CHAPTER 5: IMPACT AVOIDANCE, MINIMIZATION, AND MITIGATION

5.1 INTRODUCTION

This section defines terminology, references applicable guidance, describes the process of identifying mitigation during the NEPA, Section 404, and BLM permitting processes, and identifies committed measures by Donlin Gold intended to avoid or minimize impacts. Further discussion of resource-specific mitigation is provided in Chapter 3.

5.1.1 OVERVIEW OF NEPA AND CORPS 404 MITIGATION

NEPA requires federal agencies to consider appropriate mitigation measures to avoid or minimize specific impacts. Consideration and adoption of mitigation is a continuous process through completion of the Environmental Impact Statement (EIS) and Record of Decision (ROD). This includes efforts made as part of the project design or standard procedures (Section 5.2); Best Management Practices (BMPs), industry standards, or standard permit requirements (Section 5.3); and assessment of mitigation and monitoring measures recommended for consideration by EIS team Subject Matter Experts (SMEs), the lead and cooperating agencies, federally recognized tribal governments, and the public during the NEPA process (Sections 5.5 and 5.7). Measures included in this chapter were the subject of discussion during mitigation workshops in 2015 and 2017 in which the goal was to develop a complete listing of design features as well as mitigation and monitoring measures put forward for assessment in the Final EIS.

Additionally, the Corps of Engineers, pursuant to Section 404 of the Clean Water Act (CWA), has very specific requirements for mitigation, including a five-step process of 1) impact avoidance, 2) minimization, 3) rectifying impacts, 4) reducing and/or 5) resource-specific mitigation measure development and application to compensate for unavoidable impacts under their jurisdiction (Section 5.6). Mitigation measures are also developed through other processes such as consultation under Section 106 of the National Historic Preservation Act (NHPA), permit authorization by other federal and state agencies, and monitoring and adaptive management associated with specific permit requirements.

A general description of the key terms used in this chapter is provided in Table 5.1-1. Where mitigation measures are analyzed as part of the proposed action, their effectiveness in avoiding or reducing potential impacts has been taken into consideration in assessing potential environmental consequences.

Table 5.1-1: Common Mitigation Terms

Term Used in This EIS	NEPA Equivalent	Corps 404 Permitting Equivalent	Description
Design Features (or Measures)	Mitigation	Avoidance and Minimization	Design features are impact-reducing actions or designs that Donlin Gold has committed to in their permit applications and supporting documents. These are part of the proposed action. If during the NEPA process the proposed action is required to be changed, some aspects of those required changes may become design features and described in the Final EIS.

Table 5.1-1: Common Mitigation Terms

Term Used in This EIS	NEPA Equivalent	Corps 404 Permitting Equivalent	Description
Best Management Practices (BMPs) and standard permit requirements	Mitigation	Avoidance and Minimization	These are the predictable requirements that are required in regulation or would be stipulated in project permits issued by state and federal governments. For example, the Construction General Stormwater permit will require a Stormwater Pollution Prevention Plan (SWPPP). These are analyzed as part of the proposed action.
Agency Considered Mitigation	Mitigation	Avoidance and Minimization	Measures agencies consider that would further reduce impacts. These are not considered part of the proposed action.
Compensating for Unavoidable Impacts	Mitigation	Compensatory Mitigation	Compensating for an impact by replacing or providing substitute resources or environments is one way an agency can use mitigation to reduce environmental impacts associated with proposed projects (CEQ 2010). Compensatory mitigation is a requirement under the CWA for impacts to waters of the U.S. that cannot be avoided or minimized. Compensatory mitigation requirements are identified in Records of Decision (RODs) based on the Final EIS. Compensatory mitigation may also be required by the Department of Interior. See Section 5.6 of this chapter for further details on Compensatory Mitigation.
Monitoring and Adaptive Management	Monitoring	Monitoring	Monitoring has been proposed by Donlin Gold, is recommended in this EIS, and would be specified in the ROD as required by 40 CFR 1505.2 (c). It may also be included in the RODs of other federal agencies adopting this EIS, and by stipulation in federal and state permits. Through monitoring, appropriate data are collected to assess predicted project impacts and the effectiveness of mitigation after initial and ongoing implementation. Mitigation that is not proving effective can be adapted. Adaptive management is often defined as "a structured, iterative process of robust decision making in the face of uncertainty, with an aim to reducing uncertainty over time via system monitoring." Mitigation monitoring can incorporate elements of adaptive management if monitoring results indicate a basis for changes to a mitigation program.

5.1.2 DEFINITIONS AND PROCESS

Mitigation is considered by the Corps primarily in three ways during the NEPA process:

1. Impact avoidance;
2. Minimization measures; and
3. Resource-specific mitigation measures to compensate for unavoidable impacts.

Measures to avoid and/or minimize impacts to resources that are identified in this EIS include:

- Efforts made by Donlin Gold as part of the project design or as standard procedures during Construction, Operations, and Closure phases;
- Minimization measures incorporated into alternatives to the proposed action in order to avoid or minimize potential impacts;

- Best Management Practices (BMPs), industry standards, or standard permit requirements;
- Mitigation and monitoring measures recommended for consideration by EIS team SMEs, the lead and cooperating agencies, federally recognized Tribal governments, and the public during the NEPA process; and
- Compensatory mitigation required by the Corps pursuant to Section 404 of the CWA. Other agencies may require compensatory mitigation under their regulations as conditions of approval, documented in their Records of Decision (RODs).

After development of the EIS, if the subsequent permitting phase determines that a permit would be issued, additional conditions, stipulations and/or requirements may be added that could act as further mitigation. These could include mitigation and monitoring measures put forward for consideration in the Final EIS. Similarly, monitoring to assess that mitigation measures are achieving the expected results or monitoring for adaptive management would be used as an assessment tool where applicable. Any such post-EIS requirements are not considered in this EIS, nor does this EIS require adoption of any of the additional mitigation and monitoring measures discussed in this chapter (see Sections 5.5 and 5.7).

It should be recognized that many of the permits required for approval of the Donlin Mine are under the jurisdiction of the State of Alaska. Specific agencies may have clear compliance standards and requirements for monitoring of environmental conditions; future risks associated with unexpected conditions may also be addressed in specific permitting authorizations. Potential mitigation and monitoring measures put forward for consideration in the EIS are not intended to dictate conditions of State permit approvals, but to identify potential measures for consideration, as applicable. Some of these permits are revisited or reauthorized on a regular basis, which provides opportunities for adaptive management and consideration of additional conditions.

Department of the Army Permit (RHA Section 10 and CWA Section 404) Process. The Corps will complete the Department of the Army Permit review process, including the 404(b)(1) evaluation for compliance with the CWA, prior to issuance of the Corps' Record of Decision (ROD). These decision documents will be available after publication of the Final EIS. Final wetland compensatory mitigation plans and the 404(b)(1) evaluation are not required by the Corps to complete the NEPA process. However, various aspects of the EIS and permit analysis phases are iterative and therefore may repeat analytical steps that result in the further development of mitigation for any or all potential project related effects. The Corps' determination of compliance with the Section 404(b)(1) Guidelines will rely, in large part, on information presented in the Final EIS. Pursuant to the Section 404(b)(1) Guidelines, the Corps has a formal process and requirements that must be met, including a determination of practicable and appropriate mitigation, prior to selection of the Least Environmentally Damaging Practicable Alternative (LEDPA). In determining which mitigation measures are practicable and appropriate for inclusion in the Section 404(b)(1) analysis and Record of Decision (ROD), the Corps will incorporate, as appropriate, consideration of the potential mitigation measures presented in Sections 5.5 and 5.7, and additional public and agency comments received during review of the Draft EIS. Corps' regulatory authority encompasses waters of the U.S. and their adjacent wetlands, and ensures that environmental impacts on aquatic resources from permitted projects are avoided, minimized and mitigated; however, the Corps permit can also include conditions necessary to comply with other federal laws (e.g.,

Endangered Species Act [ESA], and National Historic Preservation Act [NHPA]) and requirements imposed by conditions on state CWA Section 401 water quality certifications.

Following the Final EIS, the Corps will prepare the ROD, which will document the Corps decision as to whether to issue the requested permit as proposed, to issue the requested permit with conditions, or to deny the permit. If the Corps determines it will issue the permit, the ROD will also identify any conditions, including all required mitigation within its jurisdiction. The ROD will include appropriate Donlin Gold-proposed design features and any additional mitigation measures determined by the Corps to be necessary to offset aquatic resource impacts that remain after all efforts to avoid and minimize have occurred, as well as measures adopted by the Corps as the lead federal agency through consultation processes with other federal and state agencies (e.g., ESA, and NHPA, Section 401 water quality certifications). The final measures included in the ROD would be considered part of the project by the Corps, to be considered during its permitting process.

BLM Mitigation Process. BLM also has responsibility to identify the conditions, including all required mitigation (including compensatory mitigation), for any Mineral Leasing Act right-of-way (ROW) issued pursuant to the Final EIS. BLM has participated in the development of the mitigation measures being considered by the Corps (see Section 5.6, Compensatory Mitigation).

5.1.3 NEPA GUIDANCE

NEPA requires federal agencies to describe potential impacts to resources potentially affected by the proposed action and alternatives to the proposed action. Alternatives may be designed to avoid or minimize potential impacts that may be caused by the proposed action. Because one of the purposes of NEPA is to promote efforts that will prevent or minimize damage to the environment (42 USC Section 4321), mitigation and monitoring are important tools used to avoid, minimize, or compensate for potential adverse impacts. Early consideration of measures to avoid and reduce impacts is often integral to project design, and the effort to avoid, reduce, or offset impacts is a key component of the alternatives development and decision-making process. Many federal agencies, laws, and regulations have specific guidance regarding required efforts to reduce impacts to resources, and the Council on Environmental Quality (CEQ) requires mitigation to be considered during the NEPA process. According to the CEQ (1981):

> Mitigation measures discussed in an EIS must cover the range of impacts of the proposal. The measures must include such things as design alternatives that would decrease pollution emissions, construction impacts, esthetic intrusion, as well as relocation assistance, possible land use controls that could be enacted, and other possible efforts. Mitigation measures must be considered even for impacts that by themselves would not be considered "significant." Once the proposal itself is considered as a whole to have significant effects, all of its specific effects on the environment (whether or not "significant") must be considered, and mitigation measures must be developed where it is feasible to do so.
>
> All relevant, reasonable mitigation measures that could improve the project are to be identified; even if they are outside the jurisdiction of the lead agency or cooperating agency, and thus would not be committed as part of the RODs of these agencies.
>
> The ROD must state whether all practicable measures have been adopted, and if not, why not.

> However, to ensure that environmental effects of a proposed action are fairly assessed, the probability of mitigation measures being implemented must also be discussed. Thus, the EIS and ROD should indicate the likelihood that such measures will be adopted or enforced by the responsible agencies.
>
> Lead agencies "shall include appropriate conditions [including mitigation measures, monitoring, and enforcement programs] in grants, permits, or other approvals" and shall "condition funding of actions on mitigation." Any such measures that are adopted must be explained in the ROD.

CEQ regulations describe several ways an agency can use mitigation to reduce environmental impacts associated with proposed projects (CEQ 2010). These include:

- Avoiding an impact by not taking a certain action or parts of an action;
- Minimizing an impact by limiting the degree or magnitude of the action and its implementation;
- Rectifying an impact by repairing, rehabilitating, or restoring the affected environment;
- Reducing or eliminating an impact over time, through preservation and maintenance operations during the life of the action; and
- Compensating for an impact by replacing or providing substitute resources or environments.

Additional specific Corps mitigation requirements are found at 33 CFR 325.4 (a):

> District engineers will add special conditions to Department of the Army permits when such conditions are necessary to satisfy legal requirements or to otherwise satisfy the public interest requirement. Permit conditions will be directly related to the impacts of the proposal, appropriate to the scope and degree of those impacts, and reasonably enforceable.

Regulatory standards and criteria for the use of compensatory mitigation to offset unavoidable impacts to waters of the United States, including wetlands, authorized under the CWA, were established on April 10, 2008, under 33 CFR Part 332 (Corps) and 40 CFR Part 230 (U.S. Environmental Protection Agency [EPA]).

On January 14, 2011, the CEQ issued a memorandum to federal departments and agencies containing guidance on establishing, implementing, and monitoring mitigation commitments identified and analyzed in Environmental Assessments and EISs, and adopted in the final decision documents. The Donlin Gold EIS complies with federal guidance by considering mitigation during alternatives development and by disclosing mitigation as components incorporated into project design, construction, and operations as efforts to avoid and minimize potential impacts.

5.2 DESIGN FEATURES PROPOSED BY DONLIN GOLD

The EIS serves in part to inform the public and review agencies of design features measures, or project elements that are included to reduce or avoid impacts. The Corps views these elements as part of the project, and considers Donlin Gold's proposed design measures as inherent to the Donlin Gold proposed action (Alternative 2) as well as applicable components of the other alternatives' descriptions. These measures, including any potential impacts associated with

these measures, are part of the proposed action and other alternatives, and were considered during the NEPA impact analysis.

Donlin Gold's design features for the Proposed Action (Alternative 2) are incorporated into Table 5.2-1 below. The table is organized by:

- Design feature ID number;
- A description of the design feature;
- Project component or subcomponent the design feature applies to;
- The project phase associated with the design feature (Construction [in some cases, the term pre-Construction is applied, in which the proposed design feature activities would incorporate actions that would take place prior to Construction activities], Operations, and Closure [in some cases, the term post-Closure is applied, to refer to a period of time after the Closure Phase]); and
- The specific resources affected (based on the resources discussed in Chapter 3 of this document), in no particular order.

This table is intended to be a summary of the design features that Donlin Gold is proposing to implement to avoid and minimize impacts. Donlin Gold's proposed action is described in Chapter 2 and shown in the pipeline strip maps in Appendix D. A description of Donlin Gold's proposed action can be found in Chapter 2 (Section 2.3.2 Alternative 2 – Donlin Gold's Proposed Action). Engineering design and Construction, Operations, or Closure Phase procedures are often preliminary at the time that an EIS is prepared, typically final engineering designs and construction and operating plans are finalized during the permitting phase. Similar measures would be employed for the other action alternatives (Alternatives 3A, 3B, 4, 5A, or 6A; or any options), as applicable.

Table 5.2-1: Design Features

I.D.	Design Feature Description	Subcomponent	Project Phase(s)	Resource(s) Affected
Design Features Common to All Components				
A1	Pre-Construction surveys of vegetation to be disturbed on BLM-managed land would be conducted to determine the presence or absence of any rare and sensitive plant species. If any individuals or populations are found, the appropriate agencies would be consulted to determine potential mitigation such as avoidance or transplant. These mitigation measures could substantially reduce the potential effects on any rare plants.	All	Pre-Construction	Vegetation
A2	Raptor nest surveys would be conducted during the spring prior to start of construction. If occupied nests are found close to areas of proposed activity, the activity would be scheduled to occur outside the nesting season if feasible. If not feasible, the USFWS would be consulted to assist in determining measures necessary to avoid or minimize impacts to nesting raptors.	All	Pre-Construction	Wildlife
A3	Agreements with Alaska Native landowners create contractual commitments to shareholder hire and revenue flows for Alaska Native shareholders.	All	Pre-Construction Construction Operations Closure Post-Closure	Environmental Justice Socioeconomics
A4	Where an important cultural resource site is identified near the proposed project upriver port site, a community-based excavation project would be undertaken to involve the community in scientific documentation of the site, thereby avoiding loss of context for the cultural resource.	All	Pre-Construction	Cultural Resources
A5	All work would be performed in accordance with relevant permit and lease stipulations and in a manner to prevent infestation of bark beetles or other potential problems consistent with the Donlin Gold Timber Clearing Utilization Plan.	All	Construction Operations Closure	Vegetation Land Ownership Management, and Use
A6	Temporary ice roads instead of gravel roads would be used for pipeline construction in many places to minimize disturbance to wetlands.	All	Construction Operations Closure	Vegetation Wetlands Cultural Resources Visual Resources
A7	The project design includes consultation with the public and tourism and recreation businesses to minimize impacts to current uses and operations.	All	Construction Operations Closure	Recreation Socioeconomics
A8	Where practicable, the project design includes proposed facilities with earth tone colors characteristic of the natural landscapes during the summer months (browns, tans, warm grays, and greens) with matte-finish to minimize visual impacts. The project design includes features to minimize visual impacts to the natural landscape to extent practicable.	All	Construction Operations Closure	Recreation Visual Resources
A9	Salvaged growth media and topsoil removed during construction would be used for revegetation. Salvaged material would be stored using methods to prevent erosion of the stockpiled salvaged material. Native seed mixes and natural recolonization would be utilized to the extent practicable in reclamation activities to minimize potential for introducing non-native or invasive species.	All	Construction Operations Closure	Vegetation Land Ownership, Management, and Use Visual Resources
A10	Where practicable, fully shielded light fixtures would be used to reduce potential light attraction to migratory birds.	All	Construction Operations Closure Post-Closure	Wildlife
A11	Material sites at the Mine Site, mine access road, and pipeline would be evaluated prior to use for metals leaching and acid rock drainage (ARD) potential in final design using bulk geochemistry analysis, meteoric water mobility procedure (MWMP), and acid-base accounting (ABA) methods. Alternative sites would be selected if results indicate the potential for impacts to downgradient water resources.	All	Construction Operations	Water Quality
A12	Where practicable, construction and maintenance schedules would seek to minimize impacts on subsistence hunting and fishing, with the understanding that some construction activities must also take advantage of seasonal and environmental conditions.	All	Construction Operations	Subsistence Human Health

Table 5.2-1: Design Features

I.D.	Design Feature Description	Subcomponent	Project Phase(s)	Resource(s) Affected
A13	Donlin Gold would implement a no hunting/fishing policy for employees at work sites to minimize competition from employees for local resources.	All	Pre-Construction Construction Operations Closure Post-Closure	Subsistence Human Health
A14	The project design includes the development and implementation of a Construction Communications Plan to inform the public and commercial operators of construction activities.	All	Construction	Noise and Vibration Recreation Socioeconomics Subsistence
A15	The project design includes (when practicable) crossing drainages at right angles and use of bridges to reduce impacts and minimize footprint in riparian areas.	All	Construction	Vegetation Wetlands Fish and Aquatic Resources
A16	The project design includes routing transmission lines in proximity to roads, where possible, to reduce additional vegetation impacts.	All	Construction	Vegetation Wetlands Visual Resources Wildlife
A17	The project design includes assistance to develop project-related training programs for local residents to enhance local hire potential during Construction and Operations phases.	All	Construction Operations	Socioeconomics Environmental Justice
A18	Shareholder preference in hiring maximizes economic benefit to local communities (minority and low income); along with enclave work place, this minimizes risk of influx of non-local workers into nearby communities.	All	Construction Operations	Socioeconomics Environmental Justice Human Health
A19	The project design includes shift work schedules to maximize opportunities for employees to remain active in subsistence harvest efforts during Construction and Operations phases.	All	Construction Operations Closure Post-Closure	Subsistence Human Health
A20	Donlin Gold would develop and implement a drug and alcohol abuse prevention program for employees during all phases of the project. Donlin Gold would develop and apply employee sensitivity training for issues such as cultural respect, racial bias, sexual harassment. They would provide counselors; and discuss the dangers and history of alcoholism and drug abuse.	All	Construction Operations Closure	Human Health Spill Risk
A21	Donlin Gold would develop an Operations and Maintenance Plan/Manual; Health, Safety, and Environment Plan (including a Safety Plan/Program); Pipeline Surveillance and Monitoring Plan; and other plans that would outline safety measures that would be implemented during Operations.	All	Operations	Human Health Pipeline Reliability and Safety
A22	Areas of disturbed bedrock and surficial deposits along the pipeline ROW, roads, and material sites would be contoured to match existing landforms as feasible, ripped to mitigate compaction effects, covered with growth media as needed and revegetated, and would support the overall drainage of the site, the long-term geotechnical stability, and post-mining land use.	All	Construction Closure	Geology Soils Geohazards and Seismic Conditions Vegetation Wetlands Land Ownership, Management, and Use Visual Resources
A23	Surfaces would be progressively reclaimed throughout operation. Post-closure sediment controls would include site grading and capping of erodible material, revegetation, and re-routing of surface runoff to reestablish natural conditions.	All	Operations Closure Post-Closure	Surface Water Hydrology Fish and Aquatic Resources Vegetation Subsistence

Table 5.2-1: Design Features

I.D.	Design Feature Description	Subcomponent	Project Phase(s)	Resource(s) Affected
A24	Where feasible and practicable, valley bottom and lowland material sites will be reclaimed to create new wetland areas with ponds and emergent vegetation or black spruce wetlands.	All	Construction Closure	Wetlands Wildlife
A25	Recyclable materials, including equipment and metals, will be handled in accordance with the Integrated Waste Management (IWM) Plan (SRK 2016b). Materials will be recycled and shipped offsite for disposal to the extent practicable and as required by project permits and applicable regulations.	All	Construction Operations Closure	Land Ownership, Management, and Use
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.	All	Construction Operations Closure Post-Closure	Surface Water Hydrology Water Quality Geology (Mass Stability Fish and Aquatic Resources Wetlands Vegetation Spill Risk
A27	Compressors will be housed in metal-framed and sided buildings with sound insulation designed into the wall thickness, as practicable.	All	Construction Operations	Noise and Vibration Recreation
A28	Where practicable, large surface area/low impact tires/tracks would be used on or near wetlands to help reduce equipment impacts.	All	Construction Operations	Vegetation Wetlands
A29	A cultural anthropologist will be available during construction activities.	All	Construction Operations	Cultural Resources
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 reclamation; 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: Donlin Gold has submitted an initial draft of the CRMP, which may be available as an appendix of Programmatic Agreement (PA) in Appendix Y, if these documents are available at the time of publication of the Final EIS).	All	Pre-Construction	Cultural Resources
A31	Donlin Gold's surface use agreements with Calista and The Kuskokwim Corporation (TKC) include the Donlin Advisory and Technical Review Oversight Committee (DATROC), which is active and meets quarterly. Appropriate project communications would be managed under the purview of the DATROC, ultimately in the form of advisory subcommittees. Donlin Gold has committed to two subcommittees, the Barge Subcommittee and Subsistence Subcommittee, which would act in parallel to engage and inform local communities. The primary function of these committees is to engage the local communities to identify locations and times when subsistence activities occur, and opportunities to avoid, eliminate, or reduce conflicts that serve to restrict access to subsistence resources during construction, operations and post-closure. The Subsistence Subcommittee would also contribute to the identification of practical and effective monitoring measures to address concerns of subsistence users that subsistence resources may be adversely affected by project-related activities and would support development of an information-sharing framework to efficiently and effectively share results of monitoring (and other project-related technical information), at a practical level, with local subsistence users. The long duration of the project, the wide range of resources involved, and the varied interests among participants may require that the form and function of the subcommittees and the processes they oversee, evolve with time. The subcommittees would be encouraged to work through the DATROC to identify and/or recommend adaptive management needs. (Donlin Gold 2018a).	All	Construction Operations Post-Closure	Subsistence Transportation Land Ownership, Management, and Use
A32	Cyanide and mercury spill response planning would be components of Donlin Gold's hazardous materials management and spill plans. The applicable training, inspection, reporting, preparedness, spill prevention, contingency planning, and emergency procedures required by RCRA and ADEC Division of Spill Prevention and Response would be implemented. Emergency response information would be provided and maintained according to Title 49 CFR 172.	Mine Transportation	Operations	Water Quality Wetlands Wildlife Fish and Aquatic Resources Spill Risk Human Health

Table 5.2-1: Design Features

I.D.	Design Feature Description	Subcomponent	Project Phase(s)	Resource(s) Affected
A33	A Crooked Creek aquatic resources monitoring plan would be developed in conjunction with ADF&G and ADNR through habitat and water rights permitting processes. The objectives of the plan are to: 1) monitor for major changes to aquatic communities, 2) monitor for smaller scale and incremental changes to aquatic communities, and 3) guide results-based refinement to the monitoring program. The plan would build on the existing baseline dataset and include both biological and flow components, including: fish presence/abundance, invertebrate and periphyton sampling, and fish metals analysis; flow monitoring and winter surface water sampling to characterize fish habitat/passage and freezedown patterns; sediment sampling; and collection of additional geology and hydrology data to refine understanding of dewatering and groundwater/surface water flow dynamics (Donlin Gold 2018a,b; Owl Ridge 2017c). The ongoing data collection would be used in an adaptive management approach to refine the understanding of the dynamics surrounding Crooked Creek flow in winter as well as the open water seasons and to identify the most effective measures that can be used to ensure that minimum flows in Crooked Creek are maintained. If the project results in minimal losses to Crooked Creek flows, adaptive management measures may be unnecessary. If flow losses warrant a response, a range of measures could be considered that include but would not limited to: lining or relocating portions of the stream channel; augmenting flows from the Snow Gulch Reservoir; pumping water from the Kuskokwim River, or grouting areas of bedrock demonstrating high flow rates. (Donlin Gold 2018a).	Mine Site	Pre-Construction Construction Operations Closure	Fish and Aquatic Resources Surface Water Hydrology Groundwater Hydrology
Design Features at the Mine Site				
M1	In final design, site infrastructure, material sites, and roads would avoid ground-disturbing activity in wetland areas whenever practicable. Details would be developed as design and permitting progress. Those details will not be finalized at the Final EIS stage.	General Mine Roads	Construction Operations Closure	Vegetation Wetlands Wildlife
M2	An air blast evaporation system or sprinklers would be used to minimize fugitive dust emissions from TSF beaches during dry conditions.	TSF	Construction Operations	Air Quality Vegetation Recreation Visual Resources Subsistence Human Health
M3	The project design includes developing multiple use facilities – using the same piece of ground for more than one purpose over the life of the mine as well as using existing disturbed areas for temporary construction activities to minimize impacts.	General Mine	Construction Operations	Wetlands Vegetation
M4	Siting and design of material sites would include site assessments for the potential for conversion of the sites to wetlands or restoration of the sites to create high(er) functioning wetlands.	General Mine	Construction Operations Closure	Wetlands Wildlife Fish and Aquatic Resources
M5	The shape of the WRF has been designed to conform to the landscape to the extent practicable to reduce visual impact.	WRF	Construction Operations Closure	Geology Visual 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.	TSF	Construction Operations Closure	Soils Geohazards and Seismic Conditions Spill Risk
M7	Based on the proposed design, the WRF stability meets or exceeds industry design criteria under both static and pseudo-static (earthquake) loading conditions.	WRF	Construction Operations Closure Post-Closure	Soils Geohazards and Seismic Conditions
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.	TSF	Construction Operations Closure Post-Closure	Soils Water Quality

Table 5.2-1: Design Features

I.D.	Design Feature Description	Subcomponent	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.	TSF WRF	Construction	Soils Spill Risk
M10	The overall and area-specific pit wall slopes were designed to accommodate varying faults, fractures, and rock quality to ensure stability.	Pit	Construction Operations	Soils Geohazards and Seismic Conditions
M11	Numerous locations and combinations of locations were analyzed for TSF and WRF layouts during the alternatives development process. These are summarized in Appendix C. The layout of major mine facilities was designed to minimize wetland impacts and limit effects on water quality to the American and Anaconda Creek watersheds. The 404(b)(1) analysis will document the steps taken to minimize wetlands impacts.	General Mine	Construction	Water Quality Wetlands Fish and Aquatic Resources Subsistence
M12	Geosynthetic liner would be used over permafrost in wetland areas to minimize thawing or degradation that could lead to requirements of excessive amounts of fill to avoid shoulder sloughing (i.e., collapse or sliding of shoulder material).	General Mine	Construction	Wetlands
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 2016h). M13 broadly covers design features of the water management plan, with details available in Chapter 2, Alternatives. Chapter 3 sections provide design and impact analysis pertaining to individual resources.	General Mine	Operations Closure Post-Closure	Surface Water Hydrology Groundwater Hydrology Water Quality Fish and Aquatic Resources Subsistence
M14	During the Operations Phase, concurrent reclamation activities (e.g., certain tiers and areas within the WRF) would be conducted immediately after construction and stabilization and whenever practicable in disturbed areas no longer required for active mining.	General Mine	Operations Closure	Geology Air Quality Vegetation Fish and Aquatic Resources Visual Resources Subsistence
M15	The project design at the Mine Site includes water management strategies that would maintain flow and storage within 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.	General Mine	Operations	Soils Surface Water Hydrology Water Quality Climate Change
M16	The project design includes stream flow monitoring and dam inspections (SRK 2016h) and monitoring to continually provide data for water management and dam safety purposes.	General Mine	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.	General Mine	Construction Operations Closure	Water Quality
M18	The project design includes the use of natural gas to fuel the power plant and the other dual-fuel fired units at the Mine Site, which would result in lowering greenhouse gas (GHG) emissions by 9.6 million metric tons (MMT) CO_2-e during the mine life of 27.5 years compared to diesel fuel.	Process Plant	Operations	Air Quality Climate Change
M19	The project design includes use of selective catalytic reduction to minimize oxides of nitrogen emissions at the power plant.	Process Plant	Operations	Air Quality
M20	The project design includes the use of state-of-the-art mercury abatement systems at the kiln feed and discharge, pressure oxidation vent gas, and electrowinning cell fume hoods and gold refinery area to comply with federal Clean Air Act maximum achievable control technology regulations (40 CFR 63).	Process Plant	Operations	Air Quality

Table 5.2-1: Design Features

I.D.	Design Feature Description	Subcomponent	Project Phase(s)	Resource(s) Affected
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.	General Mine	Closure	Geology Soils Surface Water Hydrology Water Quality Vegetation Wetlands Fish and Aquatic Resources Socioeconomics Subsistence
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 reclamation, minimize the effects of PAG materials, minimize infiltration and erosion, and promote controlled surface runoff and revegetation.	TSF WRF	Closure	Geology Surface Water Hydrology Water Quality Vegetation
M23	Dewatering during Operations, as well as monitoring and maintenance of pit lake and groundwater levels during Closure and post-Closure, is designed to maintain overall groundwater flow gradients towards the pit, so that impacted mine contact water would not flow away from the Mine Site. Overall hydraulic containment is expected during all mine phases, including pit-filling in early Closure, due to head differences between groundwater away from the pit and lake level. Hydraulic containment would also continue in winter when no pumping occurs, due to summer stage management that accounts for expected rise in winter.	Pit	Operations Closure Post-Closure	Groundwater Hydrology Water Quality
M24	The project design includes maintenance of sufficient freeboard at the pit lake in post-Closure with several years of lead time to address pumping failures in order to prevent overflow to Crooked Creek.	General Mine	Post-Closure	Soils Surface Water Hydrology Water Quality
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.	TSF	Operations	Surface Water Hydrology Soils Air Quality
M26	Design of TSF liner includes allowance for differential settling due to permafrost and season.	TSF	Operations	Soils Water Quality Surface Water and 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 reclamation and closure plan and would be subject to approval by ADNR.	TSF	Closure	Water Quality Surface Water and Groundwater Hydrology
M28	A detailed Mercury Management Plan would be developed that describes mercury control systems, storage areas, inspections, training, hazard communication, and procedures for off-site transport and disposal (Donlin Gold 2015d). Implementation of this plan would minimize the potential for release of mercury to the environment through normal ancillary activities.	Process Plant	Operations	Air Quality Human Health Water Quality Soils Fish and Aquatic Resources
M29	A Fugitive Dust Control Plan and air quality permit requirements would be followed that describe BACTs and source testing for PM emissions, BMPs for controlling dust from site activities (including roads) and wind erosion, and training and performance assessment procedures (ADEC 2017i).	General Mine	Construction Operations Closure	Air Quality Human Health Water Quality Soils Fish and Aquatic Resources

Table 5.2-1: Design Features

I.D.	Design Feature Description	Subcomponent	Project Phase(s)	Resource(s) Affected
M30	BMPs and design guidelines would incorporate elements for avian protection from electrocution on above-ground powerlines. An example is the "Suggested Practices of Avian Protection on Power Lines: The State of the Art in 2006" (APLIC 2012).	Mine Site	Pre-Construction Construction Operations	Wildlife
M31	Seismic stability analyses of the southern pit wall in the post-Closure period would include analysis with high level seismic event possibilities (due to recovered groundwater levels), and would include discussion with permitting agencies in final design as to acceptable level of risk for the post-Closure pit. Experience gained during Operations as to performance and deformation of the pit walls would be taken into account if there is a need to modify location of the waste rock backfill accordingly (as a buttressing effect) to increase the post-Closure stability of the pit (BGC 2014j).	General Mine	Closure Post-Closure	Geohazards and Seismic Conditions
M32	Further investigation and revised seismic stability analysis of the WRF design criteria and plans for excavation at the WRF toe would continue to assess if deeper liquefiable materials exist and would require additional excavation during site preparation.[a]	General Mine	Pre-Construction	Soils Geohazards and Seismic Conditions[b]
M33	Slope stability would be monitored with sufficient lead time to preclude the potential for a breach to occur at the narrow geomorphic barrier between the Crooked Creek floodplain and the northwest pit crest.[cd]	General Mine	Operations	Geohazards and Seismic Conditions Water Quality
M34	The American Creek Landslide would be monitored during construction of the Lower Contact Water Dam (CWD) (see Sections 3.3.2.1.2 and 3.3.3.2.2), utilizing instrumentation such as an inclinometer and piezometer (BGC 2011c), for indications of downslope movement and the need for additional mitigation measures beyond the planned stabilization berm.[e]	General Mine	Pre-Construction Construction Operations	Geohazards and Seismic Conditions
M35	Donlin Gold's monitoring program would include monitoring and inspection of stream banks on Crooked Creek and tributaries, where water would be discharged, and corrective action plans for appropriate streambank protection in order to ensure erosion of stream banks does not occur.[fg]	General Mine	Operations	Fish and Aquatic Resources Water Quality
M36	The Alaska Pollutant Discharge Elimination (APDES) five-year permit would be reevaluated, as required, including water flow models and/or pit lake modeling as appropriate. The adequacy of post-Closure Water Treatment Plant (WTP) technology would also be reevaluated as pit lake water monitoring is conducted; and treatment technologies would be adjusted, as necessary, as a result of this evaluation.[h]	General Mine	Operations	Fish and Aquatic Resources Water Quality Climate Change
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.	General Mine	Operations	Water Quality
M38	A Mine Site wildlife protection plan (which may include elements typical to such plans as Avian Protection Plans) would be developed to identify measures to prevent birds or wildlife from accessing the TSF, the pit lake, or other mine waters.[i]	General Mine	Construction Operations	Fish and Aquatic Resources Wildlife Water Quality Climate Change Subsistence
M39	Agreements with Alaska Native landowners create contractual commitments to bidding preferences for Calista and TKC companies with respect to contracts for work on the Donlin Gold property.	General Mine	Construction Operations Closure Post-Closure	Environmental Justice Socioeconomics

[a] WRF design criteria and plans for excavation at the WRF incorporate assumptions with regard to depth of permafrost. Seismic analysis of the WRF indicates the possibility of instability in the event that liquefiable ice-rich soils are present beneath the WRF deeper than is currently known. If fine-grained and/or ice-rich soil conditions are present deeper than expected, the stability of the soils as they thaw is uncertain and could result in high intensity effects downgradient in the event of WRF deformation or slope failure (Section 3.2.3.2.3, Soils).
[b] Note: Impact is potential instability of built up area of WRF.
[c] BGC (2014j) suggests several possible options that could be considered during detailed design, and reassessed during Operations and Closure preparation as part of an adaptive management strategy, based on actual slope performance and geometry and future climate conditions:
- The cut slope angle in overburden at the top of the crest could be reduced by flattening and armoring with coarse rock fill to increase the stability of the slope and reduce the likelihood of erosion at flood stage.
- A berm or diversion dike could be placed at the crest of the pit to limit the likelihood of Crooked Creek reaching the pit crest at flood stage.
- A retaining wall could be constructed on the first bedrock bench below the crest to improve stability of the soil excavation at the crest.

[d] Mine Safety and Health Administration (MSHA) and ADNR Dam Safety and Water Section have potential jurisdiction.
[e] If warranted, adaptive management measures could include lowering of the water table through pumping wells, temporary buttressing of the slope, additional excavation of overburden, or layback of the slope crest to a stable configuration (BGC 2011c).
[f] Note: requires consultation with ADF&G.
[g] Details to be determined in permitting phase.
[h] Monitoring would follow ADEC permit requirements.
[i] Note: consultation with ADF&G and USFWS would be necessary for development of an effective plan.

Table 5.2-1: Design Features

I.D.	Design Feature Description	Subcomponent	Project Phase(s)	Resource(s) Affected
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).	General Mine	Operations	Water Quality Wetlands Wildlife Fish and Aquatic Resources Spill Risk Human Health
M41	Secondary containment would be provided for all fuel and chemical storage tanks to prevent release of stored contents to the environment.	General Mine	Construction Operations Closure Post-Closure	Spill Risk
M42	Construction camp and plant potable wells are sited on a groundwater interfluve (ridge) upgradient or side-gradient of potential future contaminant sources of mine contact water in American and Anaconda Creek drainages.	Construction Camp and Plant Site	Construction and Operations	Groundwater Hydrology and Water Quality
M45	The Reclamation and Closure Plan would be updated as required to keep current with operations, regulatory changes, and issues identified during the regular five-year third-party Environmental Compliance Audits. Each updated and revised Plan would contain sufficient detail to allow for calculation of estimated closure costs including post-closure maintenance and monitoring.	General Mine	Operations	Water Quality
Design Features in the Transportation Corridor				
T1	Ocean and river fuel barges would be double hulled and have multiple isolated compartments for transporting fuel to reduce the risk of a spill.	Barge	Construction Operations	Water Quality Wildlife Fish and Aquatic Resources Subsistence Spill Risk
T2	Mine transportation facilities, access routes, airstrips and other transportation infrastructure would be sited along ridge tops whenever possible to minimize wetlands and stream impacts.	General Transportation	Construction Operations	Water Quality Wetlands
T3	The barge operations system was designed to avoid the need for dredging the navigation channel in the river.	Barge	Construction Operations	Surface Water Hydrology Fish and Aquatic Resources Subsistence
T4	Specific siting of the new airstrip was conducted to minimize the amount of cut and fill required for runway construction.	General Mine	Construction	Geology Wetlands
T5	The routing of a small segment of the Alternative 4 – Birch Tree Crossing access road within the Yukon Delta National Wildlife Refuge was located on ANCSA Corporation inholdings to avoid impacts to refuge land management.	Road	Construction	Land Ownership, Management, and Use
T6	Donlin Gold would implement barge guidelines for operating at certain river flow rates, and conduct ongoing surveys of the Kuskokwim River navigation channel to identify locations that should be avoided to minimize effects on bed scour and the potential for barge groundings. As part of the proposed operation, equipment will be available to free or unload/lighter barges in the event of groundings. The equipment will be available as part of ongoing operations, it will not all be dedicated standby equipment.	Barge	Construction Operations	Surface Water Hydrology Fish and Aquatic Resources Socioeconomics Subsistence Spill Risk Climate Change
T7	Special ISO-approved water tight tank-tainers would be used for the transport of cyanide and the containers would be tracked during shipment. Design features for cyanide also include cyanide handling, storage, and transport in compliance with the ICMC.	General Transportation	Operations	Water Quality Wetlands Wildlife Fish and Aquatic Resources Spill Risk Human Health

Table 5.2-1: Design Features

I.D.	Design Feature Description	Subcomponent	Project Phase(s)	Resource(s) Affected
T8	The project design includes special flasks and metric ton containers for mercury transport.	General Transportation	Operations	Water Quality Wetlands Wildlife Fish and Aquatic Resources Spill Risk Human Health
T9	The project design includes a communication program, managed under purview of the DATROC Barge Subcommittee (see Design Feature A31), to keep local communities informed of the schedules and current status of barge traffic as well as minimize displacement of subsistence fishing by barges (see Appendix W for Donlin Gold's Barge Communication Plan). Donlin Gold would consult with people experienced with navigation on Kuskokwim River to incorporate local knowledge as they are designing their barging operations and guidelines. As contained in the communication plan, potential conflict would be avoided through the following steps: • Community Meeting Plan – annual community meetings before and after every barge season to outline the needs and expectations going into a season and debrief how things went after each season; • Additional Barging Status Updates – in-season communications via community meetings, newsletters, website, social media; • Barge Location Information System – system to view the current location and movement of project barges available to users of the river; • Stakeholder Communication with Barges – published VHF channels and vessel cellular phone numbers to contact the barges directly; and • Barge Communication with Stakeholders – deployment of pilot boat in congested and high use areas ahead of the barge arrival to coordinate safe passage of the barge. In the event of any barging-related conflict or concern, Donlin Gold is committed to resolving issues with stakeholders through an established conflict or concern resolution process (outlined in Section 6.0 of Donlin Gold's Barge Communication Plan).	Barge	Operations	Fish and Aquatic Resources Subsistence Transportation Human Health
T10	To reduce impacts on existing river traffic and potential for groundings and accidents, Donlin Gold would establish navigational aids and develop procedures for queuing in narrow channels. Donlin Gold vessels would use state-of-the-art navigation and communication equipment.	Barge	Construction Operations Closure Post-Closure	Fish and Aquatic Resources Subsistence Spill Risk Human Health
T11	The project design includes new, dedicated transportation equipment and infrastructure (such as the new port at Angyaruaq (Jungjuk), the Mine Site airstrip, and the double-hulled barges) that would minimize impacts to existing regional transportation facilities and activities.	General Transportation	Construction Operations Closure Post-Closure	Transportation Human Health
T12	Culverts and bridges on transportation routes would be designed for fish passage.	Road	Construction	Fish and Aquatic Resources
T13	Helicopters would be available for logistics to support activities such as monitoring/surveillance or special projects on the transportation corridor; which would reduce the need for overland travel and associated roads/trails.	General Transportation	Construction Operations	Wetlands Vegetation Transportation
T14	River pilots would be used for all tug and barge traffic between the mouth of the Kuskokwim River and Bethel (see Appendix W for Donlin Gold's Barge Communication Plan).	Barge	Construction Operations	Subsistence Water Quality Transportation
T15	Monitoring of bank erosion immediately upstream and downstream of Angyaruaq (Jungjuk) port would continue, with measures applied, as warranted, for streambank protection as part of adaptive management (as a Standard Operating Procedure). If warranted, this may include installation of geotextile matting, riprap armoring or methods from the ADF&G Streambank Revegetation and Protection Manual (Walter et al. 2005), such as willow staking, to reduce the effects of eddy formation, scour, and bank erosion during flood events (BGC 2014e).[j]	Barge	Construction Operations	Water Quality Fish and Aquatic Resources
T16	Barges would maintain speeds less than 10 knots (18.5 km/hr) and reduce speeds to 5 knots (9.3 km/hr) when approaching marine mammals to minimize the risk of vessel strikes.	Barge	Construction Operations	Threatened and Endangered Species

[j] Note: consultation with ADF&G would be required prior to installing streambank protection to determine the need for a fish habitat permit.

Table 5.2-1: Design Features

I.D.	Design Feature Description	Subcomponent	Project Phase(s)	Resource(s) Affected
T17	Donlin Gold would develop and implement a rainbow smelt monitoring program to establish additional baseline data for a better understanding of the species' occurrence and the character, use, and distribution of spawning habitat along the Kuskokwim River. Survey methodology would likely include documenting sex ratio and age structure of the population and if possible, fecundity of females. Initially, surveys would be conducted annually to document the age structure of the rainbow smelt population and further document spawning patterns. Once an adequate baseline is established, regular sampling would be used to monitor for changes to existing patterns. The frequency of surveys over the long-term would depend on previous results and whether the data indicate a potential shift. If rainbow smelt population changes are observed over a defined time period, additional work would need to be undertaken to investigate the reason for those changes. If observed changes were attributed to project-related activities, Donlin Gold would implement an assessment of measures available to address or mitigate those activities. Such activities would be coordinated with the DATROC Subsistence Subcommittee. (Donlin Gold 2018a)	Barge	Pre-Construction Construction	Fish and Aquatic Resources
Design Features in the Pipeline Component				
P1	Routing decisions were made taking into account baseline archeological studies to avoid identified cultural resource sites and historic properties where practicable.	General Pipeline	Pre-Construction	Cultural Resources
P2	The above-ground fault crossing of the pipeline was designed to resist surface fault rupture hazards, and would be designed to withstand the stress that could occur during a seismic event.	Fault Crossings	Construction Operations	Geohazards and Seismic Conditions Spill Risk Pipeline Reliability and Safety
P3	The project design includes a natural gas pipeline to decrease amount of barging to transport diesel fuel. The design decision to use a natural gas pipeline instead of barging 110 Mgal of diesel per year was in response to community concern about barge traffic levels.	General Pipeline	Construction Operations	Air Quality Subsistence Transportation Threatened and Endangered Species
P4	Burying the pipeline and blending with the natural setting minimizes the potential for pipeline to dominate the landscape and decreases visual impacts. The cleared pipeline ROW would be revegetated progressively throughout construction as segments of construction are complete. Vegetative cover would be maintained during Operations to the extent permitted under PHMSA regulations; minimizing visual contrast of ROW by blending with existing low vegetation or open areas. While the ROW would be revegetated, PHMSA regulations require brushing of the 50 foot ROW.	ROW	Construction Operations	Vegetation Visual Resources
P5	The project design includes routing decisions to minimize visual impacts to the Iditarod National Historic Trail (INHT) including co-location of the proposed pipeline with the INHT where appropriate to reduce multiple crossings by the pipeline and thereby reduce the possibility that the pipeline ROW becomes used as a separate trail.	Route	Construction Operations	Recreation Visual Resources Cultural Resources
P6	Donlin Gold will work with user groups to promote trail preservation and use. Any actual mitigation measures for impacts to the INHT would be determined through the Section 106 compliance process and application of the PA.	General Pipeline	Construction Operations	Recreation Visual Resources Cultural Resources
P7	Appropriate notices, warning signs, and flagging would be used to promote public safety. Barricades may also be used around dangerous areas such as open trenches during construction.	General Pipeline	Construction	Subsistence Pipeline Reliability and Safety
P8	Approximately 68 percent of the total pipeline length would be constructed during frozen winter conditions to minimize wetland and soil disturbances from support equipment. Areas selected for summer or fall construction would be based on geotechnical, terrain, safety, and continuity considerations.	General Pipeline	Construction	Soils Wetlands Fish and Aquatic Resources
P9	Construction would employ design measures to preclude extended soil compaction.	ROW	Construction	Soils Vegetation Recreation
P10	A special permit granted by PHMSA would allow the use of strain based design in areas where geotechnical hazards may be present to maintain equivalent levels of safety. The strain based design may use heavier wall pipe in these areas, rather than just using the wall thickness required for pressure containment, so that equivalent levels of safety are maintained.	General Pipeline	Construction	Geohazards and Seismic Conditions Spill Risk Pipeline Reliability and Safety

Table 5.2-1: Design Features

I.D.	Design Feature Description	Subcomponent	Project Phase(s)	Resource(s) Affected
P11	The project design includes use of BMPs at pipeline stream crossings (such as wattles, silt fence, brush berms, erosion control matting, etc.) to minimize alterations of the stream bed and bank erosion. It also includes design of pipeline depth of burial at stream crossings to avoid scour exposure of the pipe.	Stream Crossings	Construction	Surface Water Hydrology Water Quality Fish and Aquatic Resources Pipeline Reliability and Safety
P12	The project design includes routing of the pipeline and siting of the related compressor station along an existing corridor in Susitna Flats State Game Refuge to minimize impacts.	Route	Construction	Wildlife Fish and Aquatic Resources Subsistence Wetlands
P13	The project design includes routing of the pipeline to avoid private lands (outside of ANCSA Corporation lands) to the maximum extent possible (e.g., in the vicinity of state disposals of remote parcels near Farewell or Happy Valley).	Route	Construction	Land Ownership, Management, and Use
P14	Donlin Gold has studied various pipeline corridors that would avoid and/or minimize adverse effects to the INHT. The most significant route modifications are described below and have been incorporated into the analysis: • Jones Route Alternative – incorporation of the Jones Route Alternative would remove all contact between the pipeline ROW and the INHT through Rainy Pass north of Threemile Creek, Dalzell Gorge, Rohn Cabin, and South Fork Kuskokwim areas (Alternative 6A). • North Route Option – incorporation of the North Route Option would relocate the proposed pipeline corridor from the south to the north side of the Happy River, from the junction of the Happy and Skwentna rivers, to Threemile Creek. This option would avoid adverse impacts to the Happy River Steps, eliminate a large number of crossings with the INHT, and eliminate several miles of INHT trail and pipeline ROW collocation.	Route	Construction	Land Ownership, Management, and Use Recreation Visual Resources Cultural Resources
P15	Pipeline construction schedules were adjusted to minimize impacts to peak periods of recreation and tourism activities in the area (e.g., recreation uses of INHT for annual events).	General Pipeline	Construction	Recreation Cultural Resources
P16	Donlin Gold would coordinate with and help educate people who want to travel in the area during the pipeline construction period through its Public Outreach Plan to either allow controlled access through or within construction zones or identify alternate access.	General Pipeline	Construction	Subsistence Recreation Pipeline Reliability and Safety
P17	The project design includes avoiding areas with tourist-related facilities if reasonably possible. Donlin Gold would engage with lodges and guides in advance of construction to coordinate activities and reduce impacts if practicable during important seasons.	General Pipeline	Construction	Recreation Socioeconomics
P18	The project design includes locked security fencing surrounding aboveground facilities.	Facilities	Operations	Recreation Pipeline Reliability and Safety
P19	The ROW would be reclaimed progressively throughout construction to minimize erosion effects on exposed bedrock and surficial deposit cuts.	General Pipeline	Construction Closure	Geology Soils Surface Water Hydrology Vegetation
P20	The project design includes in-place abandonment of all subgrade pipeline; avoiding impacts that would occur if the pipe were removed.	General Pipeline	Closure	Soils Vegetation
P21	The pipeline route has been selected, and will continue to be refined in detailed design, to avoid slope stability hazards as much as feasible and practical.	General Pipeline	Construction Operations	Geohazards and Seismic Conditions Pipeline Reliability and Safety
P22	Main line valves (block valves) would be placed at intervals of no more than 20 miles along the length of the pipeline to minimize loss of contents during a leak event.	General Pipeline	Construction Operations	Pipeline Reliability and Safety Spill Risk

Table 5.2-1: Design Features

I.D.	Design Feature Description	Subcomponent	Project Phase(s)	Resource(s) Affected
P23	The project design includes installation of pipeline components (temporary roads and pipelines) at most water bodies and wetlands primarily in the winter months when frozen ground and snow are present, flows are lowest, and disturbance of the river, stream banks, and local groundwater would be minimized, or by using horizontal directional drilling (HDD) technology to avoid flow impacts at major pipeline river crossings.	Pipeline	Construction	Soils Surface Water Hydrology Ground Water Hydrology Water Quality Wetlands
P24	Donlin Gold would conduct a public outreach program that would include information regarding participation in the "One-Call" program, hazards associated with the unintended release of natural gas, unintended release indicators, and reporting procedures.	Pipeline	Operations	Spill Risk Pipeline Reliability and Safety
P25	An HDD plan would be developed for each HDD river crossing to reduce potential effects from "frac-out," which can occur if drilling fluids are lost into fractures or voids and released into the river above. Details of the plan TBD.[k]	General Pipeline	Pre-Construction Construction Operations	Pipeline Reliability and Safety Spill Risk
P26	Donlin Gold proposes the following measures to minimize potential adverse effects to the INHT. Final details of mitigation measures for impacts to the INHT would be determined through the Section 106 compliance process and application of the PA. • Visual Documentation – Collection of photo and video documentation of the INHT scenic area during winter conditions from the Skwentna Crossing to Three-mile Creek, and at Egypt Mountain. • Pipeline Construction at INHT Crossings – As practicable, construction of pipeline ROW / INHT crossings in a manner that minimizes the observer's view of the pipeline ROW. This may include narrowing and/or feathering of the pipeline construction ROW and placement of visual barriers such as vegetation, brush piles, and/or berms. • Placement of Surface Infrastructure – As practicable, placement of mile markers, main blocks valves, and cathodic protectors at inconspicuous locations to avoid or minimize their view from the INHT. • Material Site MS-25 – Reevaluation of the need to develop Material Site 25 (MS-25) during detailed construction planning. MS-25 may not be required and thus, not developed. If required, Donlin Gold would investigate means to minimize adverse effects by reducing the area of disturbance of the material site. If developed, MS-25 would be reclaimed by re-contouring the area to blend with the surrounding environment and methods would meet State of Alaska reclamation requirements. Visual barriers may also be installed, depending on the final configuration of the development at MS-25. • Communication and Coordination – Communication and coordination with INHT trail users (including the Iditarod Trail Committee and the Iron Dog) about pipeline construction plans and progress to enable free and safe passage at INHT/construction ROW crossings. Through its Public Outreach work, Donlin Gold would also provide information regarding pipeline construction and maintenance activities. • Donlin Gold INHT Annual Endowment – Providing the INHTA with an annual endowment. Donlin Gold believes the proposed funding offer is proportionate to the INHT significance and integrity, and is conservative with respect to the scale of the effects.	General Pipeline	Pre-Construction	Visual

[k] Plan elements typically include:
- Findings of geotechnical investigations, geologic cross-sections, construction drawings, and specifications;
- Cross-sections should include vertical and lateral extent of channel migration zone to avoid river scour exposing the pipe during Operations and post-Closure;
- Construction techniques, including information on equipment layout, welding, surveying, grouting, and disposal of spoils and drilling fluids;
- Description of the drilling fluid system, identification of points where potential failure would occur (pilot hole, hole reaming, and pullback), and prevention measures;
- Mud management plan to track that the amount of drilling mud going into the system is the same as that coming out;
- Turbidity monitoring during drilling, both upstream and downstream of the crossing; and
- Spill contingency plan for a release underwater or to the ground.

5.3 BEST MANAGEMENT PRACTICES AND PERMIT REQUIREMENTS

Donlin Gold would follow BMPs and industry standards required to comply with regulations and standard permit requirements that are designed to reduce impacts to the environment (SRK 2016a, 2013b). The Corps took these BMPs and permit requirements into consideration when assessing the impacts of the project on the resources as described in Chapter 3, Environmental Analysis. This section describes the robust permitting process and regulatory standards for large mine projects in Alaska and summarizes some of the more prominent BMPs and standard permit conditions that would likely be required for the Donlin Gold Project.

5.3.1 PERMITTING FOR LARGE MINE PROJECTS IN ALASKA

Numerous state, federal, and local government permits and approvals are required before development and operation of a mining project in Alaska can begin. Relevant permits and regulatory requirements for the Donlin Gold Project are described in Section 1.7 (Chapter 1, Purpose and Need) and Appendix AA. These permitting processes and regulatory requirements are established to ensure that projects are designed, operated and reclaimed in a manner consistent with applicable laws and regulations. Among these are the CWA, which in part requires Alaska Pollutant Discharge Elimination System (APDES) water quality permits for waste water discharges (including stormwater), and the Clean Air Act (CAA), which requires air quality permits and associated BMPs (EPA 2015).

Under the CWA and Oil Pollution Act (OPA) regulations (40 CFR Part 112), the EPA requires facilities that store, use, and manage petroleum products to develop Spill Prevention, Control and Countermeasure (SPCC) Plans and Facility Response Plans (FRP).

Under Sections 165 and 502 of the CAA (42 USC 7401 et seq.), the Alaska Department of Environmental Conservation (ADEC) is delegated authority to issue air quality permits for facilities operating within state jurisdiction for the Title V operating permit (40 CFR Part 70) and the Prevention of Significant Deterioration (PSD) permit (40 CFR 52.21) to address air pollution emissions. The EPA maintains oversight authority of the State's program.

The project will require ROW authorizations from the BLM and the Alaska Department of Natural Resources (ADNR) for the natural gas pipeline. BLM regulations at 43 CFR 2885.11(b) allow the BLM to require that a holder of a ROW grant or temporary use permit furnish a bond, or other security satisfactory to secure all or any of the obligations imposed by the ROW grant and temporary use permits and applicable laws and regulations. The ADNR's State Pipeline Coordinator's Section (SPCS) issues ROW leases for pipeline transportation systems that are on or cross state lands. Applicants for a ROW lease are required to prepare numerous plans such as surveillance and monitoring, fire prevention and suppression, erosion and sedimentation, restoration and revegetation of disturbed areas, groundwater control, comprehensive waste management plans, wildlife avoidance and human encounter / interaction plan, and more. Plans may apply just to the construction phase or may be required to be updated over the life of the pipeline, if applicable to the operations and termination phases. Additionally, the SPCS requires that lessees perform a wide range of other processes such as reporting incidents, ensuring access to state lands, protecting health and safety of all persons affected by pipeline activities, and protecting cultural resources. The SPCS reviews plans in coordination with other state agencies and develops project-specific stipulations that are required as part of the ROW lease.

An Oil Discharge Prevention and Contingency Plan (ODPCP), required by the ADEC under 18 AAC 75.425, describes the response actions, equipment, procedures, and other required elements necessary to rapidly respond to and manage an oil spill response.

In order to coordinate State agency permitting and integrate with federal and local permitting for large mining projects, the State of Alaska has developed a Large Mine Permitting Team (LMPT) process. Each LMPT is an interagency group of regulatory experts that works cooperatively with large mine applicants and operators, federal resource agencies, and the Alaska public to ensure that projects are designed, operated and reclaimed in a manner consistent with state laws and regulations. The goal of the LMPT process is to coordinate the sequencing and intergovernmental review of the numerous permits required of a large, complex hardrock mine. The following is a summary of the general process the state follows (ADNR 2017b):

Pre-Application. One of the first tasks for the LMPT is to work with the potential applicant to ensure the pending permitting process and regulatory requirements are understood, that appropriate baseline environmental data are collected, to define application information requirements, and develop a realistic schedule.

Permit Application. The applicant submits an application package, typically consisting of the Plan of Operations, Reclamation Plan, Waste Management Plan, reclamation and closure cost estimates, associated monitoring and management plans, and baseline study reports. The LMPT reviews the package to make sure all the necessary information for a complete review is included.

Review and Analysis. The LMPT collaboratively reviews the proposed plans and supporting documents to inform their respective agencies' permitting decisions and to ensure the project design complies with all applicable state laws and regulations.

Issues Resolution. The team works with the applicant to resolve issues, usually resulting in modifications to the project design, operation, and monitoring plans.

Public Notice and Permit Issuance. Draft Plan of Operations Approval, Reclamation Plan Approval, Integrated Waste Management Permit, and financial assurance costs are publicly noticed together with final proposed plans and supporting documents from the applicant. Public comments are reviewed by the LMPT and incorporated, as appropriate, into final agency approvals, which are then posted publicly on ADNR's Large Mine Project website.

Post Permit Issuance. Once the permits are issued and construction and operation begins, the LMPT is active in permit maintenance, site inspections, and compliance monitoring.

Reclamation and Final Closure. The LMPT ensures that reclamation and closure objectives are met, including long-term environmental management, and that financial assurances are in place to ensure an orderly and stable closure.

Funding the LMPT Process. OPMP establishes a Memorandum of Understanding (MOU) with each applicant and Reimbursable Service Agreements (RSAs) with each participating state agency to reimburse the State's costs for the LMPT process. An MOU does not guarantee an applicant receives any of the required permits, rather it provides the means for the State to dedicate experienced staff to the coordinated permitting effort. These agreements are renewed annually, and "not-to-exceed" limitations are applied to help control costs.

5.3.2 BEST MANAGEMENT PRACTICES

Summaries of the BMPs considered to assess impacts of the project on resources are discussed under each resource in Chapter 3. A partial list of more prominent BMPs and standard permit conditions that would likely be required for the Donlin Gold Project includes:

- Using secondary containment for the storage of all fuel and hazardous or dangerous materials at the shipping terminals, Mine Site area, and gas pipeline alignment during all phases of the proposed project to prevent potential releases from fuel handling, tank failures, or contaminated stormwater from reaching the aquatic environment;
- Designing and installing culverts and bridges on transportation routes for fish passage;
- Implementation of Stormwater Pollution Prevention Plans (SWPPPs) and/or Erosion and Sediment Control Plans (ESCPs) and use of industry standard BMPs for sediment and erosion control;
- Development and maintenance of ODPCPs, SPCC Plans, and FRPs;
- Use of BMPs such as revegetation planning, watering and use of dust suppressants to control fugitive dust;
- Preparation and implementation of a Reclamation and Closure Plan (SRK 2017f);
- Compliance with ADNR Dam Safety requirements through certificates of approval to construct and operate dams to include preparation of Emergency Action Plans and completion of a Failure Modes Effects Analysis (FMEA);
- Appropriate bonding/financial assurance required by ADNR, ADEC, and BLM;
- Compliance with ADNR Temporary Water Use Authorization conditions for water withdrawal, such as screening requirements to avoid fish entrainment or injury, establishing water withdrawal rates and volumes, and as appropriate timing of water withdrawal to avoid fish migration, spawning, and incubating eggs;
- Monitoring of water withdrawals to ensure permitted limits are not exceeded;
- Potable well siting, construction, treatment, monitoring, and decommissioning in accordance with ADEC source water assessment and drinking water protection programs; and use of waste management BMPs under RCRA and ADNR solid waste programs (SRK 2016b) to minimize potential wellhead sources of contamination to drinking water wells;
- Preparation and implementation of a Wildlife Avoidance and Human Encounter/Interaction Plan;
- Verification that project vessels are equipped with proper emergency towing equipment in accordance with 18 AAC 75.027(f);
- Development of Blasting Plans;
- Development of Invasive Species Prevention and Management Plan (ISPMP) and application of industry-standard BMPs relating to nonnative invasive species (NNIS) prevention and management;

- Compliance with Section 106 Programmatic Agreement (PA) and Cultural Resources Management Plan (CRMP), including adequate survey prior to ground-breaking activities and protocol for inadvertent discovery of cultural resources;
- Compliance with Alaska Ambient Air Quality Standards (AAAQS), National Ambient Air Quality Standards (NAAQS), and Prevention of Significant Deterioration (PSD) increments.
- Verifying pipeline integrity with visual and other non-destructive inspections of welds, hydrostatic testing, use of in-line inspection tools, and aerial inspections;
- Use of cathodic protection (specific method to be determined in final design) for corrosion protection of the steel pipeline;
- Monitoring Mine Site facilities and associated surface water and groundwater, water in Crooked Creek, and discharge water from WTPs during all project phases; as established in State of Alaska permits to ensure the proper reclamation is completed for the protection of aquatic resources in Crooked Creek; and
- Compliance with permit provisions established by the State of Alaska to ensure the proper protection of aquatic resources in Crooked Creek pursuant to the Appropriation and Use of Water (11 AAC 90.035-147), Anadromous Fish Act (AS 16.05.871-901), and Fish Passage Act (AS 16.05.841).

5.4 STRAIN-BASED DESIGN SPECIAL PERMIT CONDITIONS

Donlin Gold anticipates there will be areas along the pipeline with potentially frost unstable soils or ground movement, and has applied for a Special Permit from PHMSA to allow Strain-Based Design (SBD) of segments of the pipeline (Docket No. PHMSA-2016-0149). SBD involves advanced metallurgy and engineering to allow the pipe to deform in the longitudinal direction and better maintain its integrity and safety. PHMSA issues special permits only when consistent with pipeline safety. PHMSA imposes conditions on the grant of special permits to assure safety and environmental protection in accordance with 49 CFR 190.341. PHMSA is required to comply with NEPA in deciding whether to issue the special permit. Appendix E includes PHMSA Enclosure B. The Special Permit includes conditions to ensure the pipeline has equal or greater safety than a pipeline constructed in accordance with 49 CFR Part 192. Appendix E lists those conditions that take into account the material, design, construction, and operations and maintenance (O&M) parameters, which a pipeline operated using SBD must incorporate during its operating life cycle.

5.5 AGENCY-CONSIDERED MITIGATION

Mitigation measures listed in this section were developed for consideration by the Corps and cooperating agencies to further minimize project impacts, as reasonable and practicable. The measures were developed based on analysis of project impacts and through input from federal, state and Tribal cooperating agencies, as well as the public through comment on the Draft EIS.

Agency considered mitigation put forward for discussion in this section is used to inform agencies with individual permit reviews and authorizations as an outcome of the NEPA process. It should be recognized that many of the permits required for approval of the Donlin Mine are under the jurisdiction of the State of Alaska. Specific agencies may have clear

compliance standards and requirements for monitoring of environmental conditions; future risks associated with unexpected conditions may also be addressed in specific permitting authorizations. Potential mitigation and monitoring measures put forward for consideration in the EIS are not intended to dictate conditions of State permit approval, but to identify potential measures for consideration as applicable. In assessing potential mitigation measures and monitoring, agencies may take into account whether they have:

1) "boots on the ground" to implement mitigation;
2) Adequate resources to enforce mitigation or a source of funding to do so; and
3) Measurable metrics in the mitigation measure to assess compliance and performance.

Development of a comprehensive list of design features, mitigation measures, and monitoring for assessment in the EIS was the primary goal of the mitigation workshops in 2015 and 2017. During the NEPA process it is important to note that the mitigation identified in the EIS may not be required by the federal agencies in their RODs. For example, CEQ guidance uses terms such as "reasonable, practicable, and appropriate" when considering potential mitigation and permit conditions. In addition, there may be potential mitigation measures identified in the EIS that are not within the federal agencies' authority to require as a condition to a permit. The ROD would identify those mitigation measures that the agency has committed itself to adopt and explain why any other practicable mitigation measures have not been adopted. It is also possible that some of the individual mitigation measures listed in this section may be adopted by Donlin Gold and incorporated into project plans as design features.

The Corps may continue to refine required mitigation subsequent to completion of the EIS and issuance of their ROD during the permit application review process, and other permitting agencies may do likewise. Additional mitigation identified during that process may include project modifications that are in part considered feasible from a cost and constructability perspective. For unavoidable impacts to aquatic resources, Donlin Gold will propose compensatory mitigation. All compensatory mitigation required by the Corps must be directly related to the impacts of the proposed project, appropriate to the scope and degree of those impacts, and reasonably enforceable (see Section 5.6, Compensatory Mitigation).

The overall assessment of the measures identified in this section takes into consideration SME judgement, as well as input from cooperating agencies, on whether a suggested mitigation measure would be effective in addressing and reducing the nature of a potential impact, and considers NEPA/CWA Section 404(b)(1) guidance on what is "reasonable, practicable, and appropriate" for mitigation. Guidance includes the following:

- Reasonable (NEPA) – must be capable of achieving the basic project goal; and
- Practicable (CWA) – available and capable of being done after taking into consideration cost, existing technology, and logistics in the light of overall project purpose. The terms "common sense" and "unreasonably expensive or exorbitant" are also used.

Based on recommendations from the mitigation workshops, public review comments , and the guidance above, the tables in this section are organized by:

- A description of the mitigation measure;
- Assessment of the mitigation measure. This assessment is in response to NEPA guidance that balances the need for a thorough look at potential mitigation measures with the

emphasis on mitigation measures that can be practicably and legally implemented under agency authority. The column includes:

  - "Likelihood of Implementation" assessment: probability or likelihood that the mitigation measure would be adopted by responsible agencies and could be reasonably enforced (Low, Medium, High);
  - "Effective" assessment: the mitigation measure would be effective in reducing the impact (Yes / No / Potentially); and
  - "Reasonable / Practicable" assessment: the mitigation measure achieves the basic project goal and is capable of being done after taking into consideration cost, existing technology, and logistics (Yes / No / Potentially);

- The project phase the mitigation applies to (Construction [in some cases, the term pre-Construction is applied, in which the proposed design feature activities would incorporate actions that would take place prior to Construction activities], Operations, Closure [in some cases, the term post-Closure is applied, to refer to a period of time after the Closure Phase]);
- The specific resource(s) affected (based on the resources discussed in Chapter 3 of this document), in no particular order; and
- Potential jurisdiction, in no particular order, identifying the agency with potential jurisdiction for requiring, enforcing, and / or overseeing the mitigation measure or some aspect of the measure may potentially fall under the purview of the listed agency. Where there is no clear regulatory authority to require, enforce, and / or oversee the mitigation measure the cell will indicate "None".

Table 5.5-1A includes the measures identified or recommended during the NEPA process that are being considered by the Corps and cooperating agencies as part of their permit decisions to further minimize project impacts. Table 5.5-1B includes the measure identified or recommended during the NEPA process that are assessed by the Corps as not likely to be effective and / or reasonable / practicable and therefore are not likely to be required in a ROD or permit. Where appropriate, the following numbered notes are used to indicate the rationale of the conclusion, indicated in the "Assessment of Measure" column:

1. The measure is assessed to be not effective in reducing the potential impact.
2. The measure is assessed to be not reasonable in terms of cost.
3. The measure is assessed to be not reasonable in terms of existing technology.
4. The measure is assessed to be not reasonable in terms of logistics, including safety.
5. The measure is assessed to be not appropriate until monitoring indicates that an impact is observed.
6. The measure is assessed to be not effective in being able to determine the contribution of Donlin Gold actions to overall impacts.
7. The measure is assessed to not be reasonably enforceable, there is no clear authority to require the applicant to implement the measure, or the measure conflicts with existing laws / regulations.

8. The measure is assessed to be not directly related to a project impact, is unsupported by the effects analysis for the resource affected, and/or the effectiveness of reducing impacts is unknown, unsupported, and/or unclear.
9. The measure, as suggested, lacks detail/specificity for effective implementation and/or enforcement.

Table 5.5-1A: Mitigation Measures Being Considered

Mitigation Measure Description	**Assessment of Measure**: Likelihood of Implementation (Low, Medium, High) Effective (Yes/No/Potentially) Reasonable/Practicable (Yes/No/Potentially)	Project Phase(s)	Resource(s) Affected	Potential Jurisdiction
Train site construction managers to oversee work of specialists in wetland recognition, permit stipulations, and BMPs.	Likelihood of Implementation: Medium Effective: Yes Reasonable/Practicable: Yes	Pre-Construction	Wetlands	Corps
Prior to pipeline construction, the specific location of potentially contaminated soils should be mapped compared to final grading plans at the Farewell airstrip (all action alternatives), North Foreland barge landing, Tyonek-Beluga pipeline trench segment, and Puntilla airstrip (Alternative 3B). Disturbance of these soils can then be avoided if possible, and the impacts reduced. Clear documentation of the current, contaminated sites would also reduce liability for the developer.	Likelihood of Implementation: Medium Effective: Yes Reasonable/Practicable: Yes	Pre-Construction	Soils	ADEC
Develop Plans and Procedures for notification, documentation, sampling, and curation in the event that scientifically important paleontological resources (e. g., dinosaur fossils) are found during ground disturbing activities.	Likelihood of Implementation: High Effective: Yes Reasonable/Practicable: Yes – would be addressed as a part of the CRMP (see A30 in Table 5.2-1).	Pre-Construction Construction Operations	Geology (Paleontological Resources)	BLM ADNR Corps
Schedule Pipeline component Closure Phase activities to occur during the winter season (similar to how Construction Phase activities are scheduled) to minimize surface disturbances to soil and erosion potential.[l]	Likelihood of Implementation: Medium Effective: Yes Reasonable/Practicable: Potentially – specific closure details would be developed at the beginning of the closure phase in consultation with the land management agencies.	Closure	Soils	BLM ADNR
Where practicable, leave riparian bank vegetation material intact or, where needed and practicable, store for replacement on the disturbed banks to stabilize and restore the crossing. Monitoring of crossing sites to identify sites that need additional restoration to prevent bank erosion should be implemented after construction. At stream bank crossings, placement of riparian mats or root masses would be placed to facilitate rapid vegetation regrowth to prevent bank erosion.	Likelihood of Implementation: Medium Effective: Yes Reasonable/Practicable: Yes – in limited situations where salvaged material can be stored nearby and reused in a timely way; may not be practicable during winter.	Construction	Vegetation Wetlands	ADNR[m] BLM Corps
Mark wetland boundaries and vegetation clearing limits with flagging or other markers to prevent crews from damaging more vegetation than needed during construction.	Likelihood of Implementation: High Effective: Yes Reasonable/Practicable: Yes – standard conditions in permits such as ADPES and Corps 404.	Construction	Vegetation Wetlands	ADNR Corps BLM

[l] The season of final pipeline termination and reclamation activities is not specified in current pipeline plans (SRK 2013b).
[m] Note: Consultation with ADF&G would be necessary to determine the need for a permit for streambank protection/restoration activities.

Table 5.5-1A: Mitigation Measures Being Considered

Mitigation Measure Description	**Assessment of Measure**: Likelihood of Implementation (Low, Medium, High) Effective (Yes/No/Potentially) Reasonable/Practicable (Yes/No/Potentially)	Project Phase(s)	Resource(s) Affected	Potential Jurisdiction
Where practicable, for winter pipeline construction access roads, frost pack muskegs and wetlands (the combination of covering with snow and driving on it causes freezing at depth and provides a slightly elevated running surface) to minimize impacts to vegetative ground cover and wetlands.	Likelihood of Implementation: Medium Effective: Yes Reasonable/Practicable: Potentially - may have limitations depending on winter weather conditions and access.	Construction	Vegetation Wetlands	ADNR BLM Corps
Where practicable, promote salvaging and re-spreading topsoil over the overburden piles and allowing native vegetation and native seed planting vegetation growth to keep topsoil viable until it is needed during final reclamation. In pipeline reclamation practices, segregate windrowed organic soils as cover material (where present).	Likelihood of Implementation: Medium Effective: Yes Reasonable/Practicable: Potentially – to the extent space is available for topsoil storage, topsoil is available for reclamation, and topsoil can be effectively stored and kept viable.	Construction Operations Closure	Soils Vegetation	ADNR
Minimize use of an impact pile driver where practicable in noise and vibration-sensitive areas. Drilled piles or the use of a sonic or vibratory pile driver are quieter and cause lower vibration levels where the geological conditions permit their use.	Likelihood of Implementation: Medium Effective: Yes Reasonable/Practicable: Yes – where geographically and seasonally applicable to project activities.	Construction	Noise and Vibration Recreation	Corps USFWS NMFS ADF&G
Install signs that clearly distinguish trails from the pipeline ROW at points where the pipeline crosses trails to guide trail users to stay on the trail and off of the pipeline ROW where the two are not collocated. As practicable, revegetate, or otherwise block access to, a narrow strip of the pipeline ROW where it crosses the trail to help steer and keep trail users on the trail and reduce the visual effect of the pipeline ROW crossing.	Likelihood of Implementation: High Effective: Yes – to the extent public observes signs. Reasonable/Practicable: Potentially – blocking access to the pipeline ROW subject to landowner approval (see Design Feature P26 for measure proposed to reduce visual impacts to the INHT).	Construction Operations Closure	Recreation Visual Land Ownership, Management, and Use Subsistence	ADNR BLM Landowners
Where practicable, when clearing brush and shrubs as required to maintain the operations ROW, introduce variation in the edges of clearing (i.e., avoid extended straight lines) to minimize effects to visual resources.	Likelihood of Implementation: High Effective: Yes Reasonable/Practicable: Yes – measures to mitigate visual impacts to cultural resources, specifically the INHT, would be addressed as a part of the Section 106 compliance process and specified in the PA (see Design Feature P26).	Operations	Visual Resources	ADNR BLM
Include measures to mitigate visual impacts to known sensitive cultural resource areas, such as clearing a narrower construction ROW, using HDD drilling under a sensitive site, minor realignment of the construction ROW, or other appropriate measures to avoid known sensitive areas.	Likelihood of Implementation: High Effective: Yes Reasonable/Practicable: Yes – measures to mitigate visual impacts to cultural resources, specifically the INHT, would be addressed as a part of the Section 106 compliance process and specified in the PA (see Design Feature P26); although they may not be the specific examples identified in this measure.	Construction	Visual Resources	ADNR BLM Corps

Table 5.5-1A: Mitigation Measures Being Considered

Mitigation Measure Description	**Assessment of Measure**: Likelihood of Implementation (Low, Medium, High) Effective (Yes/No/Potentially) Reasonable/Practicable (Yes/No/Potentially)	Project Phase(s)	Resource(s) Affected	Potential Jurisdiction
To control dust, reclaim the dry stack tailings incrementally rather than wait until Closure (Alternative 5A), to the extent practicable.	Likelihood of Implementation: Medium Effective: Potentially – progressive reclamation would reduce infiltration on some slopes, but others would remain open for continued stacking through operations. Reasonable/Practicable: Potentially – depends on the sequence of dry stack tailings (DST) placement.	Operations Closure	Air Quality Human Health	ADNR
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.	Likelihood of Implementation: Medium Effective: Yes Reasonable/Practicable: Potentially – subject to approval from ADNR.	Construction Operations Closure	Spill Risk Dam Safety Human Health Geohazards and Seismic Conditions	ADNR
Complete a model run for the pit lake during post-Closure to confirm that containment will occur in the winter when there will be no pumping.	Likelihood of Implementation: High Effective: Yes Reasonable/Practicable: Yes	Closure	Groundwater Hydrology Water Quality	ADNR
Restore wetlands instead of simply reclaiming the mine and Jungjuk port facilities (e.g., Lower CWD, ore stockpile berm/sump, SOB, and barge landing).	Likelihood of Implementation: Medium Effective: Potentially Reasonable/Practicable: Potentially – wetland restoration addressed as part of the Section 404 permitting process and the Compensatory Mitigation Plan (CMP).	Closure	Wetlands	Corps
Apply measures to reduce substantial grading of hillsides for the pipeline ROW, on a site-specific basis.	Likelihood of Implementation: Medium Effective: Potentially Practicable: No (9)	Construction	Soils Vegetation	BLM ADNR
Apply measures to reduce the initial clearing requirements for the ROW, on a site -specific basis. Avoid vegetation clearing during the bird nesting season.	Likelihood of Implementation: Medium Effective: Potentially Reasonable/Practicable: Potentially (9)	Construction	Vegetation Wildlife	BLM ADNR
Evaluate use of slope breakers and trench breakers at wetlands boundaries to prevent trenches from draining wetlands.	Likelihood of Implementation: Medium Effective: Yes Reasonable/Practicable: Potentially (9)	Pre-Construction Construction	Wetlands	ADNR BLM Corps
During final design locate any potential vegetation buffers to reduce visual impacts.	Likelihood of Implementation: Medium Effective: Yes Reasonable/Practicable: Potentially – in locations where measure is assessed to be practicable. This would be addressed as a part of the Section 106 compliance process for mitigation associated with the INHT and specified in the PA as practicable (see Design Feature P26). (9)	Pre-Construction Construction	Visual	ADNR BLM Landowners

Table 5.5-1A: Mitigation Measures Being Considered

Mitigation Measure Description	**Assessment of Measure**: Likelihood of Implementation (Low, Medium, High) Effective (Yes/No/Potentially) Reasonable/Practicable (Yes/No/Potentially)	Project Phase(s)	Resource(s) Affected	Potential Jurisdiction
To the extent practicable, avoid wetlands in the positioning of temporary construction facilities, including camps.	Likelihood of Implementation: High Effective: Yes Reasonable/Practicable: Yes – wetland avoidance is addressed as part of the Corps Section 404 permit process.	Construction	Wetlands	Corps
Where appropriate, employ seasonal timing restrictions on blasting, as stipulated by resource agencies, to reduce noise related effects of blasting during sensitive subsistence hunting activities (e.g., fall moose hunting).	Likelihood of Implementation: Medium Effective: Potentially Reasonable/Practicable: Potentially – Dependent on blasting location and construction schedule. (9)	Construction	Wildlife Subsistence	ADNR BLM
Develop a sampling and analysis plan to ensure PAG rock and other sources of contaminants are not used for construction at the mine or for road surfacing (i.e., where such construction could lead to surface water quality impacts).	Likelihood of Implementation: High Effective: Yes Reasonable/Practicable: Yes	Pre-Construction Construction	Water Quality	ADNR Corps
Frost pack the pipeline trench cover in bogs and fens, cut the trench cover in blocks, set the blocks aside during construction and replace them over the trench fill afterwards.	Likelihood of Implementation: Medium Effective: Potentially Reasonable/Practicable: Potentially – dependent on location. Not likely feasible on a large scale. (4, 9)	Construction	Vegetation Hydrology	ADNR BLM Corps
Segregate wetlands soil for use in wetland mitigation to the maximum amount practicable.	Likelihood of Implementation: Medium Effective: Yes Reasonable/Practicable: Potentially – for limited locations along the pipeline but not likely feasible at the Mine Site due to the scale/size of the operation. (9)	Construction	Vegetation Hydrology	ADNR BLM Corps
During construction of the pipeline, avoid wetlands impacts by placing above ground appurtenances away from floating bogs and fens.	Likelihood of Implementation: High Effective: Yes Reasonable/Practicable: Yes – although feasibility would need to be assessed at specific locations.	Construction	Wetlands	Corps
To the extent practicable, bury all transmission lines to reduce potential impacts to visual resources and birds from overhead lines.	Likelihood of Implementation: Medium Effective: Potentially Reasonable/Practicable: Potentially – in locations where measure is assessed to be practicable. (8)	Construction	Visual Wildlife	ADNR Landowners
Place mercury monitors at locations in the workplace where mercury vapor is collected to ensure that workers are not exposed by inhalation.	Likelihood of Implementation: Medium Effective: Potentially Reasonable/Practicable: Potentially – placement of mercury monitors subject to OSHA regulations.	Operations	Human Health	OSHA
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.[n]	Likelihood of Implementation: Medium Effective: Potentially Reasonable/Practicable: Potentially (9)	Pre-Construction Construction Operations	Water Quality Geohazards and Seismic Conditions	ADNR

[n] Under the current tailings deposition plan, significant lengths of the TSF liner around the perimeter of the impoundment could be exposed to potential damage from ice loading during Operations (SRK 2016f).

Table 5.5-1A: Mitigation Measures Being Considered

Mitigation Measure Description	**Assessment of Measure**: Likelihood of Implementation (Low, Medium, High) Effective (Yes/No/Potentially) Reasonable/Practicable (Yes/No/Potentially)	Project Phase(s)	Resource(s) Affected	Potential Jurisdiction
Conduct an electrical leak detection survey of the TSF liner, 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.	Likelihood of Implementation: Medium Effective: Potentially Reasonable/Practicable: Yes	Construction	Groundwater Hydrology Water Quality	ADNR
Restore flat-to-gently sloping wetlands by removal of fill at project closure where practicable. Removed fill would be transported to approved upland areas for disposition.	Likelihood of Implementation: Medium Effective: Potentially Reasonable/Practicable: Potentially – wetland restoration addressed as part of the Section 404 permitting process and the Compensatory Mitigation Plan (CMP).	Closure	Surface Water Hydrology Water Quality Vegetation Wetlands	Corps
Restore riparian areas at stream crossings along the pipeline.	Likelihood of Implementation: Medium Effective: Potentially Reasonable/Practicable: Potentially – riparian restoration associated with stream crossings addressed as part of Corps Section 404 permitting and ADF&G fish habitat permitting.	Construction Operations Closure	Fish and Aquatic Resources	Corps ADF&G
Establish minimum flows in Crooked Creek.	Likelihood of Implementation: Medium Effective: Potentially Reasonable/Practicable: Potentially – would be addressed as part of the water rights and Title 16 permitting processes.	Construction Operations	Fish and Aquatic Resources Surface Water Hydrology Groundwater Hydrology	ADNR ADF&G
Install well field on west side of Crooked Creek to supplement flow loss from dewatering.	Likelihood of Implementation: Medium Effective: Potentially – depending on groundwater volume available; need based on monitoring after dewatering starts. Reasonable/Practicable: Potentially – would require treatment prior to discharge and additional APDES permitting; increased disturbance footprint and energy demand.	Construction Operations	Fish and Aquatic Resources Surface Water Hydrology Groundwater Hydrology	ADNR ADF&G ADEC
Specific plans for borrow site reclamation would be completed in a later phase of the project. In addition to standard BMPs for contouring, drainage, and erosion controls (Section 3.2, Soils), reclamation should create ponds and/or stream connections for fish and wildlife habitat at borrow sites in low lying areas (e.g., at Getmuna Creek) in accordance with ADEC and ADF&G guidance (McClean 1993; Shannon & Wilson 2012; Owl Ridge 2017c).	Likelihood of Implementation: Medium Effective: Potentially Reasonable/Practicable: Potentially – borrow site reclamation addressed as part of the material sale contracts and the Section 404 permitting process / Compensatory Mitigation Plan (CMP).	Construction Closure	Geology Surface Water Hydrology Water Quality Vegetation Wetlands Wildlife Fish and Aquatic Resources Subsistence	BLM ADNR ADF&G Corps
Reclaim lower portions of Snow and Ruby gulches, which have been disturbed by placer mining, to provide stable habitats for fish passage and shallow productive rearing (Owl Ridge 2017c; Donlin Gold 2018a).	Likelihood of Implementation: Medium - may be dependent on monitoring of dewatering impacts to Crooked Creek. Effective: Yes Reasonable/Practicable: Yes	Operations Closure	Surface Water Hydrology Water Quality Fish and Aquatic Resources	ADNR ADF&G Corps
Modify fish migration barriers in the south fork of Getmuna Creek (cascades/falls in incised gorge) by providing resting pools at appropriate locations to encourage passage to upper reaches with extensive spawning and rearing habitat (Owl Ridge 2017c; Donlin Gold 2018a).	Likelihood of Implementation: Medium – may be dependent on monitoring of dewatering impacts to Crooked Creek. Effective: Potentially Reasonable/Practicable: Yes	Operations Closure	Surface Water Hydrology Fish and Aquatic Resources	ADNR ADF&G Corps

Table 5.5-1A: Mitigation Measures Being Considered

Mitigation Measure Description	**Assessment of Measure**: Likelihood of Implementation (Low, Medium, High) Effective (Yes/No/Potentially) Reasonable/Practicable (Yes/No/Potentially)	Project Phase(s)	Resource(s) Affected	Potential Jurisdiction
Include additional erosion and sediment control measures such as settling ponds, silt fences, or sediment barriers to minimize the amount of sedimentation from snowmelt.[o]	Likelihood of Implementation: Medium Effective: Yes Reasonable/Practicable: Potentially – erosion and sediment control measures would be included in the Storm Water Pollution Prevention Plan; although they may not be the specific examples listed in this measure.	Construction	Water Quality Wetlands	BLM ADNR ADEC Corps
Implement pertinent Best Applicable Practice (BAP) recommendations from the Mount Polley review panel for the tailings storage facility 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.	Likelihood of Implementation: High Effective: Potentially Reasonable/Practicable: Yes	Pre-Construction Construction Operations Closure	Safety Geohazards and Seismic Conditions Water Quality	ADNR
Apply the following to the South Overburden Stockpile (SOB): a) Hydraulic containment (deep sump as part of sediment pond)[p]. Feasibility of digging a deep sump should be evaluated during design work; or b) Additional studies during design work (fate and transport groundwater modeling) to demonstrate a lack of substantial groundwater volume that would result in no serious impact on the creek, as a result of natural attenuation of a small temporary slug of contaminated groundwater. In either case, install downgradient monitoring wells, equip the sediment pond with redundant and freeze-protected pumping systems, and excavate and properly dispose of sediment at Closure.	Likelihood of Implementation: Medium Effective: Yes – a) groundwater would be captured by the SOB sediment pond if deep enough; or b) additional studies would show groundwater capture in sediment pond not necessary. Reasonable/Practicable: Yes	Pre-Construction Construction Operations	Groundwater Hydrology Water Quality	ADEC ADNR
For marine barging in the Bearing Sea - implement measures to minimize the risk of spills, including: avoiding operation of watercraft in fall and winter and in the presence of sea ice to the extent practicable; using double-hull tanks for fuel transport to reduce tank rupture risk; and using fully-operated vessel navigation systems composed of radar, chartplotter, sonar, marine communications systems, and satellite navigation receivers, as well as automatic identification system (AIS) for vessel tracking.	Likelihood of Implementation: High Effective: Yes – some of these measures are already addressed as design features in Table 5.2-1 (see T1, T6, and T10); Reasonable/Practicable: Yes	Construction Operations Closure	Spill Risk Fish and Aquatic Resources Water Quality Threatened and Endangered Species Wildlife Transportation	Corps NMFS
For marine barging in the Bearing Sea - either a) avoid transiting vessels through North Pacific right whale critical habitat or b) implement protective measures while transiting through North Pacific right whale critical habitat; such as maintaining a ship log for vessels transiting through designated critical habitat, reducing speed limits, and using onboard protected species observers or trained crew members. Specific training requirements as well as procedures to follow if marine mammals are observed would be specified, as necessary, in the appropriate project permit(s).	Likelihood of Implementation: High Effective: Yes Reasonable/Practicable: Yes	Construction Operations Closure	Threatened and Endangered Species	Corps NMFS

[o] Erosion and sediment control measures specified for snow stockpiles along the ROW currently include only water diversion ditches leading to energy dissipaters (SRK 2013b).
[p] The South Overburden Stockpile (SOB) is composed of materials that are potentially metal leaching. This mitigation could be applied to the diversion channels and sediment pond to capture groundwater beneath the SOB that could become contaminated from seepage/leachate and flow towards Crooked Creek. The captured groundwater would be directed to the Lower CWD.

Table 5.5-1A: Mitigation Measures Being Considered

Mitigation Measure Description	**Assessment of Measure**: Likelihood of Implementation (Low, Medium, High) Effective (Yes/No/Potentially) Reasonable/Practicable (Yes/No/Potentially)	Project Phase(s)	Resource(s) Affected	Potential Jurisdiction
Implement measures to reduce impacts from vessels to protected marine mammals and designated critical habitat, including: o Maintaining a distance 1.5 miles from the mean lower low water line (MLLW) of the Susitna Delta (MLLW line between the Little Susitna River and Beluga River) for barges transitting across the Cook Inlet. o Maintaining a safe distance from major Steller sea lion rookeries or haulouts (3 nm [5.5 km]) where vessel safety requirements allow and/or where practicable.	Likelihood of Implementation: High Effective: Yes Reasonable/Practicable: Yes	Construction Operations Closure	Threatened and Endangered Species	Corps NMFS

Table 5.5-1B Mitigation Measures Assessed as Not Likely to be Required

Mitigation Measure Description	Assessment of Measure: Likelihood of Implementation (Low, Medium, High) Effective (Yes/No/Potentially) Reasonable/Practicable (Yes/No/Potentially)	Project Phase(s)	Resource(s) Affected	Potential Jurisdiction
Where needed and practicable, use mats or other appropriate types of ground protection to minimize disturbance to ground vegetative cover during non-winter construction.	Likelihood of Implementation: Low Effective: Yes Reasonable/Practicable: No – not on a large scale due to limitations with transportation, storage, and deployment in remote areas or in rough terrain. (see Design Feature A28 for use of low impact tires to minimize disturbance from equipment). (4)	Construction	Vegetation Wetlands	ADNR BLM Corps
Where practicable, salvage and replace the native vegetation mat in wetlands, and/or re-establish wetland vegetation that is typical of the general area.	Likelihood of Implementation: Low Effective: Yes Reasonable/Practicable: No – not on a large scale. Although may be practicable in limited situations where salvaged material can be stored nearby and reused in a timely way. (4)	Construction Closure	Vegetation Wetlands	ADNR BLM Corps
Where practicable, reduce construction ROW width to 85 feet where protective mats may be required to minimize disturbance to ground vegetative cover.	Likelihood of Implementation: Low Effective: No Reasonable/Practicable: No – full construction ROW width is considered necessary for pipeline construction. (4, 8)	Construction	Vegetation Wetlands	ADNR BLM
Develop and maintain a native species seed bank and propagule or plant material source for reclamation and, where appropriate or practicable, restoration practices. Develop and implement test vegetation plots to determine potential revegetation success with native and local plant material and seeds (including lichens and mosses). Where appropriate and practicable, include confirmed sensitive and rare plant species identified in the Project Area as part of the seed mix used in the Reclamation Plan to mitigate for loss of habitat.	Likelihood of Implementation: Low Effective: Yes Reasonable/Practicable: No – Donlin Gold's Reclamation and Closure Plan (SRK 2017f) includes details of seed mix developed in cooperation with the ADNR Plant Materials Center. Reclamation practices would follow ADNR permit requirements. (8)	Pre-Construction Construction Operations Closure	Vegetation	None
Where practicable and in compliance with FAA and safety requirements, establish appropriate minimum flight altitudes to minimize impacts to wildlife when animals are present in the vicinity of the work (both >1,000 feet and > 1,500 have been specified for other projects in Alaska).	Likelihood of Implementation: Low Effective: Yes Reasonable/Practicable: No –Fixed altitude requirements can result in unsafe operation; safety is primary goal. (4, 7)	Construction Operations	Wildlife Subsistence	None
Review the success and practicability of measures that were taken to prevent or minimize adverse effects on visual resources on other linear projects, including the Trans-Alaska Pipeline System (TAPS), the Dalton Highway, the Elliott and Parks Highways, and the Anchorage-to-Fairbanks Intertie, and incorporate successful measures into the design and location of the pipeline where reasonable and appropriate.	Likelihood of Implementation: Low Effective: No Reasonable/Practicable: No (7, 8, 9)	Pre-Construction	Visual Resources	ADNR BLM
Develop a Mitigation Implementation Plan that outlines proposed design features, mitigation measures, and BMPs during project Construction, Operations, and Closure and prepare annual Mitigation Reports which document mitigation that has been carried out and tracks/ summarizes the successes and problems with each type of mitigation. The annual Mitigation Reports should also include recommendations for additional design features, mitigation measures, and BMPs, as appropriate, to address future project needs and requirements.	Likelihood of Implementation: Low Effective: Potentially Reasonable/Practicable: No – individual permits issued for the project would likely have specific requirements for enforcement of mitigation measures as well as reporting requirements with distinct timelines. It is not reasonable to require an annual overall mitigation report. (7)	Construction Operations Closure	All	None

Table 5.5-1B Mitigation Measures Assessed as Not Likely to be Required

Mitigation Measure Description	Assessment of Measure: Likelihood of Implementation (Low, Medium, High) Effective (Yes/No/Potentially) Reasonable/Practicable (Yes/No/Potentially)	Project Phase(s)	Resource(s) Affected	Potential Jurisdiction
Work with communities to make equipment and parts available at Closure, and remaining material should be shipped off site for recycling or disposal.	Likelihood of Implementation: Low Effective: No Reasonable/Practicable: No – offsite shipping would increase barging; ADEC would approve what may be disposed of onsite. (1, 2, 8)	Closure	None	None
Provide monies to communities for programs, activities, infrastructure needs, schools, community centers, or for assistance in building improvements, based on communities' discussions, possibly facilitated by DATROC. These discussions should identify what proactive programs or options may be available to pursue as part of community planning and programs designed to maintain traditional ways of life.	Likelihood of Implementation: Low Effective: No – not directly related to impact Reasonable/Practicable: No – Donlin Gold could elect to may make voluntary contributions. (7, 8)	Construction Operations Closure	Environmental Justice	None
Develop a Subsistence Plan and Report which would incorporate BMPs for the mine operations to maintain or improve subsistence activities and avoid potential conflicts. The plan may be developed with input from the local subsistence users, and may be organized through efforts from DATROC. The plan may include monitoring of mine activities to ensure that subsistence resources are adequately protected throughout the active mine life and post-Closure. The plan may also include an adaptive management framework where certain monitoring activities may no longer be needed, but additional monitoring may be required based on the results of previous years' activities.	Likelihood of Implementation: Low Effective: No Reasonable/Practicable: No – the activities intended by this measure would already be addressed through establishment of the DATROC Subsistence Subcommittee (see Design Feature A31).	Construction Operations Closure	Subsistence	None
Agencies should coordinate to refine clearing practices that both meet PHMSA regulations and protect ecological values.	Likelihood of Implementation: Low Effective: No Reasonable/Practicable: No – Design Feature P4 addresses the maintenance of vegetative cover to the extent permitted under PHMSA regulations. (7, 9)	Construction Operations	Vegetation	PHMSA
Relocate treated wastewater discharge location to mitigate flow loss in Crooked Creek. The location should be upstream of project effects (e.g., at the Lewis Gulch confluence), optimized based on aquatic habitat, and the volume managed so that it maintains the natural hydrograph.	Likelihood of Implementation: Low – not effective in addressing impact; need for implementation would be determined by observed effect on Crooked Creek. Effective: No – WTP discharge not available during season of greatest flow loss (winter); would only be effective if additional water source available. Reasonable/Practicable: Potentially – moving discharge point would require additional permitting and infrastructure; location and flow would need to be managed; may lead to recycling additional water through WTP (1, 5)	Operations	Hydrology	ADNR ADF&G ADEC
Install security fencing around the perimeter of the storage yard adjacent to Bethel Yard Dock and identify an emergency access route to dock and storage yard.	Likelihood of Implementation: Low. Effective: Yes Reasonable/Practicable: No – activities at the Bethel Yard Dock are not part of Donlin's proposed project but are considered a connected action (see Chapter 1, Section 1.2.1-Connected Actions). Installation of fencing would be subject to landowner approval. (7)	Construction Operations	Safety	None

Table 5.5-1B Mitigation Measures Assessed as Not Likely to be Required

Mitigation Measure Description	Assessment of Measure: Likelihood of Implementation (Low, Medium, High) Effective (Yes/No/Potentially) Reasonable/Practicable (Yes/No/Potentially)	Project Phase(s)	Resource(s) Affected	Potential Jurisdiction
Develop a Fugitive Dust Control Plan for the Pipeline component.	Likelihood of Implementation: Low Effective: Yes – however, the amount of dust generated by pipeline construction would be temporary and is not expected to require a control plan. Reasonable/Practicable: Yes (8)	Pre-Construction	Vegetation Wetlands Water Quality Soils	BLM
Use LiDAR technology in advance of ground disturbing operations to avoid or minimize impacts to Cultural Resources.	Likelihood of Implementation: Low Effective: Potentially Reasonable/Practicable: Potentially – if identified as necessary through the Section 106 compliance process. (8)	Construction	Cultural Resources	ADNR
Conduct pre-construction surveys of all vegetation to be disturbed (not just BLM-managed land as specified in Design Feature A1, Table 5.2-1) to determine the presence or absence of any rare and sensitive plant species listed on the ACCS state wide rare plant list (ACCS 2017b) or the BLM sensitive species list (BLM 2010b). If any individuals or populations are found, consult with the appropriate agencies to determine potential mitigation such as avoidance or transplant.	Likelihood of Implementation: Low Effective: Potentially Reasonable/Practicable: No – not likely feasible due to the scale/size of the project. (2, 4)	Pre-Construction	Vegetation	ADNR
Revise the current closure plan to preclude disposal of any tailings-related fluids in the pit / lake at or following closure, including: the estimated 8,200 ac-ft of TSF supernatant pond water; ~13,200 ac-ft of TSF “void water” collected during tailings consolidation over ~50 years; and runoff and/or infiltration into the post-Closure TSF cover, or any seepage from beneath the lined TSF which does not meet applicable water quality standards.	Likelihood of Implementation: Low Effective: No Reasonable/Practicable: No – an option of decommissioning the pit without backfill of PAG waste rock, TSF water or drainage/seepage from the WRF was considered but eliminated because it would provide no environmental benefit (see Option MS-92a in Appendix C). (1, 2, 8)	Closure	Water Quality Groundwater Hydrology	ADNR ADEC
The Failure Modes Effects Analysis (FMEA) should be reevaluated periodically, every five 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.	Likelihood of Implementation: Low Effective: Potentially Reasonable/Practicable: Potentially – the proposed dams present varying levels of risk and requiring a FMEA on a prescribed 5 year cycle for every dam is not likely to be required.	Operations Closure Post-Closure	Dam Safety Water Quality Fish	ADNR
Pump Kuskokwim River water via pipeline to Mine Site to supplement Crooked Creek flow loss from dewatering.	Likelihood of Implementation: Low Effective: Potentially – only if monitoring and permit conditions indicate a need. Reasonable/Practicable: No –potential introduction of invasives and non-endemic pathogens into upper Crooked Creek; would require settling pond and separate or expanded WTP; additional APDES, Title 16, and water rights permitting required; increased wetlands impact; thaw settlement issues along pipeline. (4, 5)			ADEC ADNR ADF&G
Replace culverts along the mine access road with low water crossings to minimize long-term effects of extreme precipitation events and climate change after Closure.	Likelihood of Implementation: Low Effective: Potentially Reasonable/Practicable: Potentially – this is something that could be considered during post-Closure.	Closure	Surface Water Hydrology Climate Change	Corps

Table 5.5-1B Mitigation Measures Assessed as Not Likely to be Required

Mitigation Measure Description	Assessment of Measure: Likelihood of Implementation (Low, Medium, High) Effective (Yes/No/Potentially) Reasonable/Practicable (Yes/No/Potentially)	Project Phase(s)	Resource(s) Affected	Potential Jurisdiction
Leave accessible borrow sites open beyond project Closure along the mine access road and pipeline, particularly those near communities and major river crossings, depending on permitter/stakeholder/landowner interest. This may mitigate area wide geologic impacts through use of existing sites rather than opening of new sites for borrow materials.	Likelihood of Implementation: Low Effective: Potentially Reasonable/Practicable: No – the mine access road would be on private land and disposal of material would be at the discretion of the landowner.	Closure	Geology Socioeconomics	BLM ADNR
Include an impermeable cover or 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.	Likelihood of Implementation: Low Effective: No Reasonable/Practicable: No (1, 4, 5)	Closure	Water Quality	ADNR
Cover waste rock immediately to prevent formation of dust.	Likelihood of Implementation: Low Effective: No Reasonable/Practicable: No (2, 4)	Construction Operations	Air Quality Human Health	ADNR
Reduce the total number of material sites by increasing their size and maximizing haul distance between them.	Likelihood of Implementation: Low Effective: Potentially Reasonable/Practicable: No (1, 2, 4)	Pre-Construction Construction	Land Ownership, Management, and Use Visual	ADNR BLM Landowners
Use of liners under the WRF and other mine facilities, such as the contact water ponds, which have the potential to contaminate groundwater.	Likelihood of Implementation: Low Effective: Potentially Reasonable/Practicable: No – this was Option MS-75b; see Options Considered but Eliminated in Appendix C. (2, 4)	Construction Operations	Water Quality Human Health	ADNR
Current monitoring of the Kuskokwim River with stationary and profiling sensors should be performed in conjunction with the hydrographic surveys.	Likelihood of Implementation: Low Effective: No – not focused on a specific concern or impact. Reasonable/Practicable: No (1, 6, 7)	Pre-Construction Construction Operations	Surface Water Hydrology	None
Practice composting to increase the availability of soil for reclamation. Composting could be instituted adjacent to the cafeteria (in a fenced or enclosed area to prevent it from becoming an attractant). Similarly, sewage sludge and wood waste can be turned into viable soil for reclamation. Using food waste and human waste in this manner would also reduce the costs of disposal.	Likelihood of Implementation: Low Effective: No – could create wildlife hazard Reasonable/Practicable: No (1, 2, 4, 7)	Operations Closure	Wildlife	None
Install fencing around perimeter of mine pit and TSF in post closure to prevent hazards to wildlife.	Likelihood of Implementation: Low Effective: Potentially Reasonable/Practicable: No (4)	Construction Operations Closure	Wildlife	ADNR
The north diversion channel should be mitigated at project closure into a functioning stream. This channel could mitigate some of the stream impacts to ensure a functioning stream remains after project closure.	Likelihood of Implementation: Low Effective: No – the diversion would no longer exist by Closure as it would be overtaken by the tailings impoundment. Reasonable/Practicable: No (1)	Closure	Hydrology	ADNR

Table 5.5-1B Mitigation Measures Assessed as Not Likely to be Required

Mitigation Measure Description	Assessment of Measure: Likelihood of Implementation (Low, Medium, High) Effective (Yes/No/Potentially) Reasonable/Practicable (Yes/No/Potentially)	Project Phase(s)	Resource(s) Affected	Potential Jurisdiction
Add a colorant to bedrock cuts on roads or corridors to reduce visual impacts of exposed rock faces.	Likelihood of Implementation: Low Effective: Potentially Reasonable/Practicable: No – the impacts being mitigated would only apply to a small number of potential viewers in places where there may be a road cut, and there may be negative impacts associated with adding colorant. (1, 2, 7)	Construction	Visual Resources	None
Use raincoatings to cover stockpiles or other areas expected to produce runoff to reduce potential seepage of contaminants.	Likelihood of Implementation: Low Effective: Potentially Reasonable/Practicable: No (1, 2)	Construction Operations	Water Quality	ADNR
Implement the Mount Polley Independent Review Panel recommendations for dewatering of tailings through filtering (“dry stack” tailings).	Likelihood of Implementation: Low Effective: Yes Reasonable/Practicable: No. Cost estimates for implementation of variations of the “dry stack” tailings options (unlined and lined) range from approximately $1.6 Billion to $1.9 Billion more than the proposed Alternative 2 tailings management option (BGC 2015e). (2)	Operations Closure	Safety	ADNR
Establish scientifically based thresholds or quantitative indicators for construction operations (e.g., # of days below freezing, depth of ground frost penetration, minimum thickness of surface water freeze-up) to promote accomplishment of minimum impact winter construction techniques, above which construction activities would be postponed until these conditions are met. Such practices have already been established and successfully implemented in cases such as the permitting and development of ice roads on the North Slope of Alaska where these practices have been assessed to be feasible and practicable.	Likelihood of Implementation: Low Effective: Potentially Reasonable/Practicable: No – not in this project location and the scale is small, as compared to North Slope tundra travel, with limited duration that would make use of existing winter trails. (2, 4)	Construction	Surface Water Hydrology Water Quality Vegetation Wetlands	ADNR BLM
Revise the current closure plan to preclude disposal of any PAG 6 waste rock (a proposed 11.7 million tons) or PAG 7 waste rock (an estimated 2.5 million tons), or any WRF seepage, in the pit / lake at or following closure to improve water quality and to avoid any outflow of water from the pit.	Likelihood of Implementation: Low Effective: No Reasonable/Practicable: No – An option of decommissioning the pit without backfill of PAG waste rock, TSF water or drainage/seepage from the WRF was considered but eliminated because it would provide no environmental benefit (see Option MS-92a in Appendix C). (1, 2, 8)	Closure	Water Quality	ADNR ADEC
Transport mercury by air (rather than by barge) to a regulated storage facility.	Likelihood of Implementation: Low Effective: No – barging is assessed to be a safe manner of transportation. Reasonable/Practicable: No (1, 2, 4, 7, 8)	Operations	Water Quality Transportation	None
Use at least 1 ½ to 2 inch rebar implanted in the tailings dam to help anchor the rockpile fill to bedrock and provide additional structural integrity.	Likelihood of Implementation: Low Effective: No Reasonable/Practicable: No (1, 2, 3, 8)	Operations	Safety Geohazards and Seismic Conditions Water Quality	ADNR

Table 5.5-1B Mitigation Measures Assessed as Not Likely to be Required

Mitigation Measure Description	Assessment of Measure: Likelihood of Implementation (Low, Medium, High) Effective (Yes/No/Potentially) Reasonable/Practicable (Yes/No/Potentially)	Project Phase(s)	Resource(s) Affected	Potential Jurisdiction
Place valve stations to avoid visual impacts to local businesses, the INHT, hunting/guiding camps and cabins, as necessary on a site-specific basis.	Likelihood of Implementation: Low Effective: Potentially Reasonable/Practicable: No – valve stations would need to be installed at intervals no more than 20 miles so avoidance to all specified groups is impracticable. However, mitigation to reduce visual impacts to the INHT will be addressed as a part of the Section 106 compliance process and specified in the PA (see Design Feature P26). (4, 8)	Pre-Construction Construction	Visual	ADNR BLM
During final design, increase the number of remote closure valves to limit the release from a pipeline leak or rupture.	Likelihood of Implementation: Low Effective: No – not for a natural gas pipeline. Reasonable/Practicable: No (1, 2, 8)	Pre-Construction Construction	Spill Risk	ADNR BLM
Use solar power to reduce GHG emissions from power generation at the Mine Site.	Likelihood of Implementation: Low Effective: No - limited applicability. Reasonable/Practicable: No – use of solar power as the main source of power was assessed in Appendix C (TI-71a) and eliminated as economically infeasible given the scale of the power needs at the mine site. (1,2,3, 7)	Pre-Construction Construction Operations	Air Quality	None
Add physical containment to the South Overburden Stockpile (SOB) (i.e., liner beneath SOB and sediment pond) to capture groundwater beneath the SOB that could become contaminated from seepage/leachate and flow towards Crooked Creek.	Likelihood of Implementation: Low Effective: Yes. Reasonable/Practicable: No - liner would be high cost and may not be necessary to address impact[q] (2)	Pre-Construction Construction Operations	Groundwater Hydrology Water Quality	ADEC ADNR
Construct temporary access roads using geotextile, “Chip Seal”, “High Float”, paving, or similar design feature and controls to reduce erosion, sedimentation and dust impacts.	Likelihood of Implementation: Low Effective: Yes. Reasonable/Practicable: No – other effective erosion and sediment control measures would effectively reduce impacts, as required by APDES permitting. (2)	Construction	Vegetation Wetlands Surface Water Hydrology Soils	ADNR BLM
Inert solid wastes that are proposed to be permanently disposed of onsite after the project is completed should be transported offsite to a licensed landfill facility, if feasible.	Likelihood of Implementation: Low Effective: No – disposal of inert wastes onsite incompliance with State permits would not have a negative impact. Reasonable/Practicable: No - An option of decommissioning and removing all mine infrastructure at closure was considered but eliminated because it would provide little environmental benefit and increase impacts to other resources (see Option MS-88 in Appendix C). (1, 2, 8)	Closure	Land Ownership, Management, and Use	ADEC
Install automatic and publicly accessible air and water quality data collection stations that are on-site and available for point sources and in the surrounding areas for diffuse emissions.	Likelihood of Implementation: Low Effective: No Reasonable/Practicable: No – requires clarity and justification or explanation for what impact is being reduced. (8, 9)	Operations	Air Quality Water Quality	ADEC

[q] Other mitigation in Table 5.5-1A regarding potential SOB seepage to groundwater is likely to show this measure is unnecessary to address impact.

Table 5.5-1B Mitigation Measures Assessed as Not Likely to be Required

Mitigation Measure Description	Assessment of Measure: Likelihood of Implementation (Low, Medium, High) Effective (Yes/No/Potentially) Reasonable/Practicable (Yes/No/Potentially)	Project Phase(s)	Resource(s) Affected	Potential Jurisdiction
Include speed limits in barge guidelines proposed as a design feature and identify periods of limited or suspended barging, to the extent practicable. Limit barging or restricted timing of barges during key commercial or subsistence fishing periods. Suspend barging during the smelt spawn (May) until the spawn is over.	Likelihood of Implementation: Low Effective: No – existing barge management plan reduces conflicts. Reasonable/Practicable: No – the slow speed of barges overall (10 knots), the commitment to engage and inform local communities through the barge and subsistence subcommittees, and the procedures outlined in Donlin Gold's Barge Communication Plan would effectively minimize impacts (see Design Features A31 and T9). (4, 7, 8)	Construction Operations	Subsistence Fish and Aquatic Resources Wildlife	None
Use carbon capture and utilization technology to capture CO_2 waste emissions and use them to produce new products and economic opportunities.	Likelihood of Implementation: Low Effective: No Reasonable/Practicable: No (1,2,3, 7)	Construction Operations	Air Quality	None
Employ local colleges or businesses to assist with appropriate biological or environmental studies, to work with the local hire program. Where practicable, integrate local resources to develop citizen science programs to assist with science observations or provide opportunities to enter information into the Local Environmental Observer Network (https://anthc.org/what-we-do/community-environment-and-health/leo-network/) managed by the Alaska Native Tribal Health Consortium. DATROC may be available to help coordinate.	Likelihood of Implementation: Low Effective: No Reasonable/Practicable: No (1, 7, 8)	Construction Operations	Socioeconomics	None
Project flight operations should be viewed as an opportunity for partnership with the Yuut Yaqungviat flight school in Bethel, AK to recruit, train and hire local residents to begin careers in aviation.	Likelihood of Implementation: Low Effective: No Reasonable/Practicable: No (1, 7, 8)	Operations	Socioeconomics	None
Time pipe staging at the Anchorage Port to avoid seasonal presence of Beluga whales in critical habitat.	Likelihood of Implementation: Low Effective: No – the slow speed of barges overall (10 knots) and the commitment to reduce speeds to 5 knots when approaching marine mammals would effectively minimize impacts (see Design Feature T16). Reasonable/Practicable: No – not required for other shippers. (1, 4, 7, 8)	Construction	Threatened and Endangered Species	NMFS
Equip GPS trackers (or equivalent technology) to the 4-Drum Spill Containment Pallets containing mercury and spent carbon, or other applicable mercury containers for shipment.	Likelihood of Implementation: Low Effective: Yes Reasonable/Practicable: Potentially (7)	Operations	Spill Risk	None
Apply restoration practices to vegetation in wetland areas in trenches along the pipeline route to prevent permanent water filled trenches with no vegetative cover as seen at the Beluga to Anchorage Pipeline.	Likelihood of Implementation: Low Effective: No Reasonable/Practicable: No – these impacts are not expected. Wetland restoration addressed as part of Corps Section 404 permitting process. (8)	Closure	Wetlands	Closure
Apply measures to further restrict public access to the ROW to reduce indirect effects, such as closing the pipeline ROW to Off Highway Vehicle (OHV) and snowmachine use, where appropriate based on landowner approval.	Likelihood of Implementation: Low Effective: Potentially – some trespass is likely Reasonable/Practicable: Potentially – but it is unclear who would be responsible for enforcing such a measure. (7, 8)	Construction Operations Closure	Recreation Visual Land Ownership, Management, and Use Subsistence	ADNR BLM Landowners

Table 5.5-1B Mitigation Measures Assessed as Not Likely to be Required

Mitigation Measure Description	Assessment of Measure: Likelihood of Implementation (Low, Medium, High) Effective (Yes/No/Potentially) Reasonable/Practicable (Yes/No/Potentially)	Project Phase(s)	Resource(s) Affected	Potential Jurisdiction
Treating and discharging water from the bottom layer in the pit (instead of the top layer) should be considered to minimize adverse impacts to water quality at the surface of the lake.	Likelihood of Implementation: Low Effective: No Reasonable/Practicable: No (2, 3, 8)	Closure Post-Closure	Water Quality	ADNR ADEC
Add training for staff or construction managers in identification of nonnative invasive species (NNIS) for the full project area (especially along the pipeline route, all project and local roads, and the mine area.[r]	Likelihood of Implementation: High for the Pipeline component; Low in other project components. Effective: Yes Reasonable/Practicable: Potentially (6, 7)	All Phases	Vegetation Wetlands Wildlife Fish and Aquatic Resources	BLM ADNR
Leave a buffer between the pit and the Crooked Creek alluvium to decrease the connection with the alluvium and decrease the amount of water potentially drawn from the creek.	Likelihood of Implementation: Low Effective: Potentially Reasonable/Practicable: No – would not allow the development of the ore resource and there are other more feasible measures to address the concern of flow losses from Crooked Creek (e.g., installation of a slurry wall or grout curtain).	Operations	Surface Water Hydrology	ADNR

[r] The Donlin Gold Invasive Species Prevention and Management Plan (ISPMP) (Appendix U) was developed in cooperation with the BLM and State of Alaska for the Pipeline component, and discusses training strategies.

5.6 COMPENSATORY MITIGATION

CEQ has defined mitigation in its regulations at 40 CFR 1508.20 to include "compensating for the impact by replacing or providing substitute resources or environments." Compensatory mitigation is also specified in some federal legislation that apply to permitting of the Donlin Gold Project, notably the CWA and the Federal Lands Policy and Management Act (FLPMA).

5.6.1 SECTION 404 OF THE CLEAN WATER ACT

Compensatory mitigation can be a critical tool to help the federal government meet the longstanding national goal of "no net loss" of wetland acreage, function, and value. For projects authorized under Section 404, compensatory mitigation is not considered until all appropriate and practicable steps have been taken to first avoid and then minimize adverse impacts to the aquatic ecosystem pursuant to 40 CFR Part 230 (e.g., the CWA Section 404(b)(1) Guidelines).

Regulatory standards and criteria for the use of compensatory mitigation to offset unavoidable impacts to waters of the U.S., including wetlands, authorized under the CWA, were established on April 10, 2008 under 33 CFR Part 332 (Corps) and 40 CFR Part 230 (EPA). Compensatory mitigation for unavoidable impacts may be required to ensure that activities requiring a permit comply with Section 404(b)(1) Guidelines. Compensatory mitigation is the restoration (reestablishment or rehabilitation), establishment (creation), enhancement, and/or in certain circumstances preservation of aquatic resources to offset unavoidable adverse impacts. Compensatory mitigation may be achieved by purchasing credits through mitigation banks or in-lieu fee programs, by permittee-responsible mitigation, or by a combination of the three. Donlin Gold has developed a Compensatory Mitigation Plan (CMP) in coordination with federal, state, and local governments and landowners (Appendix M). The CMP explains how Donlin Gold will compensate for the unavoidable losses of waters of the United States (WOUS) including wetlands, streams, ponds, and creeks in the Donlin Gold Project Area. Because there are no approved mitigation banks that can provide credits currently or in the timeframe of the project permitting process and there are no statewide in-lieu fee providers in Alaska, Donlin Gold is proposing all compensatory mitigation through permittee-responsible mitigation projects. Donlin Gold has evaluated a full suite of available and practicable permittee-responsible mitigation options to assure compliance with the provisions of the 2008 Mitigation Rule and the 1994 Alaska Wetland Initiative (EPA et. al 1994).

Mitigation has been considered throughout the NEPA process and will continue to be considered throughout the permitting processes. A summary of mitigation measures (including some that could potentially be considered as compensatory mitigation for losses of aquatic resources) are discussed under each resource in Chapter 3. The Corps will complete a 404(b)(1) evaluation for compliance with the CWA prior to issuance of the Corps' Record of Decision. The decision documents will be available after publication of the Final EIS. The 404(b)(1) evaluation is not required by the Corps to complete the NEPA process. Specific mitigation conditions would be determined following review of the permit application and will be included in the Record of Decision for any permit that may be issued.

5.6.2 U.S. DEPARTMENT OF THE INTERIOR

BLM's authority and obligation to consider compensatory mitigation for the proposed Donlin Gold natural gas pipeline right-of-way comes from several statutes, including Section 28 of the Mineral Leasing Act, Title VIII of the Alaska National Interest Lands Conservation Act

(ANILCA), and the Federal Land Policy and Management Act (FLPMA). Each of these statutes and their implementing regulations require BLM to consider impacts to the environment and other resources and uses during its processing of applications for land use authorizations; and each provide broad authority for BLM to impose measures requiring applicants to mitigate adverse impacts to resources and uses, including measures that avoid or reduce impacts or compensate for unavoidable impacts.

Section 28 of the Mineral Leasing Act provides BLM with authority to issue rights-of-way across federal lands for oil and natural gas pipelines and related facilities, and provides that such rights-of-way "shall be subject to such terms and conditions as the Secretary or agency head may prescribe regarding extent, duration, survey, location, construction, operation, maintenance, use, and termination" (30 USC § 185). Specific to environmental protection, subsection 28(h) of the act requires BLM to impose stipulations which are "designed to control or prevent damage to the environment (including damage to fish and wildlife habitat)" and that "protect the interests of individuals living in the general area of the right-of-way or permit who rely on the fish, wildlife, and biotic resources of the area for subsistence purposes" (30 USC § 185(h)).

Title VIII of ANILCA requires federal land managing agencies to evaluate impacts of proposed actions on subsistence uses, and provides that any action which would significantly restrict subsistence uses cannot be approved unless the agency takes reasonable steps to minimize impacts to subsistence uses and resources resulting from such actions (16 USC § 3120).

The congressional declaration of policy for FLPMA states that "the public lands be managed in a manner that will protect the quality of scientific, scenic, historical, ecological, environmental, air and atmospheric, water resource, and archeological values." (43 USC § 1701(a)(8)). The FLPMA directs that "[i]n managing the public lands the Secretary shall, by regulation or otherwise, take any action necessary to prevent unnecessary or undue degradation of the lands" (43 USC § 1732(b)).

5.7 MONITORING AND ADAPTIVE MANAGEMENT

Monitoring is an important part of mitigation strategy, both so the effectiveness of mitigation efforts can be assessed and for an adaptive management response in the case of unforeseen effects. A monitoring program describes monitoring objectives, performance standards, monitoring methods, a schedule, and reporting. If performance standards are not being met, mitigation can be adjusted as appropriate. In some cases, adaptive management (a structured, iterative process of robust decision making in the face of uncertainty, with an aim to reducing uncertainty over time via system monitoring) elements may be included as part of mitigation.

As part of issuing permits, the Corps or other agencies may require Donlin Gold to prepare mitigation monitoring plans, which may include elements of adaptive management, to monitor success of mitigation efforts. Plans may detail the process for making changes to or adding mitigation and monitoring as needed.

They may also include routine monitoring as a part permit compliance, which is not considered mitigation but could lead to adaptive management. For example, the Alaska Department of Environmental Conservation (ADEC) will require monitoring to determine compliance with effluent limits established in the Alaska Pollutant Discharge Elimination System (APDES) permit for wastewater discharges from the Donlin Gold Project. Monitoring may also be

required to gather effluent and receiving water data to determine if additional effluent limits are required and/or to monitor effluent impact on the receiving waterbody quality. Opportunity for public comment on monitoring measures specific to the APDES permit will be available during their formal public review period. Monitoring activities considered as part of Donlin Gold's Proposed Action are discussed in Chapter 2.

Measures listed in this section represent a comprehensive list of the monitoring and adaptive management measures put forth for consideration by the Corps and appropriate resource agencies to further minimize project impacts, as reasonable and practicable. The measures were developed based on analysis of project impacts and through input from federal, state and Tribal cooperating agencies, as well as the public through comment on the Draft EIS. As noted in Section 5.5, specific measures identified in the EIS may not be required by the federal agencies in their RODs, or by State agencies when issuing permits. These measures may continue to be refined during the each agencies' individual permitting processes and the final measures would be outlined in the appropriate permit decision documents.

The overall assessment of the measures identified in this section takes in to consideration SME judgement, as well as input from cooperating agencies, on whether a suggested measure would be effective in addressing and reducing the nature of the potential impact, and considers the NEPA/CWA guidance described in Section 5.5. The tables in this section are organized by:

- A description of the monitoring or adaptive management-type measure;
- Assessment of the measure. This assessment is in response to NEPA guidance that balances the need for a thorough look at potential measures with the emphasis on those that can be practicably and legally implemented under agency authority. The column includes:
    - "Likelihood of Implementation" assessment: probability or likelihood that the measure would be adopted by responsible agencies and could be reasonably enforced (Low, Medium, High);
    - "Effective" assessment: the mitigation monitoring measure would be effective in reducing the impact (Yes/No/Potentially);
    - "Reasonable/Practicable" assessment: the mitigation measure achieves the basic purpose of the project goal and is capable of being done after taking into consideration cost, existing technology, and logistics (Yes/No/Potentially);
- The specific resources affected (based on the resources discussed in Chapter 3 of this document), in no particular order; and
- Potential jurisdiction, in no particular order, identifying the agency with potential jurisdiction for requiring, enforcing, and/or overseeing the measure or some aspect of the measure may potentially fall under the purview of the listed agency. Where there is no clear regulatory authority to require, enforcing, and/or oversee the measure the cell will indicate "None".

Table 5.7-1A includes the measures identified or recommended during the NEPA process that are being considered by the Corps and cooperating agencies as part of their permit decisions to further minimize project impacts. Table 5.7-1B includes the measure identified or recommended during the NEPA process that are assessed by the Corps as not likely to be effective and/or

reasonable/practicable and therefore are not likely to be required in a ROD or permit. Where appropriate, the following numbered notes are used to indicate the rationale of the conclusion, indicated in the "Assessment of Measure" column:

1. The measure is assessed to be not effective in reducing the potential impact.
2. The measure is assessed to be not reasonable in terms of cost.
3. The measure is assessed to be not reasonable in terms of existing technology.
4. The measure is assessed to be not reasonable in terms of logistics, including safety.
5. The measure is assessed to be not effective in being able to determine the contribution of Donlin Gold actions to overall impacts.
6. The measure is assessed to not be reasonably enforceable, there is no clear authority to require the applicant to implement the measure, or the measure conflicts with existing laws/regulations.
7. The measure is assessed to be not directly related to a project impact, is unsupported by the effects analysis for the resource affected, and/or the effectiveness of reducing impacts is unknown, unsupported, and/or unclear.
8. The measure, as written, lacks detail/specificity for effective implementation and/or enforcement.

Table 5.7-1A: Monitoring and Adaptive Management being Considered

Monitoring or Adaptive Management Measure Description	**Assessment of Measure:** **Likelihood of Implementation (Low, Medium, High)** **Effective (Yes/No/Potentially)** **Reasonable/Practicable (Yes/No/Potentially)**	Resource(s) Affected	Potential Jurisdiction
Prepare a mitigation monitoring and adaptive management plan to monitor success of mitigation efforts that includes a process for making changes to or adding mitigation as needed. The plan should clearly identify, at a minimum: • Performance standards and thresholds; • Where and when monitoring will take place; Monitoring goals and objectives; • Who will be responsible for monitoring; • How the information will be evaluated; • What actions (contingencies, adaptive management, corrections to future actions) will be taken based on the results of monitoring; and • How the public can get information on mitigation effectiveness and monitoring results.	Likelihood of Implementation: Medium Effective: Yes Reasonable/Practicable: Potentially – may not be reasonable for agencies with set monitoring standards and requirements	All	Corps BLM ADNR
Reexamine the continuing applicability of key portions of the water balance model at regular intervals as determined by the data collected and operational or closure conditions and experience, specifically by incorporating climate change precipitation predictions to be reevaluated periodically in post-Closure. Incorporate climate change precipitation predictions into water balance and groundwater model updates, in order to adequately anticipate climate change effects on pit filling and other project structures such as reclamation components.	Likelihood of Implementation: Medium Effective: Yes – however, ADNR permitting renewals would examine water balance model and post-Closure conditions every five years. Reasonable/Practicable: Potentially (7, 9)	Surface Water Hydrology Groundwater Hydrology	ADNR
To characterize winter low flow conditions, conduct quarterly surface water monitoring at Mine Site stations during Construction, Operations, and Closure.	Likelihood of Implementation: Medium - Quarterly flow monitoring would occur under ADNR IWM permit at several surface water stations (2.Table3-33). Effective: Yes Reasonable/Practicable: Potentially – limitations for winter surface water monitoring in terms of logistics and safety. (4)	Surface Water Hydrology	ADNR
Add an upstream monitoring site on Donlin Creek as a control point for monitoring water quality and discharge to enhance understanding of dewatering impacts on Crooked Creek habitat (monitoring site DCBO was specifically suggested as a location for background monitoring).	Likelihood of Implementation: Low – for water quality monitoring; DCBO not included in APDES or IWM permits Medium – for discharge; may be considered under Title 16 or water rights permits Effective: Yes Reasonable/Practicable: Yes	Surface Water Hydrology Water Quality Fish and Aquatic Resources	ADNR ADEC ADF&G
Reexamine the groundwater flow model sooner than required by typical permit reevaluations[s], e.g., 3 years after the commencement of pit dewatering, to evaluate unexpected conditions (including impacts from faults and effects on WTP capacity), minimize uncertainty in the model, update and recalibrate the model as more groundwater level data are available, revise projections, and adjust management plans as needed.	Likelihood of Implementation: Medium - based on probability of encountering unexpected conditions in first 3 years. Effective: Yes Reasonable/Practicable: Yes	Surface Water Hydrology Groundwater Hydrology Water Quality	ADNR
Conduct a reevaluation of the groundwater model and sensitivity analysis of potential contaminant migration from the pit lake after Year 15 of mining, when the ACMA pit is within a few 100 feet of its maximum depth.	Likelihood of Implementation: High Effective: Yes Reasonable/Practicable: Yes	Surface Water Hydrology Groundwater Hydrology Water Quality	ADNR ADEC
Collect relevant geotechnical and groundwater data (such as dewatering well testing, production rates, fault information, and water table levels around the pit) as mining progresses to refine interpretations and facilitate model revisions.	Likelihood of Implementation: Medium Effective: Yes Reasonable/Practicable: Yes	Surface Water Hydrology Groundwater Hydrology Water Quality	ADNR ADEC

[s] Donlin Gold plans to reevaluate as part of the APDES permit five-year reevaluation. See M36 in Table 5.2-1.

Table 5.7-1A: Monitoring and Adaptive Management being Considered

Monitoring or Adaptive Management Measure Description	**Assessment of Measure:** Likelihood of Implementation (Low, Medium, High) Effective (Yes/No/Potentially) Reasonable/Practicable (Yes/No/Potentially)	Resource(s) Affected	Potential Jurisdiction
Expand monitoring plans and data evaluation details to describe the proposed approach to facilitate comparisons with baseline data, and how it will be determined that water quality standards have been met and management activities can/should change. Baseline data should be evaluated using non-statistical means, such as spatial and temporal distribution, to allow a range of interpretive assessments.	Likelihood of Implementation: Medium – details such as these would be part of the APDES permitting process and stipulated in project permits as determined applicable by ADEC. Effective: Yes Reasonable/Practicable: Yes	Groundwater Hydrology Water Quality	ADEC
Conduct water quality monitoring during Operations in the sedimentation ponds downgradient of the North and South overburden stockpiles, as well as in Lewis Gulch for the North overburden pile.[t] Monitoring results would form the basis for additional adaptive management measures (such as increased pumping or pond size) to reduce potential water quality effects.	Likelihood of Implementation: Low-Medium[u] Effective: Yes Reasonable/Practicable: Yes	Water Quality Fish and Aquatic Resources	ADNR ADEC
Include additional alluvial and/or bedrock groundwater monitoring wells at locations downgradient of mine facilities not already covered by the planned monitoring network (Figure 2.3-38, SRK 2016h) (e.g., overburden stockpiles), where sufficient alluvial aquifer material is present that could represent a pathway for contaminant migration to Crooked Creek, and bedrock groundwater is not captured by the pit cone of depression.	Likelihood of Implementation: Medium Effective: Yes Reasonable/Practicable: Yes	Water Quality Groundwater Hydrology	ADNR
Monitor drainages from the low-grade ore stockpile (which contains PAG 7 waste rock), the non-acid generating (NAG) WRF, and the isolated PAG cells within the WRF to allow evaluation of the effects of stockpile drainage and seasonal variability on CWD source water to the Operations WTP, and on pit lake stratification in Closure.[v]	Likelihood of Implementation: Medium Effective: Yes Reasonable/Practicable: Yes	Water Quality	ADNR ADEC
Consider preferential processing of the PAG 7 material in the low-grade ore stockpile, if monitoring of WTP inflows and stockpile drainage indicates the need for improving CWD water quality.	Likelihood of Implementation: Medium Effective: Yes Reasonable/Practicable: Potentially –may have practicability/cost considerations	Water Quality	ADNR ADEC
Continue semi-annual (after spring melt and in late summer) monitoring and sampling of the NAG WRF seepage long-term, beyond 30 years in case acid rock drainage (ARD) produced in PAG 5 rock in the WRF develops after 30 years of monitoring, or in case transport time is longer than 30 years for any contamination concerns.[w]	Likelihood of Implementation: Medium Effective: Yes Reasonable/Practicable: Potentially – may have practicability/cost considerations. (6, 8)	Water Quality	ADNR
Conduct semi-annual pit lake monitoring (after spring melt and in late summer) for collection of in-situ temperature and total dissolved solids (TDS) (or the related measurement of specific conductance) at 20-foot depth intervals from the surface through the pycnocline, and then every 100 feet to the bottom, noting the depth of the discharge end of the pipe from the TSF and WRF. The goal would be to evaluate whether the pit lake is stratified; whether the water being delivered at depth is aiding or detracting from optimal pit lake stratification; and whether water from the TSF, WRF, or other source would improve stratification and long-term surface water quality (source water being treated in the Closure WTP), as well as minimize treatment cost, if delivered to an alternate depth.[x]	Likelihood of Implementation: Medium Effective: Yes Reasonable/Practicable: Potentially	Water Quality	ADNR ADEC

[t] The potential exists for arsenic and/or other metals leaching and ARD formation from overburden taken from the pit and TSF areas and stored in stockpiles near Crooked Creek.
[u] Preliminary APDES and IWM permitting documents (ADEC 2017h; SRK 2016h) specify monitoring downstream of ponds in Crooked Creek only, not between ponds and Crooked Creek. ADEC would follow their specific guidance for regulation of sediment ponds, which may or may not include this additional monitoring.
[v] IWM permit monitoring (SRK 2016h) includes WRF seepage monitoring in Closure, but is not specific as to location within WRF, and does not include monitoring of low-grade ore stockpile drainage, which may have high ARD in Operations and would report to the CWDs and WTP.
[w] Monitoring would follow ADNR IWM permit requirements.
[x] Monitoring would follow ADNR and ADEC permit requirements.

Table 5.7-1A: Monitoring and Adaptive Management being Considered

Monitoring or Adaptive Management Measure Description	**Assessment of Measure**: Likelihood of Implementation (Low, Medium, High) Effective (Yes/No/Potentially) Reasonable/Practicable (Yes/No/Potentially)	Resource(s) Affected	Potential Jurisdiction
Rerun the pit lake model at regular intervals using the latest groundwater modeling results to predict the estimated duration of the pycnocline, the estimated source water quality going to the Closure WTP, and evaluate whether groundwater and reclaimed WRF runoff and seepage water delivered below the pycnocline would affect these changes.	Likelihood of Implementation: Medium Effective: Yes Reasonable/Practicable: Yes	Water Quality Groundwater Hydrology	ADNR ADEC
Based on pit lake monitoring and modeling results in post-Closure, 1) piped water from the reclaimed WRF and any other controlled water inputs to the lake should be delivered to the pit lake at such a depth so as to maximize the vertical salinity gradient; and 2) treating and discharging water from the bottom layer in the pit (instead of the top layer) should be considered to minimize adverse impacts to water quality at the surface of the lake.	Likelihood of Implementation: Medium Effective: Potentially - depends on results of monitoring and model updates. Reasonable/Practicable: Potentially - need based on post-Closure modelling results	Water Quality	ADNR ADEC[y]
If substantially more dewatering water needs to be treated in Operations than the current WTP design basis allows, apply adaptive management measures such as extending the treatment season beyond April-November; storing more water in the TSF which would have excess capacity, reducing inflow from faults/fractures through grouting or sealing, and/or expanding the WTP which would take about 2 years.	Likelihood of Implementation: High Effective: Yes Reasonable/Practicable: Yes	Surface Water Hydrology Groundwater Hydrology Water Quality	ADNR
Groundwater monitoring during Operations, Closure, and post-Closure should be sufficient to show that the hydraulic gradient towards the pit from Crooked Creek is maintained, and that dewatering drawdown has not extended beyond the monitoring system. If significant drawdown occurs at distant wells (e.g., due to the presence of faults), additional monitoring wells should be installed. Construction of dewatering wells should be suitable, to the extent practicable, for use or eventual conversion to monitoring wells for both water level and water quality purposes. Specifically, dewatering wells between the pit Rim Road and Crooked Creek should be converted for monitoring purposes in Closure.	Likelihood of Implementation: High Effective: Yes Reasonable/Practicable: Yes	Groundwater Hydrology	ADNR
Monitor tailings dam with remote sensing devices as part of the monitoring program, for early detection of any movement or disturbance to the dam.	Likelihood of Implementation: Medium Effective: Yes Reasonable/Practicable: Yes	Safety Spill Risk	ADNR
Develop a Pit Lake Groundwater Sampling and Monitoring Plan to focus on long-term water quality monitoring, sampling, and testing of the groundwater around the pit for the presence, abundance, and migration of contaminants such as mercury and arsenic.	Likelihood of Implementation: Medium Effective: Yes Reasonable/Practicable: Yes	Groundwater Hydrology Water Quality	ADNR
Develop a Mine Pit Dewatering Monitoring Plan to ensure that flow reductions to Crooked Creek are being monitored in real time as the pit is being developed, and design features, mitigation measures, and advanced water treatment are appropriate and adequately implemented to minimize impacts.[z]	Likelihood of Implementation: Medium Effective: Yes Reasonable/Practicable: Potentially – however, a standalone plan may not be necessary because the ADNR water rights permit would stipulate monitoring to ensure that permit conditions are being met.	Groundwater Hydrology Water Quality	ADNR ADF&G
Based on performance of the Seepage Recovery System (SRS) in Operations, add an additional well field and/or pond that acts as a secondary containment system and/or supplemental storage to the SRS downgradient of the SRS. This measure may minimize the likelihood of an extended pumping failure in Alternatives 2 and 5A, if determined to be an issue through adaptive management.	Likelihood of Implementation: Low-Medium Effective: Yes Reasonable/Practicable: Yes	Groundwater Hydrology Water Quality	ADNR ADEC[aa]

[y] ADEC sets and enforces performance-based water quality standards, but does not make prescriptive requirements on how the Operator would meet them.
[z] Note: This plan should be developed in consultation with ADF&G and USFWS.
[aa] ADEC sets and enforces performance-based water quality standards, but does not make prescriptive requirements on how to meet them.

Table 5.7-1A: Monitoring and Adaptive Management being Considered

Monitoring or Adaptive Management Measure Description	**Assessment of Measure:** **Likelihood of Implementation (Low, Medium, High)** **Effective (Yes/No/Potentially)** **Reasonable/Practicable (Yes/No/Potentially)**	Resource(s) Affected	Potential Jurisdiction
Perform testing of the SRS monitoring/pumping wells periodically throughout Operations and Closure to demonstrate that adequate hydraulic containment of TSF seepage is occurring.	Likelihood of Implementation: Medium Effective: Yes Reasonable/Practicable: Yes	Groundwater Hydrology Water Quality	ADNR ADEC[uu]
Monitor containment ponds and dams more frequently than quarterly or annually.	Likelihood of Implementation: Medium Effective: Potentially – needs more specific focus on what the monitoring measure(s) would involve and why more frequent monitoring would be advised. Reasonable/Practicable: Potentially – monitoring frequency would be contingent on hazard potential in accordance with 11 AAC 93.157.	Water Quality	ADNR
Monitor the TSF cap for potential breaching by vegetation or animals and potential damage to the integrity of the cap.	Likelihood of Implementation: High Effective: Yes Reasonable/Practicable: Yes – monitoring of the cover for some period of time is anticipated to be required. (7, 8)	Water Quality	ADNR
Monitor revegetation progress of reclaimed construction areas and facilities annually for the first 5 years after closure or until observations indicate stabilized conditions. Should vegetative cover not meet criterion established by permit requirements or achievement goals specified in the reclamation plan, further remedial action may include reseeding the area, additional application of soil amendments, and/or incorporation of additional growth media on a particular site or facility.	Likelihood of Implementation: High Effective: Yes Reasonable/Practicable: Yes – anticipated permit condition.	Vegetation	ADNR BLM ADF&G
Conduct a baseline survey and regular monitoring for nonnative invasive species (NNIS) of all taxa on all disturbed lands on all project components.[bb]	Likelihood of Implementation: High for the Pipeline component; Low in other project components. Effective: Yes Reasonable/Practicable: Potentially – with coordination among agencies as landowners. (6, 7)	Vegetation Wetlands Wildlife Fish and Aquatic Resources	BLM ADNR
Construct one monitoring well to a depth equal to or deeper than the lowest elevation of the pit bottom, on the southwest side of the pit rim between Crooked Creek and the pit, prior to any pumping to dewater the pit. The primary purpose is to measure hydraulic head at the bottom of the hole and to confirm model predictions that water from the pit lake would not leak into a regional groundwater flow system. The well should be completed as water quality sampling well and incorporated into the groundwater monitoring program for the project in order to verify continuing protection of deep groundwater resources by the process of hydraulic containment through mining and post-mining periods. The well should be drilled at an elevation above Crooked Creek floodplain, if possible, to avoid having the well exhibit flowing artesian conditions.	Likelihood of Implementation: Medium Effective: Yes Reasonable/Practicable: Potentially	Groundwater Hydrology Water Quality	ADNR
Conduct Pre-Construction surveys at stream crossings along the mine access road of suitable detail to be able to monitor erosion and deposition after culvert placement.	Likelihood of Implementation: Medium Effective: Yes Reasonable/Practicable: Yes – but may not be feasible for all culverts.	Surface Water Hydrology Fish and Aquatic Resources	ADNR Corps

[bb] In the Pipeline component, BLM may include permit stipulations on NNIS survey and monitoring in their ROW grant. ADNR may include permit stipulations on NNIS survey and monitoring in their ROW lease. BLM and the State of Alaska have collaborated with Donlin Gold on the Invasive Species Prevention and Management Plan (ISPMP) for the Pipeline component (see Appendix U).

Table 5.7-1A: Monitoring and Adaptive Management being Considered

Monitoring or Adaptive Management Measure Description	**Assessment of Measure:** **Likelihood of Implementation (Low, Medium, High)** **Effective (Yes/No/Potentially)** **Reasonable/Practicable (Yes/No/Potentially)**	Resource(s) Affected	Potential Jurisdiction
Conduct Crooked Creek monitoring that may incorporate adaptive management elements, including: • Conduct further analysis of alternative WTP discharge points higher in the drainage (e.g., Queen, Lewis or American) or use of Snow Gulch Reservoir to supplement flow to reduce impacts to aquatic species. • Implement low flow requirements in Crooked Creek in the event that, based on streamflow monitoring, flow losses from pit dewatering are outside the magnitude of historical seasonal variations. • Monitor for adequate winter discharge measurements at the Crooked Creek gauging stations.	Likelihood of Implementation: Medium Effective: Potentially Reasonable/Practicable: Yes	Fish and Aquatic Resources Surface Water Hydrology Groundwater Hydrology	ADF&G ADNR
Extend pit lake pumping and treatment into winter months if necessary to maintain managed lake level, based on monitoring of lake and groundwater levels.	Likelihood of Implementation: Medium Effective: Yes Reasonable/Practicable: Yes	Groundwater Hydrology Water Quality	ADNR ADEC[cc]
If warranted, install a slurry wall or grout curtain between Crooked Creek and the pit (recommended placement at the margin of the alluvium) to minimize stream flow loss due to pit dewatering. This measure would require monitoring during dewatering and further evaluation to assess effectiveness in reducing vertical flow.	Likelihood of Implementation: Medium – implementation would be determined by observed effect on Crooked Creek, and conditions suitable to support design. Effective: Potentially – would require further assessment based on monitoring during dewatering; additional information on bedrock hydraulic conductivity and interactions with alluvium would need to be investigated. Reasonable/Practicable: Potentially – but only if monitoring and permit conditions indicate a need, and additional assessment shows that wall would be effective in reducing vertical flow.	Fish and Aquatic Resources Surface Water Hydrology Groundwater Hydrology	ADNR
If warranted, divert water in Crooked Creek that is subject to streambed loss from dewatering through a culvert or lined open-flow channel (flume), which could be seasonally controlled by a floodgate or similar structure.	Likelihood of Implementation: Medium Effective: Potentially - could cause greater habitat effects adjacent to mine, but retain more flow for downstream; need based on Crooked Creek and groundwater monitoring after dewatering starts. Reasonable/Practicable: Potentially – would require additional Title 16 permitting; increased disturbance footprint.	Fish and Aquatic Resources Surface Water Hydrology Groundwater Hydrology	ADNR ADF&G
Monitor riparian crossing sites to identify areas that need additional restoration to prevent bank erosion which would be implemented after construction.	Likelihood of Implementation: High Effective: Yes Practicable: Yes – likely covered under permit conditions.	Soils Water Quality Fish and Aquatic Resources	Corps ADEC ADF&G
The need for monitoring and rehabilitation in post-Closure should be addressed in the revised Stabilization, Rehabilitation, and Reclamation Plan prior to Closure; include discussion of additional financial assurance to cover these activities.	Likelihood of Implementation: High Effective: Yes Reasonable/Practicable: Yes – likely covered under permit conditions.	Soils Climate Change	ADNR BLM

[cc] Measure may affect outfall flow limits in APDES permit.

Table 5.7-1A: Monitoring and Adaptive Management being Considered

Monitoring or Adaptive Management Measure Description	**Assessment of Measure**: **Likelihood of Implementation (Low, Medium, High)** **Effective (Yes/No/Potentially)** **Reasonable/Practicable (Yes/No/Potentially)**	Resource(s) Affected	Potential Jurisdiction
Conduct monitoring and analysis for mercury-related concerns, including: • Include methylmercury fish tissue (e.g., pike and burbot) monitoring.[dd] If mercury levels exceed standards, develop and define contingency measures through adaptive management elements if impacts occur, and define objectives in an adaptive management plan. • Building on the biomonitoring program to date (e.g., Ottertail 2014c) and fish tissue metals testing proposed as part of the aquatics monitoring plan (see Design Feature A33), conduct a baseline survey and monitoring of mercury levels in macroinvertebrates and fish [vv] within the Project Area, larger HHRA Study Area, and a control site to monitor potential mercury deposition from the mine. • Conduct a periodic re-evaluation of the HIA/HHRA during and after mining activities (adaptive management), including periodic literature reviews or surveys, to confirm that the exposure assumptions and consumption assumptions made in the HHRA remain valid.	Likelihood of Implementation: Low-Medium Effective: Potentially – would confirm the findings of low risk in HHRA Reasonable/Practicable: Potentially – fish and macroinvertebrate program guidance available and many ongoing national projects	Fish and Aquatic Resources Water Quality Human Health	ADEC ADHSS ADF&G
Develop and implement a fugitive dust management, testing, and monitoring plan[ee] to evaluate fugitive dust emissions and their distribution to soils, sediment, air, water, vegetation, and the potential exposure of contaminants, such as mercury, arsenic, ARD/ML, to humans and wildlife. Collect additional baseline sediment data in Crooked Creek tributaries southeast of the Mine Site, an area of sub-dominant wind direction, to support future monitoring interpretations. Include elements of risk management and monitoring in the plan. Suggested risk assessment elements include: • Periodic re-evaluation of the HIA/HHRA during and after mining activities (adaptive management); including periodic literature reviews or surveys to confirm the exposure assumptions and consumptions assumptions made in the HHRA remain valid • A decision-making framework for addressing future fugitive dust issues; • Summaries (from previous risk assessments) of conceptual site models, receptors, exposure pathways, media and contaminants of concern, existing datasets, and acceptable exposure concentrations; and • Monitoring of fugitive dust emissions, deposition, and exposure during the active mine life and in post-Closure. Based on the results of the testing, determine through adaptive management if additional future sampling would be required during operations and post-closure, particularly for fugitive dust resulting from truck traffic along the access road.	Likelihood of Implementation: Low-Medium Effective: Potentially – would confirm the findings of low risk in HHRA Reasonable/Practicable: Potentially – dust management, testing, and monitoring program guidance available and many ongoing national projects	Human Health Fish and Aquatic Resources Water Quality Soils Air Quality	ADEC ADHSS

[dd] Appropriateness of fish tissue monitoring depends on the species of fish. For example, salmon are migratory and accumulate most of their mass in marine waters well beyond the project area. Pike are a resident and would be candidate fish, but are a very low portion of the subsistence diet.
[ee] Monitoring and reporting for fugitive dust at the Mine Site that would take place as a requirement of the ADEC (2017i) Air Quality Control Construction Permit includes BACTs and source testing for PM emissions, and BMPs for controlling dust from site activities/wind erosion and performance assessment procedures, but no testing of other media.

Table 5.7-1B: Monitoring Measures Assessed as Not Likely to be Required

Monitoring or Adaptive Management Measure Description	**Assessment of Measure:** **Likelihood of Implementation (Low, Medium, High)** **Effective (Yes/No/Potentially)** **Reasonable/Practicable (Yes/No/Potentially)**	Resource(s) Affected	Potential Jurisdiction
If groundwater monitoring detects contamination outside of planned areas of hydraulic containment, reestablish hydraulic containment in the affected areas and implement a groundwater remediation program.	Likelihood of Implementation: Low – monitoring and adaptive management expected to prevent contamination outside of planned zones of hydraulic containment Effective: No – groundwater design features expected to mitigate potential impacts. Reasonable/Practicable: Potentially – may not be feasible for deep groundwater contamination. Permitting authority would determine appropriate response to permit noncompliance if groundwater contamination were to occur. (7)	Groundwater Hydrology Water Quality	ADNR ADEC[ff]
Collect additional groundwater quality data in Anaconda Valley upgradient of the TSF construction in order to establish site-specific background conditions that are pertinent to future monitoring and decommissioning of the SRS. Install 1 to 2 additional monitoring wells east and southeast of the TSF prior to construction for background data.	Likelihood of Implementation: Low[gg] Effective: Yes Reasonable/Practicable: Yes (7)	Groundwater Hydrology Water Quality	ADNR ADEC
Conduct Environmental DNA (eDNA) sampling for aquatic NNIS from barges coming into the lower river to identify impacts and incorporate rapid response detection plans. Use eDNA sampling for aquatic NNIS for all Donlin-related permitting.	Likelihood of Implementation: Low Effective: Potentially – at this time, effective application of this technology is being expanded in this region. Reasonable/Practicable: No – due to limitations of this technology at this time. (3)	Fish and Aquatic Resources	None
Use vessel based scanning LiDAR for accurate and detailed monitoring of shoreline erosion. This survey equipment can be used to document conditions and monitor change overtime.	Likelihood of Implementation: Low Effective: Potentially Reasonable/Practicable: No – the ability to discern barge erosion from natural erosion is not feasible at this time. (4, 5)	Fish and Aquatic Resources Water Quality Soils	Corps
Continue the current hair mercury bio-monitoring program throughout the active mine life. Specific elements may include: • Expand the hair mercury bio-monitoring program to include infants, young children, and the elderly. • Conduct long-term monitoring of the human health impacts, food consumption and exposure to methylmercury throughout the active mine life and during post-Closure. • Develop a long-term monitoring plan in coordination and involvement with the local native communities. • Conduct mercury bio-monitoring efforts in communities along the middle-Kuskokwim River region with active engagement and involvement from the native communities. • Establish screening levels or thresholds, based on the EPA reference dose for mercury, to determine whether or not further monitoring would be required using an adaptive management approach. • Conduct baseline survey and regular (annual) testing of workers for mercury[hh].	Likelihood of Implementation: Low Effective: No Reasonable/Practicable: No (1, 5, 6)	Human Health	ADHSS

[ff] Groundwater contamination outside of zones of hydraulic containment is not considered reasonably foreseeable. ADEC may only have potential jurisdiction in the unlikely event of an unplanned release (e.g., through Contaminated Sites Program).
[gg] Measure not included in ADNR IWM permit monitoring plan (SRK 2016h); and ADEC has limited regulatory oversight on groundwater if not a drinking water source.

[hh] Suggestions were made to publish results; however, it is noted that the Health Insurance Portability and Accountability Act would preclude publishing health records.

Table 5.7-1B: Monitoring Measures Assessed as Not Likely to be Required

Monitoring or Adaptive Management Measure Description	**Assessment of Measure:** **Likelihood of Implementation (Low, Medium, High)** **Effective (Yes/No/Potentially)** **Reasonable/Practicable (Yes/No/Potentially)**	Resource(s) Affected	Potential Jurisdiction
Monitor socioeconomic conditions (population, demographics, employment, income, education, and health indicators) in Yukon-Kuskokwim villages using existing/annually updated state and federal statistics.	Likelihood of Implementation: Low Effective: No Reasonable/Practicable: No (1, 2, 5, 6)	Socioeconomics Human Health	None
As a condition of permitting, conduct additional pre-Construction baseline analysis of fish and aquatic resource habitat along the barge transport route. Monitor fish and aquatic habitat along the barge route upstream of Bethel during the barging season to assess potential changes in habitat. If warranted, measures to reduce adverse impacts would be assessed.[ii]	Likelihood of Implementation: Low Effective: No Reasonable/Practicable: No (5, 6, 7, 8)	Fish and Aquatic Resources	None
Monitor potential effects of barge traffic and natural environmental parameters on salmon spawning areas. Should potential impacts of barge traffic be documented, minimize impacts on salmon through feasible adaptive management elements while barges are traveling in the vicinity of previously identified salmon spawning grounds between mid-May and late June depending on the annual timing of peak spawning activity. Monitor both physical environment impacts (e.g., water parameters) and biological impacts (fish spawning locations, etc.) associated with the range of potential barge impacts to form adaptive management approaches. If warranted based on monitoring results, apply measures such as reduced barge speed during critical fish spawning and larval migration periods, to minimize prop scour impacts.	Likelihood of Implementation: Low Effective: No – salmon do not spawn where the barges would operate. Reasonable/Practicable: No (1, 5)	Fish and Aquatic Resources	ADF&G
Compare actual measured water quality concentrations during mine Construction, Operations, and post-Closure to baseline concentrations. Establish screening levels to determine whether or not further testing would be required through adaptive management. Develop annual reports of the water[jj] and sediment concentrations to present to the communities for review. Establish a publically accessible Web-based exchange site where, following QA/QC of data, monitoring data (baseline and thereafter) is posted as it becomes available, including basic graphics.	Likelihood of Implementation: Low Effective: Potentially – measure needs a more specific focus and justification Reasonable/Practicable: No (2, 5, 8)	Water Quality	ADEC
Monitor tug-barge passages during the first years of construction to assess potential effects of barge traffic on riverbed scour, bank erosion, and nearshore velocities at variable depths and channel configurations, as well as fish habitat and fish passage.[kk] Analysis of barge passage monitoring results would provide a basis for potential adaptive management through which operational changes could be considered, as needed.	Likelihood of Implementation: Low Effective: Potentially Reasonable/Practicable: Potentially – a practicable monitoring protocol would need to be suggested. (4, 5, 6)	Fish and Aquatic Resources	None

[ii] Note: this measure would require consultation with ADF&G.
[jj] APDES permit will require reports of water sampling test results.
[kk] This measure would require consultation with ADF&G.

Table 5.7-1B: Monitoring Measures Assessed as Not Likely to be Required

Monitoring or Adaptive Management Measure Description	**Assessment of Measure:** **Likelihood of Implementation (Low, Medium, High)** **Effective (Yes/No/Potentially)** **Reasonable/Practicable (Yes/No/Potentially)**	Resource(s) Affected	Potential Jurisdiction
Implement additional long-term hydrologic monitoring of functioning wetlands.[ll]	Likelihood of Implementation: Low Effective: No – needs specific focus Reasonable/Practicable: No (1,4,5)	Wetlands	None
Monitor and test bird carcasses and fish, if and where appropriate,[mm] as part of a communication strategy to address perceived risk throughout the project. Designate a point of contact for monitoring and testing procedures.	Likelihood of Implementation: Low Effective: No – analysis shows no risk of contamination in birds and fish. Reasonable/Practicable: No (5, 6, 7)	Subsistence Human Health	None
Expand the existing ADHSS state-wide mercury hair testing program for women of child-bearing age to include additional receptors in Kuskokwim villages near the Mine Site (e.g., children, elderly). Include identification of comparison criteria (Agency for Toxic Substances and Disease Registry [ATSDR] or EPA values) in the hair monitoring plan.	Likelihood of Implementation: Low Effective: No Reasonable/Practicable: No (1, 5, 6)	Human Health	ADHSS
Monitoring to evaluate the relationship between vessel speeds and wave heights of representative barge tows in potential hotspot areas during the first years of construction would help determine what barge operational measures are needed (if any) to minimize or avoid risks relative to the displacement and/or stranding of small outmigrant salmon and other young-of-year fishes, as well as commercial and subsistence fishing.[nn]	Likelihood of Implementation: Low Effective: Potentially – depending on locations if barge-related impacts could be differentiated from naturally occurring processes and small boat traffic. Reasonable/Practicable: Potentially – a practicable monitoring protocol would need to be suggested. (4, 5, 7)	Fish and Aquatic Resources Socioeconomics Subsistence Human Health	None
Coordinate Construction and Operations Phase fish population and water quality monitoring with agencies or working groups (such as the Kuskokwim River Salmon Management Working Group [KRSMWG]). Continue baseline project fish and water quality studies to help track possible incremental impacts for development of adaptive management strategies as necessary.	Likelihood of Implementation: Low Effective: No Reasonable/Practicable: No – fish population studies (other than a rainbow smelt monitoring program – See Design Feature T17) are not proposed by Donlin Gold and are not anticipated to be required by resource agencies. (See A31 in Table 5.2-1 for Donlin Gold's commitment to facilitate appropriate project communications through DATROC). (5, 7)	Fish and Aquatic Resources Water Quality	None
Monitor potential effects of barge traffic and natural environmental parameters on salmon spawning areas. Should potential impacts of barge traffic be documented, apply adaptive management measures to minimize impacts on salmon such as directing barge traffic to deeper portions of the river channel while traveling in the vicinity of previously identified salmon spawning grounds between mid-May and late June depending on the annual timing of peak spawning activity. Monitoring of both physical environment impacts (e.g., water parameters) and biological impacts (fish spawning locations, etc.) associated with the range of potential barge impacts would allow clearer answers to adaptive management questions. If warranted, based on monitoring results, apply measures such as reduced barge speed during critical fish spawning and larval migration periods to minimize prop scour impacts.	Likelihood of Implementation: Low Effective: No – salmon do not spawn where the barges would operate (see Design Feature T17 for Donlin Gold's rainbow smelt monitoring program). Reasonable/Practicable: No (1, 2, 5, 7)	Fish and Aquatic Resources	ADF&G

[ll] Impacts from drawdown are not governed by CWA Section 404.
[mm] Note: Consultation with ADF&G would be necessary to determine the need for a permit to conduct biological testing.
[nn] This measure would require consultation with ADF&G.