very Heavy (≥ 10 ft to < 30 ft)	Extremely Heavy (≥ 30 ft)		
Total Area	94.2	716.3	1,140.8	3,469.2	62.1	5,482.6	100%
Streams[3]							
Intermittent Streams (miles)	0.1	1.2	2.0	4.1	0.0	7.5	23%
Perennial Streams (miles)	0.4	5.3	10.2	8.8	0.2	24.8	77%
Total Stream Length	0.5	6.5	12.2	12.9	0.2	32.3	100%

Notes:

[1] Proportion of total study area by wetland category. Note that mosaic classes calculated as 100% wetlands overestimate the wetland area proportion.
[2] Proportion of total study area that is wetland, excluding ponds, rivers, and uplands.
[3] Stream impacts are measured in linear miles.
NA = Not Applicable 0 = None 0.0 = < 0.1
Sources: 3PPI 2014; BGC 2026a

4.11.5.2 27 Percent Scenario – 100-Year Flood Conditions

Impacts from a 27 percent release under 100-year flood conditions would be similar to those described previously under normal hydrologic conditions. However, the extent would be greater, with an additional 10,293 acres of wetlands impacted predominantly along the Kuskokwim River floodplain. Approximately 170,423.6 acres of wetlands would be impacted in total under this scenario.

4.11.5.3 Timeframe of Wetland Impacts – 27 Percent Scenario

Under the 27 percent tailings spill scenario, the recovery timeframe and general pathways of wetland recovery are expected to be similar to those described for the 5.4 and 13.3 percent scenarios, but with a larger spatial extent of impacts. Wetland extent, hydrology, function, and vegetation would be altered both in the near term and over decades to a century or more. The scale and duration of these impacts would depend on factors such as the spill magnitude, the redistribution and depth of tailings deposition, and the extent of tailings removal and active remediation. Cleanup and remediation efforts may not be feasible or effective due to the magnitude and scope of the impacts.

In the first 5 to 10 years, tailings erosion and sedimentation would redistribute material, with deeper deposits persisting in concave and low-lying areas. These areas would gradually support wetland re-establishment, starting with early successional vegetation. Stream channels altered by the spill could foster the growth of riparian vegetation, while depressions retaining water might evolve into new wetlands or ponds over decades to a century. Actively remediated areas, where tailings are removed and vegetation is restored, would recover more quickly—within years to a few decades—compared to areas left to natural processes, which may take several decades or more.

The larger spill would result in proportionally less active remediation and more areas with long-lasting, deep tailings deposits, leading to extended recovery timelines. Thick deposits would likely convert many existing wetlands to uplands, alter hydrology, and create new wetland conditions in some areas. Overall, recovery would result in a mosaic of wetland loss, conversion, and formation, with timelines and outcomes varying based on depth of burial, level of contamination, local conditions, and remediation efforts. Wetland function is expected to remain significantly impaired for several decades, with eventual recovery uncertain in terms of both extent and functionality. Relative to the smaller spill scenarios, the 27 percent spill would result in an even more extensive loss of wetland function, increased downstream sedimentation, reduced pollutant retention, diminished flood attenuation, and habitat degradation, with impacts persisting for decades or to a century or more.

4.12 WILDLIFE

4.12.1 TERRESTRIAL MAMMALS

4.12.1.1 Summary of Impacts from 2018 EIS Scenario – 0.5 Percent Scenario

Over 360 acres of forested habitat and 60 acres of shrub habitat (which provide habitat for wildlife species) could be directly affected under the 0.5 percent tailings and water release. The effects on wildlife were assessed based on the analysis of the effects on wetlands, vegetation, and aquatic resources. The 0.5 percent tailings release would primarily impact terrestrial mammal habitat through:

- Removal or burial of soils and vegetation;
- Reduced soil nutrient availability resulting in delayed regrowth;
- Alteration of stream morphology and aquatic habitat in Anaconda Creek and Crooked Creek; and
- Elimination or burial of aquatic invertebrate communities and other prey species important to the diet of some wildlife species.

In addition to loss and alteration of habitat, less-mobile wildlife that may be in the path of the flood of materials may experience injury/mortality, burial, or other direct effects. Species most affected include those that spend the majority of their life history in the aquatic or riparian areas around Anaconda and Crooked Creeks. These include voles, river otters, beavers, muskrats, and other smaller-bodied wildlife. Some larger-bodied mammals could be injured or buried in the initial debris flow. Wildlife could experience short-term, acute exposure to chemical contaminants (e.g., mercury) in the tailings solids and fluids, resulting in injury or death. However, the bioaccumulation of heavy metals in the food chain from chronic exposure would be unlikely. Population-level effects on wildlife are unlikely under this scenario.

4.12.1.2 2026 SEIS Scenario – 5.4 Percent Scenario

Under the 5.4 percent scenario, effects to wildlife would be similar to those under the 0.5 percent tailings release scenario; however, the magnitude, duration, and extent would be greater. A total of 57,883 acres of terrestrial wildlife habitat could be directly impacted. Direct impacts to wildlife habitat would extend throughout the Crooked Creek drainage down to the Kuskokwim River. Habitat alteration would likely extend into the more biologically productive lower reaches of Crooked Creek, where fish abundance is higher. Riparian and floodplain habitats in the Anaconda and Crooked Creek drainages would be altered from scouring of vegetation, removal and burial of native soils, and changes in stream morphology.

A higher number of terrestrial mammals in the direct path of the release would likely experience injury or mortality. Small mammals (e.g., lemmings, voles, shrews, hares) and furbearers (e.g., red fox, beavers, weasels, muskrats, and river otters) would be most impacted from the initial flood wave with the smothering of habitat and drowning of individuals. Large terrestrial mammals in the immediate path of the debris flow could experience drowning, burial, injury, or other direct effects. Terrestrial mammals with large home ranges such as black bears (*Ursus americanus*), brown bears (*Ursus arctos horribilis*), wolves (*Canus lupus*), wolverines (*Gulo gulo*), and moose (*Alces alces*) would likely avoid the area during cleanup and restoration activities. Based on baseline surveys and available data, the area directly affected does not appear to support high numbers or seasonal concentrations of large terrestrial mammals. Caribou from the Mulchatna caribou herd are unlikely to be impacted considering their current and historical range is primarily south of the Kuskokwim River.

Since fish are an important part of the food chain for terrestrial mammals such as bears, wolves, and others, impacts to fish populations may result in impacts to these species. Impacts may include altered foraging locations (if fish levels are reduced) and potential for increased competition and decreased fitness through increased energy expenditure to find resources.

Wildlife may experience acute effects from exposure to elevated metal concentrations in tailings solids (thallium, arsenic, antimony) and fluid (mercury) prior to cleanup efforts. High exposure to thallium can cause acute effects in terrestrial mammals including paralysis and seizures (Karbowska 2016). Acute effects on wildlife from arsenic exposure includes metabolic failure, neurological dysfunction and mortality (Eisler 1994).

Elevated metals concentrations remaining in soils post-cleanup could have long-term impacts on wildlife from chronic exposure. Thallium is highly bioavailable, mobile in soils, and persistent, making ecological exposure more likely. Terrestrial plants readily accumulate thallium from soil allowing for trophic transfer (Karbowska 2016). Arsenic is readily known to bioaccumulate in the food chain. Potential impacts to mammals from chronic exposure to arsenic include organ damage, neurological toxicity, immune system suppression, and reproductive developmental effects (Fuchs et al. 2023; Eisler 1994). Mercury has unique features making it more susceptible to bioaccumulation in the food chain (Naik and Gamare 2025). Mercury can impair biodiversity by impacting species growth, reproduction, and survival at all trophic levels. Mercury biomagnifies when present as methyl mercury, which is formed under anoxic conditions; is readily bioaccumulated by algal species; and subsequently biomagnified through trophic transfer (Mann et al. 2011 in Sánchez-Bayo et al. 2011). Species such as river otters and bears can bioaccumulate mercury from fish (Mann et al. 2011 in Sánchez-Bayo et al. 2011).

Overall, the bioaccumulation of metals in the food chain is expected to have a negligible impact on wildlife populations. The Crooked Creek drainage is a small portion of the overall area and most of the larger wildlife species have large home ranges that encompass multiple drainages. Hence impacts to one drainage are unlikely to cause wildlife population impacts because species can forage in other nearby drainages. While there may be behavioral avoidance of Crooked Creek and the adjacent areas during cleanup and restoration activities, wildlife are anticipated to return once vegetation recovery begins.

In summary, terrestrial mammal species would be impacted from the initial release event and through increased levels of metals in the Crooked Creek drainage. Generally, carnivorous species show higher biomagnification compared to herbivorous species (Mann et al. 2011 in Sánchez-Bayo et al. 2011). The duration of impacts is expected to vary based on the timing of the event, ability to clean up and remediate the tailings, and the impact on fish and aquatic species (which form the basis of the food chain for many mammal species). The Crooked Creek drainage would be impacted for years to decades until vegetation and fish populations recover. The extent of impacts would stretch from the location of the spill downstream in Crooked Creek until the confluence with the Kuskokwim River, at which point metals would be diluted. The extent of impacts on carnivorous mammals would be directly related to altered prey populations and parallel to the extent of impacts on fish and aquatic species populations.

4.12.1.3 2026 SEIS Scenario – 13.3 Percent Scenario

Under the 13.3 percent scenario, effects to terrestrial mammals would be similar to those under the 5.4 percent tailings release scenario; however, the magnitude, duration, and extent of effects would be greater. A total of 58,020 acres of terrestrial wildlife habitat would be directly impacted. Direct and indirect impacts to wildlife would occur over a larger geographic area due to the increased volume of released material. Habitat surrounding the confluence of Anaconda and Crooked Creeks would be buried by tailings ranging from less than 1 foot to about 18 feet. A greater number of individuals could experience injury or mortality because the initial flood event would have increased volume and spread across a larger geographic area. Wildlife would be more likely to experience acute and potentially chronic exposure to contaminants. Impacts would be similar to those described for the 5.4 percent release scenario. Aquatic and riparian habitats important to wildlife would take longer to recover due to the increased magnitude of disturbance. Wildlife use, composition, and distribution in the Crooked Creek drainage would be altered over a longer duration and likely follow the length of time for vegetation recovery. Wildlife may avoid use of the Crooked Creek drainage for a longer duration due to the greater amount of tailings that would cover vegetation and soils. While some larger wildlife (that are less vulnerable to predators) may transit across exposed areas where tailings were deposited, wildlife that are vulnerable to predation would likely avoid the area until vegetation recovers to provide sufficient cover from predators.

There would be an increased potential for impacts such as erosion and stream scour with the higher velocity of tailings. These impacts would affect both vegetation and aquatic resources (including fish) that terrestrial wildlife rely on, and therefore, impacts would be greater for both the physical environment and the wildlife resources that rely on the area. Wildlife are anticipated to avoid or leave the Crooked Creek drainage and relocate to nearby areas, especially while cleanup efforts are underway. Some smaller wildlife species may experience local population declines in the Crooked Creek drainage due to injury and mortality from the initial release event. Eventually, as vegetation slowly regrows on and through the tailings, wildlife are anticipated to reoccupy the area in conjunction with the recovery of their preferred vegetation communities. Depending on the wildlife species and on vegetation recovery, recovery may take decades.

4.12.1.4 2026 SEIS Scenario – 27 Percent Scenario

Under the 27 percent scenario occurring during normal hydrologic conditions, effects on terrestrial mammals would be similar to those under the 13.3 percent tailings release scenario; however, the magnitude, duration, and extent of effects would be substantially greater. A total of 60,842 acres of terrestrial wildlife habitat would be directly impacted. The release would create an initial flood wave up to 100 feet that would cause tailings to be widely deposited, making remediation more difficult and, in certain areas, impractical. Habitat surrounding the confluence of Crooked Creek and the Kuskokwim River would be buried by tailings to a depth of up to

30 feet. Impacts on wildlife composition and distribution within the Crooked Creek drainage would last decades due to the magnitude of disturbance. Stream morphology may require decades to reach a new equilibrium.

Bank overtopping from the initial pulse event would likely deposit tailings outside of the Crooked Creek drainage into areas that experience less flushing and are more likely to remain long-term. Wildlife would be more likely to experience acute and potentially chronic exposure to contaminants. Terrestrial mammals at greatest risk include small mammals that cannot escape the release event, and those species at higher tropic levels that are more susceptible to bioaccumulation. Chronic exposure to toxins have been shown to affect population growth and disrupt ecosystem functions for generations (Fuchs et al. 2023).

If the tailings release coincides with 100-year flood conditions, the tailings fluids would be more rapidly diluted but would be distributed more widespread farther downstream on the Kuskokwim River. Conversely, if the release occurred during normal hydrological conditions, the tailings fluids would be less diluted and the sediment more contained within the Kuskokwim River. Under both scenarios, there would be sediment deposition into areas along the Kuskokwim River that would be challenging to remove and would likely remain for years. Over time, the tailings would be covered with additional sediment and slowly leach metals, which may cause chronic impacts to local species. The timeframe and extent of recovery in the Crooked Creek drainage would depend on recovery of vegetation communities and fish populations and could take decades to more than a century.

4.12.2 MARINE MAMMALS

The marine mammal analysis includes both Endangered Species Act of 1973 (ESA)-listed and non-listed marine mammals that are likely to occur in the Kuskokwim Bay and River and may be impacted by a tailings release. This section includes ESA-listed marine mammals because the impacts would be similar for both ESA-listed and non-listed marine mammals and because they are both protected by the Marine Mammal Protection Act. Table 4.12-1 lists the marine mammal species most likely to be affected by the tailings release scenarios, their ESA status, and their seasonality of occurrence in the Kuskokwim River and Bay.

Table 4.12-1: Marine Mammal Species Likely to Occur in the Kuskokwim River and Bay

Common Name	Scientific Name	Stock	ESA-Status	Season Most Likely to Occur	Species Location
Harbor seal	*Phoca vitulina richardii*	Bristol Bay Stock	Not listed	All seasons	Kuskokwim River and Bay
Spotted seal	*Phoca largha*	Bering Stock	Not listed	Spring/summer	Kuskokwim River and Bay
Ringed seal	*Pusa hispida*	Arctic Stock	Threatened	Winter/early spring	Kuskokwim River and Bay
Bearded seal	*Erignathus barbatus nauticus*	Beringia DPS	Threatened	Late winter/early spring	Kuskokwim River and Bay
Steller sea lion	*Eumetopias jubatus*	Western DPS	Endangered	Summer	Kuskokwim Bay
Beluga whale	*Delphinapterus leucas*	Eastern Bering Sea Stock	Not listed	Summer	Kuskokwim River and Bay

Common Name	Scientific Name	Stock	ESA-Status	Season Most Likely to Occur	Species Location
Gray whale	*Eschrichtius robustus*	Eastern North Pacific DPS	Not listed	Summer	Kuskokwim River and Bay
Pacific walrus	*Odobenus rosmarus divergens*	Alaska Stock	Not listed	Late spring/early summer	Kuskokwim Bay

Note: DPS = Distinct Population Segment

Based on the Donlin Gold environmental baseline surveys, the most commonly documented marine mammals within the Kuskokwim River are spotted and harbor seals (RWJ Consulting Inc. 2010). Seals have been documented as far as 100 miles upriver of Kuskokwim Bay. Most species tend to be more common in Kuskokwim Bay (especially the whales and larger pinnipeds) and near the mouth of the river.

4.12.2.1 Summary of Impacts from 2018 EIS Scenario – 0.5 Percent Scenario

The 2018 EIS determined marine mammals are not expected to be impacted under the 0.5 percent release scenario. A water-only release would reach the Kuskokwim River; however, it is not expected to have a noticeable or measurable impact on marine mammals or their habitat.

4.12.2.2 2026 SEIS Scenario – 5.4 Percent Scenario

Under the 5.4 percent release scenario, marine mammals in the Kuskokwim River, if present, may experience behavioral disturbance from the initial sediment plume as it moves downriver. Harbor and spotted seals would be most at risk as these species travel the farthest up the Kuskokwim River. Sedimentation would likely be rapidly diluted and flushed once the sediment plume reaches the Kuskokwim River, which would lessen the potential impacts as it flows downriver (Section 4.7 Water and Sediment Quality).

Impacts to marine mammal prey are not expected to have a detectable impact on marine mammals. The Crooked Creek drainage, where fish production would be reduced, composes less than 1 percent of the total Kuskokwim River watershed area, representing only a fraction of available prey (Wang 1999). Migrating salmon in the Kuskokwim River could experience some disturbance, but not enough to have a measurable impact on marine mammal behavior. Any tailings reaching Kuskokwim Bay would be fine-grained and are not expected to have a detectable impact on marine mammals or their habitat.

A small amount of tailings may remain post-cleanup and leach heavy metals over the long-term, potentially leading to the bioaccumulation of heavy metals in individual marine mammal prey species (Section 4.7 Water and Sediment Quality; Section 4.13 Fish and Aquatic Resources). Chronic heavy metals can cause developmental, reproductive, and neurological disorders in marine mammals (Das et al. 2003). Marine mammals would be more susceptible to bioaccumulation due to their higher trophic level. However, the likelihood of population-level impacts to marine mammals is considered low, especially because marine mammals consume a variety of prey species, and not all prey species are anticipated to be affected by bioaccumulation. Direct exposure would be limited in duration based on the slow rate of leaching, and continual flushing and dilution of sediments (Section 4.7, Water and Sediment Quality). Remediation efforts would commence shortly after the spill, and efforts would prioritize select areas to minimize tailings re-distribution and downstream erosional run-off.

4.12.2.3 2026 SEIS Scenario – 13.3 Percent Scenario

Impacts to marine mammals from a 13.3 percent release would be greater in magnitude, duration, and extent compared with the 5.4 percent release scenario. There would be a much larger initial pulse of sediment and fluids that would cause a large sediment plume in the Kuskokwim River. While the metals in the tailings fluids would be diluted by the Kuskokwim River, the tailings could have acute impacts on marine mammal prey species due to heavy metals leaching over time. Tailings may eventually be deposited at the mouth of the Kuskokwim River and into Kuskokwim Bay where a variety of marine mammals feed on both fish and benthic species. Benthic filter feeding species would be at highest risk for intake of tailings, which may lead to toxicity. Marine mammals that feed on benthic species (e.g., gray whales, which are primarily bottom feeders) would be especially susceptible to bioaccumulation.

Marine mammals that feed primarily on fish (e.g., seals, beluga whales, sea lions) could also be exposed to bioaccumulation. Species most at risk are those that remain within the Kuskokwim River and Bay year-round, such as harbor seals. Species that only occur in the area during the summer would have reduced exposure.

4.12.2.4 2026 SEIS Scenario – 27 Percent Scenario

The 27 percent release scenario would increase the magnitude, duration, and extent of impacts due to the greater amount of tailings discharged into the Kuskokwim River. Marine mammals present in the Kuskokwim River, and nearshore areas of Kuskokwim Bay, would likely experience distress from the larger sediment plume as it travels downriver. Marine mammals' ability to feed could be temporarily impacted. Reductions in prey availability could extend for several years due to the magnitude of impacts on fish production in the Crooked Creek drainage and beyond. This is not expected to have a measurable impact on marine mammals considering the abundance of available prey in the Kuskokwim River. A larger amount of tailings could remain entrained in backwater areas, increasing the potential for bioaccumulation. Tailings that reach Kuskokwim Bay would be fine-grained and settle out across the Bay. Continual flushing and sediment deposition would eventually cover the tailings and slow the release of metals. However, once tailings enter the Kuskokwim River, they are unlikely to be successfully removed and may remain in the system for years.

If the release occurs during a 100-year flood, the tailings fluids would be more rapidly diluted, but the tailings sediment would be spread over a larger area. Marine mammals present in Kuskokwim Bay would be at similar risk of short-term disturbance from the sediment plume.

4.12.3 BIRDS

4.12.3.1 Summary of Impacts from 2018 EIS Scenario – 0.5 Percent Scenario

Waterbird (e.g., ducks, grebes, loons, swans) and shorebird (e.g., sandpipers, yellowlegs) species would likely be the bird species most impacted under the 0.5 percent release scenario considering their life history tied to aquatic habitats. Species that breed in Anaconda and Crooked Creeks would likely experience nest failure if young were unable to escape the debris flow or were covered by sediment. Adult birds would likely temporarily vacate the affected area, and any birds in the flightless stage would be more susceptible to impacts. Some shrub-nesting species (especially ground-nesting species) may also experience effects if their nests are smothered in tailings or inundated. Direct impacts to bird habitat would be limited to the middle and upper reaches of the Crooked Creek drainage and are not expected to result in population-level effects. Birds would continually repopulate the area over the following years as vegetation communities recover.

4.12.3.2 2026 SEIS Scenario – 5.4 Percent Scenario

Under the 5.4 percent scenario, effects to birds would be similar to those under the 0.5 percent tailings release scenario; however, the magnitude, duration, and extent would be greater and extend beyond Anaconda Creek to encompass a large area within the Crooked Creek drainage. Habitat loss would extend from the point of release to the confluence of Crooked Creek and the Kuskokwim River where higher numbers of waterbirds may occur seasonally. Any ground nests or nests low in shrubs in the path of the debris flow would be smothered. Stream-nesting waterbird surveys along Crooked Creek indicate red-breasted mergansers (*Mergus serrator*), common mergansers (*Mergus merganser*), green-winged teal (*Anas carolinensis*), mallards (*Anas platyrhynchos*), common goldeneye (*Bucephala clangula*), Canada geese (*Branta canadensis*) and other water bird species may nest in areas potentially impacted. If waterbirds are present, they may be displaced or washed downstream with the initial release. Impacts could be magnified for upland bird species, such as spruce grouse (*Canachites canadensis*), sharp-tailed grouse (*Tympanuchus phasianellus*), and willow (*Lagopus lagopus*) and rock ptarmigan (*Lagopus muta*), which nest on the ground. Furthermore, species that rely on Crooked Creek for chick rearing would likely experience direct loss of habitat.

Prey abundance for piscivorous bird species would be reduced throughout the Anaconda and Crooked Creek drainages, reducing localized abundance over the short and long term. This is not expected to have larger population-level effects considering there is adjacent comparable unaffected habitat in the area.

Tailings would reach the shores of the Kuskokwim River, the southern boundary of the Yukon-Kuskokwim (Y-K) Delta, an important wetland ecosystem for migratory birds. The Y-K Delta provides important breeding and nesting habitat for millions of migrating birds and supports some of the highest densities of nesting waterfowl in the world (Bart and Johnston 2012). The Y-K Delta also provides habitat for numerous raptor species including bald eagles (*Haliaeetus leucocephalus*), northern harriers (*Circus hudsonius*) and peregrine falcons (*Falco peregrinus*). Tailings would be transported down the Kuskokwim River adjacent to the Y-K Delta, impacting the prey base for both resident and migratory bird species. Over time, the sediment plume would be diluted, and is not expected to have a noticeable effect on birds in the Y-K Delta.

Birds that breed and feed in and around Crooked Creek and along the Kuskokwim River could be exposed to elevated levels of heavy metals including thallium, arsenic, antimony, and mercury. Birds feeding or nesting in the Anaconda and Crooked Creek drainages would be most at risk. Mercury in tailings water has the potential to contaminate soils, putting piscivorous species at greater risk. Generally, mercury accumulates up aquatic food chains, resulting in greater concentrations in higher trophic levels (EPA 1997). Effects of mercury biomagnification on birds include mortality, reduced reproductive success, impaired growth, and developmental abnormalities. Sublethal effects include liver damage, kidney damage, and neurobehavioral effects (EPA 1997).

Raptors are highly sensitive to heavy metals exposure as upper-level trophic predators. Potential impacts include impaired flight, reduced feeding, and embryo mortality. Exposure would be more limited considering most raptor species are migratory with only few remaining year-round.

Raptor species documented nesting in and around the Mine Site area include bald eagle, great gray owl (*Strix nebulosa*), Harlan's red-tailed hawk (*Buteo jamaicensis harlani*), red-tailed hawk (*Buteo jamaicensis*), and other species.

Bird species would likely avoid the area during the initial release and cleanup efforts until a time when vegetative cover returns and is sufficient to provide suitable nesting and foraging habitat. Bird distribution and use would be impacted for years to decades, and recovery would be dependent upon re-establishment of vegetation communities and fish populations. Impacts on birds that inhabit the affected area would be local and are not expected to rise to the larger population level for any of the larger spill scenarios.

4.12.3.3 2026 SEIS Scenario – 13.3 Percent Scenario

The magnitude and extent of impacts would be greater under the 13.3 percent release scenario. Direct impacts would extend to the confluence of Crooked Creek with the Kuskokwim River where tailings deposition thickness would range from 1 foot to 18 feet. A greater amount of riparian habitat would be flooded and scoured, particularly at stream confluences where deposition would be higher. Increased injury and mortality would be expected with the larger debris flow. Bank overtopping with the initial release would deposit tailings further into riparian zones, increasing the potential for heavy metals exposure. Bird distribution and use in the Crooked Creek area would be impacted for decades, and recovery would be dependent upon re-establishment of vegetation communities and fish populations.

4.12.3.4 2026 SEIS Scenario – 27 Percent Scenario

The 27 percent release scenario would be similar to those described above, but with increased magnitude, duration, and extent. Riparian habitats in the Anaconda and Crooked Creek drainages would be permanently altered, likely changing the distribution of birds for years. Acute and chronic exposure to contaminants would be more likely, potentially leading to local population declines for species that nest within Crooked Creek drainage. A release under 100-year flood stage conditions would spread tailings geographically over a larger area across downstream floodplains, but the tailings flow would become much more diluted upon entering and traveling down the Kuskokwim River compared with normal hydrologic conditions. Over time, the tailings would be spread around Kuskokwim Bay, become buried by additional sediment, and be further diluted. Bird distribution and use in the Crooked Creek area would be impacted for decades, and recovery would be dependent upon re-establishment of vegetation communities and fish populations.

4.13 FISH AND AQUATIC RESOURCES

Since the 2018 EIS, western Alaska has continued to experience a significant decline in both Chinook (*Oncorhynchus tshawytscha*) and chum (*Oncorhynchus keta*) salmon populations. Low marine survival appears to be a primary driver, particularly during years of anomalously warm ocean temperatures. In particular, chum salmon populations have been depressed for the last 6 years. In 2025, chum salmon returns underperformed compared to the previous two seasons, and remained well beneath historical harvest and escapement levels. Final passage estimates at the Kuskokwim River sonar recorded 159,622 chum salmon, compared to pre-collapse baselines of 556,000 in 2018 and 385,000 in 2019 (Federal Subsistence Board 2026). In response to these declines in Chinook and chum salmon, state and federal fishery management agencies have implemented a range of conservation measures, including restrictions or closures of subsistence, commercial, and sport fisheries to protect returning adults, reduced bycatch limits in federally managed fisheries, and enhanced monitoring and research efforts.

4.13.1 SUMMARY OF IMPACTS FROM 2018 EIS SCENARIO – 0.5 PERCENT SCENARIO

Approximately 21 acres of river and pond habitat would be subject to erosion and deposition, and 3.9 miles of streams would be directly affected by tailings deposition under the 0.5 percent water and tailings release. Approximately 340 acres of mostly riparian habitat would be inundated and subject to some degree of scouring. Flood inundation and tailings deposition are not expected to extend beyond the Crooked Creek drainage.

The degree of impacts to aquatic life would be comparatively greater under a summer tailings and water release scenario due to the nature of the release, higher water flows, and access challenges with removal and recovery of tailings. The intensity of impacts to overall fish production in the Crooked Creek watershed would vary depending on the physical and chemical nature of the water quality effects. Potential impacts include the burial and elimination of physical habitat, injury or mortality of fish and aquatic life, displacement and stranding of fish and aquatic biota, barriers to fish migration, and isolation of fish populations in the upper Crooked Creek watershed. Impacts are expected to be the most intense in the middle reaches of Crooked Creek, where salmon density was comparatively less than in lower reaches (Figure F1; OtterTail 2014). The confluence of Anaconda and Crooked Creeks is expected to have the greatest deposition of tailings. Incubating eggs, rearing juvenile, or adult fish in the vicinity of Anaconda Creek would be directly affected. Water and suspended solids would be transported downstream to the Kuskokwim River and beyond but would not be expected to have a measurable impact on aquatic life in the Kuskokwim River. Water quality impacts immediately downstream of the debris flow could result in behavioral disturbance, mortality, and chronic levels of stress or toxicity to aquatic life. Impacts could be as intense as acute or obvious/abrupt changes in fish behavior. These impacts are expected to be limited to the waters in the vicinity of the spill and not extend to the lower Crooked Creek reaches. Impacts could persist over several years but would diminish over time as residual tailings are flushed out from Crooked Creek. Drainage-wide or generational impacts on fish production are not expected under this scenario.

For a detailed description of species life history and habitats, see 2018 EIS Section 3.13, Fish and Aquatic Resources, and Appendix Q, Essential Fish Habitat Assessment.

4.13.2 2026 SEIS SCENARIO – 5.4 PERCENT SCENARIO

4.13.2.1 Anaconda and Crooked Creek Drainages

The magnitude, duration, and extent would be substantially greater under the 5.4 percent release scenario, although impacts on aquatic resources would be similar in nature. Aquatic resources would be most affected under a summer tailings release scenario due to the nature of the release, higher water flows, and access challenges with removal. The release would create a highly erosive debris flow, permanently altering the fluvial geomorphology in the drainages, that could strand, bury, and physically injure fish and other aquatic life. Riparian vegetation would be eliminated throughout the drainage for years, reducing stream nutrients and changing temperature regimes. Latitudinal and longitudinal ecological stream connectivity would be greatly disrupted. The loss of riparian and surrounding vegetation would lead to a sudden loss in the allochthonous input of energy and nutrients (e.g., fallen leaves, branches, terrestrial insects, detritus, fine particulate organic matter, and dissolved organic matter) that are fundamental to supporting macroinvertebrates and food chain relationships that support fish populations. Aquatic habitat would be altered or eliminated by scour, burial, and fill in these drainages. Direct impacts would extend into the lower reaches of Crooked Creek, where the greatest proportion of salmon spawning and smolt production has been documented (Figure 3.13-1, Section 3.13 in the 2018 EIS; OtterTail 2012). Salmon redds observed in 2009 were distributed in far greater abundance in the lower reaches of Crooked Creek where proportionally higher baseflows typically occur as compared to upstream reaches (OtterTail 2012). Injury or mortality to fish or incubating eggs would be noticeable and acute due to the initial flooding and smothering of habitat. Interstitial spaces important to juvenile fish would be eliminated and filled, and over time new channels would form. Fine sediment could fill void spaces between gravel clasts and adversely affect the survival of incubating eggs, inhibit fry emergence, and reduce overall fish-carrying capacity within the drainage (Limpinsel et al. 2017). Elevated TSS could injure juvenile fish and reduce their ability to sight-feed at or near water surface in higher turbidity waters (Corps 2009). Prolonged exposure to elevated TSS could lead to slower growth rates, altered behavior, habitat avoidance, and decreased survival. Early life stages would be most vulnerable, with elevated TSS potentially impairing egg development, hatching success, and juvenile survival. Fish populations would not be expected to recover until stream habitat, riparian vegetation, and associated ecological processes re-establish themselves to sufficiently support successful spawning, egg incubation, and rearing of juveniles. Uncertainty exists over the timeframe of recovery, and in part the rate of recovery would depend on the success of remediation and cleanup efforts.

Potential fish overwintering habitat in the lower reaches of Crooked Creek below Flat Creek would be drastically altered from flooding and deposition (OtterTail 2012). The availability and quality of overwintering habitat can regulate fish populations independently of spawning habitat availability in Alaska (Sethi et al. 2022). Off-channel habitats would be altered, potentially reducing year-class abundance. Off-channel complexes such as sloughs, beaver ponds, abandoned channels, and floodplain wetlands provide important feeding and refuge habitat for juvenile salmon and several resident species including northern pike *(Esox lucius*), Dolly Varden (*Salvelinus malma*), Arctic grayling (*Thymallus arcticus*), slimy sculpin (*Cottus cognatus*), and ninespine stickleback (*Pungitius pungitius*).

Temporary barriers to fish migration would likely extend into the lower reaches of Crooked Creek. Tailings depositions are expected to be greatest at stream meanders and confluences, increasing the likelihood of fish movement barriers. Fish would be temporarily isolated until a passageway is eroded through or tailings are removed. Barriers would extend into the lower reaches of Crooked Creek and tributaries, including the major tributaries of Getmuna and Bell Creeks, where salmon abundance is comparatively high. Depending on timing and intensity, barriers to spawning, rearing, and feeding habitat could cause population fragmentation and decrease fish year-class abundance (Sethi et al. 2022; Limpinsel et al. 2017).

Sedimentation and the loss of riparian vegetation would likely cause a short- and long-term reduction in the density and diversity of macroinvertebrate prey important to fish (McKenzie et al. 2023). Benthic macroinvertebrate communities would be expected to recolonize as vegetation recovers and as sediment is continually flushed downstream, although community structure would likely be altered over the long term (Nikl et al. 2016). Impacts to macroinvertebrate community structure and productivity are not expected to extend beyond the Crooked Creek drainage.

Elevated metal concentrations, including thallium, arsenic, antimony, and mercury, could impact aquatic life and would likely temporarily exceed AWQC. In the short term, acute toxicity may occur in fish and other aquatic organisms immediately downstream of the spill from metals exposure. A trace amount of metals could remain in the streambed and slowly release into surface water, particularly in back channels where metals could accumulate (Surface Water 4.71). Fish could bioaccumulate metals from direct water uptake or the consumption of contaminated invertebrates, particularly in off-channel habitats. Once absorbed, metals accumulate in tissues, especially liver, gills, kidney, and muscle. Potential impacts include altered swimming and predator avoidance, reduced foraging efficiency, reduced stress tolerance, and reproductive effects (Garai et al. 2021). The potential for mercury bioaccumulation in aquatic life is high and well documented (Dietz et al. 2022; Ghosh 2024; Naik and Gamare 2025). Fish are particularly vulnerable to the effects of arsenic, where it is known to disrupt metabolic function and immune responses. Chronic arsenic exposure can reduce population fitness and lead to biomagnification in higher trophic level species (Saç and Yeltekin 2023; Sankhla et al. 2024).

The bioaccumulation of metals in fish is not expected to impact populations outside the Crooked Creek drainage. Some individual fish could experience acute exposure and injury or mortality. The risk of exposure would be highest in the Crooked Creek watershed where the majority of tailings would be deposited. Direct exposure would be limited in duration and decrease farther downstream based on the slow rate of leaching, high precipitation in the area, and continual flushing and dilution of sediments (Section 4.7, Water and Sediment Quality). Based on these factors, metals concentrations in streamflow are unlikely to be high enough to exceed AWQC in most areas, reducing the likelihood of bioaccumulation. Remediation efforts would commence shortly after the spill, potentially reducing the likelihood of chronic exposure.

Population-level effects on anadromous and resident fish in the Crooked Creek drainage would be expected under this scenario when considering the totality of impacts, likely lasting a few years to a decade until stream ecosystem processes recover sufficiently to support successful spawning, egg incubation, and rearing of juveniles. Activities that restrict an individual fish from completing their lifecycle or diminish their vital rates (reproduction, survival, growth) will ultimately result in a reduction in yield at the population level (Bradford et al. 2014). Seasonal conditions, the time of release, and response measures would influence the duration, extent, and intensity of impacts. Changes in stream and floodplain characteristics in the Crooked Creek drainage are expected to be noticeable and permanent. Recovery of channel morphology and substrate suitable for fish spawning and rearing habitat would depend on rates of fine sediment export and gravel recruitment from post-failure streams and valley fill. The rate of fish recolonization would partially depend on the specific time of release and the amount of suitable habitat refuge available as the drainage reconfigures and new habitats are formed. Recent evaluations of stream remediation efforts with the Mount Polley tailings dam failure, where 25 million m^3 of water and tailings were released, indicate benthic invertebrate community and fish usage has returned to pre-disturbance numbers with strong salmon returns 4 years following the tailings release (Nikl et al. 2024). Mount Polley restoration efforts focused on rebuilding fish habitat, restoring stream function, stabilizing sediments, revegetating disturbed areas, and long-term ecosystem monitoring. Waters could return to a state of equilibrium over time through natural processes and if similar restoration efforts are successful. Impacts to fish production within the Kuskokwim

River watershed are not expected to be noticeable or measurable considering the Crooked Creek drainage makes up less than 1 percent of the total watershed area (Wang 1999).

4.13.2.2 Kuskokwim River

Most of the tailings that are flushed into the Kuskokwim River would be the finer-grained silts and clays and would likely be carried all the way downstream and flushed into the Bering Sea. Fine tailings particles from previous tailings dam failures have been documented to travel over 400 miles, remaining suspended long enough to move from river systems into coastal and marine environments (Carmo et al. 2017). These tailings would have the short-term impact of increasing the river water turbidity/TSS in the Kuskokwim River water but are not expected to be noticeable over the long term. The Kuskokwim River is characterized by sediment-rich, low-gradient, meandering channels of water depth that greatly fluctuates with tides and seasons.

Five species of Pacific salmon have been documented in the Kuskokwim River at various life stages. The intensity of impacts would partially depend on what fish species and life stages are present at time of release. A late spring/early summer release could disturb out-migrating anadromous fishes, including multiple stocks of juvenile salmon. This period generally represents when the largest stocks of juvenile salmon are present in the mainstem Kuskokwim River (Owl Ridge 2016). Juvenile salmon may occupy a variety of habitats during outmigration including strong currents with high flows, slower velocity nearshore margins, and off-channel habitats (Limpinsel et al. 2017). Adult salmon migrating to natal streams in the Crooked Creek drainage could experience behavioral stress from sediment plumes, particularly along river margins. High concentrations of suspended sediments can cause physiological stress, including damage to gills, reduced growth, and decreased survival in fish (Krupa et al. 2025). High sediment loads also interfere with migration behavior, as changes in turbidity and flow regimes can alter timing and movement patterns of juvenile and adult salmon.

Broad whitefish (*Coregonus nasus*), humpback whitefish (*Coregonus pidschian*), and least cisco (*Coregonus sardinella*) would be most impacted with a late spring/early summer release as they migrate in the mainstem to preferred feeding areas. Impacts could include behavioral disturbance, injury, or mortality, although the likelihood would drastically decrease as the plume becomes more diluted downriver. Northern pike could be impacted as they migrate from overwintering areas to spawning grounds or summer feeding areas. Burbot would likely be most affected with a late winter or early spring release when they gather in dense populations to spawn under the ice. Behavioral disturbance, injury, mortality, or sedimentation of incubating eggs could occur, although impacts would not be expected to rise to the population level.

Rainbow smelt (*Osmerus mordax mordax*) could be disturbed by the sediment plume as they migrate along the river's margins in early to late May depending on the timing of the release. Rainbow smelt spawning habitat in the Kalskag-Aniak vicinity would be affected as the sediment plume travels downriver. The sedimentation of seagrass could inhibit photosynthetic activity and decrease plant productivity (Krupa et al. 2025). Incubating eggs and larval fish would be most vulnerable to sedimentation if the release were to occur in May when spawning has been documented (Owl Ridge 2014).

The likelihood of this release scenario impacting rainbow smelt production is considered low. Sedimentation and habitat disturbance are common in the Kuskokwim River from annual ice break up, bank erosion, natural flooding, and scour. Most of the tailings flushed into the Kuskokwim River are expected to be suspended, finer-grained silts and clays that would likely be continually carried downriver and ultimately flushed into the Bering Sea. Minimal disturbance to rainbow smelt and their habitat is expected.

The exposure to heavy metals in the Kuskokwim River is not expected to have a measurable impact on fish production, although some individuals could be directly affected following the initial release. Most of the tailings that are flushed into the Kuskokwim River would be the finer-grained silts and clays and are likely to stay in suspension and be carried all the way downstream and flushed into the Bering Sea. The concentration and bioavailability of toxic metals is expected to become increasingly more diluted with increasing distance from Crooked Creek. The Kuskokwim River mean monthly discharge is approximately 63 times greater than the flow of Crooked Creek in May, and approximately 295 times greater in February (Table 3.24-15 of the 2018 EIS). The bioavailability of metals would be continually reduced from physical and biological processes, reducing the likelihood of bioaccumulation. Direct exposure would be limited in duration based on the slow rate of leaching, and continual flushing and dilution of sediments (Section 4.7, Water and Sediment Quality). Species most at risk include those that spend most of their life history in backwater areas where heavy metals have a greater likelihood of settling.

4.13.3 2026 SEIS SCENARIO – 13.3 PERCENT SCENARIO

4.13.3.1 Anaconda and Crooked Creek

Impacts on aquatic organisms and habitat would be similar to those identified in the 0.5 percent and 5.4 percent scenarios, although the magnitude, duration, and extent of effects would be greater. Aquatic habitat would take longer to recover due to increased burial by tailings, sedimentation, and intense scouring of channels and floodplains. Habitat loss would extend farther into anadromous waters with extensive deposition expected at all major confluences. The intensity and frequency of barriers to fish movement would be greater, increasing the likelihood of fish becoming isolated over a longer duration. The biologically productive Bell and Getmuna tributaries would be impacted, with greater deposition amounts extending farther upstream. Impacts on fish year-class abundance would be likely and could last a few years to longer than a decade until stream ecosystem processes recover sufficiently to support successful spawning, egg incubation, and rearing of juveniles, resulting in generational-level effects on local populations. Successful remediation efforts may improve the timeframe and level of recovery. Channel realignment and reconfiguration would occur over a longer period of time as the Crooked Creek drainage reaches a state of equilibrium. The potential for the bioaccumulation of metals would be more likely under the 13.3 percent release scenario considering the increased deposition, larger area impacted, and increased challenges with remediation. Even after successful cleanup, dispersed deposits of tailings would likely remain in and around the Crooked Creek channel for years. Acute levels of stress or toxicity would likely result in greater injury and more individual mortalities. The potential for chronic effects from bioaccumulation, including altered swimming and predator avoidance, reduced foraging efficiency, reduced stress tolerance, and reproductive effects, would be greater under this scenario. Fish productivity would be reduced over a longer duration under this scenario.

4.13.3.2 Kuskokwim River

Impacts on Kuskokwim River aquatic resources would be similar to those described under the 5.4 percent release scenario. The initial sediment plume would be similar in volume; however, sedimentation would be greater over the long term as it is continually flushed from the Crooked Creek drainage. Higher concentrations of heavy metals could accumulate in backwater areas, leading to long-term exposure. Chronic levels of stress or toxicity could result in individual injury or mortality. The likelihood of contaminants exposure is expected to progressively decrease over time and farther downstream from the spill with continual flushing.

4.13.4 2026 SEIS SCENARIO – 27 PERCENT SCENARIO

4.13.4.1 Anaconda and Crooked Creek

The 27 percent scenario would have substantial long-term impacts on the aquatic habitats of Anaconda Creek and Crooked Creek. Impacts would be similar to those identified in the previous scenarios, but the magnitude, duration, and extent of effects would increase. The blockage of flow would be much more extensive and would temporarily extend to the Crooked Creek–Kuskokwim River confluence. Salmon migration and outmigration to and from the Crooked Creek drainage would be disrupted, leading to a reduction or loss of multiple year-classes. Fish injury and mortality would be higher in all tributaries. Changes to stream morphology would be extensive and may require decades to reach a new equilibrium. Cleanup efforts would be increasingly difficult and may not be feasible in many areas. The loss of stream connectivity and habitat refugia would lengthen the duration of effects. Changes in fish composition and fish production would be generational and may never recover to pre-disturbance numbers even with fish reintroduction. The potential for the bioaccumulation of metals would be more likely under the 27 percent release scenario considering the increased deposition, larger area impacted, and challenges with remediation. Higher concentrations of heavy metals could accumulate in backwater areas, leading to long-term exposure. Acute and chronic levels of stress or toxicity could result in higher individual mortality or population-level impacts depending on contaminant concentrations after cleanup and tailings have settled. A release under the 100-year flood stage would have similar effects to Anaconda and Crooked Creeks because the magnitude of the dam breach would greatly exceed baseflows during the flood event.

4.13.4.2 Kuskokwim River

Impacts on aquatic resources in the Kuskokwim River would be noticeable over the short term as the sediment plume travels downriver. Depending on timing, fish making seasonal migrations, including sheefish (*Stenodus leucichthys*), rainbow smelt, ciscoes, whitefish, northern pike, and Arctic grayling would likely experience some physiological and behavioral stress due to the increased discharge and voluminous sediment plume. Salmon movement patterns and timing could be temporarily disrupted, leading to changes in productivity in drainages beyond Crooked Creek. Rainbow smelt spawning habitat would be more likely affected from the increased sedimentation, potentially reducing overall fish production. The potential for the bioaccumulation of metals would be more likely under the 27 percent release scenario considering the increased deposition in the Kuskokwim River. Some of the tailings deposited along the Kuskokwim River may remain in oxbows and backwater sloughs for years before being flushed downstream or being buried by sedimentation. The likelihood of contaminants exposure is expected to progressively decrease over time and farther downstream from the spill with continual flushing.

Short-term effects from the sediment plume would extend into Kuskokwim Bay and could result in some fish injury or mortality. The initial flood could impact seasonal fish migrations depending on timing of the release. Sediment deposition could reduce habitat quality and fish productivity over the long term. Effects would be most intense immediately following the release and are expected to decrease in magnitude with dilution by currents and tides as the plume moves downriver.

A release under the 100-year flood stage would have similar effects, although tailings materials would be distributed much more widely across downstream floodplains, and the tailing contaminants would be more diluted compared to baseline hydrological conditions.

4.14 THREATENED AND ENDANGERED BIRD SPECIES

Two ESA-listed bird species, Steller's eider (*Polysticta stelleri*) and spectacled eider (*Somateria fischeri*), were considered in the analysis based on their potential to occur around the mouth of the Kuskokwim River and in Kuskokwim Bay.

Steller's eiders are present in Kuskokwim Bay for spring staging and a 3-week molt period following breeding when they are most vulnerable to disturbance or injury. Northern Kuskokwim Bay is thought to provide critical habitat for the Alaska population as they migrate to northern nesting grounds (Larned 2007). The U.S. Fish and Wildlife Service has designated Steller's eider critical habitat in Kuskokwim Bay around Kuskokwim Shoals (from the mouth of the Kolavinarak River to near Kwigillingok village), in the northwest portion of the bay (Figures of critical habitat are included in Section 3.24.6.14.1 of the 2018 EIS).

Spectacled eiders nest in the Y-K Delta National Wildlife Refuge close to the mouth of the Yukon River and could be present foraging in Kuskokwim Bay during summer months. While breeding habitat has been historically documented on the north shore of Kuskokwim Bay near the mouth of the Kuskokwim River, most breeding occurs north of the Kuskokwim River around the Yukon River. Kuskokwim Bay is at the southern portion of the species breeding range in the Y-K Delta, and their potential for occurrence is low.

4.14.1 SUMMARY OF IMPACTS FROM 2018 EIS SCENARIO – 0.5 PERCENT SCENARIO

The 2018 EIS determined no effects to threatened and endangered birds from a 0.5 percent tailings release because no federally listed bird species are known to occur within, or use the habitat affected by, the 0.5 percent scenario.

4.14.2 2026 SEIS SCENARIO – 5.4 PERCENT SCENARIO

Under the 5.4 percent release scenario, tailings that reach Kuskokwim Bay would be substantially diluted, flushed, and would rapidly mix with silt, sand, and other debris that is naturally discharged into Kuskokwim Bay. While tailings would likely reach the mouth of the Kuskokwim River, due to natural processes, the tailings would get covered and are not expected to have a noticeable or measurable impact on ESA-listed species or habitat.

4.14.3 2026 SEIS SCENARIO – 13.3 PERCENT SCENARIO

ESA-listed bird species would have an increased potential for impacts under the 13.3 percent release scenario due to the larger amount of tailings that could reach Kuskokwim Bay. Tailings that reach Kuskokwim Bay may cover up and smother benthic aquatic species that eiders feed on. Steller's eiders have an increased potential for exposure to ingestion of benthic invertebrates due to their potential presence in Kuskokwim Bay during spring staging and molt. The preferred marine habitat for Steller's eider during molt includes marine waters up to 30 feet deep, the associated invertebrate communities, and where present, eelgrass beds along with their associated flora and fauna (65 FR 13262).

The initial flush of tailings is likely to cause reduced prey availability due to smothering, and the tailings are likely to be deposited across a large portion of Kuskokwim Bay due to currents and tidal action. Over time, the tailings may slowly leach metals, become resuspended, experience continued flushing and dilution, and eventually be carried farther out outside the Bay. This action is unlikely to have a noticeable or measurable impact on eiders because both species are uncommon in the area, only use it during specific life history periods, and tailings would be widely dispersed and not concentrated in a specific area in Kuskokwim Bay.

For both eider species, the ingestion of benthic invertebrates with elevated metals may lead to bioaccumulation in some individuals. Eiders are long-lived species, and bioaccumulation of metals is a concern which could potentially lead to reduced fitness. Population-level impacts to Steller's and spectacled eiders would not be expected from chronic exposure. The bioavailability of metals would be reduced from physical and biological processes by the time they reach Kuskokwim Bay. The Kuskokwim River discharges approximately 35 million metric tons of sediment annually into Kuskokwim Bay, an area over 9,000 square miles (Miyahara and Ingraham 1984). The wide distribution of tailings would reduce the likelihood of contaminants becoming concentrated and bioavailable in specific areas. Chronic exposure to contaminants by Steller's and spectacled eiders populations would be unlikely considering these factors.

4.14.4 2026 SEIS SCENARIO – 27 PERCENT SCENARIO

Both eider species may experience impacts under the 27 percent release scenario due to the greater amount of suspended tailings that would reach Kuskokwim Bay and be deposited in sediments. A greater amount of tailings are expected to reach the Kuskokwim Bay, where they have potential to contaminate prey, particularly benthic invertebrates such as clams, mussels, and worms. Chronic exposure to heavy metals can affect reproduction, immune function, and physiology in eiders (Provencher et al. 2016).

If the release occurred during 100-year flood conditions, the tailings fluids would be more rapidly diluted and the tailings sediment would be spread over a larger area and more rapidly transported downstream and deposited into Kuskokwim Bay. If the release occurred during normal hydrological conditions, the tailings fluids would be less diluted and the sediment more contained within the Kuskokwim River. Under both scenarios, a large portion of the tailings would eventually end up in Kuskokwim Bay, where eiders may be exposed to their impacts.

Similar to the 13.3 percent release scenario, population-level impacts to Steller's and spectacled eiders would not be expected from chronic exposure. The wide distribution of tailings would reduce the likelihood of contaminants becoming concentrated and bioavailable in specific areas.

4.15 LAND OWNERSHIP, MANAGEMENT, AND USE

Land ownership would not be affected by any spill scenario; land management and use are discussed for each scenario.

4.15.1 SUMMARY OF IMPACTS FROM 2018 EIS SCENARIO – 0.5 PERCENT SCENARIO

The tailings dam, associated facilities, and spill trajectory resulting from a potential partial tailings dam failure are located on private land (Native Patent or Interim Conveyed). If there were to be a partial tailings dam failure, of either water and tailings or just water, the impacts to land management would range from no impact to acute or obvious impacts, depending on the volume of spill and location of spill trajectory. The duration of effects would range from the duration of the spill to the duration of the cleanup effort and limited to the vicinity of the spill site that would require actions by the land managers. The potential for these impacts would likely require preventative mitigation measures, such as the development of a spill contingency plan in coordination with nearby land managers. Impacts to land use from a partial tailings dam failure would thus range from no impact for small spills to impacts that may require evacuation of lands, be intermittent in duration, and be limited to nearby landowners.

4.15.2 2026 SEIS SCENARIO – 5.4 PERCENT SCENARIO

Modeling predicts that spilled tailings into the Kuskokwim River would be primarily on private land (Native Patent or Interim Conveyed), with a few sections bordered by the State of Alaska, and then the U.S. Fish and Wildlife Service near the river outlet. The most intense impacts would occur near the Mine Site and along Crooked Creek, dissipating quickly on the Kuskokwim River. The impacts to land management would have acute or obvious impacts. The duration of effects would range from the duration of the spill to the duration of the cleanup effort and limited to the vicinity of the spill site that would require oversight by the land managers. The potential for these impacts would likely require preventative mitigation measures, such as the development of a spill contingency plan in coordination with nearby land managers. Impacts to land use from the 5.4 percent spill scenario would have an intensity that would require evacuation in some parts of the Village of Crooked Creek but would not likely require evacuation of lands in villages further downstream (Napaimute, Chuathbaluk, Aniak, Upper Kalskag, and Lower Kalskag). Impacts would be intermittent in duration and limited to nearby landowners.

4.15.3 2026 SEIS SCENARIO – 13.3 PERCENT SCENARIO

The spill trajectory resulting from a 13.3 percent spill would be the same as the 5.4 percent scenario. As with the 5.4 percent scenario, the most intense impacts would occur near the Mine Site and along Crooked Creek, although the dissipation on the Kuskokwim River would occur farther downstream. The impacts to land management and use would be the same as described for the 5.4 percent scenario, although intensity would increase. It would not likely require evacuation of lands in villages farther downstream (Napaimute, Chuathbaluk, Aniak, Upper Kalskag, and Lower Kalskag).

4.15.4 2026 SEIS SCENARIO – 27 PERCENT SCENARIO

The spill trajectory resulting from a 27 percent spill would be the same as the 5.4 percent scenario. As with the 5.4 percent scenario, the most intense impacts would occur near the Mine Site and along Crooked Creek, although the dissipation on the Kuskokwim River would occur farther downstream. The impacts to land management and use would be the same as described for the 5.4 percent scenario, although intensity would increase. A spill during normal hydrologic conditions would not likely require evacuation of lands in villages farther downstream

(Chuathbaluk, Aniak, Upper Kalskag, and Lower Kalskag). During Kuskokwim 100-year flood conditions, evacuation of some areas of Crooked Creek, Georgetown, Napaimute, Chuathbaluk, Aniak, Upper Kalskag, and Lower Kalskag would likely be required. A spill during such a flood would have a small added effect on evacuations.

4.16 RECREATION

4.16.1 SUMMARY OF IMPACTS FROM 2018 EIS SCENARIO – 0.5 PERCENT SCENARIO

In the event of a partial tailings dam failure, impacts on the recreation setting would be acute or obvious, but the levels of recreation activities downstream from the Mine Site are estimated to remain very low. The recreation activities that may be affected by a partial tailings dam failure could include sport fishing, river recreation (such as kayaking and rafting), recreational snowmachining, and sport hunting. Sport anglers generally use clear tributary streams as opposed to the turbid waters of the Kuskokwim River, and Crooked Creek and Anaconda Creek are not popular sport fishing or sport hunting locations. While low in probability, a partial tailings dam failure may cause probable loss or damage to anadromous fisheries, which could impact sport anglers. There would be impacts to recreational sightseeing as visual resources would be impacted. Sightseeing and flightseeing are typically secondary recreational activities done in conjunction with travel for sport fishing and sport hunting.

If a release occurred in winter, it could impact recreational snowmachine or dogsled travel on a small portion of the Kuskokwim River and on Crooked and Anaconda Creeks. These direct and indirect impacts are expected to be acute or obvious in intensity but would affect very low recreation use levels. Displacement of recreationists would be brief in duration, with potential displacement of sport anglers and sport hunters through the life of the Project if contamination of fish and waterfowl occurred or was perceived. Impacts to recreation would be limited to the vicinity of the spill site. Resources would be widely available in context as there are ample alternative locations for recreation, many of which are more popular locations for guided and unguided sport fishing and sport hunting. Displaced recreationists would likely make use of alternative locations for their activities. In summary, the impacts from a partial tailings dam failure would impact the recreation setting but would affect few recreationists in the area.

4.16.2 2026 SEIS SCENARIO – 5.4 PERCENT SCENARIO

Impacts from the 5.4 percent scenario would be similar to those described for the 0.5 percent scenario, except that the duration may increase if cleanup efforts are extended. The recreation activities that may be affected by the 5.4 percent scenarios would be the same as the 0.5 percent scenarios, although sport fishing would be more impacted as spill volume increase, because impacts to fish would increase (refer to Section 4.13).

4.16.3 2026 SEIS SCENARIO – 13.3 PERCENT SCENARIO

Impacts from the 13.3 percent scenario would be the same as those described for the 0.5 percent scenario, although sport fishing would be more impacted as spill volume increases because impacts to fish would increase (refer to Section 4.13). The duration may increase if cleanup efforts are extended.

4.16.4 2026 SEIS SCENARIO – 27 PERCENT SCENARIO

Impacts from the 27 percent scenarios (both normal hydrologic conditions and 100-year flood stage conditions) would be the same as those described for the 0.5 percent scenario, although sport fishing would be more impacted as spill volume increases because impacts to fish would increase (refer to Section 4.13). The duration would increase as cleanup efforts are extended.

4.17 VISUAL RESOURCES

4.17.1 SUMMARY OF IMPACTS FROM 2018 EIS SCENARIO – 0.5 PERCENT SCENARIO

In the event of a liner rupture or tailings dam breach in which a large volume of water and tailings is released into the environment, direct impacts to visual resources could result. While unlikely in probability, impacts would extend to the background distance zone and potentially affect visual resources in the vicinity of villages along the Kuskokwim River. A release of tailings and water would result in strong visual contrast against the existing landscape from materials transported downstream and excavated soils as part of cleanup efforts. Impacts on visual resources would be evident from communities along the Kuskokwim River and from elevated or aerial locations. Indirect impacts to visual resources may result from subsequent cleanup efforts if excavation or earthmoving equipment were used as part of the recovery effort. Impacts would range in duration, depending on the extent and location (setting) of the release and cleanup efforts.

4.17.2 2026 SEIS SCENARIO – 5.4 PERCENT SCENARIO

Impacts from the 5.4 percent scenario would be similar to those described for the 0.5 percent scenario, except that the spatial extent would be larger and the duration may increase if cleanup efforts are extended. A release of tailings would result in strong visual contrast against the existing landscape from vegetation loss and large amounts of tailing deposition, as well as materials transported downstream and excavated soils as part of cleanup efforts. The 5.4 percent scenario would extend to the background distance zone and potentially affect visual resources in the vicinity of villages along the Kuskokwim River. The community of Crooked Creek would have the greatest intensity of change, experiencing in-community flooding, vegetation loss, tailings deposition, and response efforts, while the downstream communities would have an increase of flow in the Kuskokwim River.

4.17.3 2026 SEIS SCENARIO – 13.3 PERCENT SCENARIO

Impacts from the 13.3 percent scenario would be the same as those described for the 0.5 percent scenario, except that the duration of impacts from cleanup efforts would be extended. Visual impacts from vegetation loss and tailings deposition would be extended farther down the Kuskokwim River and potentially last for several years. The communities of Crooked Creek and Upper Kalskag would experience in-community flooding and response, while the downstream communities would have an increase of flow in the Kuskokwim River.

4.17.4 2026 SEIS SCENARIO – 27 PERCENT SCENARIO

Impacts from the 27 percent normal hydrologic conditions scenario would be the same as those described for the 0.5 percent scenario, except that the duration of impacts from cleanup efforts would be extended. Visual impacts from vegetation loss and tailings deposition would be extended farther down the Kuskokwim River and potentially last for several years. The communities of Crooked Creek and Upper Kalskag would experience in-community flooding and response. If the scenario were to occur during 100-year flood conditions, the river would already be turbid and over the banks and the additive effect of the 27 percent failure would be difficult to discern from the impacts of the flood. The communities of Crooked Creek, Aniak, Upper Kalskag, and Lower Kalskag would experience in-community flooding.

4.18 SOCIOCULTURAL

4.18.1 CASH ECONOMY

4.18.1.1 Summary of Impacts from 2018 EIS Scenario – 0.5 Percent Scenario

The cleanup and remediation activities following a partial tailings dam failure in which water and tailings are released into the environment would briefly increase employment opportunities and expenditures in the Y-K region. Manpower requirements would be especially high if labor-intensive response efforts such as mechanical recovery and physical removal are used, such as in the case of a tailings and water release in winter. Employment increases for cleanup activities would be brief (up to 4 years).

Over the longer term, the impacts on employment, income, and sales would be negative if commercial and recreational fishing or tourism were to suffer due to the real or perceived impacts of the spill. While these negative employment, income, and sales effects would be brief, their intensity would vary and may result in changes in socioeconomic indicators well outside normal variation and trends if a major spill occurs with shoreline contact or contamination of fish. Water contamination could also create drinking water bans, which would negatively impact local businesses and consumers. These negative employment, income, and sales impacts would be focused toward Crooked Creek and Kuskokwim River communities. In terms of context, the impacts would primarily affect low-income communities.

This scenario could potentially result in commercial fishing closures, a reduction in tourism, or local drinking water restrictions. The intensity of impacts would depend on the season; greater intensity impacts would be expected to occur during summer as tailings could be mobilized to a larger area by waterways, and it would be more difficult to move cleanup equipment into the area. Duration of impacts would likely be brief (less than 4 years), affecting socioeconomic resources during the spill and subsequent cleanup efforts. Disruptions of commercial or recreation fishing would likely be limited in extent to areas around Crooked Creek, Anaconda Creek, and the Kuskokwim River.

4.18.1.2 2026 SEIS Scenario – 5.4 Percent Scenario

Impacts from the 5.4 percent scenario would be the same as those described for the 0.5 percent scenario, except that the duration and magnitude of impacts may increase and more downstream communities may be affected. The Donlin Gold Project represents a key economic driver for the region. However, if a larger tailings spill occurs, it would likely force a temporary suspension of mining production activities. This shutdown would remain in effect while teams execute initial response actions in the Crooked Creek drainage and repair the TSF Main Dam and its supporting infrastructure. The temporary suspension of mining production could result in reduced employment, sales receipts, royalty payments, and income. However, cleanup efforts and repair work would take longer and contribute to economic activity in the short term, increasing some employment opportunities and expenditures. Employment from cleanup efforts would decline over time as response efforts wind down and transition into lower-intensity restoration work. The Village of Crooked Creek would be damaged, resulting in the displacement of much of the community and loss of economic activity until rebuilding of the community could begin. The larger spill release would also likely result in greater and longer impacts on non-mining economic sectors like tourism, recreational fishing, and commercial fishing. With a larger spill, there may be increased concern over the safety of consuming species from the Kuskokwim River, and long-term economic impacts may be realized in part depending on the persistence of public perception regarding impacts to fish and wildlife resources.

4.18.1.3 2026 SEIS Scenario – 13.3 Percent Scenario

Impacts from the 13.3 percent scenario would be the same as those described for the smaller spill scenarios, except that the duration and magnitude of impacts may increase and more downstream communities may be affected. The suspension of mining production activities would last longer, resulting in greater loss of employment, sales receipts, royalty payments, and income. However, cleanup efforts would also take longer and contribute to more economic activity in the short term compared with the smaller spill scenarios. The Village of Crooked Creek would be more severely damaged, resulting in the displacement of much of the community and loss of economic activity until rebuilding of the community could begin. Increased short- and long-term impacts would also likely be realized in non-mining economic sectors such as tourism, recreational fishing, and commercial fishing.

4.18.1.4 2026 SEIS Scenario – 27 Percent Scenario

Impacts from the 27 percent scenarios (both normal hydrologic conditions and 100-year flood conditions) would be the same as those described for the smaller spill scenarios, except that the duration and magnitude of impacts may increase and more downstream communities may be affected. The Donlin Gold Project represents a key economic driver for the region. Under the 27 percent spill scenario, financing the extensive response and remediation efforts and TSF Main Dam repairs would fundamentally undermine the economic viability of the Donlin Gold Project. Consequently, mining production operations may cease permanently, forcing the mine to transition to its closure phase early. The closure of the mine would result in significant reductions in employment, sales receipts, royalty payments, and income. Early closure prompted by a major tailings release would produce socioeconomic impacts comparable to those of the planned Closure Phase described in Section 3.18.2.2.1 of the 2018 EIS. The magnitude of the economic effects would vary depending on the specific time period within the operational phase that closure occurs. Cleanup efforts and repair work would also take longer and contribute to greater economic activity in the short term compared with the smaller spill scenarios. Crooked Creek would be more severely damaged, resulting in the displacement of the community and loss of economic activity until rebuilding of the community could begin. Damage to infrastructure and communities under a baseline 100-year flood event (i.e., without a spill release) would naturally be substantial and catastrophic in certain areas. The combination of the 100-year flood event and the 27 percent release would cause downstream water levels to rise by 0.2 to 0.7 feet above baseline 100-year flood conditions, potentially contributing to minor additional incremental damage to infrastructure in communities. Greater short- and long-term impacts would also likely be realized in non-mining economic sectors like tourism, recreational fishing, and commercial fishing compared with the smaller spill scenarios.

4.18.2 SUBSISTENCE ECONOMY

In ANILCA Title VIII, the federal statute protecting subsistence practices of rural Alaska, Section 810 requires a review, by federal land managers of lands to which ANILCA applies, of the potential for federal land management activities to "significantly restrict" subsistence uses and needs. During the development of the 2018 EIS, the BLM prepared a formal ANILCA Section 810 analysis for all related actions that are connected to the pipeline right-of-way authorization. An update to the Section 810 analysis has been prepared to include the larger spill scenarios presented in this SEIS. The updated ANILCA 810 analysis is provided in Appendix C.

The ongoing decline of salmon returns and the resulting fishing closures have had a negative impact on subsistence harvests on the Kuskokwim River. It is likely that substitution of other resources such as non-salmon fish or land mammals is necessary along with increased reliance on store-bought food. Additionally, the continued reduction of the Mulchatna caribou herd and the resulting hunting closures have practically eliminated subsistence use of caribou.

These impacts on subsistence resources and practices, although more severe than at the time of the 2018 EIS, were not unforeseen. The 2018 EIS documented the declining abundance and subsistence harvest of Chinook salmon on the Kuskokwim River, recognized the vulnerability of regional subsistence systems to continued salmon population variability, and noted the declining local availability of the Mulchatna caribou herd and its effects on subsistence use. The 2018 EIS further acknowledged that the future trajectory of both resources was uncertain and that subsistence communities might need to adapt harvest practices in response.

A potential spill of tailings would directly affect subsistence resources and may displace access to those resources, including a reduction in targeted fish population abundance; proportional reductions in availability to communities closer to the source of the spill; and reduced access while remediation efforts are completed. Spills would also indirectly affect competition for those resources, since reduced abundance and availability of affected resources might have to serve the needs of a constant-sized user group. Sociocultural impacts to subsistence would be the same as described for Alternative 2 in the 2018 EIS. For this reason, the analysis of spill scenarios will focus on the effects to subsistence resources.

4.18.2.1 Summary of Impacts from 2018 EIS Scenario – 0.5 Percent Scenario

The intensity of direct displacement in the summer tailings and contaminated water event would vary by community and response and cleanup effort and would disturb or displace access to a small area of the subsistence use area for generally abundant species. However, any spill of hazardous materials into Crooked Creek would raise concerns among subsistence users about contamination of fish in Crooked Creek and beyond, including salmon returning to spawn in the drainage and resident species. In this case, the intensity of this indirect impact on subsistence activities would be higher.

The winter spill event scenario would directly affect winter subsistence uses in Crooked Creek and in the Kuskokwim River near the confluence with Crooked Creek. Subsistence users from Crooked Creek access the drainage in winter, traveling by snow machine for trapping and for bear in spring. A spill event would impede this access, and hunters would probably go to other areas. The greatest effect would be the indirect impact of perceived contamination of subsistence resources near the spill event, but effects could also extend to confidence in any subsistence resources that pass through the spill zone. This may include resident fish species used by many communities. As a result, the impacts would be acute or obvious/abrupt and extend across subregions or throughout the EIS analysis area.

The partial tailings dam failure scenario would have direct effects, but the indirect effects of perceived contamination of subsistence foods would be acute or obvious/abrupt and extend across subregions or throughout the EIS analysis area. The duration of perceived contamination would likely extend for 1 to 3 years for most subsistence fishers, and the context includes resources that are highly valued or of high cultural importance. Valued resources affected include Essential Fish Habitat and the Kuskokwim River Chinook salmon stock, while the subsistence harvest practices of the affected villages are of high cultural importance. The greatest effect would be perceived contamination of subsistence fish resources, and this would likely extend to subsistence fishing communities up and down the entirety of the Kuskokwim River.

4.18.2.2 2026 SEIS Scenario – 5.4 Percent Scenario

Impacts from the 5.4 percent scenario would be similar to those described for the 0.5 percent scenario, although the magnitude, duration, and extent would be larger. Subsistence tools and infrastructure (such as boats, fish wheels, smoke houses, and drying racks) may be impacted or lost in Crooked Creek and other downstream communities. Inundation on the shoreline of Crooked Creek and Anaconda Creek by tailings would impact the abundance and availability of berries, and the vegetation may take years to decades to recover or may not recover at all, depending on depth of burial, level of contamination, and success of remediation efforts (refer to Section 4.10, Vegetation). Impacts to fish, waterfowl, and furbearers could severely impact the abundance and availability of these subsistence resources available for harvest on Crooked Creek. Salmon spawning areas in the Anaconda and Crooked Creek drainages would be heavily impacted (refer to Section 4.13, Fish and Aquatic Resources), which would affect subsistence harvest in those areas for a few years or more until stream ecosystem processes recover sufficiently to support successful spawning, egg incubation, and rearing of juveniles. There could be some bioaccumulation of metals from fish and mammals in the Anaconda and Crooked Creek drainages for months to years. Perceived contamination of resources may last longer. Tailings deposition as well as response and restoration activities could impede shoreline river access to subsistence resource areas for moose, black bear, and berries along Crooked Creek, the Kuskokwim River, and some smaller drainages on the Kuskokwim River. The Village of Crooked Creek would experience contamination from impacts to the drinking water supply until the tailings are cleaned up (see Section 4.6.2, Groundwater Hydrology), although perception of contamination could persist much longer.

4.18.2.3 2026 SEIS Scenario – 13.3 Percent Scenario

Impacts to the abundance and availability of subsistence resources from the 13.3 percent scenario would be the same as those described for the 0.5 percent scenario, although the magnitude, duration, and extent would be larger as the inundation area increases, and impacts to vegetation, fish, and wildlife become more severe and last longer (refer to Section 4.10, Vegetation, Section 4.12, Wildlife and Section 4.13, Fish and Aquatic Resources). The potential for the bioaccumulation of metals would be more likely under this scenario considering the increased deposition, larger area impacted, and challenges with remediation. Impacts would be most severe on Crooked Creek and its tributaries, although some habitat along the Kuskokwim River would be impacted. Tailings deposition as well as response and restoration activities could impede shoreline river access to subsistence along Crooked Creek, Kuskokwim River, and some smaller drainages on the Kuskokwim River.

4.18.2.4 2026 SEIS Scenario – 27 Percent Scenario

Impacts from the 27 percent scenario under normal hydrologic conditions would be the same as those described for the smaller spill scenarios, although the magnitude, duration, and extent would be larger as the inundation area increases, and impacts to vegetation, fish, and wildlife would be more severe and last several years longer (refer to Section 4.10, Vegetation, Section 4.12, Wildlife and Section 4.13, Fish and Aquatic Resources). Impacts would be most severe on Crooked Creek and its tributaries, although fish populations and habitat along the Kuskokwim River would also be impacted. The potential for the bioaccumulation of metals would be more likely under this scenario on both Crooked Creek and portions of the Kuskokwim River near the confluence with Crooked Creek. Tailings deposition as well as response and restoration activities could impede shoreline river access to subsistence resources could be impacted along Crooked Creek, the Kuskokwim River, and some smaller drainages on the Kuskokwim River. Impacts to fish populations could severely impact the abundance and availability of subsistence resources available for harvest on Crooked Creek and the Kuskokwim River. These impacts would be expected to result in long-term changes to the composition and structure of plant communities as described in Section 4.10, Vegetation. These changes would have substantial impacts on subsistence resources, such as berries and other edible plants. Many subsistence plants, including blueberries, low-bush cranberries, and other edible species, thrive in specific soil and vegetation conditions that may be disrupted by tailings deposition. The burial of these plants and the alteration of soil chemistry could reduce their availability in the short and long term. Additionally, the slow recovery of vegetation in heavily impacted areas may result in a prolonged loss of access to these resources.

Under the 100-year flood scenario, impacts would be similar to normal hydrological conditions. The incremental impacts of a tailings spill would raise water levels between 0.2 and 0.7 feet above 100-year baseline flood conditions downstream on the Kuskokwim River. This increase in water levels would be expected to cause minor additional impacts on infrastructure and habitat resources important for subsistence activities. The increased flow during flood conditions would more greatly dilute any tailings contaminants, potentially reducing the risk of bioaccumulation.

The changes in vegetation would also alter wildlife habitat, which is closely tied to subsistence hunting, trapping, and fishing. The loss of forested areas and the shift to shrublands, meadows, and wetlands would change the availability and quality of habitat for many species that are important for subsistence, such as moose, caribou, and waterfowl. While some species that thrive in early successional habitats may benefit in the long term, the slow pace of natural recovery and the potential for large areas to remain unvegetated for decades exist. For a more detailed analysis of the potential impacts on wildlife and habitat, refer to Section 4.12, Wildlife.

4.19 CULTURAL RESOURCES

4.19.1 SUMMARY OF IMPACTS FROM 2018 EIS SCENARIO – 0.5 PERCENT SCENARIO

A partial tailings dam failure spill scenario would impact cultural resources if tailings were carried to a cultural resource site or response efforts with ground-disturbing activities occurred near cultural resources. The spill scenario could affect sites near the Mine Site and potentially along the Kuskokwim River, and resources may not be anticipated to return to previous levels even after the actions that caused the impacts ceased. The probability of ground-disturbing cleanup activities occurring at cultural resource sites is low due to the dispersed geographical distribution of sites downstream of the tailings dam. Impacts would occur in a discrete geographic area but could affect rare cultural resources within the region.

Given the significant geographic extent, it is not possible to identify specific cultural resources that could be affected by a potential partial tailings dam failure. The probability of partial tailings dam failure requiring ground disturbance cleanup within the bounds of cultural resource sites is very low. If the failure occurred outside of cultural resource areas, there could be no impacts to cultural resources. The Corps and other parties executed a Programmatic Agreement to manage historic properties' identification, evaluation, and effects assessment. Pursuant to that Programmatic Agreement, Donlin developed a Cultural Resource Management Plan that contains, among other things, standard mitigation options, and an inadvertent discovery plan. Any effects to cultural resources outside of the Programmatic Agreement or Cultural Resource Management Plan would be handled in accordance with applicable post-review discovery regulations.

4.19.2 2026 SEIS SCENARIO – 5.4 PERCENT SCENARIO

Impacts from the 5.4 percent scenario would similar to those described for the 0.5 percent scenario. The probability of ground-disturbing cleanup activities occurring at cultural resource sites is higher than for the 0.5 scenario because more of the Crooked Creek watershed and the Kuskokwim River shoreline may be impacted.

4.19.3 2026 SEIS SCENARIO – 13.3 PERCENT SCENARIO

Impacts from the 13.3 percent scenario would be the same as those described for the 5.4 percent scenario, except that the probability of ground-disturbing cleanup activities occurring at cultural resource sites would be higher because more of the Crooked Creek watershed and the Kuskokwim River shoreline may be impacted.

4.19.4 2026 SEIS SCENARIO – 27 PERCENT SCENARIO

Impacts from the 27 percent scenarios (both normal hydrologic conditions and 100-year flood conditions) would be the same as those described for the 13.3 percent scenario, except that the probability of ground-disturbing cleanup activities occurring at cultural resource sites would be higher because more of the Crooked Creek watershed and Kuskokwim River shoreline may be impacted. Under 100-year flood conditions, the spill would raise downstream water levels on the Kuskokwim River by 0.2 to 0.7 feet, potentially causing additional minor erosion and disturbance to cultural sites above baseline flood conditions.

4.20 HUMAN HEALTH

A spill of tailings could cause stress to community members in close proximity from real or perceived risks of contamination and potentially impact human health. Any of the spill scenarios would create anxiety about the safety of subsistence foods and water quality from potential contamination. Quick response and containment of spills (particularly for spills in water) and testing of water and subsistence food resources for contamination would be essential to protecting human health and informing subsistence users about the safety of harvested resources.

4.20.1 SUMMARY OF IMPACTS FROM 2018 EIS SCENARIO – 0.5 PERCENT SCENARIO

If a release occurred in summer, drinking water in Crooked Creek and other communities closest to the Mine Site could be adversely impacted if a release infiltrated subsurface materials. Perceived contamination of subsistence foods would be acute or obvious/abrupt and extend throughout the EIS analysis area. A tailings release in winter could impede snowmachine travel by subsistence hunters from Crooked Creek.

The cleanup and remediation activities following a tailings dam failure in which water and tailings are released into the environment would temporarily increase employment opportunities and expenditures in the Y-K region. Labor requirements would be especially high if mechanical recovery and physical removal were part of the remediation effort, such as in the case of a tailings and water release in winter. Employment increases for cleanup activities would be short-term (1 to 12 months). There would be adverse impacts on employment, income, and sales if commercial fishing or sport fishing and related tourism were to decline due to the real or perceived impacts of a spill. Water contamination could also create drinking water bans, which would also negatively impact local businesses and consumers.

Potential adverse impacts could include psychosocial stress resulting from community anxiety over a tailings dam release and exposures to potentially hazardous materials. Subsistence may be impacted, with potential perceptions of subsistence food contamination that extend throughout the EIS analysis area. Impacts would vary in duration, be limited to the area of the spill, and would vary in intensity depending on the season, volume, and content of a spill's release.

4.20.2 2026 SEIS SCENARIO – 5.4 PERCENT SCENARIO

Impacts from the 5.4 percent scenario would be similar to those described for the 0.5 percent scenario, although the magnitude, duration, and extent would be larger, including increased inundation and depth of tailings burial. Contamination of subsistence foods and bioaccumulation would be acute along the Anaconda and Crooked Creek drainages; perceived contamination of subsistence foods would extend throughout the EIS analysis area, especially to downstream communities on the Kuskokwim River. The Village of Crooked Creek would also experience contamination from impacts to the drinking water supply until the tailings are cleaned up (see Section 4.6.2), although perception of contamination could persist much longer.

Under this scenario, in the Village of Crooked Creek, the Front Street boat ramp, the power plant boat ramp, parts of the airstrip, the bridge over the Crooked Creek waterway, and associated access roads would be inundated and buried, as well as several residences on the shoreline. Deposition could be 3 to 10 feet deep in some areas. This would impact public safety and the ability for the community to safely evacuate in the event of a release. Residents who lose their homes would be displaced. There would be a potential for loss of life, particularly near the tailings facility where the wave would be the highest and most intense, but also in the Village of Crooked Creek. Although some structures would see inundation in Upper Kalskag and Lower Kalskag, access for evacuation would not be impeded. Donlin Gold would be required by the Alaska Dam Safety Program (ADSP) to prepare a publicly available EAP to prevent and minimize loss of life and property downstream of the tailings dam by identifying potential emergency conditions and detailing specific, coordinated responses. An EAP would include notification flowcharts that cover non-failure, potential failure, and imminent or action failure situations. There would be primary notifications for emergency initiators and for downstream residents within the inundation area, and secondary and tertiary notifications. The EAP would also outline response actions and steps to ensure the safety of mine employees and any other people in the inundation area, including evacuation of downstream residents.

4.20.3 2026 SEIS SCENARIO – 13.3 PERCENT SCENARIO

Impacts from the 13.3 percent scenario would be the same as those described for the 0.5 and 5.4 percent scenarios, although the magnitude, duration, and extent would be larger and inundation would be deeper. The potential for the bioaccumulation of metals would be more likely under this scenario considering the increased deposition, larger area impacted, and challenges with remediation. More structures and access roads would be inundated in Crooked Creek, causing a greater impact to public safety. Deposition could be 3 to 30 feet deep in some areas, and it is likely that the Village of Crooked Creek would no longer be habitable. In other communities, no structures would be inundated and access to air evacuation would not be impeded. The potential for loss of life would be increased in the Village of Crooked Creek and near the tailings facility, where the wave would be higher and more intense than under the 5.4 percent scenario.

4.20.4 2026 SEIS SCENARIO – 27 PERCENT SCENARIO

Impacts from the 27 percent scenario under normal hydrologic conditions would be the same as those described for the 0.5, 5.4, and 13.3 percent scenarios, although the magnitude, duration, and extent would be considerably larger, with increased inundation and tailings burial depths. More structures and access roads would be inundated in Crooked Creek and the airstrip would be fully inundated, causing a substantial impact to public safety. Deposition of mine tailings could be 10 to 30 feet deep, and it is likely that the community of Crooked Creek would no longer be habitable. In other communities, no structures would be inundated and access to air evacuation would not be impeded. The potential for loss of life would be increased in the Village of Crooked Creek and near the tailings facility, where the wave would be higher and more intense than under the 13.3 percent scenario. The potential for the bioaccumulation of metals would be more likely under this scenario on both Crooked Creek and portions of the Kuskokwim River near the confluence with Crooked Creek.

Under the 100-year flood scenario, more structures and access roads would be inundated in Crooked Creek and the airstrip would be fully inundated, causing a substantial impact to public safety. Inundation of water and tailings could be over 30 feet deep in places, and it is likely the community of Crooked Creek would no longer be habitable. Downstream communities would only see an incremental increase in water depth of 0.2 to 0.7 feet above baseline 100-year flood conditions downstream on the Kuskokwim River. Additional incremental flooding impacts due solely to the tailings spill itself would be minor compared to impacts from the baseline 100-year flood. Some residential structures would be impacted in Georgetown, Napaimute, Aniak, Upper Kalskag, and Lower Kalskag which may lead to displacement, depending on structural damage. Access to air evacuation may be impeded from some areas in Aniak and Lower Kalskag but would not be impeded in other communities. The potential for loss of life would be increased in the Village of Crooked Creek and near the tailings facility, where the wave would be higher than the 13.3 percent scenario and more intense. The potential for the bioaccumulation of metals would be less likely under 100-year flood conditions because tailings contaminants would be much more diluted by the greater volume of flow on the Kuskokwim River. However, while more diluted, the suspended tailings would be much more disbursed across floodplains downstream on the Kuskokwim River.

4.21 TRANSPORTATION

4.21.1 SUMMARY OF IMPACTS FROM 2018 EIS SCENARIO – 0.5 PERCENT SCENARIO

A partial tailings dam failure would have a limited impact on air transportation, which would likely see a slight increase in air traffic related to spill response and monitoring efforts. There would be impacts to surface transportation in the vicinity of the tailings dam, and impacts would depend on sediment deposition and possible flooding of surrounding land. If excavation and earthmoving equipment from the Mine Site were part of recovery efforts, these vehicles could dominate surface travel in the vicinity. The Mine Site would have restricted access and employees would typically be flown into work; there is a limited level of surface transportation that could potentially be disrupted in communities downstream of the tailings dam.

A partial tailings dam failure would impact water travel on Crooked Creek and Anaconda Creek, and may impact water travel on the Kuskokwim River. Depending on the volume and trajectory of materials released in the event of a partial tailings dam failure, vessels could be displaced or could have to find alternate routes until the spill response was complete on affected waterways. If a partial tailings dam failure occurred in winter, snowmachine travel along frozen waterways would be impacted. Impacts to water transportation would be medium intensity, with the potential to be high intensity for Crooked Creek. The area in the vicinity of the tailings dam is roadless, and water transportation is thus considered an important resource. In terms of intensity, impacts would result in noticeable disturbance or displacement of transportation access, mode, or traffic levels. The extent or scope of impacts would be realized by communities within a subregion and persist briefly during the spill event. Impacts would primarily affect travel along small waterways close to the tailings dam and a segment of the Kuskokwim River.

4.21.2 2026 SEIS SCENARIO – 5.4 PERCENT SCENARIO

Impacts from the 5.4 percent scenario would be similar to those of the 0.5 percent scenario. Portions of the Crooked Creek air strip would be inundated, potentially restricting air transportation to and from the community. There would be impacts to surface transportation in the vicinity of the tailings dam, along Crooked Creek, and in the community of Crooked Creek if excavation and earthmoving equipment from the Mine Site were part of recovery efforts. Most of the major roads would be partially buried by tailings, in thicknesses of between several feet up to almost 30 feet in depth, and the bridge over the Crooked Creek waterway would likely be washed out or otherwise unusable. There would be noticeable disturbance or displacement of water transportation access, mode, and traffic levels on Crooked Creek. At the Angyaruaq

(Jungjuk) port site, there would be less than 10 feet of flooding of port infrastructure along the river.

4.21.3 2026 SEIS SCENARIO – 13.3 PERCENT SCENARIO

Impacts from the 13.3 percent scenario would be the same as those described for the 5.4 percent scenario, except that there would be increased impacts to surface transportation, air travel, and water travel from evacuation efforts because roads in Upper Kalskag would also be impacted. Deposition in Crooked Creek could be 3 to 30 feet deep in some areas, and it is likely that the community would no longer be habitable. At the Angyaruaq (Jungjuk) port site, there would be 10 to 20 feet of flooding of port infrastructure along the river.

4.21.4 2026 SEIS SCENARIO – 27 PERCENT SCENARIO

Impacts from the 27 percent scenario under normal hydrologic conditions would be the same as those described for the 13.3 percent scenario, although the magnitude, duration, and extent would be considerably larger, with increased inundation and tailings burial depths. More structures and access roads would be inundated in Crooked Creek, and the airstrip would be fully inundated. In other communities, access to airstrips would not be impeded. At the Angyaruaq (Jungjuk) port site, there would be 10 to 20 feet of flooding of port infrastructure along the river.

Under the 100-year flood scenario, there would be increased impacts to surface transportation, because roads in more communities would be affected, such as Napaimute, Upper Kalskag, Lower Kalskag, and Aniak. Downstream communities on the Kuskokwim River would see an incremental increase in water depth of 0.2 to 0.7 feet above baseline 100-year flood conditions due to the spill. Flooding impacts solely due to the spill would be minor compared to impacts from the baseline 100-year flood event. Access to airstrips may be impeded from some areas in Aniak and Lower Kalskag but would not be impeded in other communities. Water transportation would be impacted by increased water depth and flow in the Kuskokwim River for all communities. At the Angyaruaq (Jungjuk) port site, more port infrastructure would experience flooding, up to 30 feet along the river, which would likely make the port unusable.

4.22 IMPACT-REDUCING MEASURES

Numerous state, federal, and local government permits and approvals are required before development and operation of a mining project in Alaska can begin (refer to Section 1.7, Section 5.3, and Appendix AA of the 2018 EIS for details on regulatory requirements for the Donlin Gold Project). The TSF Main Dam is subject to regulation by ADNR through the ADSP, which reduces the likelihood of dam failure and associated releases through enforceable design standards, independent technical review, and lifecycle oversight. ADNR approval is required for each stage of dam management: construction, operation, modification, and closure. A detailed explanation of that regulatory framework is provided in Chapter 3.24.1.5 of the 2018 EIS; the following summarizes the regulatory framework applicable to those activities and provides compliance status updates since 2018.

To secure a certificate of approval for construction and operation, an applicant must demonstrate that the dam will be designed, constructed, operated, maintained, and closed in accordance with the Alaska Dam Safety Regulations (11 Alaska Administrative Code 93) and guidelines, which address hydrology, hydraulics, slope stability, seepage, cold-region conditions, and seismic performance. Notably, as a Class I facility, the Donlin TSF must withstand an Operating Basis

Earthquake with a return period of 150 to greater than 250 years, and a Maximum Design Earthquake with a return period of 2,500 years up to the Maximum Credible Earthquake. These standards are intended to ensure that the TSF is engineered to perform under severe hydrologic, geotechnical, and seismic conditions rather than average or typical conditions, substantially reducing the probability of overtopping, slope failure, or uncontrolled seepage.

The pre-construction dam safety certification process is a multi-step, multi-year technical review in which applicants submit detailed information on site conditions, engineering designs, and proposed construction and operating practices. ADSP evaluates that information at successive stages before approval is granted. ADSP reviews preliminary design packages before detailed design proceeds, ensuring that fundamental decisions—including facility siting, foundation treatment, embankment geometry, and spillway configuration—are evaluated and approved before significant engineering resources are committed, reducing the likelihood that critical safety issues are deferred or overlooked. Independent technical scrutiny at each stage provides a check on the applicant's engineering separate from the project proponent's own quality assurance processes. Construction-level drawings and specifications are reviewed at the final stage, and if ADSP determines that all requirements have been met, it issues a construction permit that typically includes specific conditions, limitations, and stipulations governing the safety and performance of the dam.

In addition to the pre-construction certification process, ADSP requires dam owners to prepare and maintain an EAP that establishes procedures for detecting and responding to potential or actual dam safety emergencies. The EAP must include notification flowcharts covering non-failure, potential failure, and imminent or action failure situations; procedures for emergency detection, evaluation, and classification for each of those situations; procedures for emergency and remedial response, including how response would vary between winter and summer conditions; inundation maps based on dam break analyses identifying downstream areas at risk; and plans for training, exercising, updating, and posting the EAP. The EAP is subject to ADSP review and must be kept current to ensure operational readiness.

The regulatory framework described above helps to ensure that any dam failure or release at Donlin, of whatever size or intensity, is extremely unlikely to occur in the first place.

Donlin Gold has been working with ADSP on the design of the Donlin TSF since 2013. In 2024, Donlin Gold submitted the preliminary design packages for the certification to ADNR. Following reviews and coordination with ADNR, potential issuance of the certificate is projected for 2028. These regulatory and planning requirements, along with Donlin Gold's design features specific to the TSF (discussed in Section 1.1 above and Table 4.22-1 below), TSF monitoring and adaptive management measures in progress (Table 4.22-2), and the many other design features and other mitigation measures to which Donlin has committed (2018 EIS, Chapter 5, Table 5.2-1 and joint record of decision) would establish Project design, operation, cleanup activities, remediation activities, and restoration activities in a manner consistent with applicable laws and regulations, and would help avoid and/or minimize impacts from a tailings spill. Numerous design features would be implemented to ensure protection of resources during the mine's construction and operation. For example, there are several design features identified in the 2018 EIS and required by the joint record of decision that would minimize the effects of the Project on subsistence (e.g., A12, A13, A14, A19, A23, A31, M2, M11, M13, M14, M21, M38, T1, T3, T6, T9, T10, T14, T17).

Specific equipment and supplies needed to respond to spill scenarios would be outlined in the EAP. Erosion and sediment control measures and other best management practices would be employed during a tailings spill response to minimize impacts during cleanup efforts.

Table 4.22-1: TSF Design Features Relevant to Minimizing Spill Likelihood and Impacts

I.D.	Design Feature Description	Project Phase(s)	Resource(s) Affected
A21	Donlin Gold would develop an Operations and Maintenance Plan/Manual; Health, Safety, and Environment Plan (including a Safety Plan/Program); and other plans that would outline safety measures that would be implemented during Operations.	Operations	Human Health Pipeline Reliability and Safety
A26	Monitoring activities of the Waste Rock Facility (WRF) and tailings dam would be conducted to include water quality, biological resources, and vegetation. In addition, all dams on site would be monitored for mass stability to detect potential movement.	Construction Operations Closure Post-Closure	Surface Water Hydrology Water and Sediment Quality Geology (Mass Stability) Fish and Aquatic Resources Wetlands Vegetation Spill Risk
A30	A Cultural Resource Management Plan (CRMP) for the management of cultural and paleontological resources on BLM, State, and private land will be prepared and implemented for the project. The plan would prescribe an effective process for managing potential effects on these resources, and ensure that agreed-upon and approved procedures are established. At a minimum, the plan would include training of workers regarding cultural resource issues and responsibilities; measures to avoid or minimize impacts to cultural resources (e.g., flagging, monitoring); standard protocols for any known cultural resources that may be exposed during project construction, operations, and cleanup activities, remediation activities, restoration activities; prescribed actions to be taken in the event that unanticipated cultural resources are discovered, or known resources are impacted in an unanticipated manner; and protocols for treatment of any discovered human remains. (Note: a draft CRMP was included in the 2018 EIS as an appendix of Programmatic Agreement in Appendix Y).	Pre-Construction	Cultural Resources
M6	The TSF and water dams will be designed using rockfill, bedrock foundations, multiple filter zones, liners, and downstream construction methods to address seismic hazards, static stability, and seepage concerns. This aligns with specific Mount Polley Independent Review Panel recommendations for Best Applicable Practices (BAP) for tailings retention dam design. Final design would be reviewed by ADNR Dam Safety and subject to change as needed to protect life and property.	Construction Operations Closure	Soils Geohazards and Seismic Conditions Spill Risk
M8	The TSF will include a relatively flexible, textured geomembrane liner (60 mil or 1.5 mm) that is expected to withstand freezing temperatures, sharp rocks, and anticipated settlement scenarios with an appropriate factor of safety and to minimize impacts from porewater seepage on groundwater quality.	Construction Operations Closure Post-Closure	Soils Water Quality Fish and Aquatic Resources

I.D.	Design Feature Description	Project Phase(s)	Resource(s) Affected
M9	The project design will include features to limit permafrost impacts at the Mine Site such as excavation to bedrock beneath large structures where needed, such as the TSF abutment and foundation of the WRF. Final design would be reviewed by ADNR Dam Safety and subject to change as needed to protect life and property.	Construction	Soils Spill Risk
M13	Water management planning at the Mine Site would assist in controlling the flow of groundwater at the pit and other major facilities (WRF, TSF), as well as controlling the potential effects of groundwater flow on water quality downgradient of the mine. This would be accomplished through design elements such as dewatering wells, collection of groundwater infiltration through and around the TSF at the SRS pond, and lake level maintenance following closure. A variety of groundwater monitoring activities would also be planned (e.g., SRK 2016).	Operations Closure Post-Closure	Surface Water Hydrology Groundwater Hydrology Water Quality Fish and Aquatic Resources Subsistence
M15	The project design at the Mine Site includes water management strategies that would maintain flow and storage in the design capacity of structures, provide flexibility for extra storage in high precipitation years, provide sufficient water supplies for processing in low precipitation years, and minimize storage if not needed through water treatment and discharge.	Operations	Soils Surface Water Hydrology Water Quality Fish and Aquatic Resources Climate Change
M16	The project design includes stream flow monitoring and dam inspections (SRK 2016) and monitoring to continually provide data for water management and dam safety purposes.	Operations	Soils Surface Water Hydrology
M17	Contact water would be collected and reused or treated and discharged. As applicable to the TSF, this process of minimizing water content of the TSF facility is aligned with specific recommendations of the Mount Polley Independent Review Board for application of Best Available Technology (BAT) and Best Applicable Practice (BAP) in TSF design and management.	Construction Operations Closure	Water Quality Fish and Aquatic Resources
M21	The mine plan incorporates the concept of design for closure. This incorporates methods for safe and efficient closure of the mine as an integral part of the planned mine design and operations. Implementing design for closure can have the effect of minimizing disturbance and the re-handling of materials.	Closure	Geology Soils Surface Water Hydrology Water Quality Vegetation Wetlands Fish and Aquatic Resources Socioeconomics

I.D.	Design Feature Description	Project Phase(s)	Resource(s) Affected
M22	At the completion of contouring of the WRF and TSF, a layer of unconsolidated material from the North and South overburden stockpiles will be spread over the surface that will be overlain with an additional layer of growth media (topsoil and overburden). This material would be tested to ensure it is non-Potentially Acid Generating (PAG). The WRF would be designed to maximize concurrent cleanup, remediation, and restoration activities, minimize the effects of PAG materials, minimize infiltration and erosion, and promote controlled surface runoff and revegetation.	Closure	Geology Surface Water Hydrology Water Quality Fish and Aquatic Resources Vegetation
M25	Evaporative sprayers would be employed at the TSF to minimize the stored water volume. These could also be directed for use in tailings beach dust control.	Operations	Surface Water Hydrology Soils Air Quality
M26	Design of TSF liner includes allowance for differential settling due to permafrost and season.	Operations	Soils Water Quality Surface Water Hydrology Groundwater Hydrology
M27	During tailings consolidation in closure, excess porewater would be captured in a capillary rock layer over the TSF, report to the lined pond at the southeast corner of the TSF, and pumped along with runoff water via pipeline to the pit until Water Quality Standards (WQS) have been met. This process of minimizing water content of the TSF facility is aligned with specific recommendations of the Mount Polley Independent Review Board for application of Best Available Technology (BAT) and Best Applicable Practice (BAP) in TSF design and management. Final closure details would be described in an updated cleanup, remediation, and restoration activities, and closure plan and would be subject to approval by ADNR.	Closure	Water Quality Fish and Aquatic Resources Surface Water Hydrology Groundwater Hydrology
M37	Regular inspections and maintenance of the Seepage Recovery System (SRS) would be performed. Specific contingency/back-up plans would be in place, so that if failure of the SRS were to occur, the situation would be identified and response actions begun immediately.	Operations	Water Quality Fish and Aquatic Resources
M40	Design features for cyanide include cyanide detoxification of the leach tailings and cyanide handling, storage, and transport in compliance with the International Cyanide Management Code (ICMC).	Operations	Water Quality Wetlands Wildlife Fish and Aquatic Resources Spill Risk Human Health

I.D.	Design Feature Description	Project Phase(s)	Resource(s) Affected
–	**Extensive site characterization over two decades.** The TSF design has been informed by extensive site characterization carried out over a period of two decades, including 51 overburden boreholes, 25 diamond drillholes with cored rock, and 43 test pits completed within the dam footprint, with boreholes drilled up to approximately 500 feet below the existing ground surface. Poor site characterization was identified as a root cause of the Mount Polley and Los Frailes failures, where weak clay layers in soil foundations were not properly characterized; within the Donlin TSF Main Dam footprint, no such weak layers have been identified. The adequacy of the site investigations will be assessed by the ADNR as part of dam safety permitting.	Pre-Construction Construction Operations Closure Post-Closure	Geology Soils Surface Water Hydrology Water Quality Vegetation Wetlands Wildlife Fish and Aquatic Resources Sociocultural Human Health
–	**Bedrock foundation.** The dam footprint will be excavated to expose bedrock, and all soil and highly weathered bedrock that could be considered frost susceptible will be removed. The sound foundation, confirmed in the extensive site characterization, minimizes embankment deformations, reduces the potential for collapse, and enhances embankment stability under both static and seismic loading.	Pre-Construction Construction Operations Closure Post-Closure	Geology Soils Surface Water Hydrology Groundwater Hydrology Water and Sediment Quality Sociocultural
–	**Feasibility-level design to meet or exceed state and industry standards.** The dam has been designed at a feasibility level to meet or exceed State of Alaska and industry standards for stability under both static and seismic conditions. In 2026, the design is advancing at a detailed level considering the Global Tailings Review (2020), ICMM (2021), and ICOLD (2025) standards. The slope of the downstream face (1.7H:1V) and target factor of safety are more conservative than those documented at facilities that have experienced failures. The final design will be reviewed by ADNR's Dam Safety Program and is subject to change as needed to protect life and property.	Pre-Construction Construction	Geology Soils Surface Water Hydrology Groundwater Hydrology Water and Sediment Quality Sociocultural Human Health
–	**Phased, downstream construction method.** The TSF Main Dam will be raised in the downstream direction in seven construction campaigns beginning with a 198-foot starter dam, with raises approximately every 4 years. Downstream TSF main dams like that proposed for this project are significantly less likely to fail compared to centerline or upstream designs, and there has not been a failure of a TSF Main Dam built using the downstream design method in the United States for decades. The downstream raise method has failed at less than half the rate of upstream-raised dams, which are typically founded on previously deposited tailings materials.	Pre-Construction Construction Operations	Geology Soils Surface Water Hydrology Groundwater Hydrology Water and Sediment Quality Sociocultural Human Health

I.D.	Design Feature Description	Project Phase(s)	Resource(s) Affected
–	**Engineered embankment zone fills.** The dam embankment includes layers of bedding material, two filter materials, transition rockfill, and rockfill to protect against internal erosion and provide drainage in the event of dam seepage. These multiple filter zones address seismic hazards, static stability, and seepage concerns, consistent with Mount Polley Independent Review Panel recommendations for Best Applicable Practices for tailings retention dam design.	Pre-Construction Construction Operations	Geology Soils Surface Water Hydrology Groundwater Hydrology Water and Sediment Quality Sociocultural Human Health
–	**Flexible, cold-climate-rated geomembrane liner.** The TSF will include a relatively flexible, textured geomembrane liner (60 mil or 1.5 mm LLDPE) that acts as a low-permeability barrier to seepage and is expected to withstand freezing temperatures, sharp rocks, and anticipated settlement scenarios with an appropriate factor of safety. The tailings themselves will also become a low-permeability medium as they consolidate and densify over time, providing an additional barrier to seepage. The liner design also includes allowance for differential settling due to permafrost and season.	Pre-Construction Construction Operations	Soils Surface Water Hydrology Groundwater Hydrology Water and Sediment Quality Sociocultural Human Health
–	**Liner bedding and filter/transition layers.** Liner bedding and filter/transition layers separate the LLDPE liner from the rockfill. This layered system directs any leakage toward the underdrain network and SRS rather than allowing it to migrate undetected into the embankment or foundation.	Pre-Construction Construction Operations	Soils Surface Water Hydrology Groundwater Hydrology Water and Sediment Quality Sociocultural Human Health
–	**Use of competent rockfill.** The embankment will be entirely constructed of durable rockfill sourced from quarry or select mine rock, placed and compacted in lifts to a dense state. Based on ICOLD statistical data, far fewer failures have occurred worldwide for rockfill dams compared to earthfill dams, and in a benchmarking study of B.C. TSF main dam failure frequency, IEEIRP (2015) found no failures of rockfill dams out of 525 dam-years of active operation for U.S. water dams.	Pre-Construction Construction Operations	Soils Surface Water Hydrology Groundwater Hydrology Water and Sediment Quality Sociocultural Human Health
–	**Underdrain network.** A rockfill underdrain network will be constructed beneath the geomembrane liner within the lined impoundment and at the full width of the base of the TSF Main Dam. The underdrain serves to convey groundwater and potential leakage through the geomembrane liner across the base of the embankment, lowering the phreatic level within the embankment and increasing embankment stability.	Pre-Construction Construction Operations	Surface Water Hydrology Groundwater Hydrology Water and Sediment Quality Sociocultural Human Health

I.D.	Design Feature Description	Project Phase(s)	Resource(s) Affected
–	**Seismic design for maximum credible earthquake.** For the final detailed design, the seismic stability of the embankment will be evaluated based on a site-specific seismic hazard assessment and designed for the maximum credible earthquake or 10,000-year return period event. The Donlin Gold TSF will be designed to withstand seismic loads that were determined based on that site-specific assessment, which is more stringent than many of the facilities that have experienced failures historically.	Pre-Construction Construction Operations Closure Post-Closure	Surface Water Hydrology Groundwater Hydrology Water and Sediment Quality Sociocultural Human Health
–	**Flood management and freeboard.** The TSF will be sized to store the 24-hour probable maximum precipitation plus snowmelt, and accounts for climate change projections. Non-contact water diversion channels will be constructed around the TSF perimeter to divert runoff from the Anaconda Creek catchment away from the facility, reducing the volume of water requiring management. The TSF Main Dam will maintain a minimum freeboard such that pond water cannot overtop the dam due to wave action even under elevated pond levels or extreme wind conditions. The TSF is also permitted for treatment and discharge of intercepted precipitation, providing an additional safeguard against overtopping, which is documented as the most frequently reported cause of tailings dam failures in the historical record.	Pre-Construction Construction Operations Closure Post-Closure	Surface Water Hydrology Groundwater Hydrology Water and Sediment Quality Sociocultural Human Health
–	**Tailings deposition plan.** The proposed tailings deposition plan is to create a tailings beach around the entire TSF perimeter, pushing the operating pond toward the center of the facility and away from the upstream face of the TSF Main Dam. This design approach reduces the hydraulic head on the liner and geomembrane, reduces the risk of overtopping, and is consistent with standard industry practice for managing pond proximity to the dam face.	Pre-Construction Construction Operations Closure Post-Closure	Surface Water Hydrology Groundwater Hydrology Water and Sediment Quality Sociocultural Human Health
–	**Seepage recovery system.** An SRS, composed of a containment pond and pumping wells, will be installed downstream of the TSF Main Dam to collect groundwater baseflows and possible leakage from the lined impoundment. It is intended to prevent TSF seepage from being discharged to the environment, with collected waters pumped back, reused, or treated and discharged. These wells will be monitored per the Monitoring Plan, and Donlin Gold is required to perform corrective actions if a leak is detected.	Pre-Construction Construction Operations Closure Post-Closure	Surface Water Hydrology Groundwater Hydrology Water and Sediment Quality Sociocultural Human Health
–	**Instrumentation and monitoring.** Instruments including vibrating wire piezometers, survey prisms, and slope inclinometers will be installed in the Starter Dam, with additional instruments added at each dam raise. Monitoring wells will be installed downstream of the SRS for groundwater quality testing. Continuous monitoring, review, and assessments of the water balance and available freeboard will be carried out throughout operations and closure to maintain adequate freeboard and mitigate against the potential of overtopping.	Pre-Construction Construction Operations Closure Post-Closure	Surface Water Hydrology Groundwater Hydrology Water and Sediment Quality Sociocultural Human Health

I.D.	Design Feature Description	Project Phase(s)	Resource(s) Affected
–	**Emergency pumping and water management capabilities.** Stockpiles of fine and coarse filter materials, as well as rockfill and transitional rockfill, will be kept in the vicinity of the dam to be readily available in an emergency to arrest or retard internal or external erosion and plug any erosion channels that may form on the dam crest or downstream face. Pumps will be on hand to lower the TSF pond level, using the reclaim system to divert water to the open pit for temporary storage. Donlin Gold will have the necessary equipment, material, labor, and engineering expertise already on site that could be deployed to respond to an emergency immediately.	Operations Closure Post-Closure	Surface Water Hydrology Groundwater Hydrology Water and Sediment Quality Sociocultural Human Health
–	**Dry closure.** During the closure phase, the operating pond will be pumped to the open pit to facilitate dry closure of the TSF. Tailings cover runoff will be diverted to Crevice Creek through the closure spillway, and the TSF cover will act as a growth medium for vegetation. Failure risk of TSF main dams with no ponded water after mine closure is small compared to dams in active operations with ponded water (IEEIRP 2015), and designing for dry closure from the outset specifically addresses this post-closure failure risk factor.	Closure Post-Closure	Surface Water Hydrology Groundwater Hydrology Water and Sediment Quality Sociocultural Human Health
–	**Independent Tailings Review Board and governance.** Risk-informed decision-making, continuous performance monitoring, independent review through an Independent Tailings Review Board (ITRB) and Dam Safety Reviews, and a commitment to the highest standard of tailings facility stewardship are embedded in the facility's governance plan. An ITRB was established for the Donlin Gold Project between 2007 and 2015, and restarted with new board members in 2024. Research indicates that improved practice and governance can each reduce the probability of failure by one order of magnitude, with two orders of magnitude reduction combined—none of the 20 TSF failure case studies reviewed by BGC had an ITRB established at the time of failure.	Pre-Construction Construction Operations Closure Post-Closure	Surface Water Hydrology Groundwater Hydrology Water and Sediment Quality Sociocultural Human Health

Source: Corps 2018; Donlin Gold 2026b

Table 4.22-2: TSF Monitoring and Adaptive Management Measures in Progress

Monitoring or Adaptive Management Measure Description	Resources(s) Affected	Anticipated Jurisdiction
Make the Emergency Action Plan for the tailings dam available to the public to review. Require a communication and alert system to be in place that is sufficient to warn people in Crooked Creek and boaters on the Kuskokwim near Crooked Creek of the potential need to move out of the area.	Spill Risk Dam Safety Human Health Geohazards and Seismic Conditions	ADNR
Include detailed contingencies to mitigate the risk of ice damage and liner leakage in the TSF in an updated tailings deposition plan during final design.	Geohazards and Seismic Conditions Water Quality	ADNR
Implement a Quality Assurance/Quality Control system using methods appropriate for the geomembrane type (e.g., TRI Environmental 2014), perform repairs prior to tailings placement, and update liner defect assumption in future WBM updates based on survey results and actual SRS flow and water quality data.	Groundwater Hydrology Water Quality	ADNR
Implement pertinent Best Applicable Practice (BAP) recommendations from the Mount Polley review panel for the TSF dam, design and tailings management, including participation in formalized tailings management program with audit functions, declaration of Quantitative Performance Objectives (QPOs) for tailings facility design and management, and use of independent tailings review boards.	Safety Geohazards and Seismic Conditions Water Quality	ADNR
During operation, the Failure Modes Effects Analysis (FMEA) should be reevaluated periodically, every 5 years, to ensure that the mine facility components, subcomponents, such as the TSF and dam, water dams, WRF, SRS, etc., are reviewed to identify all possible modes of failure, and their causes and effects as the mine develops, matures, and ages over the 27-year active mine life, and during post-closure.	Dam Safety Water Quality Fish	ADNR
Include internal drains in the TSF to reduce saturation in the tailings and make them less likely to liquefy in the event of a dam failure.	Water Quality	ADNR

Source: Donlin Gold 2026b

4.23 COMPARISON OF IMPACTS BY SCENARIO

Table 4.23-1 summarizes the resulting social, economic, physical, chemical, and biological impacts of the tailings spill scenarios analyzed in the SEIS. Resources that would have limited exposure are excluded from the summary table.

Table 4.23-1: Comparison of Impacts by Scenario

0.5 Percent Scenario	5.4 Percent Scenario	13.3 Percent Scenario	27 Percent Scenario
Soils			
Erosion. Anaconda Creek channel widened and deepened somewhat, particularly directly beneath the TSF dam.	**Erosion.** Anaconda Creek channel widened and deepened, particularly directly beneath the TSF dam. Additional soil erosion at the confluence of Anaconda and Crooked Creeks.	**Erosion.** The entire Anaconda Creek channel beneath the TSF dam would be widened and deepened. Substantial soil erosion at the confluence of Anaconda and Crooked Creeks.	**Erosion.** The entire Anaconda Creek channel beneath the TSF dam would be widened and deepened, with streambanks eroded away. Extreme soil erosion at the confluence of Anaconda and Crooked Creeks. Erosion would be more severe under flood stage conditions.
Burial. Soils in the path of the spill would be buried by deposited tailings. Duration of impact depends on speed and effectiveness of cleanup efforts.	**Burial.** Soils in the path of the spill would be buried by deposited tailings. Duration of impact depends on speed and effectiveness of cleanup efforts.	**Burial.** Soils in the path of the spill would be buried by deposited tailings. Duration of impact depends on speed and effectiveness of cleanup efforts.	**Burial.** Soils in the path of the spill would be buried by deposited tailings. Duration of impact depends on speed and effectiveness of cleanup efforts. Flood stage conditions would disperse tailings more widely.
Chemical. Immediate soil contamination from elevated metals and chemical residues present in tailings fluid. Potential for long-term soil contamination from acid and leached metals from any unrecovered tailings.	**Chemical.** Immediate soil contamination from elevated metals and chemical residues present in tailings fluid. Potential for long-term soil contamination from acid and leached metals from any unrecovered tailings.	**Chemical.** Immediate soil contamination from elevated metals and chemical residues present in tailings fluid. Potential for long-term soil contamination from acid and leached metals from any unrecovered tailings.	**Chemical.** Immediate soil contamination from elevated metals and chemical residues present in tailings fluid. Potential for long-term soil contamination from acid and leached metals from any unrecovered tailings. Flood scenario would dilute contaminants in the released material, but would allow flows to spread out where floodplains widen.
Cleanup. Recovery of spilled tailings would reduce potential for long-term soil contamination. Channel reconstruction would help to stabilize soils. All cleanup activities could temporarily disturb soils and remobilize spilled tailings.	**Cleanup.** Recovery of spilled tailings would reduce potential for long-term soil contamination. Channel reconstruction would help to stabilize soils. All cleanup activities could temporarily disturb soils and remobilize spilled tailings.	**Cleanup.** Recovery of spilled tailings would reduce potential for long-term soil contamination. Channel reconstruction would help to stabilize soils. All cleanup activities could temporarily disturb soils and remobilize spilled tailings.	**Cleanup.** Recovery of spilled tailings would reduce potential for long-term soil contamination. Channel reconstruction would help to stabilize soils. Flood stage conditions would cause impacts across wider area, increasing the cleanup area. All cleanup activities could temporarily disturb soils and remobilize spilled tailings.

0.5 Percent Scenario	5.4 Percent Scenario	13.3 Percent Scenario	27 Percent Scenario
Surface Water Hydrology			
Flood wave. Spill would cause maximum flow depths >20 feet along Anaconda Creek. No change to hydrology in the Kuskokwim River.	**Flood wave.** Spill would cause a flood wave of 40 to 70 feet in Anaconda Creek and maximum water depth of 20 to 40 feet along the length of Crooked Creek. No substantial change to hydrology in the Kuskokwim River.	**Flood wave.** Spill would cause a flood wave of 50 to 80 feet in Anaconda Creek and maximum water depth of 30 to 40 feet along the length of Crooked Creek. No substantial change to hydrology in the Kuskokwim River.	**Flood wave.** Spill would cause a flood wave of 90 to 100 feet in Anaconda Creek and maximum water depth of 30 to 50 feet along the length of Crooked Creek under both normal hydrological conditions and 100-year flood conditions. Elevated streamflow of 1 to 2 feet in Kuskokwim River.
Flooding in Village of Crooked Creek. No flooding predicted under this scenario.	**Flooding in Village of Crooked Creek.** Flooding near the confluence of Crooked Creek and the Kuskokwim River would cause water levels to rise about 20 to 30 feet across much of the village.	**Flooding in Village of Crooked Creek.** Flooding near the confluence of Crooked Creek and the Kuskokwim River would cause water levels to rise about 20 to 30 feet across much of the village.	**Flooding in Village of Crooked Creek.** Flooding near the confluence of Crooked Creek and the Kuskokwim River would cause water levels to rise about 30 to 40 feet across much of the village under both normal hydrological conditions and 100-year flood conditions.
Stream Morphology. Erosion of stream channel along upper reaches of Anaconda Creek. Deposition of tailings would cause temporary and minor changes to streambed along Crooked Creek.	**Stream Morphology.** Erosion of stream channel along upper reaches of Anaconda Creek. Deposition of tailings would cause temporary and minor changes to streambed along Crooked Creek.	**Stream Morphology.** Modification of stream channel from erosion along entire length of Anaconda Creek. Deposition of tailings would cause long-term changes to streambed along entire length of Crooked Creek downstream of spill.	**Stream Morphology.** Major modification of stream channel from erosion along entire length of Anaconda Creek under both normal hydrologic conditions and flood stage conditions. Deposition of tailings would cause long-term changes to streambed along entire length of Crooked Creek downstream of spill.
Cleanup. Recovery of spilled tailings and channel reconstruction would help stabilize stream morphology. Cleanup activities could remobilize spilled tailings.	**Cleanup**. Recovery of spilled tailings and channel reconstruction would help stabilize stream morphology. Cleanup activities could remobilize spilled tailings.	**Cleanup**. Recovery of spilled tailings and channel reconstruction would help stabilize stream morphology. Cleanup activities could remobilize spilled tailings.	**Cleanup**. Recovery of spilled tailings and channel reconstruction would help stabilize stream morphology. Flood stage conditions would cause impacts across wider area, increasing the cleanup area. Cleanup activities could remobilize spilled tailings.
Groundwater Hydrology			
Infiltration into Shallow Groundwater. Floodwaters would infiltrate into shallow aquifers along the extent of the spill path.	**Infiltration into Shallow Groundwater.** Floodwaters would infiltrate into shallow aquifers along the extent of the spill path.	**Infiltration into Shallow Groundwater.** Floodwaters would infiltrate into shallow aquifers along the extent of the spill path.	**Infiltration into Shallow Groundwater.** Floodwaters would infiltrate into shallow aquifers along the extent of the spill path. Flood stage conditions would cause impacts across wider area where floodplains widen.

0.5 Percent Scenario	5.4 Percent Scenario	13.3 Percent Scenario	27 Percent Scenario
Elevated Water Table. Where there is a thick deposition of tailings, groundwater would mound and elevate the water table in that area.	**Elevated Water Table.** Where there is a thick deposition of tailings, groundwater would mound and elevate the water table in that area.	**Elevated Water Table.** Where there is a thick deposition of tailings, groundwater would mound and elevate the water table in that area.	**Elevated Water Table.** Where there is a thick deposition of tailings, groundwater would mound and elevate the water table in that area.
Drinking Water Hydrologic Impacts. No impact to drinking water source protection areas in the Village of Crooked Creek or other downstream communities.	**Drinking Water Hydrologic Impacts.** Floodwaters may infiltrate drinking water source protection area in the Village of Crooked Creek, and deposited tailings may cause groundwater mounding in the area. Unlikely to impact drinking water protection areas in downstream communities.	**Drinking Water Hydrologic Impacts.** Floodwaters may infiltrate drinking water source protection area in the Village of Crooked Creek, and deposited tailings may cause groundwater mounding in the area. Unlikely to impact drinking water protection areas in downstream communities.	**Drinking Water Hydrologic Impacts.** Floodwaters would infiltrate drinking water source protection area in the Village of Crooked Creek, and deposited tailings would likely cause groundwater mounding in the area. Unlikely to impact drinking water protection areas in downstream communities.
Cleanup. Recovery of spilled tailings would reduce potential for long-term groundwater contamination.	**Cleanup**. Recovery of spilled tailings would reduce potential for long-term groundwater contamination.	**Cleanup**. Recovery of spilled tailings would reduce potential for long-term groundwater contamination.	**Cleanup**. Recovery of spilled tailings would reduce potential for long-term groundwater contamination.
Water and Sediment Quality			
Turbidity/TSS. Acute increase in downstream turbidity; ongoing periodic elevated turbidity for months to years.	**Turbidity/TSS.** Acute increase in downstream turbidity; ongoing periodic elevated turbidity for years.	**Turbidity/TSS.** Acute increase in downstream turbidity; ongoing periodic elevated turbidity for years to decades.	**Turbidity/TSS.** Acute increase in downstream turbidity; ongoing periodic elevated turbidity for several decades.
Metals and Major Constituents. Acute influx of elevated metals from tailings fluid; potential for low levels of elevated metals leached from deposited tailings for years.	**Metals and Major Constituents.** Acute influx of elevated metals from tailings fluid; potential for low levels of elevated metals leached from deposited tailings for years.	**Metals and Major Constituents.** Acute influx of elevated metals from tailings fluid; potential for low levels of elevated metals leached from deposited tailings for years to decades.	**Metals and Major Constituents.** Acute influx of elevated metals from tailings fluid; potential for low levels of elevated metals leached from deposited tailings for several decades. Flood stage conditions would allow for more dilution of contaminants, but the extent of impacts could be greater.
Acid Generation. Low potential for minor acid generation from deposited tailings for years.	**Acid Generation.** Low potential for minor acid generation from deposited tailings for years.	**Acid Generation.** Low potential for minor acid generation from deposited tailings for years to decades.	**Acid Generation.** Low potential for minor acid generation from deposited tailings for several decades.

0.5 Percent Scenario	5.4 Percent Scenario	13.3 Percent Scenario	27 Percent Scenario
Other contaminants. Acute water and sediment contamination from residual reagents and other contaminants in tailings fluid.	**Other contaminants.** Acute water and sediment contamination from residual reagents and other contaminants in tailings fluid.	**Other contaminants.** Acute water and sediment contamination from residual reagents and other contaminants in tailings fluid.	**Other contaminants.** Acute water and sediment contamination from residual reagents and other contaminants in tailings fluid. Flood stage conditions would allow for more dilution of contaminants, but the extent of impacts could be greater.
Drinking Water Quality Impacts. No impact to drinking water source protection areas in Village of Crooked Creek or other downstream communities.	**Drinking Water Quality Impacts.** Groundwater that supplies the drinking water in the Village of Crooked Creek may be contaminated by tailings fluid in the short term, and leached constituents from unrecovered tailings in the long term. Drinking water in downstream communities would not be impacted.	**Drinking Water Quality Impacts.** Groundwater that supplies the drinking water in the Village of Crooked Creek is likely to be contaminated by tailings fluid in the short term, and may be impacted by leached constituents from unrecovered tailings in the long term. Drinking water in downstream communities would not be impacted.	**Drinking Water Quality Impacts.** Groundwater that supplies the drinking water in the Village of Crooked Creek would be contaminated by tailings fluid in the short term, and may be impacted by leached constituents from unrecovered tailings in the long term. Drinking water in downstream communities may be impacted but would be unlikely to exceed water quality standards.
Cleanup. Recovery of spilled tailings would reduce potential for long-term water and sediment quality impacts. Cleanup activities could temporarily remobilize spilled tailings downstream.	**Cleanup**. Recovery of spilled tailings would reduce potential for long-term water and sediment quality impacts. Cleanup activities could temporarily remobilize spilled tailings downstream.	**Cleanup**. Recovery of spilled tailings would reduce potential for long-term water and sediment quality impacts. Cleanup activities could temporarily remobilize spilled tailings downstream.	**Cleanup**. Recovery of spilled tailings would reduce potential for long-term water and sediment quality impacts. Flood stage conditions would cause impacts across wider area, increasing the cleanup area. Cleanup activities could temporarily remobilize spilled tailings downstream.
Air Quality			
Fugitive Dust. Potential for mobilization of dried-out, spilled tailings as dust.	**Fugitive Dust.** Potential for mobilization of dried-out, spilled tailings as dust.	**Fugitive Dust.** Potential for mobilization of dried-out, spilled tailings as dust.	**Fugitive Dust.** Potential for mobilization of dried-out, spilled tailings as dust under both normal and flood stage scenarios.
Cleanup. Emissions from excavation and earthmoving equipment, vehicles and river vessels, helicopters, or other aircraft. Duration would be at least 1 to 2 years.	**Cleanup.** Emissions from excavation and earthmoving equipment, vehicles and river vessels, helicopters, or other aircraft. Duration would be multiple years.	**Cleanup.** Emissions from excavation and earthmoving equipment, vehicles and river vessels, helicopters, or other aircraft. Duration would be multiple years.	**Cleanup.** Emissions from excavation and earthmoving equipment, vehicles and river vessels, helicopters, or other aircraft. Flood stage conditions would cause impacts across wider area, increasing the cleanup area. Duration would be years to more than a decade.

0.5 Percent Scenario	5.4 Percent Scenario	13.3 Percent Scenario	27 Percent Scenario
Noise and Vibration			
Flow of Floodwaters. The spill would generate noise from the initial release of floodwaters. The sound would be very notable at the TSF, and would diminish with distance downstream.	**Flow of Floodwaters.** The spill would generate noise from the initial release of floodwaters. The sound would be very notable at the TSF, and would diminish with distance downstream.	**Flow of Floodwaters.** The spill would generate noise from the initial release of floodwaters. The sound would be very notable at the TSF, and would diminish with distance downstream.	**Flow of Floodwaters.** The spill would generate noise from the initial release of floodwaters. The sound would be very notable at the TSF, and would diminish with distance downstream. The arrival of the initial flood wave may also be heard in the Village of Crooked Creek, although this effect would be diminished if the spill occurred during a natural flood event.
Cleanup. Low-level/periodic noise from excavation and earthmoving equipment, vehicles and river vessels, helicopters, or other aircraft would be ongoing during a year or more of cleanup activities.	**Cleanup.** Low-level/periodic noise from excavation and earthmoving equipment, vehicles and river vessels, helicopters, or other aircraft would be ongoing during multiple years of cleanup activities.	**Cleanup.** Low-level/periodic noise from excavation and earthmoving equipment, vehicles and river vessels, helicopters, or other aircraft would be ongoing during multiple years of cleanup activities.	**Cleanup.** Low-level/periodic noise from excavation and earthmoving equipment, vehicles and river vessels, helicopters, or other aircraft would be ongoing during multiple years to more than a decade of cleanup activities.
Vegetation			
Inundation. Approximately 473 acres of vegetation would be impacted by inundation.	**Inundation.** Approximately 57,882.6 acres of vegetation would be impacted by inundation.	**Inundation.** Approximately 58,019.9 acres of vegetation would be impacted by inundation.	**Inundation.** Under normal hydrologic conditions, approximately 60,841.9 acres of vegetation would be impacted by inundation. Under 100-year flood conditions, approximately 11,365.7 acres of vegetation would be impacted by inundation, in addition to the 213,743.8 acres of vegetation that would already be inundated by flood conditions.
Cleanup. Recovery of spilled tailings could reduce potential for long-term vegetation impacts. However, altered soil chemistry and reduced nutrient availability could be permanent in many locations. All cleanup activities could temporarily disturb soils and remobilize spilled tailings.	**Cleanup.** Recovery of spilled tailings could reduce potential for long-term vegetation impacts. However, altered soil chemistry and reduced nutrient availability could be permanent in many locations. All cleanup activities could temporarily disturb soils and remobilize spilled tailings.	**Cleanup.** Recovery of spilled tailings could reduce potential for long-term vegetation impacts. However, altered soil chemistry and reduced nutrient availability could be permanent in many locations. All cleanup activities could temporarily disturb soils and remobilize spilled tailings.	**Cleanup.** Recovery of spilled tailings could reduce potential for long-term vegetation impacts. However, altered soil chemistry and reduced nutrient availability could be permanent in many locations. All cleanup activities could temporarily disturb soils and remobilize spilled tailings.

0.5 Percent Scenario	5.4 Percent Scenario	13.3 Percent Scenario	27 Percent Scenario
Wetlands			
Inundation. Approximately 445.4 acres of wetlands would be impacted by inundation.	**Inundation.** Approximately 12,876.3 acres of wetlands would be impacted by inundation.	**Inundation.** Approximately 12,712.3 acres of wetlands would be impacted by inundation.	**Inundation.** Under normal hydrologic conditions, approximately 15,603.1 acres of wetlands would be impacted by inundation. Under 100-year flood conditions, approximately 10,293 acres of wetlands would be impacted, in addition to the 160,130.6 acres of wetlands that would already be inundated by the flood conditions.
Deposition. Approximately 442 acres of wetlands would be covered by tailings. The burial or fill of wetlands and waters would alter or remove their capacity to provide hydrologic, biogeochemical, and biological functions.	**Deposition.** Approximately 3,332.1 acres of wetlands would be impacted by deposition. The burial or fill of wetlands and waters would alter or remove their capacity to provide hydrologic, biogeochemical, and biological functions.	**Deposition.** Approximately 4,185.7 acres of wetlands would be impacted by deposition. The burial or fill of wetlands and waters would alter or remove their capacity to provide hydrologic, biogeochemical, and biological functions.	**Deposition.** Approximately 4,811.8 acres of wetlands would be impacted by deposition. The burial or fill of wetlands and waters would alter or remove their capacity to provide hydrologic, biogeochemical, and biological functions.
Cleanup. Recovery of spilled tailings could reduce potential for long-term water and sediment quality impacts. However, some impairment of wetland functions would likely persist beyond cleanup.	**Cleanup.** Recovery of spilled tailings could reduce potential for long-term water and sediment quality impacts. However, some impairment of wetland functions would likely persist beyond cleanup.	**Cleanup.** Recovery of spilled tailings could reduce potential for long-term water and sediment quality impacts. However, some impairment of wetland functions would likely persist beyond cleanup.	**Cleanup.** Recovery of spilled tailings could reduce potential for long-term water and sediment quality impacts. However, some impairment of wetland functions would likely persist beyond cleanup.
Wildlife (Terrestrial Mammals, Marine Mammals, Birds)			
Injury and Mortality. Acute from the initial debris flow. Limited to middle and upper reaches of Crooked Creek. Ground-nesting birds and small mammals at greater risk. No effects on marine mammals.	**Injury and Mortality.** Acute from the initial debris flow. Extends into the lower reaches of Crooked Creek. Ground-nesting birds and small mammals at greater risk.	**Injury and Mortality.** Acute from the initial debris flow. Extends into the lower reaches of Crooked Creek. Ground-nesting birds and small mammals would be most exposed. Large terrestrial mammals at greater risk.	**Injury and Mortality.** Acute from the initial debris flow. Extends beyond Crooked Creek drainage. Ground-nesting birds and small mammals would be most exposed. Large terrestrial mammals at greater risk.
Habitat Loss and Alteration. Limited to middle and upper reaches of Crooked Creek. Approximately 420 acres directly impacted. Recovery could take years.	**Habitat Loss and Alteration.** Extends into the lower reaches of Crooked Creek drainage. Approximately 57,883 acres impacted. Recovery would take years.	**Habitat Loss and Alteration.** Extends into the lower reaches of Crooked Creek drainage. Approximately 58,020 acres impacted. Recovery would take years.	**Habitat Loss and Alteration.** Extends throughout Crooked Creek drainage and beyond. Approximately 60,842 acres impacted. Recovery could take decades.

0.5 Percent Scenario	5.4 Percent Scenario	13.3 Percent Scenario	27 Percent Scenario
Behavioral Changes. Minor impact on wildlife use and distribution.	**Behavioral Changes.** Noticeable impact on wildlife use and distribution throughout Crooked Creek drainage.	**Behavioral Changes.** Noticeable impact on wildlife use and distribution throughout Crooked Creek drainage.	**Behavioral Changes.** Noticeable impact on wildlife use and distribution throughout Crooked Creek drainage and beyond. Recovery could take decades.
Contaminants Exposure. Potential for acute effects from exposure. Chronic effects from long-term exposure not likely.	**Contaminants Exposure.** Potential for acute effects from exposure. Chronic effects from long-term exposure not likely.	**Contaminants Exposure.** Potential for acute effects from exposure. Chronic effects from long-term exposure not likely.	**Contaminants Exposure.** Higher potential for acute and chronic effects from exposure. Effects from bioaccumulation of heavy metals could last decades and extend beyond Kuskokwim River watershed.
Fish and Aquatic Resources			
Injury and Mortality. Acute from the initial debris flow. Limited to the upper and middle reaches of Crooked Creek.	**Injury and Mortality.** Acute and widespread from the initial debris flow. Extends into the lower reaches of Crooked Creek.	**Injury and Mortality.** Acute and widespread from the initial debris flow. Extends into the lower reaches of Crooked Creek.	**Injury and Mortality.** Acute and chronic. Effects would extend beyond Crooked Creek drainage into the Kuskokwim River and could last years due to effects from sedimentation. Impacts would be similar under the 100-year flood release.
Habitat Loss and Alteration. Effects limited to middle and upper reaches of Crooked Creek drainage. Approximately 21 acres of rivers and ponds and 3.9 miles of streams directly impacted from deposition.	**Habitat Loss and Alteration.** Effects extend throughout Crooked Creek drainage. Approximately 297 acres of rivers and ponds and 20 miles of perennial streams directly impacted from deposition.	**Habitat Loss and Alteration.** Effects extend throughout Crooked Creek drainage. Approximately 307 acres of rivers and ponds and 26 miles of perennial streams directly impacted from deposition.	**Habitat Loss and Alteration.** Effects extend throughout Crooked Creek drainage. Approximately 317 acres of rivers and ponds and 32 miles of perennial streams directly impacted from deposition. Similar impacts under the 100-year flood stage release.
Sedimentation and Turbidity. Acute effects. Mostly confined to middle and upper reaches of Crooked Creek drainage.	**Sedimentation and Turbidity.** Acute and chronic. Quality and quantity of habitat affected throughout Crooked Creek drainage. Minor impacts would extend into Kuskokwim River. Impacts would be noticeable and measurable for years.	**Sedimentation and Turbidity.** Acute and chronic. Quality and quantity of habitat affected throughout Crooked Creek drainage. Minor impacts would extend into Kuskokwim River. Impacts would be noticeable and measurable for years.	**Sedimentation and Turbidity.** Acute and chronic. Quality and quantity of habitat affected throughout the Crooked Creek drainage and into Kuskokwim River. Impacts would be noticeable and measurable for decades. A release under the 100-year flood stage would result in a similar level of sediment deposition.
Fish Movement. Temporary barriers would be limited to middle and upper reaches of Crooked Creek.	**Fish Movement.** Temporary barriers would extend into the lower reaches of Crooked Creek drainage.	**Fish Movement.** Temporary barriers would extend into the lower reaches of Crooked Creek drainage. Populations would be temporarily isolated.	**Fish Movement.** Temporary barriers would be more intense and extend into the lower reaches of Crooked Creek drainage and beyond. Populations would be temporarily isolated.

0.5 Percent Scenario	5.4 Percent Scenario	13.3 Percent Scenario	27 Percent Scenario
Stream Productivity. Fisheries, invertebrate, and riparian habitat productivity would be temporarily removed. Effects limited to middle and upper reaches of Crooked Creek.	**Stream Productivity.** Fisheries, invertebrate, and riparian productivity would be temporarily removed. Productivity would be reduced throughout Crooked Creek drainage. Effects would last years.	**Stream Productivity.** Fisheries, invertebrate, and riparian productivity would be temporarily removed. Productivity would be reduced throughout Crooked Creek drainage. Effects would last years.	**Stream Productivity.** Fisheries, invertebrate, and riparian productivity would be temporarily removed. Productivity would be reduced throughout Crooked Creek drainage and beyond. Effects would be decadal. Similar impacts under the 100-year flood stage release.
Contaminants Exposure. Potential for acute effects from exposure. Chronic effects from long-term exposure not likely.	**Contaminants Exposure.** Potential for acute effects from exposure. Chronic effects from long-term exposure not likely.	**Contaminants Exposure.** Potential for acute effects from exposure. Chronic effects from long-term exposure not likely.	**Contaminants Exposure.** Higher potential for acute and chronic effects from exposure. Effects from bioaccumulation of heavy metals could last decades and extend beyond Kuskokwim River watershed. Similar impacts under the 100-year flood stage release.
Threatened and Endangered Bird Species			
No effects	No effects	**Sedimentation.** Minor impacts on prey availability. Not expected to be noticeable or measurable.	**Sedimentation.** Minor impacts on prey availability. Not expected to be noticeable or measurable.
No effects	No effects	**Contaminants Exposure.** Potential for chronic exposure from contaminated prey in Kuskokwim Bay.	**Contaminants Exposure.** Potential for chronic exposure from contaminated prey in Kuskokwim Bay.
Land Ownership, Management, and Use			
Land Ownership. Impacts would be on private land (Native Patent or Interim Conveyed).	**Land Ownership.** Trajectory of impacts would be primarily on private land (Native Patent or Interim Conveyed), with a few sections bordered by the State of Alaska, and then the U.S. Fish and Wildlife Service near the river outlet.	**Land Ownership.** Trajectory of impacts would be primarily on private land (Native Patent or Interim Conveyed), with some impacts on lands owned by the State of Alaska, and then the U.S. Fish and Wildlife Service near the river outlet.	**Land Ownership.** Trajectory of impacts would be primarily on private land (Native Patent or Interim Conveyed), with some impacts on lands owned by the State of Alaska, and then the U.S. Fish and Wildlife Service near the river outlet.
Land Management. Impacts would likely require additional mitigation measures, such as the development of a spill contingency plan in coordination with nearby land managers.	**Land Management.** Impacts would likely require additional mitigation measures, such as the development of a spill contingency plan in coordination with nearby land managers.	**Land Management.** Impacts would likely require additional mitigation measures, such as the development of a spill contingency plan in coordination with nearby land managers.	**Land Management.** Impacts would likely require additional mitigation measures, such as the development of a spill contingency plan in coordination with nearby land managers.

0.5 Percent Scenario	5.4 Percent Scenario	13.3 Percent Scenario	27 Percent Scenario
Land Use. Impacts would range from no impact for small spills to impacts that may require evacuation of lands.	**Land Use.** Impacts would require evacuation in some parts of the Village of Crooked Creek.	**Land Use.** Impacts would require evacuation in some parts of the Village of Crooked Creek.	**Land Use.** Impacts under the flood stage would require evacuation from some or all portions of Crooked Creek, Aniak, Upper Kalskag, and Lower Kalskag.
Recreation			
Recreation. Setting and activities would be impacted, but the levels of recreation downstream from the Mine Site are estimated to remain very low.	**Recreation.** Setting and activities would be impacted, but the levels of recreation downstream from the Mine Site are estimated to remain very low.	**Recreation.** Setting and activities would be impacted, but the levels of recreation downstream from the Mine Site are estimated to remain very low.	**Recreation**. Setting and activities would be impacted, but the levels of recreation downstream from the Mine Site are estimated to remain very low.
Dam Failure. A tailings dam failure may cause loss or damage to anadromous fisheries, which could impact sport anglers.	**Dam Failure.** A tailings dam failure may cause loss or damage to anadromous fisheries, which could impact sport anglers.	**Dam Failure.** A tailings dam failure may cause loss or damage to anadromous fisheries, which could impact sport anglers.	**Dam Failure.** A tailings dam failure may cause loss or damage to anadromous fisheries, which could impact sport anglers.
Visual Resources			
Visual Impact of Turbid Floodwater. A release would create strong visual contrast against the existing landscape, and would be evident from communities along the Kuskokwim River and from elevated or aerial locations.	**Visual Impact of Turbid Floodwater.** A release would create strong visual contrast against the existing landscape, and would be evident from communities along the Kuskokwim River and from elevated or aerial locations.	**Visual Impact of Turbid Floodwater.** A release would create strong visual contrast against the existing landscape, and would be evident from communities along the Kuskokwim River and from elevated or aerial locations.	**Visual Impact of Turbid Floodwater.** A release under normal conditions would create strong visual contrast against the existing landscape, and would be evident from communities along the Kuskokwim River and from elevated or aerial locations. A release during flood conditions may be difficult to discern from the high sediment load and water levels caused by flooding.
Sociocultural (Cash Economy, Subsistence Economy)			
Cleanup. The cleanup and remediation activities would briefly increase employment opportunities and expenditures in the Y-K region.	**Cleanup**. The cleanup and remediation activities would briefly increase employment opportunities and expenditures in the Y-K region.	**Cleanup**. The cleanup and remediation activities would briefly increase employment opportunities and expenditures in the Y-K region.	**Cleanup**. The cleanup and remediation activities would briefly increase employment opportunities and expenditures in the Y-K region.
Long term. Impacts on employment, income, and sales would be negative if commercial and recreational fishing and/or tourism were to suffer due to the real or perceived impacts of the spill.	**Long term**. Impacts on employment, income, and sales would be negative if commercial and recreational fishing and/or tourism were to suffer due to the real or perceived impacts of the spill.	**Long term**. Impacts on employment, income, and sales would be negative if commercial and recreational fishing and/or tourism were to suffer due to the real or perceived impacts of the spill.	**Long term**. Impacts on employment, income, and sales would be negative if commercial and recreational fishing and/or tourism were to suffer due to the real or perceived impacts of the spill.

0.5 Percent Scenario	5.4 Percent Scenario	13.3 Percent Scenario	27 Percent Scenario
Contamination Concerns. A spill into Crooked Creek would raise concerns among subsistence users about contamination of fish in Crooked Creek and beyond.	**Contamination Concerns.** A spill into Crooked Creek would raise concerns among subsistence users about contamination of fish in Crooked Creek and the Kuskokwim River.	**Contamination Concerns.** A spill into Crooked Creek would raise concerns among subsistence users about contamination of fish in Crooked Creek and the Kuskokwim River.	**Contamination Concerns.** A spill into Crooked Creek would raise concerns among subsistence users about contamination of fish in Crooked Creek and the Kuskokwim River.
Access. Access to subsistence use areas on Crooked Creek would be impacted.	**Access.** Access to subsistence use areas on Crooked Creek would be impacted, and could be impacted on the Kuskokwim River.	**Access.** Access to subsistence use areas on Crooked Creek, the Kuskokwim River, and some smaller drainages on the Kuskokwim River would be impacted.	**Access.** Access to subsistence use areas on Crooked Creek, the Kuskokwim River, and some smaller drainages on the Kuskokwim River would be impacted.
Abundance and Availability. Impacts to berries, fish, waterfowl, and furbearers could impact the abundance and availability of these subsistence resources available for harvest on Crooked Creek.	**Abundance and Availability.** Impacts to berries, fish, waterfowl, and furbearers could severely impact the abundance and availability of these subsistence resources available for harvest on Crooked Creek.	**Abundance and Availability.** Impacts to berries, fish, waterfowl, and furbearers could severely impact the abundance and availability of these subsistence resources available for harvest on Crooked Creek.	**Abundance and Availability.** Impacts to berries, fish, waterfowl, and furbearers could severely impact the abundance and availability of these subsistence resources available for harvest on Crooked Creek and the Kuskokwim River.
Cultural Resources			
Inundation. A dam failure would impact cultural resources if tailings were carried to a cultural resource site, or response efforts with ground-disturbing activities occurred near cultural resources. The spill scenario could affect sites near the Mine Site and potentially along the Kuskokwim River, and resources may not be anticipated to return to previous levels even after actions that caused the impacts ceased.	**Inundation.** A dam failure would impact cultural resources if tailings were carried to a cultural resource site, or response efforts with ground-disturbing activities occurred near cultural resources. The spill scenario could affect sites near the Mine Site and potentially along the Kuskokwim River, and resources may not be anticipated to return to previous levels even after actions that caused the impacts ceased.	**Inundation.** A dam failure would impact cultural resources if tailings were carried to a cultural resource site, or response efforts with ground-disturbing activities occurred near cultural resources. The spill scenario could affect sites near the Mine Site and potentially along the Kuskokwim River, and resources may not be anticipated to return to previous levels even after actions that caused the impacts ceased.	**Inundation.** A dam failure would impact cultural resources if tailings were carried to a cultural resource site, or response efforts with ground-disturbing activities occurred near cultural resources. The spill scenario could affect sites near the Mine Site and potentially along the Kuskokwim River, and resources may not be anticipated to return to previous levels even after actions that caused the impacts ceased.

0.5 Percent Scenario	5.4 Percent Scenario	13.3 Percent Scenario	27 Percent Scenario
Human Health			
Health. There are potential adverse impacts to social determinants of health with psychosocial stress resulting from community anxiety over a tailings dam release. There could be exposures to potentially hazardous materials.	**Health.** There are potential adverse impacts to social determinants of health with psychosocial stress resulting from community anxiety over a tailings dam release. There could be exposures to potentially hazardous materials.	**Health.** There are potential adverse impacts to social determinants of health with psychosocial stress resulting from community anxiety over a tailings dam release. There could be exposures to potentially hazardous materials.	**Health.** There are potential adverse impacts to social determinants of health with psychosocial stress resulting from community anxiety over a tailings dam release. There could be exposures to potentially hazardous materials.
Safety. Likely no evacuations.	**Safety.** Inundation could substantially impact the ability to safely evacuate in Crooked Creek. Potential for loss of life, especially near the Mine Site.	**Safety.** Inundation could substantially impact the ability to safely evacuate in Crooked Creek. Potential for loss of life, especially near the Mine Site.	**Safety.** Inundation could substantially impact the ability to safely evacuate in Crooked Creek, Aniak, and Lower Kalskag. Under the flood scenario, more structures and access roads inundated in Crooked Creek and the airstrip would be fully inundated. Potential for loss of life, especially near the Mine Site.
Transportation			
Air Transportation. Slight increase in air traffic related to spill response and monitoring efforts.	**Air Transportation.** Slight increase in air traffic related to evacuations, spill response, and monitoring efforts.	**Air Transportation.** Slight increase in air traffic related to evacuations, spill response, and monitoring efforts.	**Air Transportation.** Slight increase in air traffic related to evacuations, spill response, and monitoring efforts.
Surface Transportation. There would be impacts in the vicinity of the tailings dam, and a limited level of impacts to surface transportation in communities downstream of the tailings dam.	**Surface Transportation.** There would be impacts in the vicinity of the tailings dam, and some impacts to surface transportation in communities downstream of the tailings dam.	**Surface Transportation.** There would be impacts in the vicinity of the tailings dam, and some impacts to surface transportation in communities downstream of the tailings dam from response efforts.	**Surface Transportation.** There would be impacts in the vicinity of the tailings dam, and some impacts to surface transportation in communities downstream of the tailings dam from response efforts.
Water Transportation. Impacts to water travel on Crooked Creek and Anaconda Creek; may impact water travel on the Kuskokwim River.	**Water Transportation.** Impacts to water travel on Crooked Creek and Anaconda Creek; may impact water travel on the Kuskokwim River.	**Water Transportation.** Impacts to water travel on Crooked Creek, Anaconda Creek, and the Kuskokwim River from the spill and evacuation efforts.	**Water Transportation.** Impacts to water travel on Crooked Creek, Anaconda Creek, and the Kuskokwim River from the spill and evacuation efforts.

CHAPTER 5 PROJECT COORDINATION AND CONSULTATION

The Corps and BLM published a notice of intent to prepare an SEIS on January 26, 2026 (Corps 2026). The special public notice period for the SEIS began on January 26, 2026, and expired on February 24, 2026. The Corps received a total of 14 submissions during the special public notice comment period. Comments were considered and incorporated into the analysis of this draft SEIS where applicable to the scope of the remand.

The Corps held two meetings with the cooperating agencies. A FAST-41 kickoff meeting was held December 9, 2025, to introduce the process, timelines, and plan for completing the SEIS. The meeting on April 9, 2026, presented the scenarios selected for analysis in the SEIS and described the expected outline and topics to be addressed. Input on the scenarios and organization of the SEIS was requested.

CHAPTER 6 LIST OF PREPARERS

Table 4.23-1: List of Preparers

Name	Degree(s)	Years of Experience	Project Role
Lead Federal Agency			
U.S. Army Corps of Engineers			
Jonathan Hegna	M.S. Biological Sciences Ph.D. Fisheries and Wildlife	11	Project Manager
Janet Post	B.A. Economics	18	North Branch Chief
Cooperating Agencies			
U.S. Bureau of Land Management			
Jorjena Barringer	M.S. Natural Resources Conservation Social Science	26	BLM Anchorage District Planning and NEPA Coordinator
Emmanuel May	M.S. Ecology	8	BLM Easter Interior Field Office Fish Biologist
Neil Perry	M.S. Wildlife Management	20	BLM Anchorage Assistant Field Manager
Jamie Rhoades	M.S. Organizational Leadership	18	BLM Anchorage Assistant Field Manager
Craig Townsend	B.S. Wildlife Biology	15	BLM Anchorage Field Office Wildlife Bioloigst
Jake Vialpando	B.S. Range Management	33	BLM Anchorage Field Manager
U.S. Environmental Protection Agency			
Theo Mbabaliye	Ph.D. Environmental and Natural Resource Sciences	22	Lead NEPA Reviewer
State of Alaska			
James Hyun	B.S. Biological Sciences M.S. Environmental Science	15	Large Project Coordinator
Third Party SEIS Preparers (Prime Contractor – AECOM)			
AECOM Technical Services, Inc.			
Erin Arrington	B.A. Journalism	7	Technical Editing, Word Processing, Document Control
Tara Bellion	B.S. Marine Science	30	Deputy Project Manager
Wes Cornelison	M.S. Biology	27	Fish and Aquatic, Biological Resources Lead
Bill Craig	B.S. Environmental Studies	35	Project Manager
Jessica Evans	B.S. Environmental Science M.S. Environmental Planning	16	Social Sciences Lead

Name	Degree(s)	Years of Experience	Project Role
Andrew Fisher	B.S. Wildlife, Fish, and Conservation Biology	18	Biological Sciences
Sasha Forland	B.S. Biology	28	Mitigation
Frank Lan	B.S. Hydraulic Engineering M.S. Civil Engineering Ph.D. Civil Engineering	36	Dam Breach Modeling
Arika Mercer	A.A.S. Fire Science B.E.M. Emergency Management	6	Public Health and Safety
Finn Newman	B.A. Environmental Studies	2	Wetlands and Vegetation
Allison Payne	B.S. Geology and Environmental Science M.S. Geology/Volcanology	19	Physical Resources Lead
Thomas Schultz	B.S. Environmental Science	17	GIS Coordinator
Matt Spansky	B.S. Geology Graduate Study – Hydrogeology	21	Water Resources
James Scott	A.A. Engineering B.S. Civil Engineering M.S. Civil Engineer/Geotechnical Engineering	47	Geotechnical
Aaron Wells	B.S. Environmental Science Ph.D. Soils Science	22	Wetlands and Vegetation