CHAPTER 2: ALTERNATIVES

2.1 REGULATORY SETTING FOR ALTERNATIVES ANALYSIS

The Council on Environmental Quality's (CEQ's) regulations describe the alternatives section as the "heart of an Environmental Impact Statement (EIS)" and require exploration and evaluation of all reasonable alternatives (40 Code of Federal Regulations [CFR] 1502.14). CEQ further defines reasonable alternatives as "those that are practical or feasible from the technical and economic standpoint and using common sense" (CEQ 1981). National Environmental Policy Act (NEPA) implementation procedures for the United States Army Corps of Engineers (the Corps) describe reasonable alternatives as those that are feasible, and then further specify that such feasibility must focus on the accomplishment of the underlying Purpose and Need (33 CFR Part 325, Appendix B).

The Corps will follow the Clean Water Act (CWA) Section 404(b)(1) Guidelines (40 CFR Part 230) when evaluating the permit application from Donlin Gold, LLC (Donlin Gold). The 404(b)(1) Guidelines require examination of practicable alternatives to the proposed discharge (or action) and other factual determinations. An alternative is considered practicable "if it is available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes" (40 CFR 230.10). The Guidelines require that the least environmentally damaging practicable alternative (LEDPA) be determined for permit consideration.

The Section 404(b)(1) guidelines (Corps 2009) also require the determination of whether a project is water dependent. Water dependent means that the project by its very nature requires access, proximity to, or siting within a special aquatic site[1] to fulfill its "basic purpose." If a project is determined not to be water dependent, the guidelines state that:

> "…practicable alternatives that do not involve special aquatic sites are presumed to be available, unless clearly demonstrated otherwise;" and
>
> "…all practicable alternatives to the proposed discharge which do not involve a discharge into a special aquatic site are presumed to have less adverse impact on the aquatic ecosystem, unless clearly demonstrated otherwise" (40 CFR 230.10(a)(3).

The Corps has determined that the basic purpose of the Applicant's discharge of dredged or fill material is to extract and process gold. Extraction and processing of gold in and of itself does not require access, proximity to, or siting within, a special aquatic site to fulfill its "basic purpose." Therefore, the Corps has found that the project is not water dependent.

Both the CEQ and the Corps NEPA implementation procedures require consideration of a No Action Alternative; for a Corps EIS this alternative would preclude any construction that would require a Corps permit (33 CFR Part 325, Appendix B). The No Action Alternative (Alternative 1) is described in Section 2.3.1. Donlin Gold's proposed mine development project is Alternative 2 and is described in Section 2.3.2.

[1] "Special aquatic sites" as described in 40 CFR Part 230, Subpart E include wetlands, sanctuaries and refuges, mud flats, vegetated shallows, coral reefs, riffle and pool complexes.

Over 300 alternative options were developed and screened to satisfy NEPA requirements; satisfy the Corps Public Interest Review (33 CFR 320.4(a)); assure compliance with the requirements of the 404(b)(1) Guidelines; and to enable federal, state, and cooperating entities the ability to make permitting decisions if and where necessary (Appendix C). These options were systematically examined to determine the reasonable alternatives to include in the Draft EIS. Alternatives carried forward for detailed study are presented in Sections 2.3.1 through 2.3.7.

CEQ regulations also require a brief discussion of the reasons for eliminating alternatives that were considered but not carried forward for detailed study. Alternatives that were considered but eliminated are presented in Section 2.4.

2.2 ALTERNATIVES DEVELOPMENT PROCESS

In addition to the No Action and the Proposed Action alternatives, the EIS team conducted several workshops with the Cooperating Agencies, and developed a range of alternatives for analysis using a five-step process that began with issues raised during scoping (see Section 1.7).

It is important to understand the terms "component," "subcomponent," "option," and "alternative" when reviewing this chapter:

- Component – a complete mine has several components, each necessary to allow production. For the Donlin Gold Project, there are three primary components: Mine Site, Transportation Corridor, and Pipeline.
- Subcomponent – each primary component includes subcomponents; for example, the open pit and processing plant are subcomponents of the Mine Site.
- Option – for each component / subcomponent there are one or more options.
- Alternative – an alternative is a complete package of options that comprise a functioning mine project.

In the overall Alternatives Development Process described below, consideration was given to the project's large geographic footprint; the three different, but connected, primary components (Mine Site, Transportation Corridor, and Pipeline), and comments provided by the public, stakeholders, and agencies in scoping.

Alternatives Development Process

Step 1: *Identify Scoping Issues and Related Project Components*

Step 2: *Develop Screening Criteria*

Step 3: *Identify Options to Address Concerns for Each Component & Subcomponent*

Step 4: *Apply Screening Criteria to All Options; Develop Options to Carry Forward and Carefully Document Option Disposition*

Step 5: *Package Options into Action Alternatives*

Step 1 of the alternatives development process was to identify the issues raised in scoping and then to relate them to the project components and subcomponents.

Step 2 was to develop the criteria for future screening of each option. To narrow the range of options considered, criteria were organized around three screening tests: purpose and need, feasibility (including logistics), and environmental impacts. The screening criteria are more fully described in Section 2.2.1.1.

In Step 3, options were identified to address concerns raised during scoping; options originating from scoping comments, Donlin Gold's consideration of design alternatives, and the Corps' EIS contractor, AECOM, were compiled into tables, organized by project component and subcomponent.

In Step 4, screening criteria from Step 2 were applied to the options developed in Step 3. The criteria were used to screen options and to eliminate options that would not meet the Corps' determination of Purpose and Need, that were not feasible, or that would not reduce environmental impacts over similar options. The EIS contractor completed preliminary screening, which was reviewed and refined by the Corps.

Step 5 was to package the options that met all of the screening criteria into action alternatives for detailed analysis in the EIS. Options that were dismissed from further analysis are summarized in Section 2.4. The range of reasonable alternatives is described in Section 2.3.1 through Section 2.3.7.

2.2.1 SCREENING THE FULL RANGE OF ALTERNATIVES

2.2.1.1 SCREENING CRITERIA

The EIS team organized screening criteria around three topic areas: purpose and need, feasibility, and environmental impacts. First, the EIS team documented and eliminated options clearly outside of the purpose and need. Each remaining option was then rated for feasibility (technical, economic and, where relevant, logistical) and environmental impacts (physical, biological, and socioeconomic).

The final decision to analyze options rested with the Corps in consultation with the cooperating agencies. For any option eliminated from further analysis, the rationale for elimination is documented in Section 2.4, Alternatives Considered but Eliminated from Detailed Analysis.

Alternatives Screening Process

Step 1: *Eliminate Options that Clearly Do Not Meet Purpose and Need*

Step 2: *Determine if Option is Feasible*

- *Identify Technologically Feasible and Operationally Efficient Options*
- *Screen Technologically Feasible Options for Relative Cost Effectiveness*
- *Where Necessary, Evaluate the Logistical Feasibility of Options*

Step 3: *Eliminate Options that Increase Negative Environmental Impacts*

2.2.1.1.1 SCREENING – PURPOSE AND NEED

Three federal agencies have regulatory permitting authority for the project that will require a Record of Decision (ROD): the Corps, the Bureau of Land Management (BLM), and the Pipeline and Hazardous Materials Safety Administration (PHMSA). The Purpose and Need statements for the project are provided in Section 1.3 of the EIS. Options that did not meet the Corps' determination of Overall Purpose and Need and NEPA Purpose and Need were not analyzed further in the EIS. Similarly, any options to the Pipeline component that fall outside the BLM or PHMSA Purpose and Need statements were dismissed.

2.2.1.1.2 SCREENING – FEASIBILITY

The feasibility screening test considers technological, economic and, where relevant, logistical feasibility. Technological feasibility was evaluated to minimize the risk of an option causing a component to be unable to perform its intended function efficiently. Options that make project components too complex or use unproven technology increase the risk of operational failure and accidents.

Options identified for a specific project component may be subject to technical constraints that affect the workability of the option. For example, topography, resource needs, spatial relationships of one component to another, temporal sequences, operating considerations, or engineering data for a specific option may influence whether a particular option is capable of meeting the project objectives. The technological feasibility criterion considers the practicability of each option in meeting these challenges.

Economic feasibility considers the relative cost effectiveness of technologically feasible and operationally efficient component options. If project costs of implementing an option exceed reasonable or practical limits, the option could be considered economically infeasible. CWA regulations enumerate cost as among the considerations to be factored into whether an alternative is practicable (40 CFR 230.10(a)(2)): "An alternative is practicable if it is available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes…." In the screening stage, rough order of magnitude cost comparisons were made, as detailed engineering and costs could not reasonably be developed for over 300 options. Where the order of magnitude cost review was not sufficient to decide whether an option was economically feasible, it was advanced for additional review, and additional information gathered before reaching a screening conclusion.

2.2.1.1.3 SCREENING – ENVIRONMENTAL IMPACTS

Based on assessment of likely environmental impacts, including physical, biological, and socioeconomic, the EIS team eliminated options that had a high potential to increase negative direct environmental impacts and, when appropriate, indirect and cumulative environmental impacts.

2.2.1.2 FULL RANGE OF OPTIONS CONSIDERED

Using the first three steps of the Alternative Development Process described in Section 2.2, the EIS team compiled scoping comments, cooperating agency suggestions, Donlin Gold's consideration of design alternatives, and input from the EIS contractor to form the full range of options for consideration.

The options were gathered into three common primary components of the Mine Site, Transportation Corridor, and Pipeline.

Primary Components

Mine Site: Consists of 13 Subcomponents and 113 Alternative Options

Transportation Corridor: Consists of 9 Subcomponents and 89 Alternative Options

Pipeline: Consists of 5 Subcomponents and 111 Alternative Options

From the full range of options, options that met the three alternatives screening criteria were addressed by the EIS team in a preliminary assessment and recommendation forwarded for the Corps' consideration. These were then packaged into alternatives for full analysis. The alternatives that were advanced for full analysis for the EIS were then developed to a sufficient level of conceptual engineering to allow impact analysis.

Following conceptual engineering, options were rechecked to ensure they still met the screening criteria. The conceptual engineering work identified feasibility concerns for three of the options initially carried forward:

- Alternative 5B – Comingled Tailings. This was Option MS-75 and would have dewatered the tailings and placed them as a comingled mix with waste rock into the Waste Rock Facility (WRF). The option was ultimately found to be infeasible for reasons documented in Appendix C, Table C-13.
- Alternative 5C – Return Potentially Acid Generating (PAG) 6 Waste Rock to Completed Mine Pit. This was Option MS-60A and would have returned all PAG 6 waste rock to the pit bottom so that it would be later submerged in the pit lake. The option was ultimately found to have little or no potential environmental benefit and infeasible for reasons documented in Appendix C, Table C-13.
- Alternative 6B – Kichatna Pipeline Alignment. This was Option PL-26 and would have deviated around a pipeline segment that is proposed to be constructed near the Iditarod National Historic Trail (INHT). The option was ultimately found to be infeasible for reasons documented in Appendix C, Table C-21.
- Additionally, Alternative 5D – Treat and Discharge Some Excess Water considered using a water treatment process that has been accepted by Donlin Gold as a component of their proposed project. It has been incorporated into the description of the Proposed Action (Alternative 2 – see Section 2.3.2) and is not a stand-alone action alternative.

The alternatives to be advanced for full analysis in the EIS, including the No Action and Proposed Action alternatives, are presented in Section 2.3. The options eliminated from further analysis are listed in Section 2.4.

2.3 DESCRIPTIONS OF ALTERNATIVES

2.3.1 ALTERNATIVE 1 – NO ACTION

NEPA requires consideration of a No Action Alternative. The No Action Alternative means that no permits would be issued and the proposed project would not be undertaken. The No Action Alternative applies to all three components of this project. There would be no Mine Site development, no new Transportation Corridor, and no Pipeline. Baseline barge trips along the Kuskokwim River would continue at approximately 68 per year. The future of the existing camp, airstrip, and related facilities, developed for exploration and baseline environmental studies, would be decided at the discretion of the landowners, The Kuskokwim Corporation (TKC) and Calista Corporation (Calista). There is currently no requirement for the camp and airstrip to be reclaimed should the project not be permitted (Enos 2013a). Current ocean and river barging traffic would likely continue at similar levels.

The No Action Alternative would result from the Corps not issuing required permits under Section 404 of the CWA and Section 10 of the Rivers and Harbors Act. Under the No Action Alternative, BLM would not grant the requested Mineral Leasing Act (MLA) Right-of-Way (ROW) permits and the proponent would have to seek other alternatives to power the proposed Donlin Gold Mine and provide telecommunications which do not involve BLM managed federal public lands. Whether the Mine Site would move forward would depend on an alternative design not requiring a MLA ROW. The No Action Alternative thus meets NEPA requirements for analysis as well as MLA, CWA, and Rivers and Harbors Act analysis.

The No Action Alternative is intended to be used as a baseline to facilitate the comparison of impacts between the proposed action alternative and the alternatives analyzed in detail. Baseline conditions for all resources are described in the affected environment sections of Chapter 3. Project-related impacts (both positive and negative) would not occur under the No Action Alternative.

2.3.2 ALTERNATIVE 2 – DONLIN GOLD'S PROPOSED ACTION

This section describes the Proposed Action for the Donlin Gold Project. The proposed Donlin Gold Project would be an open pit, hard-rock gold mine in Southwest Alaska, 10 miles north of the village of Crooked Creek within the Crooked Creek drainage, on land leased from the Calista Corporation, an Alaska Native Claims Settlement Act (ANCSA) regional corporation. The Kuskokwim Corporation, an ANCSA village corporation, has granted surface use rights to Donlin Gold. Donlin Gold also has legal control of approximately 13 acres of surface estate in the Snow Gulch area per a lease agreement with Lyman Resources in Alaska, Inc. The proposed mine (including the open pit, the processing plant, WRF, and tailings storage facility [TSF]) would have a total footprint of approximately 16,300 acres. Project components would be located throughout 80,600 acres of land leased from the above entities, and the Angyaruaq (Jungjuk) Port and access road on State and ANCSA corporation lands. The project would also include a 316-mile natural gas pipeline within ROWs leased from the State of Alaska, BLM, Calista, and Cook Inlet Region, Inc. (CIRI).

The description of Alternative 2 is based on information provided by Donlin Gold in the following documents:

- Plan of Operations. This plan is composed of the following volumes:
  - Volume I: Project Description (SRK 2016a)
  - Volume II: Water Resources Management Plan (SRK 2017e)
  - Volume III: Integrated Waste Management Plan (SRK 2016b)
    - Volume IIIA: Tailings Management Plan (SRK 2016c)
    - Volume IIIB: Waste Rock Management Plan (SRK 2016d)
  - Volume IV: Reclamation and Closure Plan (SRK 2017c)
  - Volume VI: Transportation Plan (SRK 2013a)
    - Volume VIA: Terminal and Tank Farm Oil Discharge Prevention and Contingency Plan
    - Volume VIB: Vessel Operations Oil Discharge Prevention and Contingency Plan
  - Volume VII: Monitoring Plans
    - Volume VIIA: Integrated Waste Management Monitoring Plan (SRK 2016e)
- River Barge Fleet Design and Operation (AMEC 2013, 2014)
- Revised Pipeline Plan of Development (SRK 2013b)

The proposed Donlin Gold project would require three to four years to construct and have an active mine life of approximately 27 years. The mine is proposed to be a year-round, conventional truck and shovel operation using both bulk and selective mining methods. The mine operation would have a projected average mining rate of 422,000 tons per day (tpd). Total waste rock material is estimated at 3.145 billion tons, most of which would be placed in a WRF or backfilled in the ACMA pit.

The ore processing facilities would operate at an average production rate of 59,000 tpd. Processing components include a gyratory crusher, semi-autogenous grinding (SAG) and ball mills, followed by flotation, concentration, pressure oxidation, and carbon-in-leach (CIL) process circuits. Carbon stripping, electrowinning, and refining would produce an end product of gold doré bars, which would be shipped to a custom refinery for further processing. State-of-the-art mercury abatement controls would be installed at each of the major thermal sources, including the autoclave, carbon kiln, gold furnaces, and retort. Tailings storage would encompass an area of 2,351 acres with a total capacity of approximately 335,000 acre-feet of mill tailings, decant water, and stormwater in a fully lined facility.

Electrical power for the proposed Donlin Gold project would be generated on site from a dual-fueled reciprocating engine power plant with a steam turbine utilizing waste heat recovery from the engines. Natural gas would be the primary fuel with ultra-low sulfur diesel (ULSD) as backup. The power plant would comprise two equal halves, each consisting of six reciprocating engines, and a single separate steam turbine for a total installed capacity of 227 MW, an average running load of 153 MW, and a peak load of 184 MW. Natural gas would be transported to the Donlin Gold Mine Site via a 316-mile, 14-inch diameter buried steel pipeline originating from an existing 20 inch natural gas pipeline near Beluga, Alaska.

General cargo for mine operations would be transported to Bethel by marine barge from terminals in Seattle, Washington, Vancouver, BC, or Dutch Harbor, Alaska. At Bethel, cargo would be transferred to the dock for temporary storage or loaded onto river barges for transport up the Kuskokwim River to a port constructed at Jungjuk Creek. A two-lane, 30-foot wide, 30-mile all-season access road would be constructed from the proposed Angyaruaq (Jungjuk) Port to the Mine Site. Fuel would be transported to Dutch Harbor by tanker, then to Bethel by marine barge. At Bethel fuel would either be transferred directly to double-hull river barges for transport to Angyaruaq (Jungjuk) Port, or be off-loaded for temporary storage. From Angyaruaq (Jungjuk) Port fuel would be delivered to the Mine Site fuel storage facility by tanker trucks.

The Donlin Gold project site would be a permanent camp operation accessible primarily by a 5,000-foot by 150-foot gravel airstrip. The camp would be capable of housing up to 638 workers during Operations.

Reclamation and closure planning has been based on the concept of "design for closure," which was initiated in the very early stages of the Donlin Gold project development to address post-closure impacts on the physical resources of the area and on local communities. In addition to reclaiming disturbances associated with mining, processing, and ancillary support facilities in a manner compatible with the designated post-mining land use, the goal of the Donlin Gold reclamation plan is to minimize the area affected by operations. During Operations, concurrent reclamation would be performed whenever possible in areas no longer required for active mining.

2.3.2.1 CONNECTED ACTIONS

Any actions that would occur at Dutch Harbor, the Port of Bethel, or the Bethel Yard Dock are not part of the proposed action, and are considered connected actions pursuant to NEPA (40 CFR 1508.25). See Chapter 1, Section 1.2.1, Connected Actions. The connected actions include:

Dutch Harbor

Dutch Harbor is an international, year-round port, directly on the shipping routes between the West Coast and other countries on the Pacific Rim. With well-developed port infrastructure, sufficient available land, and well established national and international shipping connections, existing facilities at Dutch Harbor would be used as a location for forward deployment of cargo prior to the shipping season on the Kuskokwim to store containers and break-bulk cargo. Other forward deployment locations could include existing facilities in Juneau, Kodiak, and King Cove if the need arises and space is available. Additionally, fuel would be stored in Dutch Harbor for transfer to Bethel. Total fuel storage capacity at Dutch Harbor is currently approximately 12 Mgal. Additional fuel storage capacity of approximately 8 Mgal may be needed for the project which may require development of 4 to 6 acres of land. Undeveloped land adjacent to existing industrial areas appears to be available throughout Unalaska. Donlin Gold does not propose the construction of additional capacity in Dutch Harbor. Donlin Gold has indicated they would likely use a third-party to transport fuel and other supplies to the project site. That party would determine what amount of additional fuel capacity, if any, would be required in Alaska to accommodate demand. That party would also be responsible for applying for and obtaining any permits that may be required for the expansion. Although it is not certain additional capacity would be needed, this potential third party expansion is analyzed in this EIS.

Bethel Cargo Terminal

The Port of Bethel is the main port facility for the Yukon-Kuskokwim (Y-K) Delta. A 16-acre cargo terminal would likely need to be constructed in Bethel to receive barges originating from the marine terminals in Seattle, Vancouver, and Dutch Harbor (forward deployment), and barges returning from the upriver port at Angyaruaq (Jungjuk). The cargo terminal would be an expansion of the existing Knik Bethel Yard Dock and would have three general cargo berths, one for ocean barges and two for river barges, and a roll-on / roll-off berth. The terminal will have enough space to store up to 2,750 containers. Preliminary review indicates that maintenance dredging would not be required for the Bethel Yard Dock (POA 2014-64 Knik Construction Company). General cargo would be placed into temporary storage or transferred directly to river barges for transport upriver. The new terminal would provide storage for five ocean barge loads. In addition, 3.5 acres would be required for buildings, access roads, equipment storage, plowed snow, spare pallets, chains, ropes, damaged containers, lighting, dock surface, and equipment maneuvering. Figure 2.3-1 shows the proposed Bethel Cargo Terminal location. Donlin Gold has indicated that a third party would construct and operate the Bethel Cargo Terminal. That party would determine what amount of additional storage space and waterfront structures, if any, would be required to accommodate demand. That party would also likely be responsible for applying for and obtaining any permits that may be required for the expansion. Although it is not certain additional capacity would be needed, this potential third party expansion is analyzed in this EIS.

Bethel Fuel Terminal and Tank Farm

Donlin Gold anticipates a 6 Mgal fuel storage facility may be needed at Bethel. The tanks would be installed in lined containment areas. When ocean fuel barges arrive at Bethel, the fuel would be offloaded into storage, or directly to river barges alongside the ocean barge. Donlin Gold has indicated they would likely use a third party to construct and operate the Bethel Fuel Terminal. That party would determine what amount of additional storage space and waterfront structures, if any, would be required to accommodate demand. That party would also likely be responsible for applying for and obtaining any permits that may be required for the expansion. Although it is not certain additional capacity would be needed, this potential third party expansion is analyzed in this EIS.

DONLIN GOLD

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PROJECT EIS

ALTERNATIVE 2
BETHEL CARGO TERMINAL,
FUEL TERMINAL, AND TANK FARM

JUNE 2017

FIGURE 2.3-1

2.3.2.2 ALTERNATIVE 2 – MINE SITE

The Mine Site component includes two open pits, a WRF, ore processing facilities, a tailing storage facility (TSF), water treatment plants, facilities to house the workforce, equipment to transport ore from the open pit to the processing plant, hydrologic control features (freshwater diversion dams, contact water dams, and a freshwater reservoir), and a power plant. Mine Site equipment and facilities include:

- Construction camps (temporary) to provide living quarters for up to 2,560 workers, support facilities, warehouse and storage space, a water treatment and waste disposal system, communication facilities, and power generation facilities. During Operations, the permanent camp would house 638 workers.
- Open pit mining would require drilling, blasting, loading, and hauling equipment; haul roads and access roads; TSF; WRF; overburden stockpiles; and growth media stockpiles within the Mine Site.
- Mine equipment used at the mine during Construction and Operations includes wheel loaders, dozers, drills, shovels, and haul trucks. Auxiliary mine equipment includes: blast hole drills, blasting emulsion trucks, dozers, service trucks, transport vehicles, and trailer-mounted lights (see Table 2.3-1).
- The mine operation would have a projected average mining rate of 422,000 tpd. Total waste rock material is estimated at 3.145 billion tons, with approximately 2.46 billion tons to be placed in a waste rock facility located outside the mine pit and the remaining waste rock backfilled in one of the pits. Total tailings are estimated at 556 million tons with a density of 78 pounds per cubic foot to be placed in a subaqueous slurry tailings facility.
- Processing facilities to crush and grind ore for feed to flotation, flotation concentrate pressure oxidation, carbon-in-leach circuit, gold recovery, tailings management and recycle water management.
- Mercury abatement would occur at all mercury emission sources in the processing facility. All mercury would be transported in specially designed and marked mercury containers that would be managed in accordance with the mercury management plan and state and federal requirements.
- Sodium cyanide handling and storage procedures would be in accordance with state and federal requirements and the International Cyanide Management Code (ICMC) as developed by the International Cyanide Management Institute.
- Power would be provided by a dual fuel power plant. Power from the plant would be distributed to the main process areas of the mine by power cables and overhead transmission lines.
- Eight freshwater wells would be drilled south of Omega Gulch, near Crooked Creek, to supply domestic and sanitary water supplies. Two wastewater treatment plants (WTPs) would be installed at the Mine Site.
- At the ACMA and Lewis open pits, there would be up to 35 pit perimeter wells and 80 in-pit dewatering wells. Some pit dewatering groundwater would be treated to meet Alaska Department of Environmental Conservation (ADEC) Water Quality Standards

and discharged to Crooked Creek; the remainder would be used in the processing facilities.

- Hazardous waste would be managed at the Mine Site through the hazardous waste classification system described in federal regulation 40 CFR Part 262 under the Resource Conservation and Recovery Act (RCRA).

The Proposed Action would have an average process throughput rate of 59,000 tons of ore per day, an estimated operational life of 27 years, and would produce approximately 30 million ounces of gold. The gold within the Donlin Gold deposit is not visible to the human eye; it is microscopic and bound within the arsenopyrite (iron arsenic sulfide) and pyrite (iron sulfide) minerals within the host rock of the deposit. Donlin Gold proposes to mine the deposit through a combination of bulk and selective, open pit, hard-rock mining methods. Bulk mining methods are typically used in massive ore bodies with a relatively homogenous (and lower grade) distribution of gold within the host rock. Selective mining methods would be employed in areas where ore grades are higher or where local geology has produced irregularities in the ore body. The Mine Site would occupy a total area of approximately 14 square miles (9,000 acres). Figure 2.3-2 presents a general layout of the proposed Mine Site.

2.3.2.2.1 MINE SITE – FACILITIES CONSTRUCTION

Construction Sequence

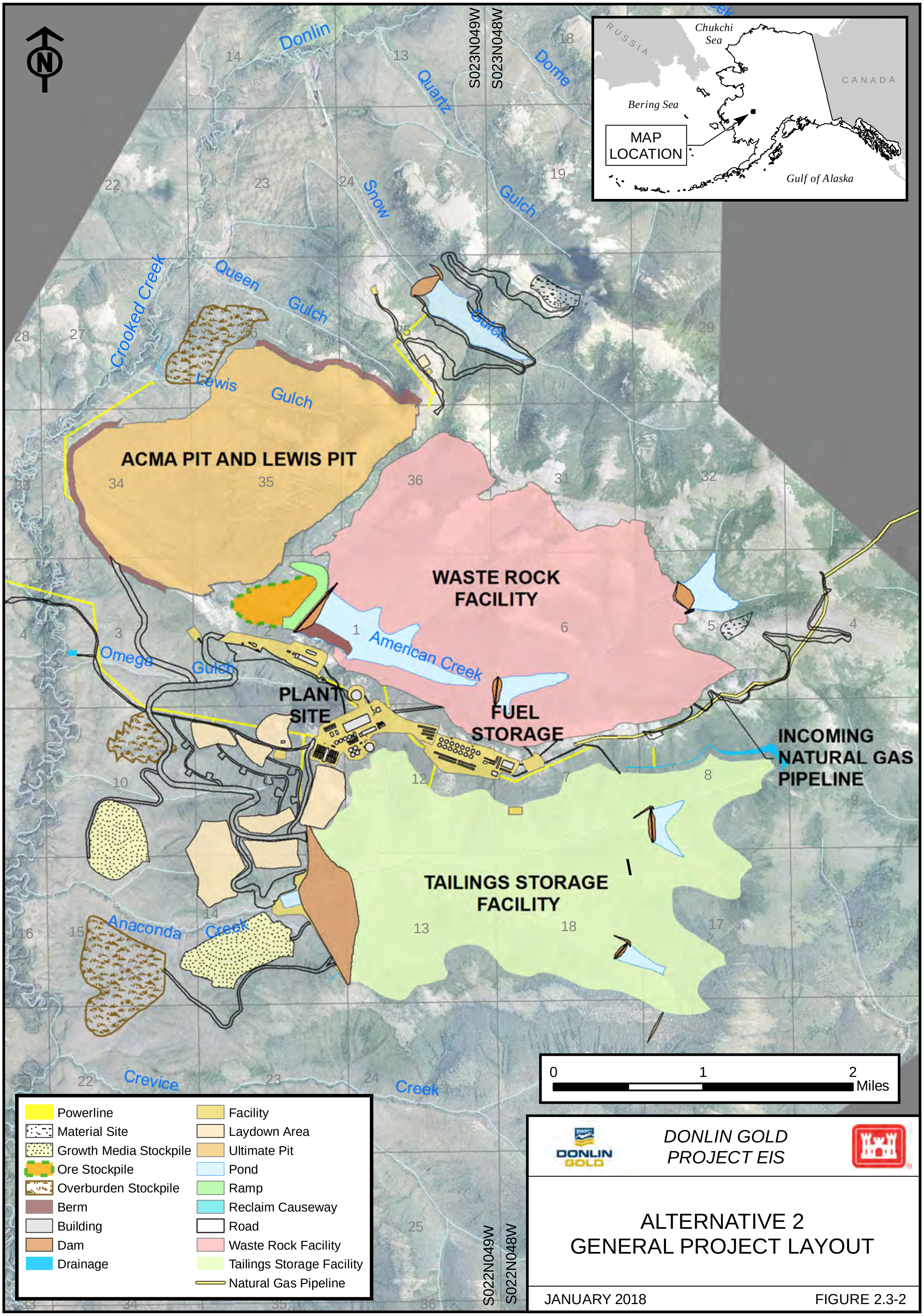
Site access, preparation, and clearing activities would take place after the completion of the permitting process to facilitate construction at the Mine Site. During pre-production, Donlin Gold would gain access to the site; erect a temporary construction workforce camp; prepare for full-scale mining operations; train work crews; install erosion controls; construct access and haul roads; and clear and grub (remove all vegetation) the pit, TSF, waste rock storage, and process facilities areas that would be utilized during the initial years of operation. Staging of equipment would be one of the first activities undertaken. Construction of facilities and removal of overburden to provide access to ore is anticipated to take three to four years to complete working year-round.

Construction Camp

The construction camp would be near the processing plant site (see Section 2.3.2.2.10 for a description of the permanent accommodation camp). The main building would include 14, 3-story dormitories designed to accommodate shift workers during construction of the mine. Building modules would be transported by barge to the Angyaruaq (Jungjuk) Port facility and then transported via truck to the construction camp site. Construction camp modules would be disassembled and removed after construction is complete. The construction camp would occupy approximately 15 acres. The separate construction camps for the pipeline are described in Section 2.3.2.4.5.

Construction Workforce

The estimated peak construction workforce for the Mine Site is 2,560. Information on the pipeline construction workforce is provided in Section 2.3.2.4.5.



DONLIN GOLD
PROJECT EIS

ALTERNATIVE 2
GENERAL PROJECT LAYOUT

JANUARY 2018

FIGURE 2.3-2

2.3.2.2.2 MINE SITE – MINING METHODS

Gold-bearing rock within the Donlin Gold deposit is present in two adjacent areas known as the ACMA and Lewis deposits. The ACMA pit would have an ultimate depth of approximately 1,850 feet and the Lewis pit would be 1,653 feet deep from the upper high wall to the final pit bottom. Mining of the ACMA pit is proposed in nine phases and the Lewis pit in six phases. The initial mining of the two pits would be independent, but they would partially merge later in the life of the mine into one roughly oval, open pit mine with dimensions roughly 2.2 miles long by 1 mile-wide (Figure 2.3-3). The overall pit slope angles would range from 23 to 42 degrees. Catch benches have generally been designed every 80 vertical feet in most areas of the pit at varying widths to meet slope design criteria, allow for catchment of loose material, and potentially allow access for bench maintenance and observation (Figure 2.3-4).

2.3.2.2.3 MINE SITE - LOADING AND HAULING EQUIPMENT

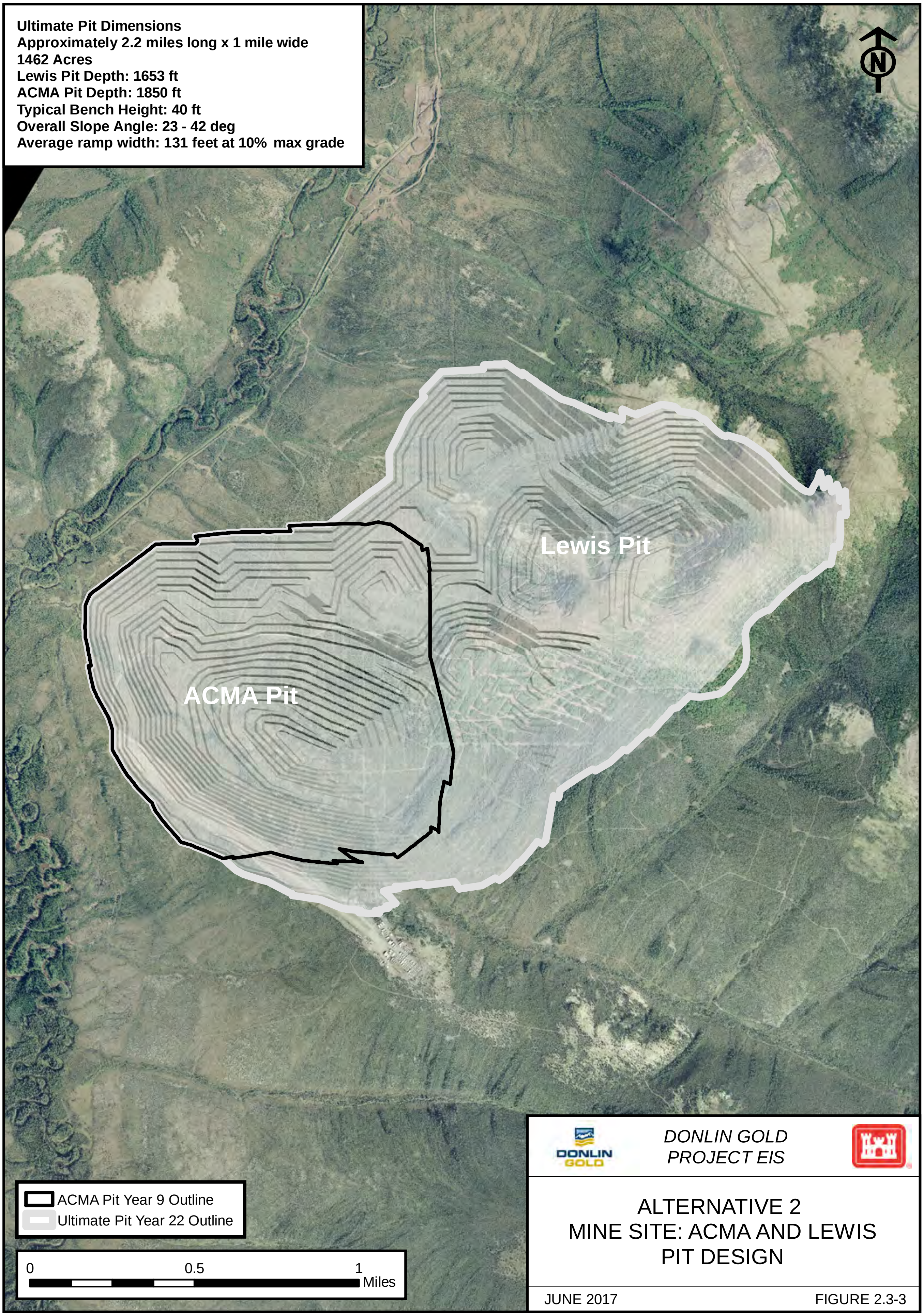
Open pit mining would use a fleet of shovels, wheel loaders, drills, large-capacity haul trucks, and a variety of auxiliary equipment. Haul roads would be required between the two pits, the ore crusher, the WRF, overburden stockpiles, construction areas, and the truck shop. During mine operation, hydraulic shovels would be the primary loading equipment, supported by front-end loaders. Auxiliary mine equipment would include track dozers, wheel dozers, water trucks, graders, excavators, small wheel loaders, blasting product trucks, service trucks, transport vehicles, cranes, and trailer-mounted light plants. A list of the types and numbers of equipment proposed to be used at the project is presented in Table 2.3-1.

Auxiliary fleet vehicles would be used for road maintenance, bench development in the open pit, construction of the WRF, and miscellaneous mine site projects. Graders would maintain the haul roads, including the mine access road. Water trucks would spray roads and working areas to mitigate dust impacts to air quality.

Blasting

Blasting would be required to fracture and loosen rock prior to excavation. Blasting operations would be conducted daily and in accordance with a blasting plan. Blasting agents would consist of a combination of emulsion and ammonium nitrate and fuel oil (ANFO) explosives. Blasting materials would be used during both construction and mining operations.

Separate storage bins or silos would be constructed for emulsion, ammonium nitrate, and fuel oil. Blasting materials would be stored and handled according to the Mine Safety and Health Administration (MSHA) regulations in 30 CFR Part 56. Explosives would be handled and transported according to the regulations of the Bureau of Alcohol, Tobacco, Firearms, and Explosives; U.S. Department of Transportation (USDOT) PHMSA; and the U.S. Coast Guard (USCG). All detonators and bagged products would be stored in an explosives magazine meeting applicable federal and state safety and security requirements.



DONLIN GOLD PROJECT EIS

ALTERNATIVE 2
MINE SITE: ACMA AND LEWIS PIT DESIGN

JUNE 2017

FIGURE 2.3-3

Goldstrike Betze Mine
Source: AECOM 2015

DONLIN GOLD
PROJECT EIS

ALTERNATIVE 2
OVERVIEW OF OPEN
PIT BENCHES

JUNE 2017

FIGURE 2.3-4

Table 2.3-1: Primary Mine Equipment Information (Estimates)

Make and Model (Typical)	Type	Engine[1]	Rating (hp)	Maximum Units Operating
Komatsu PC8000	Hydraulic shovel (electric or ultra-low sulfur diesel)	2 x squirrel-cage induction motors or 2 x Komatsu SDA16V160	3,890 (electric) or 4,020 (ultra-low sulfur diesel)	7
LeTourneau L2350	Front-end loader	MTU/DD 16V4000	2,300	2
Caterpillar 994F	Front-end loader	Cat 3516B	1,577	1
Liebherr T282C	Haul truck	MTU/DD 20V4000	3,755	69
Caterpillar 785C	Haul truck	Cat 3512B	1,450	10
Atlas Copco PV 275	Drill	Cat C32 ACERT	950	7
Atlas Copco DML	Drill	Cat C27 ACERT	800	15
Atlas Copco L8	Drill	Not specified	540	10
Caterpillar D11T	Track dozer	Cat C27 ACERT	850	6
Caterpillar D10T	Track dozer	Cat C32 ACERT	646	4
Caterpillar 854G	Wheel dozer	Cat C32 ACERT	904	6
Caterpillar 24H	Grader	Cat C13 ACERT	533	3
Caterpillar 16H	Grader	Cat C18 ACERT	297	7
Caterpillar 785C	Water truck	Cat 3512B	1,450	4
Caterpillar 390DL	Hydraulic excavator	Cat C18 ATAAC	523	2
Komatsu PC2000	Hydraulic excavator	Not specified	976	2
Caterpillar 777F	Fuel truck	Cat C32 ACERT	1,016	3
QTE Body on Peterbilt Chassis	Service truck	Not specified	300	1
Grove GMK6350 (200T)	Mobile crane	Benz OM906LA	563	1
QTE Body on Peterbilt Chassis	Low boy truck	Not specified	300	1
Caterpillar 988	Tire handler	Not specified	501	2
Terex LT7000	Light plant	Not specified	25	20
Blue Bird GSA	Bus	Not specified	300	Not estimated at this time
Ford F-150	Light vehicle	Not specified	411	Not estimated at this time
Caterpillar T660	Water truck	Not specified	550	Not estimated at this time

Notes:

hp = horsepower

1 All equipment would be diesel-powered except for the electric shovels.

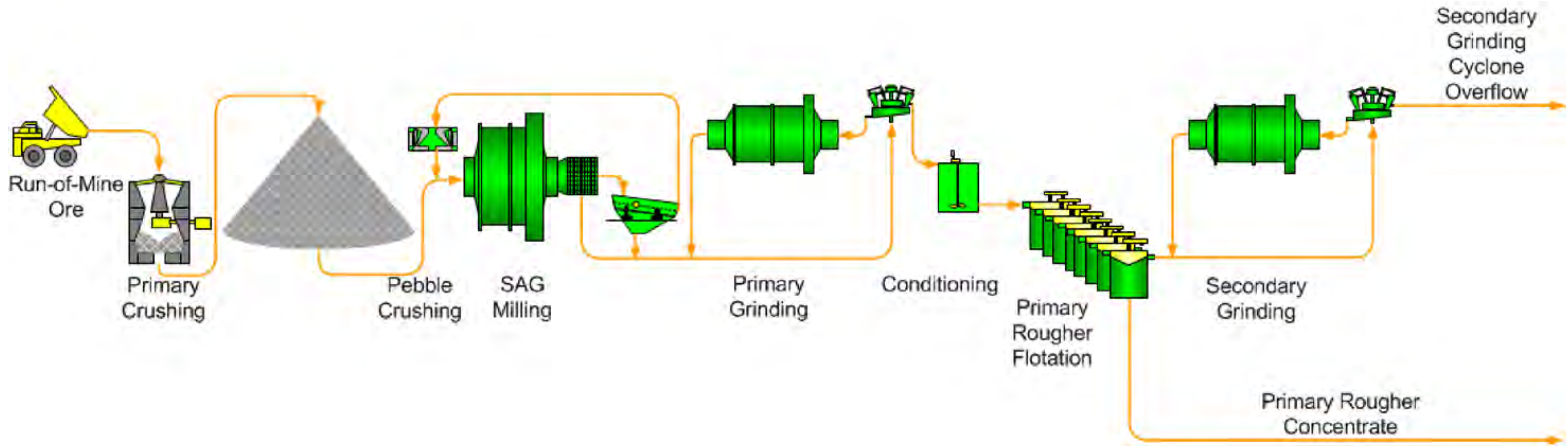
Source: Fernandez 2013b

2.3.2.2.4 MINE SITE – ORE PROCESSING

Ore processing involves sequential steps after the ore has been transported from the open pit to the nearby facilities. The process steps to break down the ore into fine particles allowing gold to be separated from the host rock and producing doré bars— summarized on Figure 2.3-5 and Figure 2.3-6 — include crushing and grinding, flotation, pressure oxidation (POX), cyanide leaching, stripping, electrowinning, refining, cyanide detoxification, and tailings storage.

Crushing and Grinding

The crushing and grinding facilities would operate continuously except for scheduled maintenance or unforeseen downtime. Ore would be crushed to 80 percent passing 5 inches in a primary gyratory crusher installed near the ACMA pit and conveyed 0.72 miles to the coarse ore stockpile near the process facilities. The coarse ore stockpile would be enclosed within an insulated steel structure to control dust emissions and minimize exposure of the ore to precipitation. The stockpile would have a live capacity of 42,000 tons, approximately the amount of coarse ore needed to operate the processing facilities for 16 hours.From the coarse ore stockpile, the ore would be fed to a semi-autogenous grinding (SAG) mill that grinds the ore in water to 80 percent passing 6 mesh (3.3 mm) and transfers the ground slurry to a sump. A ball mill and cyclones operate in closed circuit to produce ore ground to 80 percent passing 100 mesh (150 microns [µm]) for primary rougher flotation.



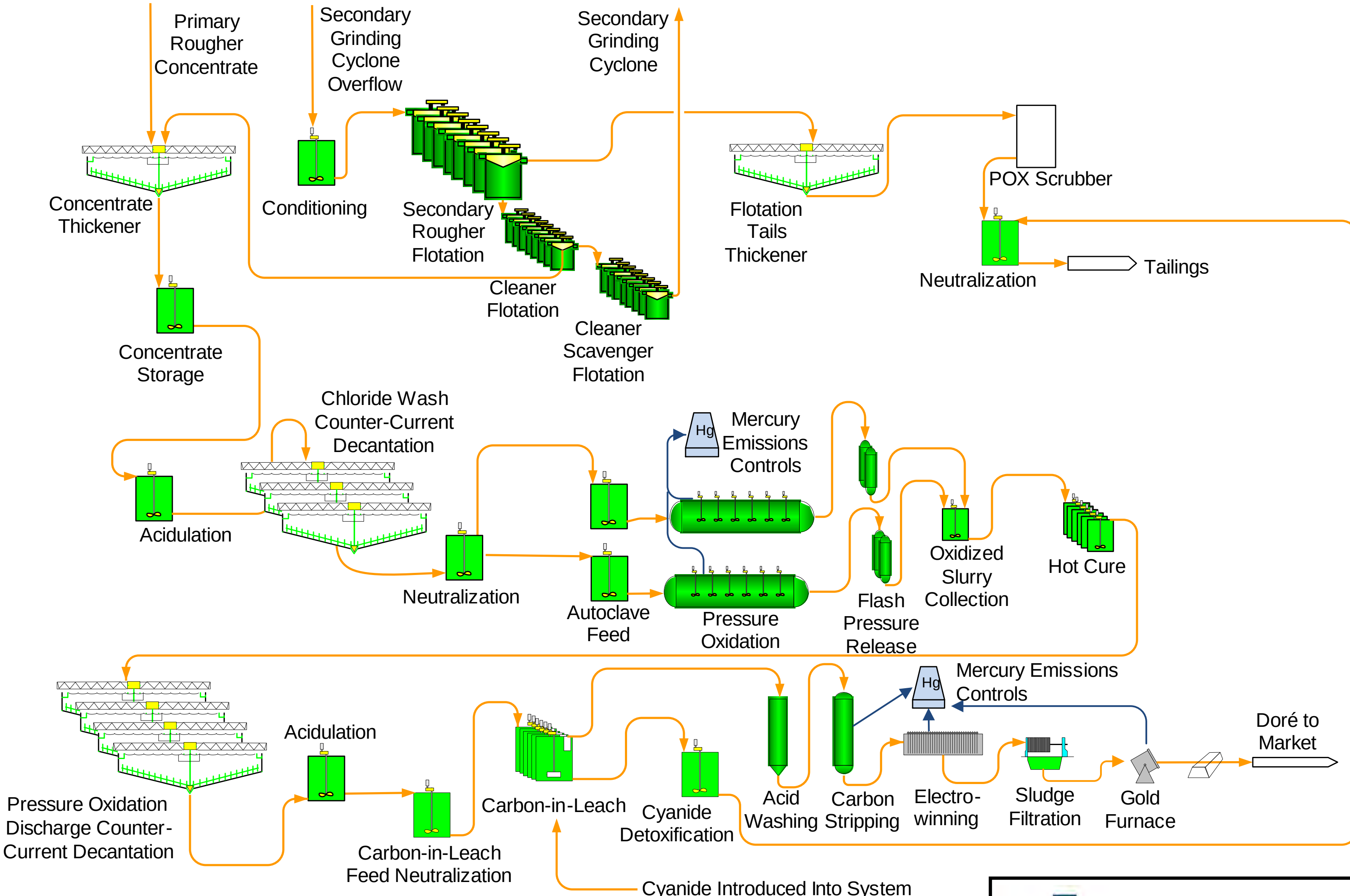
DONLIN GOLD

DONLIN GOLD PROJECT EIS

ALTERNATIVE 2
ORE CRUSHING
AND GRINDING

JANUARY 2018

FIGURE 2.3-5



DONLIN GOLD PROJECT EIS

ALTERNATIVE 2
ORE PROCESSING

JUNE 2017

FIGURE 2.3-6

Ore Processing Terminology

Refractory *– A term used to indicate a difficult-to-treat ore that requires some form of pre-treatment to liberate gold or other precious metals before the ore can be further processed to recover them.*

Flotation *– Flotation is the process of using minute amounts of chemicals, separating sulfide minerals from ore by inducing them to gather in and on the surface of a froth layer within a flotation cell. This process recovers the sulfide minerals containing the gold, which are then skimmed off the top of the flotation cells. Spent ore (tailings) is sent to a tailing storage facility.*

Pressure oxidation (POX) *– Pressure oxidation is a process for pre-treating ore or concentrates using elevated temperatures, pressures, and oxygen to oxidize sulfide materials to expose the valuable minerals encapsulated within the sulfides.*

Autoclave *– An autoclave is the equipment used to oxidize sulfide minerals. It is constructed of specialized materials to withstand the conditions necessary to oxidize the sulfides.*

Cyanidation *– A chemical reaction that uses dilute cyanide-containing solutions and oxygen to selectively solubilize (leach) gold or other precious metals from the ore or concentrate, making these metals available for separation.*

Activated carbon *– Carbon manufactured to enhance surface characteristics that attract and promote gold adsorption, removing gold from solution.*

Carbon-in-Leach (CIL) *– Carbon-in-leach is the process of leaching gold and other precious metals (if present) in agitated tanks in the presence of activated carbon particles. The gold-loaded carbon is then physically separated for further processing to recover the adsorbed gold.*

Stripping *– The separated carbon is treated by changing solution chemistry to remove (strip) the gold from carbon and concentrate the soluble gold in solution.*

Electrowinning (EW) *– A process for the deposition of metals by electricity out of metal-bearing solution.*

Refining *– Plated gold is transferred to a separate area and treated by melting the gold. In this process, impurities are removed.*

Doré *– Bars of semi-pure gold that contain residual quantities of impurities.*

Flotation

The 100 mesh ore from the primary grinding circuit would be mixed with reagents (see Section 2.3.2.2.6), water, and air to facilitate the process of separating the gold-bearing material from the ore. The air bubbles collect the gold-bearing sulfides on their surfaces and rise to the top, forming a mineral-laden layer (froth), which is scraped from the surface into a concentrate.

The tailings from the primary rougher flotation process would be further ground (80 percent passing 270 mesh [50 µm]) in a ball mill in closed circuit with cyclones to prepare the material for secondary rougher flotation.

Secondary rougher flotation would be comprised of three circuits: the secondary rougher flotation circuit, the cleaner flotation circuit, and the cleaner scavenger circuit. Final concentrate recovered from the secondary rougher flotation would be combined with concentrate from the primary rougher flotation.

The combined flotation concentrate, representing approximately 15 percent of the mill throughput, would then be sent through an acidulation circuit where acidic solution from the autoclave discharge would be added to lower the pH of the slurry and neutralize the natural carbonates prior to being sent to the POX circuit.

The tailings from the secondary rougher flotation would be combined with the primary rougher flotation tails from the secondary grinding circuit and these cleaner scavenger tails are sent to the flotation tailings thickener to remove some of the water from the slurry for reuse in the process.

The flotation tailings are then utilized for quenching autoclave off gas prior to being sent to the neutralization circuit.

The neutralization potential of the flotation tailings is utilized to modify the pH of the autoclave discharge solution prior to being transported via a pipeline to the TSF.

Pressure Oxidation

POX is a pre-treatment unit operation used to process refractory ores or concentrates where gold is contained in sulfide minerals by oxidizing the sulfides and exposing gold particles. POX is conducted in autoclaves lined with acid and abrasion-resistant bricks. The autoclaves use elevated temperature and pressure, and oxygen to oxidize the gold-bearing sulfide minerals. The chemical process inside the autoclave would convert gold-bearing sulfide minerals (i.e., FeS) to gold-bearing oxide minerals ($FeSO_4$). The pressure and temperature in the autoclaves combined with the injection of a high purity oxygen gas would oxidize the sulfide mineral complex, thus allowing gold to be extracted in the subsequent cyanide leaching process. Cooling water and steam would be used to control the operating temperature within the autoclaves. Gas vented from the autoclaves would be cooled and sent to the mercury abatement system. The oxidized flotation concentrate would be thickened and washed in a counter-current-decantation (CCD) circuit to reduce the acid content. Residual acid in the thickener overflow would be mixed with flotation tails.

Carbon-In-Leach Cyanide Leaching

The thickened solids from CCD would be sent to the cyanidation circuit. Carbon-in-leach (CIL) cyanide leaching would use sodium cyanide solution to dissolve the microscopic gold and separate it from the oxide minerals produced during the POX process. During the CIL process, the gold in solution would be adsorbed onto the activated carbon particles. Periodically, carbon loaded with gold would be screened from the depleted fine rock and transferred to holding vessels before further processing. After stripping (desorption of gold from carbon), the barren carbon particles would be regenerated using high temperatures in a rotary kiln to remove organic contaminants and to capture mercury (see Section 2.3.2.1.5 for mercury abatement). Spent carbon that could no longer be recycled into the process would be sent off-site to an approved waste facility for processing and storage.

Stripping, Electrowinning and Gold Refining

During the refining process, gold would be stripped from the loaded (gold-bearing) carbon removed from the CIL process. The pregnant (gold-bearing) solution from the stripping process would be circulated through electrowinning (EW) cells where gold is plated onto cathodes. The gold-bearing material from EW would be treated in a retort (heated air-swept chamber) to dry the material and remove mercury. The off gas from the retort is cooled to condense mercury and then passes through sulfur-impregnated carbon columns to capture any residual mercury. The retorted gold material would then be melted in an induction furnace and poured into doré bars prior to being transported off-site (as backhaul on aircraft) for final refining and purification. Doré bars are composed of a semi-pure alloy of gold and silver that requires further refining to purify. Doré bars would typically be 80-85 percent gold prior to off-site purification.

Cyanide Detoxification and Discharge to Tailings Storage Facility

The project would convert the used cyanide to a much less toxic cyanate before discharging to a tailings pond, a process known as detoxification. The screened CIL slurry discharge would be treated in a cyanide detoxification process using SO_2/air technology. A sulfur burner would provide the SO_2 gas which is used to detoxify residual cyanide from the CIL process. Two tanks operating in series would provide two hours retention for cyanide detoxification. SO_2 gas would be added at a rate sufficient to reduce the weak acid dissociable cyanide (CN_{WAD}, referring to those cyanide species measured by specific analytical techniques) levels in the tailings to $\leq$10 parts per million (ppm) prior to discharge to the TSF. The cyanide is destroyed in this reaction. Lime slurry would be added as needed to provide pH control, and copper sulfate solution would be added as a reaction catalyst. Concentrations of major constituents expected in the tailings pond water are presented in Table 3.7-33 in Section 3.7.3.2.1.

2.3.2.2.5 MINE SITE – MERCURY ABATEMENT

Mercury would not be used for ore processing and would not be shipped to the Mine Site. However, mercury is a naturally occurring element found within the Donlin Gold deposit as cinnabar (or mercuric sulfide or HgS). When ore containing mercury is processed, mercury will be released and must be captured for proper disposal. During the ore processing, volatized mercury would be separated and recovered. Donlin Gold estimates the mine would remove approximately 34,600 pounds of mercury per year from the gaseous waste streams.

There would be six points in the process at which mercury controls are in place for gaseous emissions:

1. Pressure oxidation;
2. Hot cure;
3. Electrowinning;
4. Retort;
5. Refinery furnace; and
6. Carbon regeneration kiln.

Mercury would be collected and disposed of in two forms: liquid elemental mercury and mercury impregnated carbon. Both forms would be shipped off-site by barges to a permanent, federally approved, mercury storage facility. The efficiency of the mercury controls is shown in Table 2.3-2.

Table 2.3-2: Mercury Control Efficiency

Mercury Control Point	Mercury Removal Efficiency
Pressure oxidation;	99.9%[1]
Hot cure	99%[2]
Electrowinning	99%[1]
Retort	99%[1]
Refinery furnace;	99%[1]
Carbon regeneration kiln	99%[2]

Source: [1]SRK 2014a, [2]Hatch 2014

Pressure Oxidation

Gaseous emissions are generated from the autoclave circuits at three points: the autoclave vent, flash vessel vents, and the oxidized slurry seal tank vent. The gaseous emissions from each of the two autoclave circuits are treated using vent gas cyclones, slurry heater vessel, vent gas quench vessel, barometric condenser, vent gas scrubber, and carbon bed. The vent gas cyclones capture a fraction of entrained particulate carryover and return it to the process slurry for downstream processing. The cyclones are not intended as a mercury control device. The vent gas cyclone discharges through the slurry heater vessel which is utilized as a direct contact heat exchanger to pre-heat the autoclave feed slurry. The slurry heater vessel is not considered a mercury control device. Gas from the slurry heater vessel, oxidized slurry seal tank, and the autoclave pass through the vent gas quench vessel. Flotation tailings slurry is used as a quenching medium in direct contact with the gases. The quenching process promotes reduction in gas volume and potential for further removal of particulate material due to reduced gas superficial rise velocities in the vessel. The remaining gas from the vent gas quench vessel is ducted to a barometric condenser. The gas is directly contacted with water injected into the vessel through a series of spray nozzles. The water cools the gas and further reduces the volumetric gas flow. The heated water underflow from the condenser is reused in the process as wash water. A venturi scrubber (vent gas scrubber) is used to remove particulate matter from the barometric condenser vent gas. Particulate separation is achieved by accelerating the gas through the vessel and the addition of water. The heated water underflow is reused in the process as wash water.

Mercury removal for all pressure oxidation vent gas streams is primarily performed in a carbon bed through adsorption on activated carbon. There are five stages for effective mercury removal within the carbon beds: dilution and humidity control, particulate removal, pre-cleaning (volatile organic compound [VOC] removal), primary mercury removal, and secondary mercury removal. Gas from the vent gas scrubber is diluted with heated ambient air to lower the gas relative humidity for effective adsorption of mercury on the activated carbon. Particulate removal from the diluted gas stream is achieved using a bank of high-efficiency filters within the carbon bed vessel. The gas then passes through a bank of high-efficiency particulate air (HEPA) filters. The pre-cleaning bank of carbon uses activated carbon to adsorb VOCs from the gas. VOCs are products of processing flotation concentrate and would otherwise adsorb on the carbon intended for mercury removal. The first stage of mercury removal occurs following VOC removal. The primary mercury removal bank is filled with a sulfur-impregnated carbon that captures mercury through chemical adsorption (chemisorption). The mercury combines with the sulfur in the carbon to form a stable mercury sulfide compound (cinnabar). The primary mercury removal bank is designed to perform all of the mercury removal within the carbon bed. The carbon bed vessel contains a secondary mercury removal bank to provide additional mercury removal capacity (retention time). This essentially serves as a buffer capacity to ensure that emissions are always kept to a minimum.

Hot Cure

The hot autoclave discharge slurry (oxidized material) upon passing through the flash vessels and the oxidized slurry seal tank enters the hot cure tanks. A gaseous emission is expected at the hot cure tanks as a result of steam generated due to a pressure drop through the system. Hot cure steam is processed in two stages of mercury abatement equipment: condenser and carbon bed. The condenser is expected to condense the majority of the vent steam and reduce the vent volume. As a preventive measure, a carbon filtration unit with a filter for particulate removal and a bed of sulfur-impregnated carbon for chemical adsorption of mercury will be installed.

Electrowinning

The vent from the EW cells combined with the barren solution tank vent, cathode wash tank vent, barren and pregnant eluate tank vents, carbon dewatering screen vent hood, carbon regeneration kiln hopper vent hood, and the retort area vent hood is processed in two stages of mercury abatement equipment: demister and carbon bed. The gas passes through a demisting vessel to remove entrained water droplets. If mercury is collected in the vessel, it is able to be separated by gravity and drained into a flask for disposal. Demisted vent gas proceeds to a carbon bed containing sulfur-impregnated carbon for mercury removal.

Retort

The gold-bearing material produced in EW is processed in a retort. The retort removes moisture and mercury from the material by elevating the temperature and air sweeping the chamber. The vent gas from the retort is processed in two stages of mercury abatement equipment: condenser and carbon bed. The condenser vessel is an indirect shell-and-tube heat exchanger that reduces the gas temperature and condenses elemental mercury. Mercury is collected at the bottom of the condenser and drained into a storage flask for disposal. The vent gas proceeds to a carbon bed containing sulfur-impregnated carbon for final mercury removal after the liquid mercury has been removed.

Refinery Furnace

A fume hood over the furnace collects vapor generated from the process which could contain mercury. Gas is drawn through the off-gas equipment using an extraction fan. The vent is processed in three stages of mercury abatement equipment: baghouse, HEPA filter, and carbon bed. The fume hood vent is first passed through a baghouse to remove the majority of entrained particulate matter. The solids recovered are reprocessed in the refinery for precious metal content. Smaller particles remaining in the vent gas are removed using a HEPA filter. This material is also collected and reprocessed in the refinery. The vent gas then proceeds to a carbon bed containing sulfur-impregnated carbon for mercury removal.

Carbon Regeneration

Carbon from which gold has been stripped is processed in a carbon regeneration kiln for reuse in the cyanide leaching circuit. The carbon regeneration kiln removes residual moisture, VOCs, and mercury by subjecting the carbon to high temperatures. The vent from the carbon kiln combines with the vents of the acid wash columns, the acid wash tank, the caustic tank, the spent solution tank, and the strip columns. The combined gas is processed in four stages of mercury abatement equipment: carbon knockoff box, off-gas cooler, mercury collection tank, and carbon bed. Vent gas is first passed through the carbon knockoff box to remove fines that are entrained in the gas. The carbon knockoff box vent passes into the off-gas cooler which is an indirect shell-and-tube style heat exchanger. The elemental mercury is condensed (liquefied) from the vent gas. The cooled vent gas and liquid mercury exit the off-gas cooler and enter the mercury collection tank. The vent gas rises and exits through a demisting section removing entrained droplets and mercury. The mercury is drained from the tank into a flask for disposal. The vent gas proceeds to a carbon bed containing sulfur-impregnated carbon for final mercury removal.

Tailings Storage Facility

Carbon-in-leach tailings are detoxified, combined with flotation tailings in neutralization, and transported to the TSF. There is a possibility that any remaining mercury in the tailings solution could be released as a gaseous emission. A mercury suppressant in the form of Cherokee UNR reagent would be introduced at the TSF reclaim water header to precipitate residual mercury remaining in solution as an insoluble sulfide-mercury particle. See Tables 3.2-12 and 3.7-33 for chemical compositions in the TSF.

2.3.2.2.6 MINE SITE – REAGENTS

Reagents would be used at the Mine Site during the ore processing, gold refining, and water treatment processes. Reagents are used to concentrate gold-bearing minerals, facilitate the process of separating gold from waste rock. Table 2.3-3 lists reagents, estimated annual consumption, and their use at the Mine Site.

Table 2.3-3: Estimated Annual Consumption of Reagents Used at the Mine Site

Reagent	Average Annual Consumption (tons)	Process Use
Potassium Amyl Xanthate	4,306	Used during flotation to separate and concentrate sulfide minerals
Methyl Isobutyl Carbinol and F-549	2,500	Used during flotation as a frothing agent
Nitric Acid	667	Used to wash carbon during refinery process
Sodium Cyanide	2,618	Used to dissolve gold in CIL process
Lime	42,836	Used to control the pH of oxide minerals for CIL leaching, cyanide detoxification, and to balance the pH of tailings
Activated Carbon	159	Used to absorb dissolved gold in leaching, and in mercury abatement
Caustic soda (Sodium hydroxide)	332	Used to raise the pH in the strip circuit, for mixing cyanide, and to neutralize spent acid solution used in acid-washing carbon
Mercury Suppressant (Cherokee UNR reagent)	169	Used to reduce the soluble mercury levels leached into solution from the autoclave process
Flocculants	3,662	Used to accelerate settling of solids in the thickening of tailings, chloride wash, flotation concentrate, and POX wash
Sulfur	1,444	Used in the cyanide detoxification process
Copper sulfate	2,436	Used during flotation and as a catalyst in cyanide detoxification
Fluxes (borax, sodium nitrate, and silica sand)	163	Used in the preparation of furnace charges for assaying or refining
Antiscalant	259	Added to prevent scaling during the water treatment process
Fluorospar	11	Used in flotation circuit in process plant
Ammonium nitrate	39,069	Explosives used in pit blasting
Potassium nitrate	48	Used in explosives or process plant?
Manganese dioxide	22	Used in process plant?
Microsand	7.7	Used in process plant to enhance flocculation
Cytec E40	54	Dispersant
Liquefied CO_2	376	Used in process plant?
Ferric sulfate	1,305	Operations WTP, added ahead of high-rate clarifier (HRC) to adjust pH for iron co-precipitation process
Sulfuric acid (98%)	787	Operations WTP
Potassium permanganate	35	Operations WTP, injected upstream of greensand filters to oxidize manganese
Sodium metabisulfite	17.6	Operations WTP, used for cleaning reverse osmosis (RO) membranes
Sulfur impregnated carbon	46	Used for mercury removal in process plant

Source: Fernandez 2013a; SRK 2016a; Hatch 2017

2.3.2.2.7 MINE SITE – WATER MANAGEMENT AND REQUIREMENTS

Water management at the Mine Site incorporates a number of different structures and strategies. Water balance modeling based on local precipitation and stream flow data has been utilized to optimize water use, reuse, storage, and release at the site.

The Mine Site is expected to operate with an annual water surplus during operation based on estimated water requirements, as well as the large amount of runoff anticipated from the American and Anaconda Creek basins that would be captured in major project facilities. The amount of the surplus would depend on precipitation and water demand during Operations; additional information can be found in Section 3.5 – Surface Water Hydrology. An important part of the water management strategy for construction and operations is to build a number of diversion structures and actively treat water to minimize TSF pond volume during Operations and at Closure. Most water that comes into contact with mining infrastructure would be reclaimed for use in ore processing. Excess water would be treated and discharged under an Alaska Pollutant Discharge Elimination System (APDES) permit.

Four sources of water would be treated and discharged under the anticipated APDES permit:

- Pit perimeter and in-pit dewatering wells;
- Groundwater collected from the TSF underdrains and SRS. This would include groundwater originating upslope of the areas covered by the TSF liner and any seepage through the liner;
- Contact Water Dam (CWD) water. Sources of this water would include open pit drainage (direct precipitation falling on the pit walls and flows from horizontal pit drains), seepage and runoff from the WRF; seepage and runoff from the South Overburden Pile, and undiverted runoff from undisturbed areas in the American Creek drainage; and
- TSF pond water (net precipitation collected in the TSF pond).

To achieve effluent characteristics in compliance with APDES permit limits, water treatment would be conducted as follows:

- Primary treatment by precipitation in a High Rate Clarifier (HRC) after addition of sulfuric acid and ferric sulfate (to adjust pH);
- The HRC would flow to a Greensand Filter to remove TSS and dissolved arsenic;
- The Greensand Filter water will pass through ultrafiltration media; and
- Then to Reverse Osmosis as needed.

The water treatment plant would be designed for a peak treatment rate of 4,750 gallons per minute (gpm) and an average rate of 2,789 gpm. The discharge location would be to Crooked Creek below Omega Gulch.

As part of the overall water management strategy, structures would be constructed to divert stormwater away from facilities where needed to control storage volumes, erosion, and the amount of mine contact water requiring treatment and discharge. Sufficient water storage capacity would be present to account for the possibility of successive years of drought as well as to manage water during wet years. The various components of the water management system at the site are described below.

Contact Water

Contact water is surface water or groundwater that has contacted mining infrastructure. This includes "mine drainage" defined in 40 CFR 440.132(h) as "any water drained, pumped, or siphoned from a mine, as well as stormwater runoff and seepage from infrastructure."

It would include seepage from the waste rock facility, seepage from stockpiles (except ore), and water from horizontal drains that accumulates in the pit.

It would not include groundwater from the pit dewatering wells.

Pit Dewatering Wells

Wells around the perimeter of the ACMA and Lewis pits would remove groundwater during pre-construction, construction, and operations to aid in stabilizing pit walls and to allow safe mining conditions. Additional wells would be installed in the pit at lower elevations as the pit deepens. While dewatering groundwater is not considered contact water, during Construction all pit dewatering water (about 1,343 gpm) would be sent through an on-site water treatment plant (WTP) and discharged to Crooked Creek in accordance with APDES permitting requirements. During Operations, roughly one-third of this amount on average (representing about 579 gpm) would be sent to the mill as a source of freshwater, and the rest would be treated and discharged. Average dewatering rate for the mine life is estimated at 1,391 gpm.

Contact Water Dams

Lower and upper Contact Water Dams (CWDs) would be constructed in American Creek with the objective of capturing any contact water runoff from the WRF, ore stockpiles, and water from horizontal drains that accumulates in the pit (Figure 2.3-7). Water stored in the ponds would be used to supply ore processing with water. While the ponds would not be lined and some seepage may occur, the seepage would drain to the pit and be managed with mine drainage.

The lower CWD would be constructed first to capture runoff from prestripped ground at the pit and the early phase of the WRF. Rock drains and Rob's Gulch diversion constructed in the footprint of the waste rock facility will collect and divert flow to the lower CWD. The upper CWD would be constructed during the first year of Operations in order to provide additional storage capacity and operational flexibility for management of contact water. The WRF has been designed such that the lower CWD can store 405 acre-feet of contact water without inundating any of the waste rock placed in the WRF. As water storage volumes increase in the lower CWD, waste rock would be inundated. During Operations, storage volumes in the lower CWD would not exceed 405 acre-feet more than five percent of the time to limit the amount of water in the lower CWD that inundates waste rock. When this capacity is reached, water would be pumped from the lower to upper CWD. Pipelines would take water from both CWDs to the process plant.

Freshwater Storage and Diversion

A number of structures would be built at the mine to manage non-contact fresh water; that is, water that would not come into direct contact with mining infrastructure. Examples include surface water flows or stormwater runoff diverted around mining infrastructure, as well as impounded fresh water.

A temporary freshwater diversion dam (FWDD) would be constructed and operational in the mid to upper reaches of American Creek in the first year of mine Operations only, in order to minimize runoff into the lower CWD in the early stages of the WRF use. This would reduce the amount of contact water that would need to be managed. Excess fresh water that accumulates in this dam would be discharged to Omega Gulch which flows into Crooked Creek. Two temporary diversion dams, the North and South FWDDs, would be constructed upstream of the TSF in Anaconda Creek to minimize runoff to the impoundment and facilitate construction of the starter tailings dam. Water behind the FWDDs would be controlled by pumping to diversion channels around the north and south sides of the main impoundment area. The area disturbed by the FWDDs would eventually be incorporated into the WRF and TSF as they expand during Operations.

Snow Gulch reservoir would be constructed in a tributary of Crooked Creek, located north of the mine (Figure 2.3-7), and provide a contingency source of fresh water during Operations. In years with average or below-average precipitation, the CWDs and pit dewatering system would not be able to meet process plant water requirements, in which case additional water would be obtained from the Snow Gulch reservoir. Water from the dam would be pumped to the lower CWD before being sent to the process plant.

Diversion channels would be constructed around all stockpiles at the Mine Site to minimize contact water runoff and erosion. Runoff from overburden stockpiles would be directed to stormwater/sedimentation ponds prior to discharge to Crooked Creek or its tributaries.

Process Water Requirements

The ore processing plant would require a minimum of roughly 2,500 gpm of fresh water to operate, and about 18,000 gpm on average over the life of the mine, an amount that would vary annually depending on plant feed rates.

The priority for meeting ore processing water requirements would be to use reclaim water from the TSF first, followed by contact water pond and pit dewatering water, before using freshwater from the Snow Gulch reservoir. During Operations, roughly 75-80 percent of the total process water needs would come from TSF reclaim water; on average, about 15 percent would come from the contact water ponds, and the remaining 10 percent would be made up of smaller volumes from the TSF seepage recovery system (SRS), pit dewatering water, and the Snow Gulch reservoir. During periods of low precipitation, more freshwater water from the reservoir would be used to meet the water needs of the process plant.

Reclaim water from the tailings pond would be pumped from a floating pump barge through a pipeline to ore processing. Table 2.3-4 summarizes the average water requirements for the mill.

Table 2.3-4: Estimated Processing Plant Water Use

Mill Water Source	Estimated Use (gpm)	Percent of Total
TSF reclaim water	14,146	80%
Contact water ponds	2,141	12%
TSF seepage	208	1%
Pit water	579	3%
Snow Gulch freshwater reservoir	33	<1%
Treatment plant brine	403	2
Ore moisture	188	1
Total Plant Water Use:	17,698	100%

Notes:
gpm = gallons per minute
Source: SRK 2017b

Other Water Uses

Ore processing consumes about 99 percent of the water needs at the Mine Site. Other uses such as dust control, fire protection, drinking water, truck wash, and sanitary needs comprise the remaining water requirements of the mine.

Prior to Construction, the two existing exploration camp drinking water wells (located near the future ore stockpile) would be abandoned. Potable water for the construction camp, permanent accommodations camp, and the plant site would be obtained from eight new freshwater wells that would be drilled on the hillside between Omega Gulch and the unnamed Crooked Creek tributary to the south. These wells would be located upgradient of potential future sources of groundwater contamination from the WRF, TSF, and stockpiles. The wells would supply 70 gallons of water per person per day during Construction and Operations of the mine. The water would be treated prior to consumption. The construction camp freshwater tank (80,000 gallons) and a similar freshwater storage tank, potable WTP, reserve storage tank, and distribution system would be provided for the permanent accommodations camp once mine Operations commenced. The construction camp wells and associated infrastructure would remain operable for use at the plant site throughout Operations. The distribution piping to remote buildings would be through above-ground insulated and heat-traced HDPE pipes. Where possible, the potable water distribution pipes to other areas would be within the utility corridors to buildings.

Two sanitary treatment plants (STPs) would be constructed for the project; one for the construction camp and one for the permanent camp. Untreated sewage effluent would be piped or trucked to the STPs, and treated sewage effluent from the STPs would report to the TSF.

Firewater supply for the plant site would be pumped from the lower Contact Water Pond to a 475,500-gallon combined freshwater / firewater storage tank located near the plant site. Around half the water, or 264,000 gallons, contained in the tank would be dedicated to firewater storage. In addition, the freshwater storage tanks at the construction camp and permanent camps would include a 30,000-gallon reserve supply for fire protection.

2.3.2.2.8 MINE SITE – TAILINGS STORAGE FACILITY

The TSF is proposed to be built in the Anaconda Creek Valley immediately south of the WRF location. A general layout of the TSF is shown in Figure 2.3-8.

The 2,351-acre facility would consist of a main, lined dam embankment; two temporary, lined, FWDDs; a fully lined impoundment; a reclaim water system; and an SRS. Built in phases, the facility would have the capacity to store 568 million tons, or 335,000 acre-ft of tailings. Constructed in phases, the height of the tailings dam at completion would be 471 feet.

The tailings dam footprint would be excavated to bedrock, constructed using compacted rockfill, a prepared underlayer, and lined with a 60-mil (0.06-inch) linear low-density polyethylene (LLDPE) composite liner on the upstream face. The tailings impoundment footprint would be lined with a 60-mil (0.06-inch) textured LLDPE liner.

The FWDDs would limit the amount of fresh water entering the TSF during Operations and provide control of the volume of water in the impoundment during the first three years of operation. Two FWDDs would be maintained during the first three years of TSF operation. At the end of the third year, the FWDDs would be decommissioned, their liners removed, and the areas regraded. During dam construction, the FWDDs would minimize runoff to the impoundment and facilitate construction of the facility's starter dam, and placement of the liner.

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

2.3.2.2.9 MINE SITE – WASTE ROCK FACILITY AND ORE/OVERBURDEN STOCKPILES

An estimated 3.145 billion tons of waste rock would be excavated from the pit with 2.46 billion tons placed in the WRF. The WRF would be immediately east of the pit in the American Creek Valley. A general layout of the 2,514-acre WRF and overburden stockpile is shown on Figure 2.3-7.

Drainage control would be provided in the WRF foundation using engineered rock drains in the valley bottom, with connecting secondary rock (finger) drains constructed in the smaller contributing drainages. These upstream water collection and diversion measures would be constructed prior to mine production. The WRF would be unlined.

As discussed in Section 2.3.2.2.7, the lower CWD would be constructed in the American Creek Valley downstream of the WRF and would capture runoff from the WRF. The surface and groundwater flow direction in American Creek between the lower CWD and ACMA Pit would be toward the ore stockpile and pit dewatering wells. Surface and groundwater from this area would be pumped back to the lower CWD and would be managed as mine contact water. The upper CWD would also be constructed to capture surface water before the WRF.

Waste rock to be removed from the mine pits has been characterized using samples obtained during exploration and factoring in potential for acid generation as well as for leaching metals (SRK 2012e). Waste rock was characterized as either PAG or non-acid generating (NAG), and has been assigned to reactivity categories (see Section 3.7.2.4). The waste rock would be classified again during mining Operations, as it is being generated. Categories 1 to 4 are considered NAG, and categories 5 to 7 are PAG. Approximately 93 percent would be overburden or has been characterized as NAG (see Table 2.3-5). Based on the waste rock's characterization as either PAG or NAG, it would be placed in one of three areas, the American Creek drainage WRF, the ACMA pit backfill, o the Anaconda Creek drainage TSF dam. Table 2.3-6 summarizes disposition of waste rock in each area.

Table 2.3-5: Waste Rock Characteristics and Estimated Tons

Waste Rock Classification	Description	Estimated kTons[1]	Percent of Total
NAG 1-4 and Overburden	Non-acid generating (categories 1 to 4)	2,920,000	93%
PAG 5	Potentially acid generating after several decades	87,200	2.7%
PAG 6	Potentially acid generating in less than one decade	135,300	4.3%
PAG 7	Potentially acid generating in a few years	2,600	0.08%
Total		3,145,100	100%

Notes:
1 kTons = thousands of tons
Source: SRK 2016a

Table 2.3-6: Waste Rock Placement and Estimated Tons

Waste Rock Placement	Description	Estimated kTons	Percent of Total
American Creek drainage WRF	NAG	2,335,900	74.3%
	PAG 5	75,200	2.4%
	PAG 6 (In Isolated Cells)	123,320	3.9%
	Overburden	46,400	1.5%
ACMA pit backfill	Overburden	45	<.1%
	NAG	442,900	14.1%
	PAG 5	12,000	0.4%
	PAG 6	12,000	0.4%
	PAG 7 (2,500 Kton Temporarily Stockpiled at WRF Until ACMA Pit is Completed)	2,547	0.1%
Anaconda Creek drainage TSF (Construction)	NAG	95,100	3.0%

Notes:
1 kTons = thousands of tons
Source: SRK 2016d

Some NAG would be used as construction material for haul roads and the TSF. NAG waste rock would also be dumped around the PAG waste rock to isolate the PAG from the exposed final surface of the WRF and to neutralize runoff from the PAG.

The Proposed Action would place waste rock from both pits in the WRF, located east of the pit area. The first lift of the WRF would begin during mine construction and most lifts would be about 100 feet thick. Lifts would be placed so that the finished surface has an approximate 3-to-

1 slope (18 degrees). The WRF would have a maximum height of 1,115 feet and store, at completion, 2.46 billion tons of waste rock.

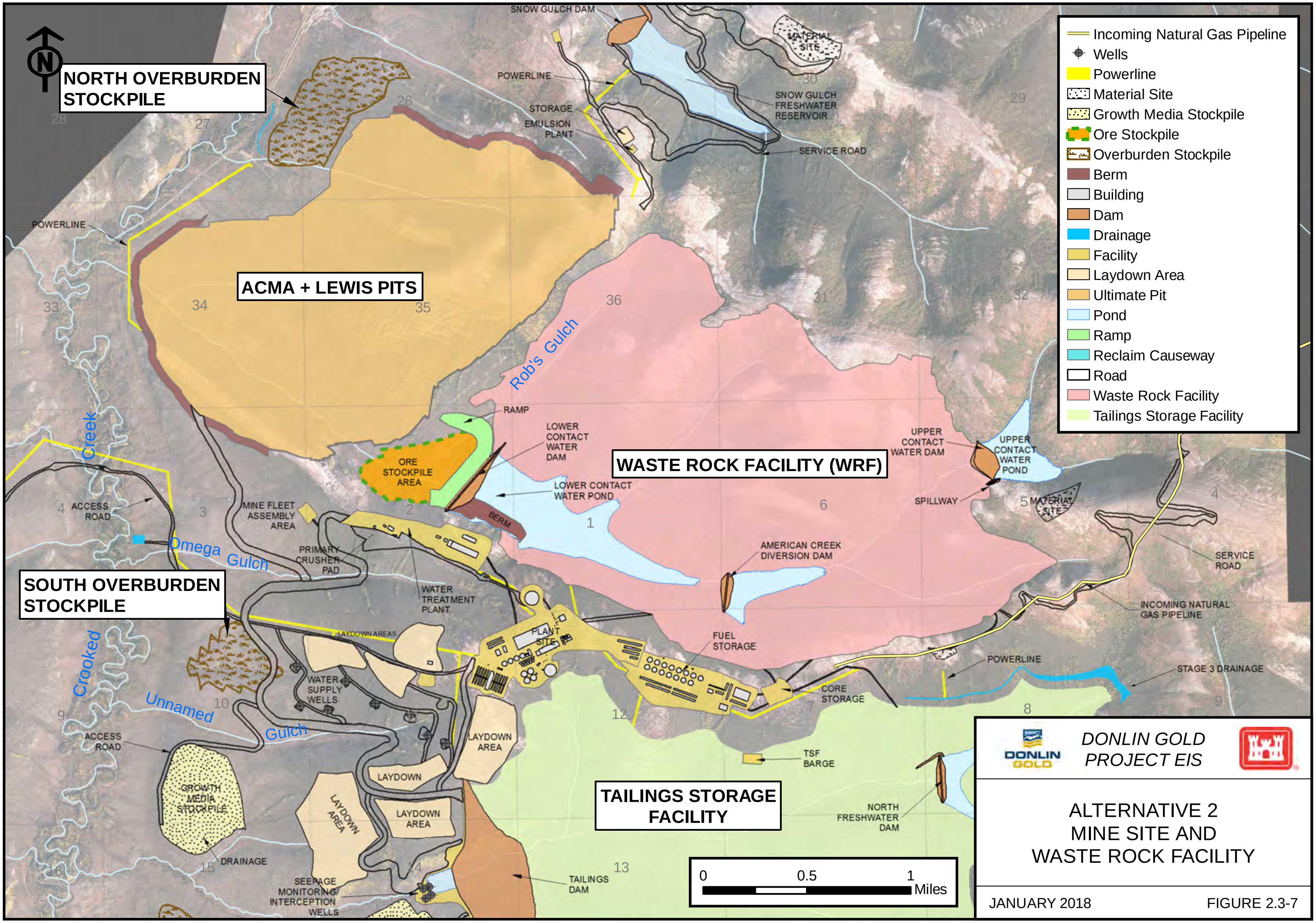
Waste rock classified as PAG 5 would usually be mixed with surrounding NAG waste rock and dispersed on the WRF to produce a well-mixed blend. To further mitigate the potential for PAG 5 to generate acid, the last 80 feet of the dump crest advancement of any lift would be limited to only NAG 1-4 waste rock. This would ensure the final regraded slopes of the WRF would consist of NAG 1-4 waste rock with an average thickness of about 30 feet. Mine engineers would develop a PAG/NAG boundary beyond which only NAG waste rock can be placed. This would ensure no PAG 5 material is placed beyond the PAG/NAG boundary and the regraded final slopes of the WRF would consist entirely of NAG material.

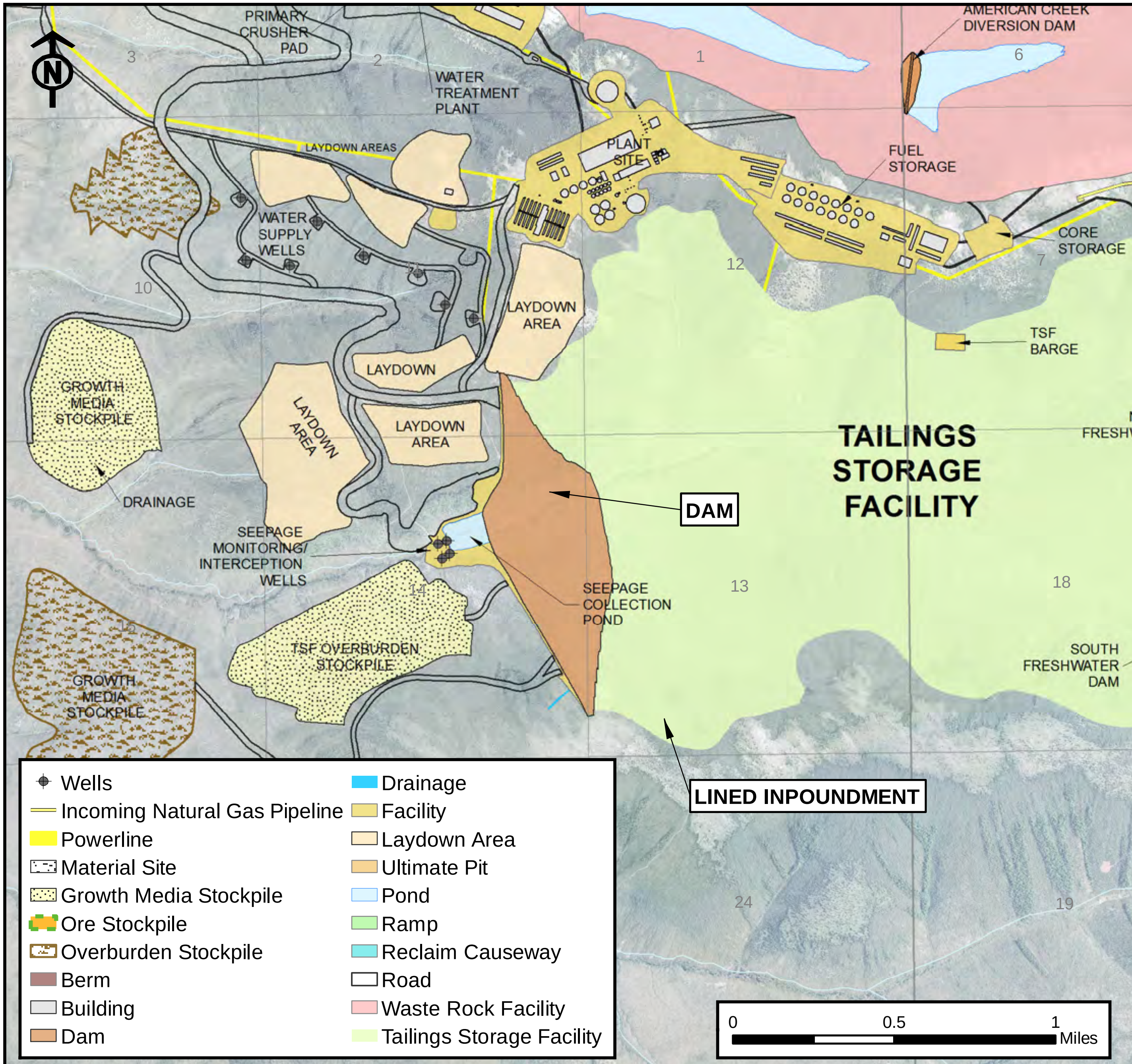
During the early years of operation, approximately 123.32 million tons of PAG 6 would be placed in permanent, isolated cells in the Rob's Gulch section of the WRF. PAG 6 waste rock placed in the WRF would be isolated to reduce contact with water and minimize the potential to become acidic. PAG 6 rock in Rob's Gulch and Unnamed Gulch would be placed in cells over a foundation of NAG waste rock and surrounded by NAG rock. The NAG foundation material would act as a rock drain to convey the runoff and perennial flows out of this drainage and limit its contact with the PAG 6 waste rock. Each PAG 6 cell would be covered with a low permeability cap to minimize infiltration of surface water.

Also during the early years of operation, approximately 2.5 million tons of PAG 7 would be segregated from the other waste rock material types and placed on a low-grade ore stockpile area for temporary storage at the toe of the WRF, near the center of American Creek Valley. Once the ACMA Pit final limits are reached at approximately Year 22 of mine operation, the PAG 7 material stored in the low-grade stockpile would be relocated to the bottom of the ACMA Pit. At this point, all PAG 6 and PAG 7 mined in the Lewis Pit would also be placed in the ACMA Pit backfill, and no additional waste rock would be placed in the low-grade stockpile or isolated cells in the WRF.

NAG waste rock would be used in the construction of the TSF as fill, filter media, riprap, and material for the underdrains. Frozen or other material unsuitable for use in dam construction would be placed in the overburden stockpiles or in the WRF.

During initial construction of the WRF, organic materials would be stripped and stored for use as growth medium during reclamation. Overburden materials removed from the foundation of the WRF would either be placed in temporary overburden stockpiles or mixed with waste rock. Overburden stockpiles would be located north and south of the open pits (Figure 2.3-7). The North Overburden Stockpile would primarily contain fine-grained materials, consisting of organics (woody debris and peat), and unconsolidated sediments. The boundary of the stockpile would be bermed to channel stormwater runoff to a settling pond for sediment control prior to any discharge. The South Overburden Stockpile would be located immediately south of Omega Gulch and contain coarse-grained materials, primarily gravels and colluvium. The boundary of the South Overburden Stockpile would be bermed. Storm and seepage water would be collected and pumped to the lower Contact Water Pond.


NORTH OVERBURDEN STOCKPILE
ACMA + LEWIS PITS
WASTE ROCK FACILITY (WRF)
SOUTH OVERBURDEN STOCKPILE
TAILINGS STORAGE FACILITY
SNOW GULCH DAM
MATERIAL SITE
POWERLINE
STORAGE
EMULSION PLANT
SNOW GULCH FRESHWATER RESERVOIR
SERVICE ROAD
Rob's Gulch
RAMP
LOWER CONTACT WATER DAM
LOWER CONTACT WATER POND
ORE STOCKPILE AREA
BERM
UPPER CONTACT WATER DAM
UPPER CONTACT WATER POND
SPILLWAY
ACCESS ROAD
MINE FLEET ASSEMBLY AREA
PRIMARY CRUSHER PAD
WATER TREATMENT PLANT
Omega Gulch
Creek
Crooked
Unnamed
Gulch
AMERICAN CREEK DIVERSION DAM
INCOMING NATURAL GAS PIPELINE
PLANT SITE
LAYDOWN AREAS
FUEL STORAGE
CORE STORAGE
STAGE 3 DRAINAGE
WATER SUPPLY WELLS
LAYDOWN AREA
LAYDOWN
GROWTH MEDIA STOCKPILE
DRAINAGE
SEEPAGE MONITORING/ INTERCEPTION WELLS
TAILINGS DAM
TSF BARGE
NORTH FRESHWATER DAM
0 0.5 1 Miles
Incoming Natural Gas Pipeline
Wells
Powerline
Material Site
Growth Media Stockpile
Ore Stockpile
Overburden Stockpile
Berm
Building
Dam
Drainage
Facility
Laydown Area
Ultimate Pit
Pond
Ramp
Reclaim Causeway
Road
Waste Rock Facility
Tailings Storage Facility
DONLIN GOLD
DONLIN GOLD PROJECT EIS
ALTERNATIVE 2 MINE SITE AND WASTE ROCK FACILITY
JANUARY 2018
FIGURE 2.3-7



DONLIN GOLD PROJECT EIS

ALTERNATIVE 2
TAILINGS STORAGE FACILITY

JUNE 2017

FIGURE 2.3-8

2.3.2.2.10 MINE SITE – POWER, UTILITIES, SERVICES AND INFRASTRUCTURE

The total planned power generating capacity to be installed for the Mine Site and permanent accommodation camp is 227 megawatts (MW) which includes redundancy. The average running load is designed to be 153 MW (see Table 2.3-7). Electric grinding mill motors at the ore processing plant would use most of the power generated.

The Angyaruaq (Jungjuk) Port site would have a stand-alone power generation facility with two 600 kilowatt (kW) generators (one primary and one backup), fueled by ULSD. The airstrip would rely on two 200 kW generators (one primary and one backup) to run pumps and lights and would also be fueled by ULSD.

Table 2.3-7: Summary of Mine Site Components Power Use

Mine Site Power	Power Use
Total connected load	227 megawatts (MW)
Engines	12 dual fuel (natural gas or ultra-low sulfur diesel) combined-cycle reciprocating engines with heat recovery, providing steam to one heat recovery steam turbine generator
Emergency power	6 gensets (2 power plant black start generators, 4 camp backup generators)
Average running load	153 MW
Average natural gas consumption	10.8 billion standard cubic feet (BSCF) per year
Angyaruaq (Jungjuk) Port site generators	2 x 600 kW, one primary, one standby
Airstrip generators	2 x 200 kW, one primary, one standby

Source: SRK 2016a

Power Plant and Transmission Lines

Electric power would be generated for the Mine Site by a dual-fueled (natural gas and ULSD) multi-engine power plant with a steam turbine utilizing waste heat recovery from the engines. The location of the power plant is shown on Figure 2.3-2. The primary source of fuel for the power plant would be natural gas transferred via a 316-mile long pipeline (see Section 2.3.2.4) although diesel could also be used as a backup fuel. The power plant would contain 12 combined-cycle reciprocating engines divided into two independent halves by a blast wall and a single steam turbine. During an emergency, half of the power plant's reciprocating engines could operate as needed to meet the essential power needs at the Mine Site.

Power from the plant would be distributed to the main process areas of the mine by power cables and overhead transmission lines. Overhead power lines would run to the more remote areas of the Mine Site, such as the primary crusher, the water system, pumping stations, tailings, and pit dewatering sites. Power to the permanent accommodations camp would be provided from the mine/process plant via a pole line. Emergency diesel generators would be installed at the camp to provide power in the event of pole line failure.

Fuel Storage and Distribution

The total diesel fuel storage capacity at the Mine Site would be 37.5 million gallons (Mgal). Mine Site fuel storage tanks would be designed to contain a 10-month supply plus one month of contingency for the mine fleet. Fuel would be stored in 15 fuel tanks, each with a capacity of 2.5 Mgal. The fuel storage facility would be HDPE-lined and bermed to provide secondary containment. A Facility Response Plan (FRP), Spill Prevention, Control, and Countermeasure Plan (SPCC), and Oil Discharge Prevention and Contingency Plan (Appendix R) would be developed and the applicable measures would be implemented. These plans would be available onsite, as required by state and federal requirements.

Camp Buildings and Facilities

The permanent accommodations camp would be located at a different location than the construction camp, along the mine access road approximately 2.4 miles from the Mine Site. It would initially house 434 workers and be expanded to house a maximum of 638 workers during mine Operations. The camp would include six, 3-story dormitory wings and a single-story core services facility. Dormitory wings would be attached to the core services building via heated utility tunnels.

Solid Waste Management and Disposal

Solid waste would be reused, recycled or returned to the vendor as appropriate and feasible. The following materials would be reused, recycled, or returned to the vendor:

- Antifreeze (ethylene and propylene glycol) – recycled and reused on site whenever possible;
- Mill liners – returned to vendor or shipped off-site for recycling as scrap metal;
- Hazardous batteries – returned to vendor for recycling or reclaimed off-site;
- Hazardous lamps – recycled off-site;
- Compressed gas cylinders – returned to vendor for reuse or recycled as scrap metal;
- Pallets – reused, incinerated and / or recycled off–site;
- Reagent containers – returned to vendor for reuse;
- Reusable parts – sold / reused on site or off-site where possible;
- Returnable / recyclable drums – returned to vendor for reuse and / or recycled as scrap metal;
- Scrap metal – recycled off-site (except for steel, which contains a small percentage of carbon);
- Reusable light vehicle tires – returned to vendor for recycling;
- Used oil – burned for energy recovery in space heaters and process boilers on site (or shipped off-site for recycling when not possible to burn for energy recovery on site); and
- Other recyclables such as aluminum cans or plastic water bottles – recycled off–site.

Solid waste management facilities at the proposed Donlin Gold Project would include inert solid waste landfills, the TSF and the WRF. The solid waste landfills would be permitted as Non-Municipal Industrial Waste Monofils by ADEC.

Solid waste landfills would be constructed at the Mine Site, for the disposal of inert, non-hazardous solid waste. These landfills would be permitted by the ADEC in accordance with 18 Alaska Administrative Code (AAC) 60. The landfills at the Mine Site would be constructed as trenches within the WRF in an area covering approximately 16 acres.

Landfills would be designed and operated to keep runoff from outside the landfill area separate from the solid wastes and in such a way as to prevent the attraction of wildlife. Waste would be stored in suitable containers prior to incineration and/or disposal in the landfills. Landfill trenches would be a minimum of 100 ft from any surface water body and greater than 200 ft from drinking water sources. Additionally trench bottoms would be located a minimum of 10 ft above the existing or expected future groundwater table. The surface surrounding the open landfill trenches would be graded to prevent precipitation from ponding or draining into the trench. A light cover of approximately 6 inches of soil or rock would be placed as needed over debris that can be windblown. Windblown litter and littered refuse from the areas around the landfill would be collected and returned to the landfill for disposal. An intermediate cover of approximately 12 inches would be applied to portions of the landfill that are inactive for 90 days or more. Once a landfill trench is filled to within 4 feet of the surface, it would be covered with a layer of rock. By the nature of the WRF construction, another layer of rock, a minimum 20 feet thick, would be placed over the filled trenches when the next lift is placed on the WRF. The additional cover would minimize the chance of water percolating through the rock material and into the refuse trench. Landfill trenches closed during final reclamation would have a minimum of 24 inches of cover material placed, as required by ADEC.

Inert, general mine refuse (e.g., packaging, non-recyclable empty containers, non-putrescible refuse) would be placed directly into permitted on-site landfill trenches in a designated section of the WRF. During Construction, solid waste that contains organic matter (e.g., wooden pallets, paper, cardboard, and wood scraps) may be incinerated in a burn pit or incinerator. Burn pits for the disposal of wood, cardboard, and paper are proposed as an alternative to incineration. This option would only be used during Construction and is not proposed for Operations. Residues from the incinerator or burn pit would be disposed of in the landfill. Unusable, small vehicle tires that cannot be returned to the vendor would be disposed of in the landfill. All large loader and truck tires would be buried in a designated area at the WRF.

Waste Water Management and Disposal

Two STPs would be installed at the Mine Site: one at the permanent accommodations camp and one at the construction camp. The construction camp STP would be reconfigured and reduced in size after construction is completed to receive sanitary flows from the process facilities during operation. Sewage from facilities would be pumped to the STPs via insulated pipelines. STPs would process sewage and produce treated effluent and filtered sludge, which would be burned in an on-site incinerator. Treated effluent from both plants would be discharged to the TSF after secondary treatment in accordance with ADEC permitting requirements. A septic tank and leach field would be installed at Angyaruaq (Jungjuk) Port, resulting in no additional effluent to the STPs.

In addition to the STPs, a WTP with a footprint of approximately 0.5 acres would be constructed near the southern end of the ACMA and Lewis pits, north of the primary crusher. The WTP would treat water from the pit dewatering wells and other excess water prior to discharge to Crooked Creek (see Section 2.3.2.2.7). A year before overburden stripping activities begin, seventeen ACMA and Lewis pit dewatering wells would be installed. The pumping of these wells would begin 6 months prior to the commencement of overburden stripping operations.

During mine operation additional wells would be installed and some wells would be decommissioned as the pit expanded. Over the mine life a total of 35 pit-perimeter wells and 80 in-pit wells would be installed. Groundwater pumped from these wells would be used in the process or treated at the WTP.

Stormwater would be managed at the Mine Site during all three phases. Surface water flows, stormwater runoff diverted around mining infrastructure, and impounded fresh water would be managed as non-contact water if it did not contact mine infrastructure or mined material. Other than settling ponds and other Best Management Practices (BMPs) to control turbidity/sediment, non-contact water would be directly discharged to surface water without treatment beyond settling. The flows from the American Creek freshwater diversion dam and from the TSF temporary FWDDs and diversions would be managed as non-contact water.

Hazardous Waste and Materials Management

Hazardous materials, such as explosives, sodium cyanide, and mercury require special handling, storage and disposal at appropriate facilities to meet regulatory requirements. In Alaska, hazardous wastes are regulated by the U.S. Environmental Protection Agency (EPA), Region 10, in accordance with RCRA. The site would have no permanent on-site hazardous waste management and all hazardous waste would be shipped off-site for permanent disposal. Donlin Gold is not proposing to operate the site as a Hazardous Waste Treatment, Storage, and Disposal Facility under RCRA. Facilities to properly store and transfer hazardous materials such as explosives, mercury, and cyanide would be provided at the port facilities and Mine Site.

Explosives

Explosives would need to be used at the Mine Site (see Section 2.3.2.2.2 regarding blasting). Explosives would be stored and handled according to the MSHA regulations contained in 30 CFR Part 56. Separate storage bins would be used for emulsion, ammonium nitrate, and fuel oil. All detonators would be stored in an explosives magazine meeting applicable federal and state safety requirements. Charges and detonators would be shipped separately under the control of the explosives supplier.

Sodium Cyanide

Sodium cyanide handling and storage procedures would be in accordance with International Cyanide Management Code (ICMC), and with all applicable state and federal regulations. The ICMC is a voluntary practice established to augment existing regulatory requirements. Cyanide would be transported according to 49 CFR Parts 171-180. Specific methods proposed for the handling of sodium cyanide include:

- Sodium cyanide would be shipped from the manufacturer to the Mine Site on barges as solid briquettes in 22-ton International Standards Organization (ISO) approved type

2 watertight sparge tank-tainers. The cylindrical tank-tainers would be permanently and prominently marked with appropriate warning labels and hazard markings.

- A secure storage area with secondary containment would be constructed at the Mine Site for the containers. An enclosed structure would be provided for storage of cyanide.
- The Angyaruaq (Jungjuk) Port would have a reserved secure and isolated cyanide container storage area, which would include secondary containment.
- All marine carriers, transportation personnel, and ore processing staff involved in the handling of sodium cyanide would be trained in safe handling and spill response procedures.
- Personal protective equipment would be onboard each tug towing sodium cyanide, at each port where the product would be stored, and with each truck that would transport the containers from the Angyaruaq (Jungjuk) Port site to the Mine Site.
- Cyanide detoxification chemicals would be available at unloading, storage, and mixing locations as required by the International Cyanide Management Code. Specific locations would include Bethel and Angyaruaq (Jungjuk) ports and the Mine Site.
- Any carrier of sodium cyanide would be required to have a contract with a certified and licensed hazardous materials response and cleanup company, located within Alaska.

Mercury

Mercury and mercury-containing materials would be managed in accordance with a Donlin Gold Mercury Management Plan that is currently under development. In general, Donlin Gold would collect elemental mercury and spent carbon into specialized containers, and store in centralized, separate, enclosed facilities. Weekly inspections would be conducted at the accumulation and storage areas (Donlin Gold 2014d).

Elemental mercury captured in the retort furnace and scrubbers during mineral processing would be managed as co-product and shipped off-site to an appropriate facility as a hazardous material. Additionally, mercury-loaded carbon from the mercury abatement process would be shipped off-site using barges to a regulated facility for permanent storage. All mercury would be transported in specially marked mercury containers that would be managed in accordance with the mercury management plan. In addition, a mercury suppressant would be used to reduce the soluble mercury levels leached into solution from the autoclave process to low levels within the reclaim water stream recycled from the TSF.

2.3.2.2.11 MINE SITE – ENVIRONMENTAL AND SAFETY

Prior to the start of mine construction, an Environmental Management System (EMS) consisting of management and maintenance plans based on permits and authorization requirements would be developed. The EMS would describe the environmental engineering standards (e.g., secondary containment for petroleum products, process solutions, and reagents), operations requirements, maintenance protocols, and emergency response actions. BMPs and safety procedures would be followed for maintenance activities during mine operation.

The proposed project would comply with the statutes governing spill prevention and emergency response including: the CWA, Section 311; Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Section 103; Emergency Planning and Community-Right-to-Know Act of 1986; Title III of the Superfund Amendments and Reauthorization Act, Section 304; and ADEC requirements under 18 AAC 75 for spill prevention and contingency planning. The SPCC plan describes the system that would be used for the prevention, response, containment, safe cleanup, and reporting of spills or discharges of substances that could potentially degrade the environment.

Construction, operation, and reclamation activities at the mine would operate in conformance with all MSHA safety regulations (30 CFR, Parts 1-199). In addition, Donlin Gold would require that all visitors, vendors, and contractors comply with all applicable safety and health standards. On-site mine rescue and medical emergencies would be handled by a Mine Rescue Team. The team would include advanced first aid and emergency medical technician trained personnel. Medical evacuation would be available by fixed-wing aircraft or helicopter to fly injured workers to medical facilities.

All structures would be designed in compliance with State of Alaska Building Codes and approved by the State Fire Marshal's Office. All heavy equipment would be equipped with automatic and/or manually activated fire suppression systems, and handheld extinguishers would be installed in all heavy equipment and small vehicles. Automatic sprinklers would be installed in buildings, and where appropriate, fire extinguishers would be mounted on the walls of all buildings.

2.3.2.2.12 MINE SITE – CLOSURE

The overall purpose of reclamation would be to stabilize disturbed areas and return them to vegetated conditions to ensure long-term protection of land and water resources in the area and to obtain near-natural conditions. During Operations, concurrent reclamation would be performed whenever possible in areas that are no longer required for active mining. After completion of reclamation of the site in accordance with an approved reclamation plan, the site would be monitored for a period of years as required by ADEC and the Alaska Department of Natural Resources (ADNR) to ensure successful implementation of the reclamation plan and to protect water quality, the environment, and human health and safety.

Donlin Gold would also update and complete a Closure Social Impact Assessment 3 years prior to closure of any operation (SRK 2016a). The Closure Social Impact Assessment would focus on identifying the social risks and impacts to the region from mine closure and would be followed by development of mitigation plans to address these risks and impacts. The ADNR requires the Reclamation and Closure Plan to be revised every five years. Revisions would address any changes in the design, construction, operations, and concurrent stabilization and reclamation of the facility (SRK 2016a).

Reclamation of Pits and Tailings Storage Facility

The reclamation and closure of the mine falls under the jurisdiction of ADNR, Division of Mining, Land, and Water; the ADEC; and the Corps. The Alaska Reclamation Act (Alaska Statute [AS] 27.19) is administered by the ADNR. The Act applies to state, federal, municipal, and private land and water subject to mining operations. Surface water and groundwater monitoring of mine facilities would continue during Closure and post-Closure. The monitoring would remain in place until each specific facility is physically and chemically stabilized.

Open Pit Reclamation

Mining in the ACMA Pit is expected to be complete in Year 22 of mine operations. When ACMA Pit mining is complete, waste rock from the Lewis Pit would be placed there instead of hauling it to the WRF. PAG 7 waste rock from the temporary stockpiles would be placed into either of the completed pits. This back fill would result in a pit lake with a design depth of 1,023.5 feet.

Upon final mine closure, the haul roads in and around the open pit would be smoothed of all berms except those necessary for erosion control and public safety. The open pit would gradually fill over the next 50-55 years with groundwater recharge, water from surface runoff, and water pumped from the TSF. It is predicted that the surface water of the pit lake would not meet APDES permit limits and would require treatment before discharge into Crooked Creek. Five years prior to the pit returning to a level that would result in discharges to the environment (e.g., loss of hydrologic sink), a post-Closure WTP would be constructed and treatment would begin two to three years before the pit is full, when the water would be about 33 feet below the spillway crest. Pumping would eventually be required in perpetuity (i.e., for an indefinitely long period of time) to ensure pit water lake levels do not overtop the banks of the pit lake. A generator would be installed to run the WTP and pump, and fuel would be flown or barged in as necessary. Sludge produced by the post-Closure WTP would be sent to the bottom of the pit lake for final storage. To ensure adequate funding for potential perpetual water treatment, a trust fund would be established during Construction and Operations to cover the costs of the WTP operations and maintenance, as well as post-Closure monitoring (see Appendix A for financial assurance information from Donlin Gold and Appendix AA for regulatory requirements related to financial assurance).

Tailings Storage Facility Reclamation

Five years of reclamation activities would occur at the TSF. In the first year of reclamation, TSF water would be pumped back into the ACMA Pit, which would become the initial pit lake. During the remaining four years, one-quarter of the tailings surface would be progressively reclaimed each year. Pumping to the pit lake would continue, when required, to prevent a large pond from redeveloping within the TSF. Closure cover would consist of 3.3 ft of NAG waste rock overlain by 12 inches of colluvium / terrace gravel overlain by 14 inches of peat / mineral mix. Runoff from the cover between Years 5 and 43 after mining operations end would be collected in a LLDPE-lined pond at the southeast corner of the reclaimed TSF. Runoff water would be tested to ensure it meets applicable water quality standards prior to discharge. If standards are not met, it would continue to be pumped to the pit lake.

During the Closure Phase and post-Closure, seepage from the TSF would be monitored for quality. In the event this seepage does not meet AWQS, it would be pumped to the pit lake. The seepage collection pond would be decommissioned when it can be demonstrated that the water meets AWQS for discharge to Anaconda Creek (see Section 2.3.2.5, Monitoring Activities, for additional information regarding monitoring).

Waste Rock Facility Reclamation

The WRF would be progressively reclaimed during mining operations by placing a cover designed to minimize infiltration and support vegetation growth. The cover would consist of a 12-inch layer of colluvium or terrace gravel and a top layer of 14 inches of growth media consisting of organics and fine-grained material. The WRF would be seeded and mulched as necessary; broadcast-seeding methods would likely be used for this facility. Before the cover layers were added, the underlying waste rock would be contoured to provide natural drainage toward the southern margin of the WRF. The contouring would also produce a drainage pattern of swales to minimize erosion and protect the cover integrity. Runoff and seepage from the reclaimed WRF would report to the pit lake in perpetuity.

Buildings and Equipment Sites Reclamation

As the Mine Site is closed and decommissioned, materials, equipment, and buildings would be removed. Equipment and piping not needed for the reclamation and post-Closure monitoring activities would not be reutilized at another mine site, sold, or salvaged, but would be disposed of onsite in an approved manner. Remaining structures at the site would be reduced to rubble and disposed of in a manner approved by the ADEC, potentially including burial on-site. Building foundations would be broken up to prevent them from being an impermeable impediment to natural percolation of precipitation. Following equipment and structure removal, sites would be graded lightly for proper drainage, ripped and scarified, seeded, and mulched if necessary.

At large sites such as the mill, crusher, shop, and fuel storage areas, once internal structures and foundations have been appropriately demolished, removed, or buried, these areas would be graded to blend with the surrounding topography. The areas would then be ripped to mitigate the compaction effects of traffic and infrastructure. Following ripping, each site would be evaluated to determine if the addition of native soil material is needed for vegetation to establish. A thickness of approximately 3.3 feet of cover colluvium would be established over any buried debris to ensure it remains subsurface into the foreseeable future.

Mine Site components that are in direct contact with process reagents would be rinsed with fresh water during decommissioning. This process water would be collected and treated at the WTP.

Fuel use during closure activities would be carefully monitored to ensure minimal excess fuel at completion. Any fuel that remains would be removed from the Mine Site.

Electrical Power Facilities

When the electrical power demand no longer requires an operational power plant, the power plant, substations, overhead power lines, and associated facilities would be removed from the site, unless it is agreed upon by the landowner to keep them. The power plant and the generators would be removed from the site or demolished and buried on-site, in keeping with regulatory requirements. As stated above, a generator would be installed to power the WTP and pump, and fuel would be flown or barged in as necessary.

Mobile Equipment and Vehicles

As practical, working mobile equipment could be offered to local communities and entities at the end of mine use. Mobile equipment and vehicles that cannot be reused or are not desired by communities would be buried in the WRF at closure. To prevent degradation of water resources or other contaminant mobilization, all fluids would be drained and batteries removed from all mobile vehicles prior to burial. The equipment would then be covered under reclaimed dump faces during regrading activities. The equipment burial locations would be surveyed and reported to the ADEC in the final closure report for the site. Current regulations require that ADEC approve or deny burial of the equipment under an Integrated Waste Disposal Permit. Should the permit requirement remain in place at the time of Closure, this permit would cover several other activities which overlap with ADNR and ADF&G authority. In addition, landowners would also need to agree to burial on any privately owned lands.

Roads and Airstrip Reclamation

Reclamation would be the same for all mine roads within the Mine Site. Onsite roads not required for long-term monitoring would be ripped, as necessary, to eliminate the effects of compaction, recontoured to blend with the surrounding topography, covered with a layer of growth media, and reseeded to meet the applicable reclamation standards. Berms, side-cast material, and road drainage ditches would be reclaimed in this process. Blacktop road and parking surfaces would be ripped and buried in place in road ditches and depressions prior to regrading. Culverts would be removed, natural drainage areas restored or stabilized, and roadbeds would be graded where necessary to provide adequate drainage. Water bars to divert run-on and run-off, and control erosion and berms to restrict human access, would be incorporated where necessary and as approved by ADNR. Reclamation of these features would include development of a streambank stabilization protocol.

The airstrip and the 30-mile road connecting the Mine Site to the Angyaruaq (Jungjuk) Port would remain to be used in long-term monitoring during mine reclamation into the foreseeable future following mine closure.

<u>Post-Mining Land Use</u>

The post-mining land use for the Mine Site after reclamation and closure would be wildlife habitat and recreation as prescribed by the Reclamation Standards (AS 27.19.020).

2.3.2.2.13 MINE SITE - SHORT TERM OR LONG TERM CESSATION OF OPERATIONS

At some point during the life of the mine, project operations could cease for one or more short periods of less than three months. The cessation of operations could be warranted due to major equipment breakdowns and subsequent replacement/repair, or severe weather-related interruptions. Longer-term, but still temporary cessations, lasting between three months and three years could occur in response to economic factors, such as a prolonged decrease in the price of gold. Long-term cessations are much less likely to occur than short term stoppages.

During a short-term cessation of operations, actions taken would be focused on stabilizing and maintaining the mine site facilities in good working order, while preventing erosion or untreated discharges. Actions could include keeping a minimal staff at the Mine Site for security and to conduct repair and maintenance work. Equipment or support items such as explosives, oil, gas, and first-aid supplies that may deteriorate in a year's time would be depleted or removed from the Mine Site during the cessation period. Hazardous materials at the Mine Site would be safely shipped off-site or would be secured in shop buildings or warehouses. All equipment would be stored on location in the shop buildings or warehouses at the Mine Site. Ventilation fans, electric lines, and transformers would be left in place to allow for a quick restart.

During a long-term cessation of operations, a more extensive removal of equipment and supplies, stabilization of facilities, and ongoing measures to prevent erosion and untreated discharges would be required. For example, mobile equipment and a portion of the fixed equipment could be removed from the Mine Site. The buildings would be left in place and they would be secured and maintained in the same manner as for short-term interim management. However, security and maintenance staff would not be likely to remain on-site at the same level of operations, and buildings would likely be "cold closed". All hazardous materials would be removed from the site and disposed of in accordance with state and federal regulations. Monitoring and inspections to comply with permit conditions would continue.

Failure to operate beyond the prescribed long-term shutdown period (three or five years in the examples) may result in a requirement for final closure and reclamation procedures described previously.

Should the mine enter into permanent closure, requirements established in the reclamation plan and permits for final closure and reclamation as described in previous subsections would still apply. Closure and reclamation standards would not be reduced due to short-term or long-term cessation of operations prior to planned closure. However, in the event of an early cessation of operations leading to mine shutdown, the self-sustaining Closure Maintenance Trust Fund trust fund may not be fully endowed. Therefore, details for long-term post-Closure finances in the event of early cessation of operations would have to be addressed in the permitting process.

2.3.2.3 ALTERNATIVE 2 – TRANSPORTATION CORRIDOR

Alternative 2 would include shipping cargo from marine terminals in Seattle and Vancouver via ocean barges up the Kuskokwim River to a cargo terminal in Bethel. At Bethel, cargo would be transferred from ocean barges to river barges for towing up the Kuskokwim River to the upriver Angyaruaq (Jungjuk) Port site. Cargo would be transported by truck from the port to the Mine Site.

Transportation facilities include:

- Consolidation of annual consumables and other general cargoes in Seattle and Vancouver operated by third parties or marine transport companies. Forward deployment of construction and general cargoes to Dutch Harbor or Juneau prior to the start of the shipping season on the Kuskokwim River.
- A cargo terminal in Bethel with three general cargo berths (one for ocean barges and two for river barges), a 950-foot long berth face, a 200-foot wide concrete ramp for roll-on / roll-off cargo handling, and a 16-acre storage yard.
- The 21-acre upriver Angyaruaq (Jungjuk) Port site including a 700- to 800-foot long wharf, a pocket berth for barges, a ramp to the pocket berth, container handling

equipment, seasonal storage for containers and break-bulk cargo, barge season office/ lunchroom facilities, and a truck shop.

- A 30-mile long, gravel two-lane road from the port site to the Mine Site.
- A 5,000-foot long by 150-foot wide gravel airstrip capable of supporting DeHavilland Dash 8 and Hercules C-130 aircraft. The airstrip would be located approximately nine miles west of the Mine Site and accessed by a three mile spur road beginning at mine access road mile 5.4.
- Construction would begin upon receipt of permits and would take approximately 1.5 years working year round.

Figure 2.3-9 provides an overview of the primary transportation facilities proposed for Alternative 2.

The following sections provide an overview of the new and existing infrastructure that would be used to transport cargo and fuel to the Mine Site, and transport materials for the natural gas pipeline.

All facilities would be operated according to applicable laws and regulations to ensure the security of the facilities, protection of the environment, and safe storage, handling and transportation of hazardous materials.

2.3.2.3.1 TRANSPORTATION CORRIDOR – EXPECTED OCEAN AND RIVER TRAFFIC

The transportation plan has been designed for an annual volume of 115,000 tons of cargo during operation of the mine. The cargo would be shipped from Pacific Northwest (Seattle, WA and Vancouver, BC) ports via ocean barges towed by ocean-going tugs to Bethel. Each ocean barge would be 360 feet long by 100 feet wide and would have a net cargo capacity of 10,040 tons at a maximum draft of 16 feet. Three sets of tugs and barges would make a total of 16 round-trips per year during Construction and 12 round-trips per year during Operations. About 85 percent of all cargoes would be containerized; the remainder would be handled as break-bulk.

The diesel transportation plan has been designed for a peak annual usage of 42.3 Mgal. For delivery to Bethel, fuel would be transported by one double-hull, 2.94-Mgal capacity ocean fuel barge. These ocean barges would have a fully loaded draft of 14 feet, but could be loaded light during low-water conditions. As a result, these fuel barges would be able to go directly to Bethel without having to lighter to reduce draft to cross the narrows at Oscarville Crossing. The ocean barge would be towed by a 3,000 horsepower tug; there would be a total of 14 trips per year during Construction and Operations.

The total number of ocean barges to Bethel would therefore be 30 during Construction (16 cargo barges plus 14 fuel barges), and 26 during Operations (12 cargo barges plus 14 fuel barges). In addition, there would be 20 ocean barges transporting pipe and equipment from Anchorage to Beluga Landing in the Pipeline component during the first year of Construction.

An increase of four ocean fuel barges from Pacific Northwest (Seattle, WA and Vancouver, BC) ports to Dutch Harbor is estimated to occur during Construction, and an increase of seven ocean fuel barges estimated during Operations, associated with project activities.

Before entering the navigation channels at the mouth of the Kuskokwim River, all vessels would take on a pilot who would remain on board until the vessel has berthed at Bethel. Pilots would also accompany vessels on the downstream transit. Ocean barges would require tug assistance while berthing and de-berthing.

Fully loaded ocean cargo barges may reach Bethel during higher river levels on a tide, however for most of the barging season a barge would need to discharge up to 3,580 tons of cargo, approximately one-third its load, at Oscarville Crossing (about 7 miles downriver from Bethel) to reduce its draft to 12 feet and permit it to transit the narrows and reach Bethel. Lightering would be accomplished by barge-to-barge transfer using a floating crane barge and would take about one day. Off-loaded cargoes would be transferred to river barges and then shipped directly to Angyaruaq (Jungjuk) Port, 199 river miles upstream from Bethel.

Fuel sourced from refineries in the Pacific Northwest would be transported to Dutch Harbor by two chartered 6.5-Mgal capacity, double-hull ocean barges making a total of seven round trips in a shipping season. In Dutch Harbor the fuel would be pumped ashore to storage tanks.

River barges can move upstream of Bethel once the river is free of ice, generally between April 24th and June 1st. The Kuskokwim River typically begins to freeze up in early October ending the shipping season. The Kuskokwim River shipping season of 110 days is assumed to occur from June 1st to October 1st, allowing for two weeks of downtime to allow for occasional low flows. Between Bethel and Angyaruaq (Jungjuk) Port, available draft on the river is limited by the depth of water in the shallower sections of the river, such as the section of river alongside Nelson Island, just upstream of Tuluksak.

General cargo would be transported up the Kuskokwim River from Bethel to Angyaruaq (Jungjuk) Port via two river-barge cargo tows typically comprised of a single-hull pusher-tug and four river barges for a combined operating capacity of 3,477 tons (Figure 2.3-10 illustrates a typical tug and 4-barge configuration). Each river cargo-barge would be 150 feet long by 44 feet wide with a maximum loaded draft of 7.5 feet (minimum operating draft of 3 feet, and an average of 4.25 feet). The river cargo barge fleet would operate 24 hours per day, 7 days per week during the shipping season. Two tows of four cargo barges each would make an estimated total of 64 round trips per season during Operations, with a round trip travel time of 81 hours. During Construction, there would be an estimated number of 50 river cargo round trips per season.

At Bethel, fuel would be transferred directly to river barges for transport to Angyaruaq (Jungjuk) Port, or off-loaded for temporary storage and later transport to Angyaruaq (Jungjuk) Port. Fuel would be transported up the Kuskokwim River from Bethel to Angyaruaq (Jungjuk) Port by a fleet of two pusher-type fuel tows typically comprising a tug and four double-hull river barges. A tow of four fuel barges would have a capacity of 1.29 Mgal. Each fuel barge would be 165 feet long by 44 feet wide with a maximum operating draft of 7 feet. The tugs would be triple-screw 1,450 horsepower with a minimum draft of 3 feet. The fuel barges would have round-trip cycle times between Bethel and Angyaruaq (Jungjuk) Port of 81 hours for a total of 58 trips per shipping season during Operations. During Construction, there would be an estimated 19 river fuel round trips per season. During the first two years of Construction, there would be an additional estimated 20 barge trips transporting pipe and equipment from Bethel to a staging area near Devil's Elbow above Stony River on the Kuskokwim River.

The total number of river barges would therefore be 89 during Construction (50 cargo barges, plus 19 fuel barges to Angyaruaq [Jungjuk] Port Site, plus 20 pipe and equipment barges during the first two years of Construction to the staging area near Devil's Elbow, above Stony River), and 122 during Operations (64 cargo barges plus 58 fuel barges) (Table 2.3-8). River data would be assessed at the beginning of each year to assist in the logistics of barging so that adjustments can be made to address any changing environmental conditions. A barge-loading plan for each trip would be based on expected river conditions and a forecast of the minimum available draft on the river for the duration of the trip between Bethel and Angyaruaq (Jungjuk) Port. An automated load planning system that constantly monitors river conditions in real time would be used to provide load planners with the information needed to load barges to maximum capacity, yet provide an adequate margin of safety against grounding. A simulation analysis of the general cargo barge fleet based on bathymetric data collected by Donlin Gold concluded that the proposed barge fleet would successfully deliver the specified volumes to the Mine Site 227 times out of 230, a success rate of about 99 percent (AMEC 2013). Fully loaded tows of four barges might have to relay in low water conditions at Nelson Island (upbound only) and Upper Oskawalik (upbound and downbound) by splitting the tow into a two barge (end to end) configuration for these short sections (AMEC 2014). During average flow years, there would be few if any conditions that require relays through these two sections (AMEC 2014).

Prior to the first barging season, the river would be surveyed again and an electronic navigation chart developed. In addition, sections of the river where navigation is difficult or tight would be buoyed annually. A series of ranges providing line-of-site navigation would be constructed, and each tug would be equipped with modern communication and navigation equipment. Each tug-and-barge set would be equipped with a tracking transmitter to provide the traffic manager and terminal managers with the location of any vessel and its position in relation to the other fleet vessels at all times.

During years where the river flow is too low, shallow, or narrow for normal barge plan operations, there are contingency strategies for mine resupply. These would include strategic inventories in Bethel to allow river barging to start prior to ice clearing of the river mouth, extending the barge season later in the year than anticipated, chartering additional barge tows with less cargo, and/or breaking down the tows into smaller units to relay through the narrow reaches at Nelson Island and Upper Oskawalik. Additionally, the storage capacity at the Mine Site would be equal to 10 months of mine consumption in the event that resupply could not occur immediately. Lastly, Donlin Gold could reduce plant throughput to conserve inventories.

Unintentional grounding of a barge could occur if a barge captain strayed from the surveyed channel due to a navigational error. In this case, an empty tow traveling down the river would be available to assist the stranded barge, as needed. In the event of a stranding in the active channel, equipment would be mobilized from the lower port site, or elsewhere on the river, to assist as needed. Donlin Gold’s Barge Grounding Response Plan can be found in Appendix W.

Table 2.3-8: Estimated Annual Ocean and River Barge Traffic Under Alternative 2

Barge	Transporting	From	To	Number of Round Trips per Season	
				Construction	Operations
Ocean	Cargo	Seattle, WA or Vancouver, B.C. area	Bethel	16	12
Ocean	Fuel	Dutch Harbor	Bethel	14	14
Total cargo and fuel barges to Bethel				**30**	**26**
Ocean	Fuel	Seattle WA or Vancouver, B.C. area	Dutch Harbor	4	7
Total fuel barges to Dutch Harbor				**4**	**7**
River	Cargo	Bethel	Angyaruaq (Jungjuk) Port Site	50[1]	64
River	Fuel	Bethel	Angyaruaq (Jungjuk) Port Site	19	58
River	Pipe and Equipment	Bethel	Staging area near Devil's Elbow, above Stony River	20 during first two years of pipeline construction[2]	0
Total river barges, Transportation Corridor Component				**89**	**122**
Ocean	Pipe and Equipment	Anchorage	Beluga Landing	20 during first year of pipeline construction	0
Total ocean barges, Pipeline Component				**20**	**0**

Notes:

1 Total would be 200 trips over four years. Exact distribution by year would be determined during final design.
2 Average: actual number would range from 9 to 29 annually.
Quantities shown for Operations represent peak year. For cargo barging, Year 7 of Operations is modeled to be the peak year and the barge trips would be reduced in early and late years. For fuel barging, Year 20 of Operations is modeled to be the peak year and the barge trips would be reduced in early and late years.
Source: SRK 2013a

The steps that would be taken in the event of an unintentional grounding/stranding would be:

1. Notify the USCG.
2. Separate and secure any barges still floating to a secure location where they would not impede the flow of traffic on the river. Once this has been completed, the tug and crew would then focus on the stranded barge.
3. Check river conditions and determine if the water depths are rising, falling, or static. In the event of rising water conditions, the crew may elect to wait a short period to see if rising water floats the barge free.
4. If water depth is falling, or static, or the water is not rising fast enough, then the next step would be to attempt to pull the barge free using the available tug. This step would be dependent on the nature of the stranding and the river bed conditions. Additional tugs could be utilized to assist in pulling the barge as needed.
5. In the event that river bed conditions and/or other factors preclude pulling the barge free, or the tug is unable to free the barge, the next step would be to obtain approval

from USCG to lighter fuel or cargo to empty barges. Lightering would be conducted by bringing an empty fuel barge (equipped with a pump for fuel transfer) or cargo barge (equipped with a crane or other equipment for transferring cargo), as appropriate, alongside the stranded barge and transferring fuel or cargo across to the empty barge until the stranded barge is refloated. All appropriate spill containment measures (booms, etc.) would be implemented prior to lightering any fuel.

6. Once enough cargo had been removed from the barge it would refloat. In extreme cases the empty barge could be pulled free using a tug. As these barges would be designed for storage on the river bank during the winter season when the river is frozen, the barges would be structurally strong enough to withstand being pulled free. Freed barges would be inspected by appropriate qualified personnel as required by the USCG and repaired, as needed, before being placed back into service.

2.3.2.3.2 TRANSPORTATION CORRIDOR – ANGYARUAQ (JUNGJUK) PORT SITE

The proposed 21-acre Angyaruaq (Jungjuk) Port Site would be the upriver terminus for barges and a transfer point for cargo going to the Mine Site. Containers, fuel, and cargo would be off-loaded and then trucked to the mine during the 110-day annual barging season. Proposed facilities include two river barge berths, a roll-on / roll-off berth, and a container storage area with sufficient space to hold up to 1,000 containers, and one 2.8 Mgal above ground diesel storage tank equipped with secondary containment equal to 110 percent of the volume (Figure 2.3-11). The port would have container handling equipment, seasonal storage for containers, break-bulk cargo, fuel, and office facilities. The barge landing would be powered by two 600 kW diesel generators. Empty containers would be returned to Bethel and then to marine terminals in Seattle or Vancouver.

2.3.2.3.3 TRANSPORTATION CORRIDOR– MINE ACCESS ROAD

A new 30-mile access road between the Angyaruaq (Jungjuk) Port and the Mine Site would be used to transport fuel and cargo (Figure 2.3-12). The access road would be a two-lane, 30-foot wide, all-season gravel road used for mine support traffic and it would not be maintained in the winter. Public use of the road would not be allowed; however, crossing the road in pursuit of local subsistence activities would be accommodated.

Construction materials would be excavated from borrow material sites (MS) along the mine access road, listed in Table 2.3-9. Material from these sites would also be used for construction and maintenance of access and spur roads. Spur roads off of the main access road would run to the proposed airstrip and permanent camp facilities. Ice roads would not be needed to construct the mine access road.

Dust control would be in accordance with the Fugitive Dust Control Plan (Air Sciences 2015d). There would be two water sources for dust control for the mine access road, listed below.

- South Fork Getmuna Creek. The project would draw 80 acre-feet per year at an extraction rate of 100 gpm. Withdrawal would occur from May through October, during Construction, Operations, and Closure. The stream is anadromous.

- Kuskokwim River. The project would draw 637 acre-feet per year at an extraction rate of 800 gpm. Withdrawal would occur from May through October, during Construction, Operations, and Closure. The river is anadromous.

Fifty-one stream or drainage crossings have been identified along the road route, of which six would require bridging (see Table 2.3-10).

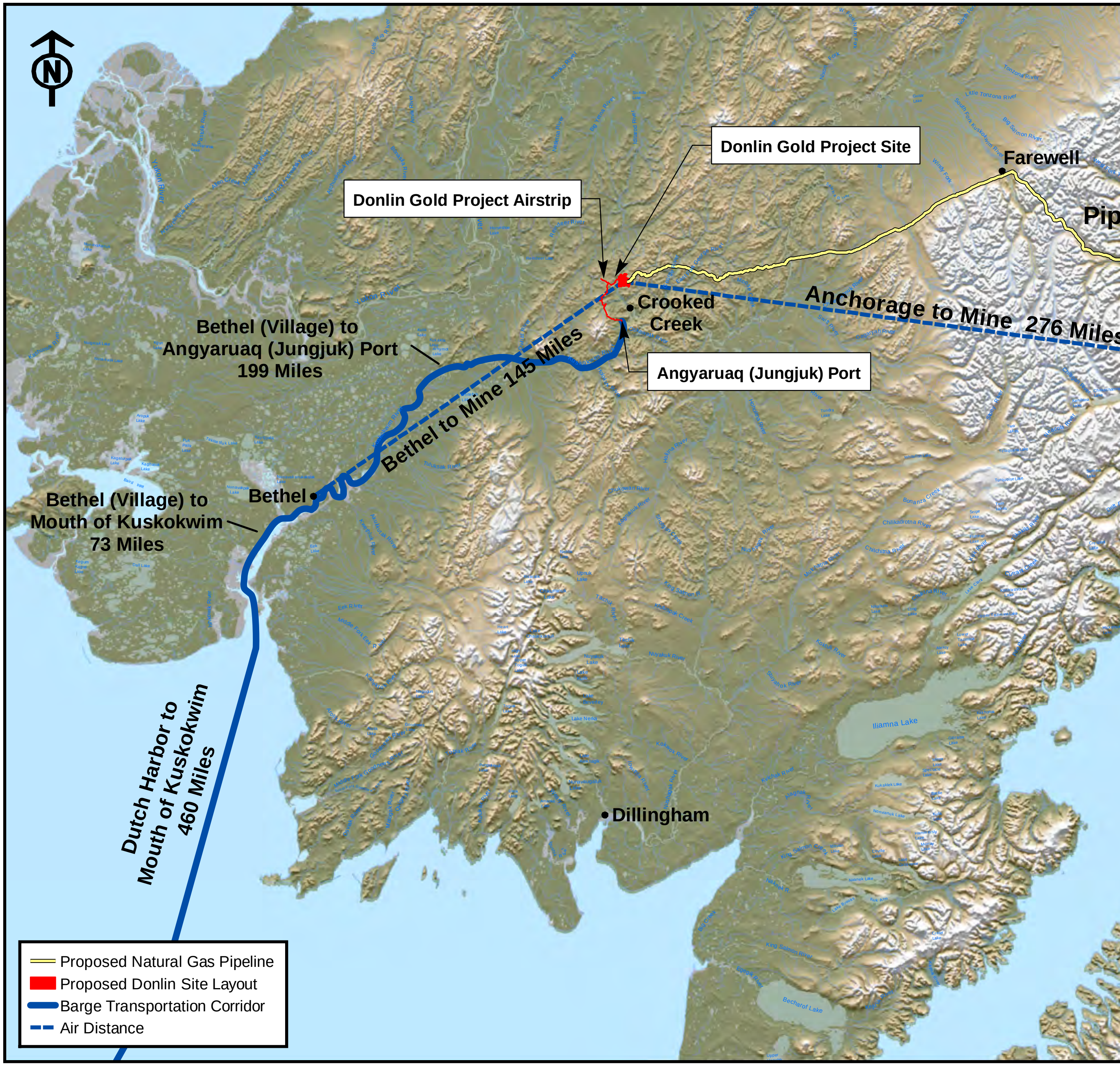
Table 2.3-9: Material Sites – Angyaruaq (Jungjuk) Road

Material Site	MP nearest Angyaruaq (Jungjuk) Road	Area (acres)	Material Type	Volume (m^3)	Volume (yd^3)
MS 01	25.3	46.5[a]	Granodiorite	1,000,000	1,307,951
MS 02	23.3	21.5	Sedimentary rock	300,000	392,385
MS 03	21.8	15.7	Sedimentary rock	100,000	130,795
MS 04	19.6	10.5	Sedimentary rock	80,000	104,636
MS 05	18.4	24.4	Rhyolite	200,000	261,590
MS 06	17.1	2.8	Rhyolite	50,000	65,398
MS 07	14.9	21.9	Rhyolite	50,000	65,398
MS 08	0	29.9[b]	Granodiorite	300,000	392,385
MS 09	12.8	4.7	Rhyolite	50,000	65,398
MS 10	10.4-11.0	208.3	Gravel	1,500,000	1,961,926
MS 12	7.2	14.2	Basalt	200,000	261,590
MS 13	5.4	10.3	Basalt	350,000	457,783
MS 16	2	30.8[b]	Sedimentary Rock	250,000	326988
Total	N/A	441.5	N/A	4,430,000	5,794,223

Notes:

a Acreage includes camp components
b Acreage includes access road and work area
m^3 = cubic meters
yd^3 = cubic yards
MP = milepost
MS = material site

Source: Recon 2011c; Donlin Gold 2017g



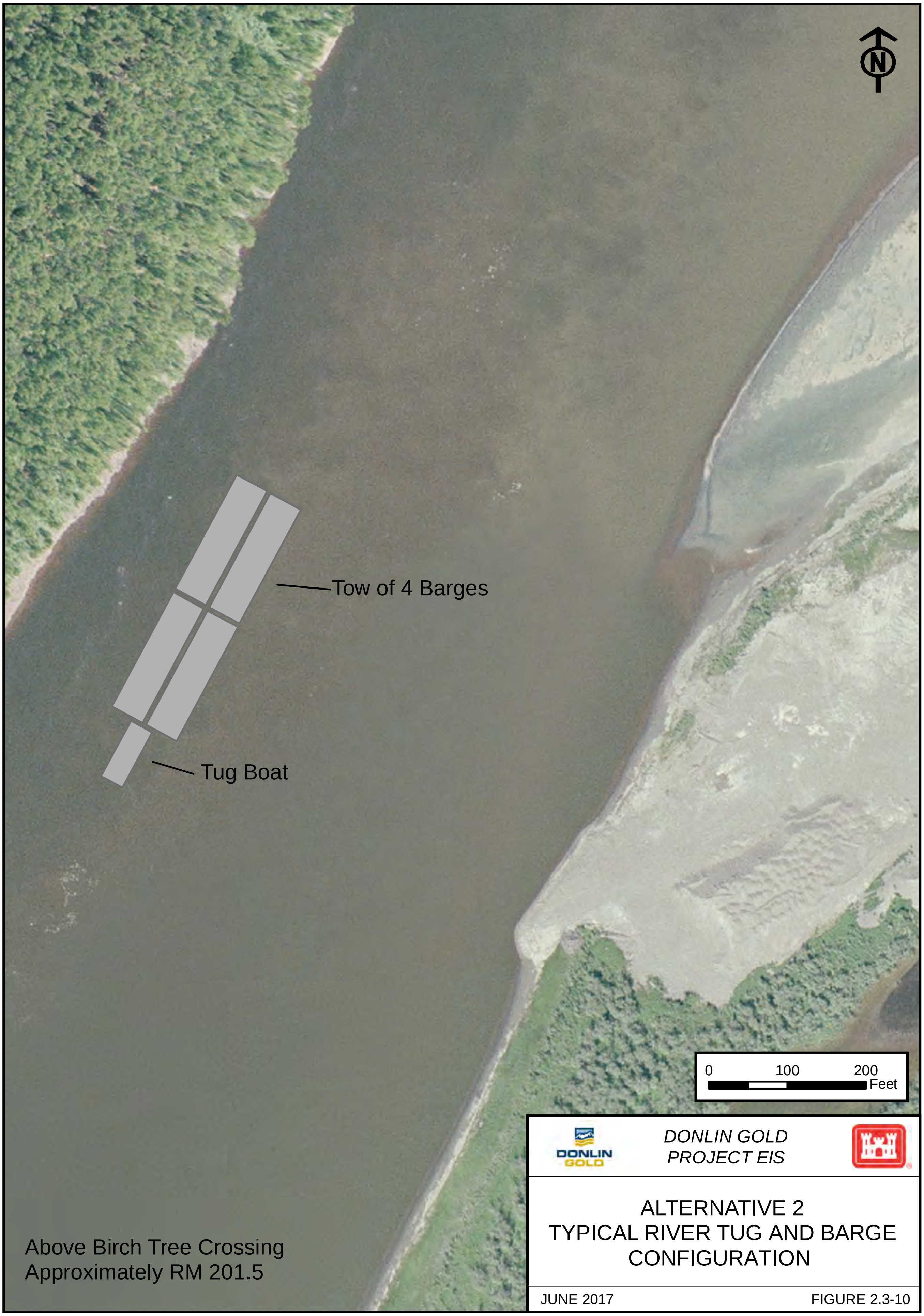
DONLIN GOLD

DONLIN GOLD PROJECT EIS

ALTERNATIVE 2
TRANSPORTATION FACILITIES
OVERVIEW

JUNE 2017

FIGURE 2.3-9

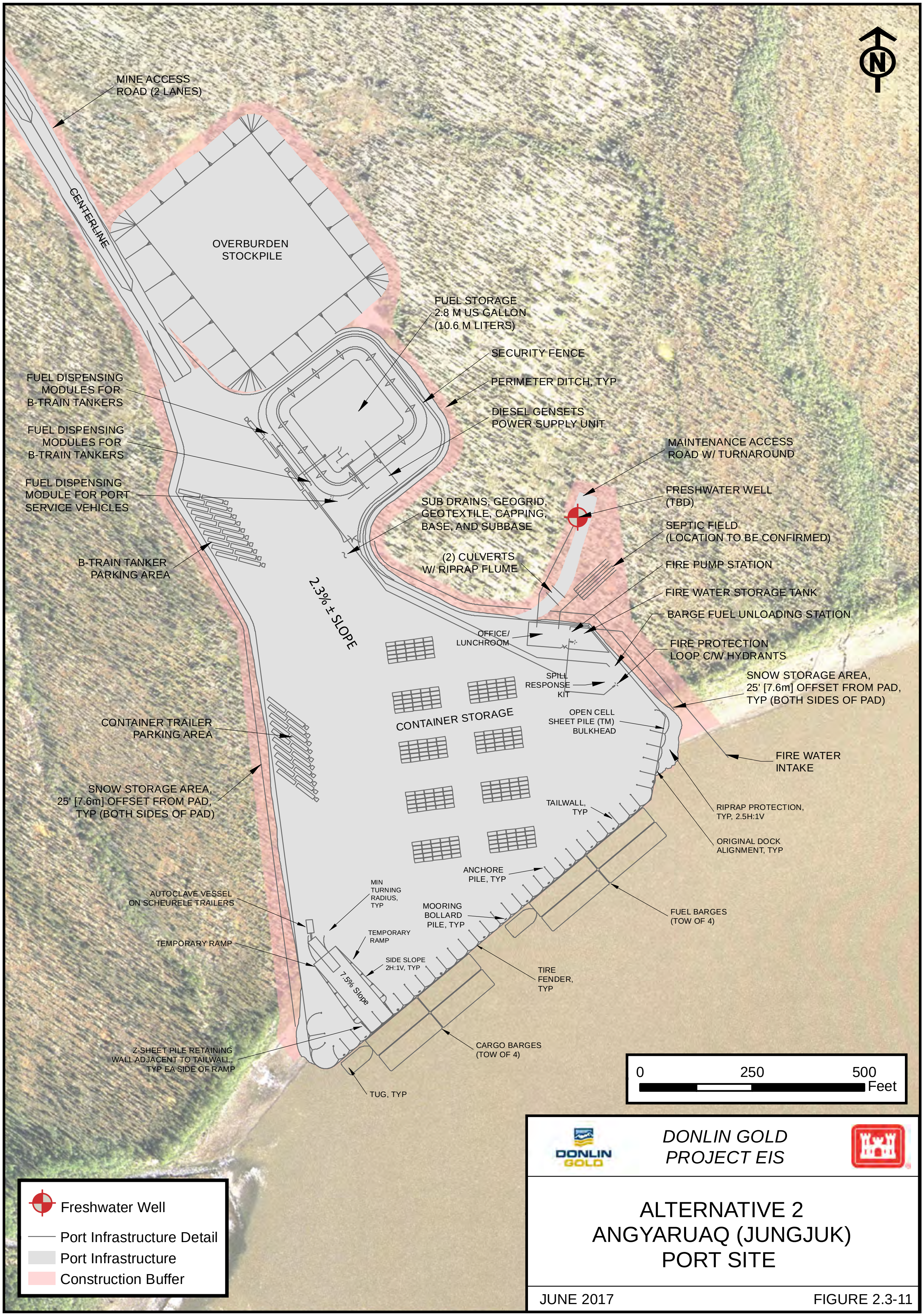


DONLIN GOLD PROJECT EIS

ALTERNATIVE 2
TYPICAL RIVER TUG AND BARGE CONFIGURATION

JUNE 2017

FIGURE 2.3-10

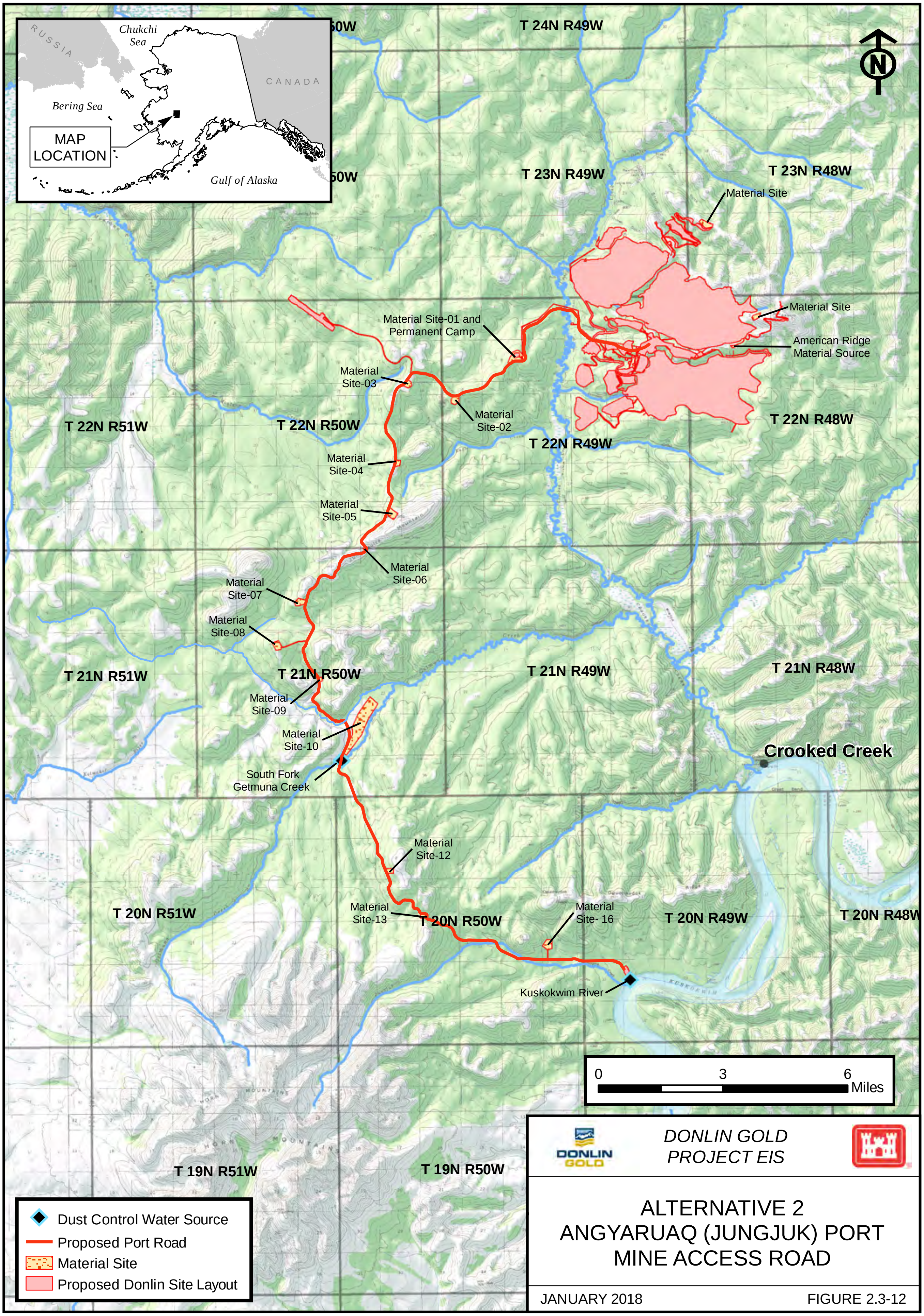


DONLIN GOLD PROJECT EIS

ALTERNATIVE 2
ANGYARUAQ (JUNGJUK)
PORT SITE

JUNE 2017

FIGURE 2.3-11



DONLIN GOLD PROJECT EIS

ALTERNATIVE 2
ANGYARUAQ (JUNGJUK) PORT
MINE ACCESS ROAD

JANUARY 2018

FIGURE 2.3-12

Table 2.3-10: Angyaruaq (Jungjuk) Road Stream Crossings

Stream Name	MP	Crossing Type	Bridge Span (ft)	Culvert Diameter (in)
Crooked Creek Floodway #1	0.1	culvert		48
Crooked Creek Floodway #2	0.1	culvert		72
Crooked Creek	0.2	bridge	82	
Crooked Creek Floodway #3	0.2	culvert		72
Crooked Creek Floodway #4	0.3	culvert		48
Unnamed	9.1	culvert		36
Unnamed	9.3	culvert		36
Unnamed	9.5	culvert		36
Unnamed	13.2	culvert		48
Unnamed	13.4	culvert		36
Unnamed	13.6	culvert		36
Unnamed	13.9	culvert		36
Two Bull Creek	14.5	culvert		48
Unnamed	14.9	culvert		36
North Fork Getmuna Creek Floodway #1	16.1	culvert		36
North Fork Getmuna Creek Floodway #2	16.1	culvert		60
North Fork Getmuna Creek	16.1	bridge	43	
South Fork Getmuna Creek Floodway #1	17.1	culvert		36
South Fork Getmuna Creek Floodway #2	17.1	culvert		60
South Fork Getmuna Creek	17.2	bridge	39	
Getmuna Creek Tributary	17.5	bridge	23	
Unnamed	19.5	culvert		36
Unnamed	19.5	culvert		36
Unnamed	19.9	culvert		30
Unnamed	20.1	culvert		24
Unnamed	20.2	culvert		24
Unnamed	20.3	culvert		36
Unnamed	20.4	culvert		24
Unnamed	20.4	culvert		24
Unnamed	20.5	culvert		36
Unnamed	20.8	culvert		30
Unnamed	20.9	culvert		24
Unnamed	21.3	culvert		36
Unnamed	21.4	culvert		36

Table 2.3-10: Angyaruaq (Jungjuk) Road Stream Crossings

Stream Name	MP	Crossing Type	Bridge Span (ft)	Culvert Diameter (in)
Unnamed	21.5	culvert		36
Unnamed	21.7	culvert		24
Unnamed	21.8	culvert		36
Unnamed	22.1	culvert		30
Unnamed	22.5	culvert		36
Unnamed	23.0	culvert		36
Jungjuk Creek, Upper Crossing	24.1	bridge	30	
Unnamed	24.5	culvert		36
Unnamed	24.5	culvert		36
Jungjuk Creek, Lower Crossing	24.8	bridge	30	
Unnamed	24.9	culvert		48
Unnamed	25.2	culvert		30
Unnamed	25.9	culvert		30
Unnamed	26.0	culvert		72
Unnamed	26.2	culvert		24
Unnamed	26.8	culvert		48
Unnamed	26.9	culvert		48

Abbreviations:
MP = milepost
Source: Recon 2011b.

With an average round-trip time of 3.25 hours, the mine access road traffic would consist of fuel and cargo trucks operating during the approximately 110-day shipping season. On average, a cargo or fuel truck would arrive about every half hour either at the Mine Site or at Angyaruaq (Jungjuk) Port during a 12-hour shift (see Table 2.3-11).

Table 2.3-11: Estimated Mine Access Road Traffic

Vehicle	Transporting	Number of Vehicles	Number of Trips per Day	Number of Trips per Season
13,500-gallon capacity B-train tanker trucks	Fuel	10	27	2,963
10 tractor units	Cargo	10	27	2,917
Total		20	54	5,880

Source: SRK 2013a.

2.3.2.3.4 TRANSPORTATION CORRIDOR – AIRSTRIP

The proposed airstrip would be a 5,000-foot by 150-foot gravel runway on a ridge approximately nine miles west of the Mine Site (Figure 2.3-13). The aircrafts specified for the design of the airstrip are the DeHavilland Dash 8 and the Hercules C-130. The three-mile airstrip spur road would begin at Mile 5.4 of the mine access road. Material for the airstrip would likely come from MS 10 along the mine access road. The Mine Site airstrip apron would have two 9,900-gallon fuel storage tanks containing Jet Fuel (A) and one 5,000-gallon fuel tank containing 100 low lead aviation gasoline. A 9,900-gallon diesel tank would store fuel for two 200-kW generators to provide power to the airstrip facilities. All tanks would have secondary containment. Deicing would occur as needed and would be managed under Best Management Practices required by the Alaska Multi-Sector General Permit for Storm Water Discharges. See Table 2.3-12 for estimated flight frequency.

Table 2.3-12: Estimates of Annual Airport Operations at Mine Airstrip

Phase	Rotary Wing Aircraft	Fixed Wing Aircraft			
		Dash 8 Q300	Twin Otter Series 400	Cargo Plane	Total Annual Operations[1]
Construction	Local use in area of Mine Site development	2,808 (27 flights per week: 3 passenger flights per day, 6 cargo flights per week)	2,190 (3 flights per day)	156 (3 flights per 2 weeks)	5,154
Operations	Casual use	936 (9 flights per week: 1 passenger flight per day, 2 cargo flights per week)	730 (1 flight per day)	52 (1 flight per 2 weeks)	1,718

Notes:

1 Arrivals and departures are counted separately. Operations = total number of arrivals and departures

Source: Fernandez 2013e.

2.3.2.3.5 TRANSPORTATION CORRIDOR – SHIPPING REQUIREMENTS AND SPILL RESPONSE

Under the Proposed Action, Donlin Gold would require compliance with the statutes governing customs, shipping of dangerous goods, and spill prevention and emergency response. These statutes include the Jones Act; International Marine Dangerous Goods Code; Oil Pollution Act; CWA, Section 311; CERCLA, Section 103; Emergency Planning and Community-Right-to-Know Act of 1986; or Title III of the Superfund Amendments and Reauthorization Act, Section 304; and ADEC requirements under 18 AAC 75 for oil spill prevention and contingency planning. The project spill plans describe the systems that would be used for the prevention, response, containment, safe cleanup, and reporting of spills or discharges of substances that potentially may degrade the environment.

The marine fuel carrier would be required to be certified under the International Safety Management Code, the American Waterways Operators Responsible Carriers Program, or both, and be a member of the Alaska Chadux Corporation (Chadux), a member-funded oil spill response organization headquartered in Anchorage. Chadux is classified as an Oil Spill Removal Organization by the USCG and registered as a Primary Response Action Contractor and a Non-tank Vessel Cleanup Contractor with the State of Alaska.

The agencies governing spill response include the ADEC, USCG, EPA, and USDOT PHMSA. Table 2.3-13 lists the oil spill response plans required for the Donlin Gold Project, the areas where they would apply and the agency with jurisdiction over the plans. In addition to oil spill response, the project would require the use, storage, transport, and disposal of other hazardous substances, which require specific environmental management plans.

Table 2.3-13: Oil Spill Response Plans

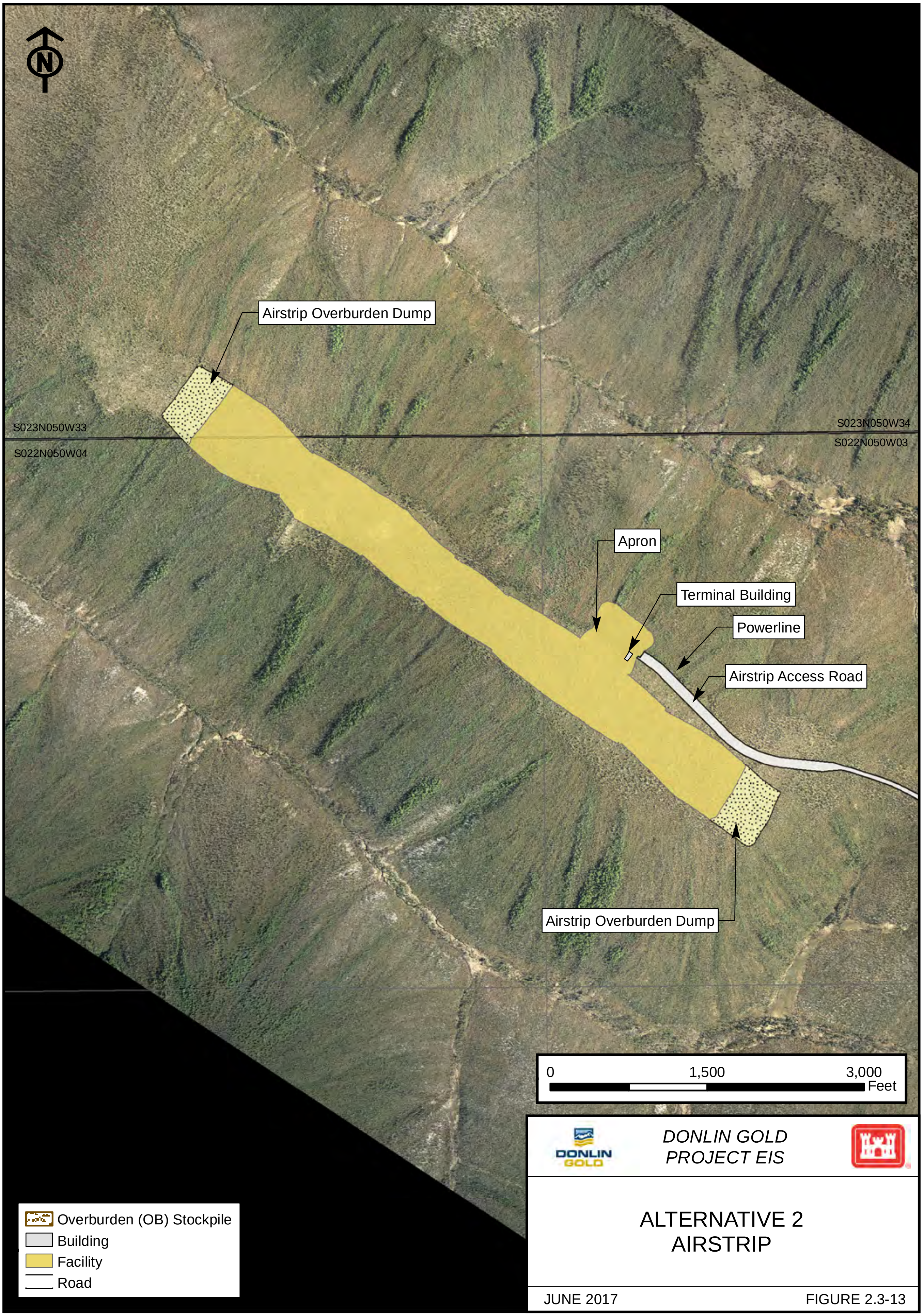
Plan	Application	Jurisdiction	Reference
Marine Transportation Facility Response Plan	Bethel tank farm Angyaruaq (Jungjuk) Port fuel storage/transfer facility	USCG	33 CFR Part 154
SPCC Facility Response Plan	Containers of oil/fuel ≥ 55 gallons Bethel tank farm/fuel transfer facility Angyaruaq (Jungjuk) Port fuel storage/transfer facility Mine Site oil/fuel storage	EPA	40 CFR Part 112
Vessel and Barge Oil Spill Response Plan	Vessels and barges	USCG	33 CFR Part 155
State of Alaska Oil Discharge Prevention and Contingency Plan	Bethel fuel storage/transfer facility Angyaruaq (Jungjuk) Port fuel storage/transfer facility Facility piping Vessels and barges Mine Site oil/fuel storage	ADEC	18 AAC Chapter 75

Source: SLR 2012a.

The Donlin Gold Vessel Operations Oil Discharge Prevention and Contingency Plan (SLR 2012b) was prepared for vessels carrying petroleum products from or to any waterways associated with the Donlin Gold mining project. Donlin Gold developed the document to guide oil spill prevention and response activities in the event or threat of a discharge originating from a vessel in waters of Western Alaska. The Plan describes oil spill prevention and response activities and procedures for the Donlin Gold mine project and its primary response action contractor.

2.3.2.3.6 TRANSPORTATION CORRIDOR – CLOSURE

Along with the removal and reclamation of all mine support facilities previously described, Angyaruaq (Jungjuk) Port would be partially reclaimed at the end of Mine Site operation. Sheet piles and fill would be removed and the area around the barge landing would be recontoured. A barge landing and the 30-mile mine access road and airstrip would be maintained for delivery of WTP reagents, equipment, fuel, and supplies, as well as to provide access to the project site for long-term monitoring and operating the pit lake water treatment plant.



ALTERNATIVE 2
AIRSTRIP

JUNE 2017

FIGURE 2.3-13

2.3.2.4 ALTERNATIVE 2 – NATURAL GAS PIPELINE

Donlin Gold proposes to construct a 14-inch-diameter buried steel pipeline to transport natural gas approximately 316 miles from an existing 20-inch gas pipeline tie-in near Beluga, Alaska, to the Mine Site power plant. Storage and treatment of natural gas prior to input would be accomplished with existing Cook Inlet infrastructure. The pipeline would require one compressor station at Milepost (MP) 0.4. At the Mine Site, natural gas would be used primarily as a fuel source for generating electricity and for space heating. The pipeline would be buried, except for at the Castle Mountain and Denali-Farewell fault crossings where it would be above ground for approximately 1,300 feet at each crossing. Horizontal Directional Drilling (HDD) and winter trenching are among the techniques proposed to bury the pipeline at stream and river crossings. The gas pipeline would be operated near seasonal ambient ground temperature to minimize thermal disturbance to the surrounding soils permafrost. Approximately 20 mainline block valves (MLV) would be installed at not more than 20-mile intervals along the pipeline ROW, and a maintenance station would be located near the halfway point at Farewell (MP 153.6) (SRK 2013b). (Mainline valves close during a pipeline leak to minimize loss of contents.) An overview of the gas pipeline route is shown on Figure 2.3-14.

The pipeline would be designed to deliver up to 73 million standard cubic feet per day (MMscfd) of natural gas, at a maximum allowable operating pressure (MAOP) of 1,480 pounds per square inch gauge (psig) for 30 years. Electrical power would be generated at the compressor station at MP 0.4 and a buried electric transmission line would be run approximately 0.4 miles to the metering station at MP 0 (see Section 2.3.2.4.3). The fiber optic cable would be installed underground, except at the two above-ground fault crossings (see Section 2.3.2.4.2 for details on the fiber optic cable and installation).

2.3.2.4.1 PIPELINE – RIGHT-OF-WAY

The 14-inch-diameter steel natural gas pipeline would connect to an existing 20-inch gas pipeline near the west side of the Beluga Gas Field, approximately 30 miles northwest of Anchorage as shown on Figure 2.3-14.

<u>Pipeline Right-of-Way Corridor</u>

Donlin Gold has identified a construction planning corridor of 300 feet. The planning corridor encompasses a long-term ROW (50 feet wide on ANCSA and State of Alaska lands and 51 feet, 2 inches on BLM-managed lands) and an additional 100-feet wide temporary construction corridor. Thus, the construction corridor would be 150 feet to install the pipeline and fiber optic cable, and would lie within the wider planning corridor.

Figure 2.3-15 shows the planned evolution of the ROW. The 300-foot corridor would provide flexibility to adjust the pipeline alignment during Construction to avoid sensitive resources, areas with steep slopes, marshes and bogs, river crossings, and permafrost terrain to the extent practicable.

Estimated total acreage on federal, state, and ANCSA corporation lands for the 300-foot planning corridor is 11,471 acres as shown in Table 2.3-14. Ancillary facilities such as access and shoofly roads, airstrips, construction laydown areas, campsites, and borrow sites would require 2,565 acres.

Table 2.3-14: Land Requirements for the Alternative 2 Natural Gas Pipeline

	Construction Planning Corridor and Ancillary Facilities (acres)		Approximate Length (miles)	Percentage of Total Length
	300-foot Planning Corridor	Ancillary Facilities*		
Pipeline				
Federal (BLM)	3,537	709	97	30.7%
State	7,509	1,781	207	65.5%
ANCSA Corporation	425	73	12	3.8%
Total	11,471	2,562	316	100%

Notes:

*Includes access and shoofly roads, work pads, pipe storage yards, HDD workspace, water extraction sites, airstrips, material sites, and campsites. Includes entire footprint, including vegetation clearing areas. Estimated acres may be over-estimated due to overlapping components.

**Includes one acre for compressor station at MP 0.4.

Source: Donlin Gold 2017g

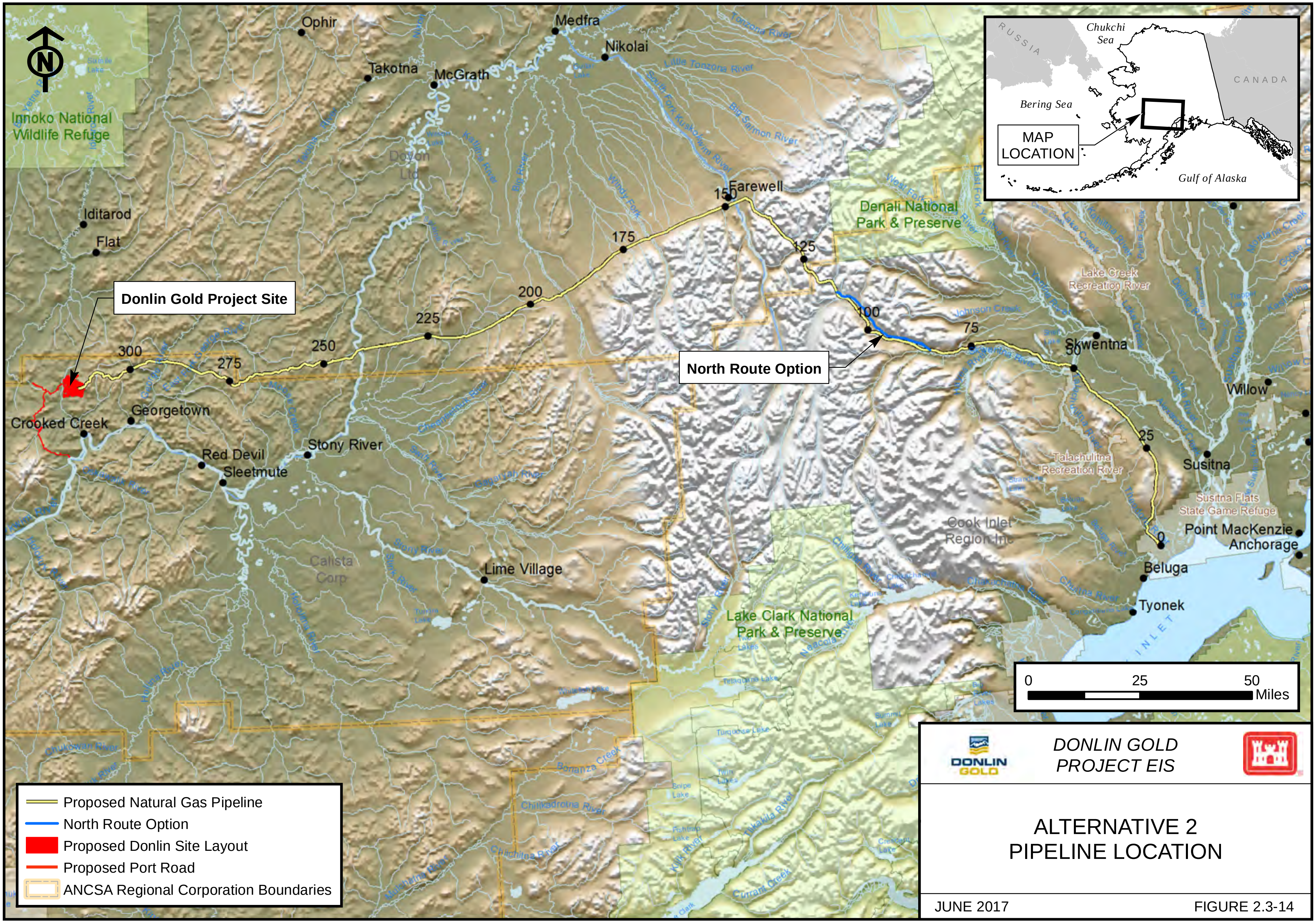
In addition to securing ROW approvals from the State of Alaska and BLM, Donlin Gold would secure ROW easements from private landowners, including ANSCA Corporations. All owners, tenants, and lessees of private land, and lessees and managers of public lands along the ROW would be notified in advance of construction activities that could affect their property, business, or operations. The pipeline ROW would not be an exclusive use ROW. Limitations on public use may be considered as mitigation but would need additional authorization and process by land management agencies.

ROW grants or leases would be necessary for the operation, maintenance, and decommissioning of the facilities. In addition, short-term ROWs would be required to accommodate construction activities, such as access roads and associated gates, material/equipment staging, geotechnical testing, and other short-term uses on those portions of the project on public land.

2.3.2.4.2 PIPELINE – FIBER OPTIC CABLE

A fiber optic link along the natural gas pipeline to Anchorage would be provided to the metering station at MP 0 (Figure 2.3-16) (metering stations measure the flow of natural gas). From the metering station, the fiber optic cable would be installed in the trench with the pipeline to the compressor station and then, except at the two fault crossings where the pipeline and cable would be above-ground, on to the Mine Site (buried within the proposed construction and operations ROW). Details regarding installation of the fiber optic cable would be completed during final design.

The fiber optic cable would be located within the permanent ROW. Following installation of the pipeline and within the same construction window, the fiber optic cable would be plowed into a narrow trench horizontally offset 2 to 10 feet from the pipeline.

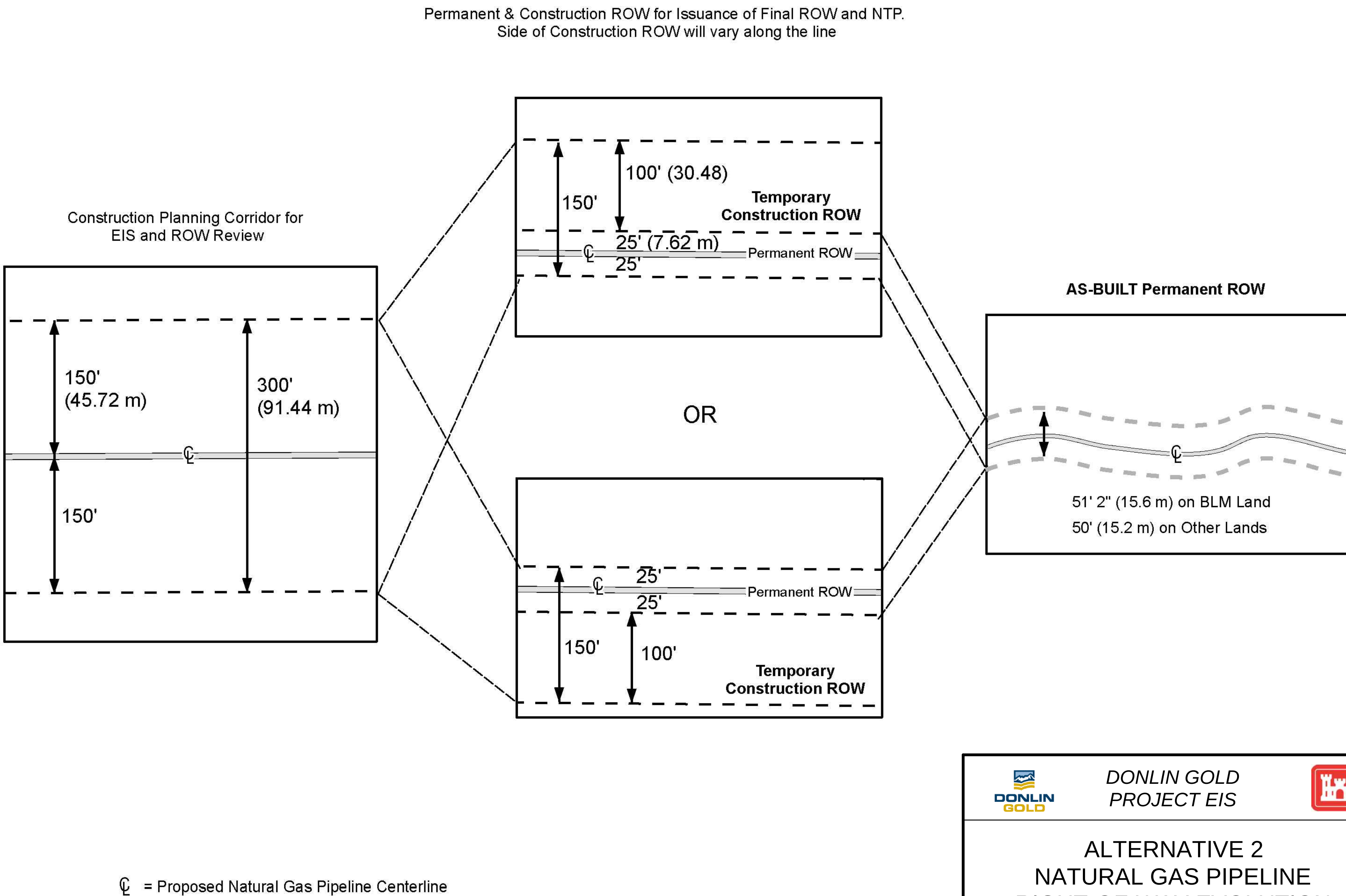


DONLIN GOLD PROJECT EIS

ALTERNATIVE 2
PIPELINE LOCATION

JUNE 2017

FIGURE 2.3-14

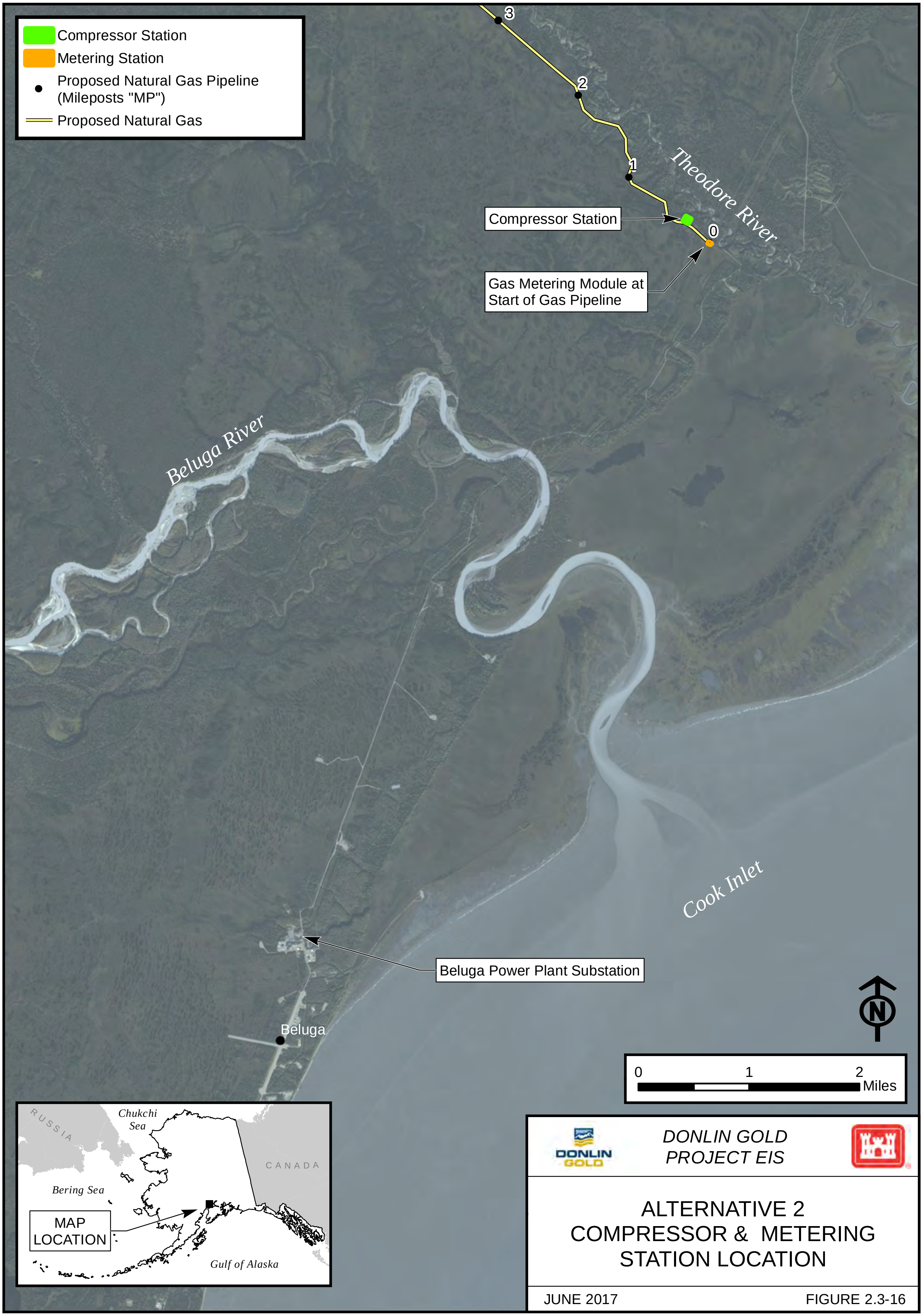


DONLIN GOLD
PROJECT EIS

ALTERNATIVE 2
NATURAL GAS PIPELINE
RIGHT-OF-WAY EVOLUTION

JUNE 2018

FIGURE 2.3-15



DONLIN GOLD PROJECT EIS

ALTERNATIVE 2
COMPRESSOR & METERING STATION LOCATION

JUNE 2017

FIGURE 2.3-16

2.3.2.4.3 PIPELINE – ABOVEGROUND FACILITIES

Above ground pipe and equipment would include: two approximately 1,300-foot, sections where the pipeline crosses the Castle Mountain and the Denali-Farewell faults, the compressor station near MP 0.4; the pig launcher and receiver station near Farewell; metering stations at the start and end of the pipeline; and above-ground piping and associated valves at the 16 remote MLVs located at no more than 20-mile intervals. The design also includes four additional MLVs associated with other facilities. MLVs can be closed to stop the flow of natural gas.

Compressor Station

The flow of natural gas through a pipeline causes friction, thereby increasing the pressure needed to efficiently move gas through the pipeline. Compressors are used to increase the pressure and keep the flow of natural gas moving through the pipeline at an appropriate rate. To meet the delivery requirements of 550 psig minimum pressure, one compressor station would be required. The approximately 1.5-acre facility would be located near MP 0.4 of the pipeline. The facility would be unmanned, with fully automated equipment operated by remote control. The workpad would be gravel, have a thickness of approximately 3 feet, and be approximately 240 feet by 272 feet in plan dimension (Figure 2.3-17). No provisions would be made for short- or long-term human occupancy at the site.

The compressor station would have two main components: natural gas powered compression machines with after-coolers provided to reduce gas temperature following the compression process, and electrical generation machinery. Three compressors of approximately 1,000 horsepower each would be used to deliver natural gas at different rates and pressures, depending on the fuel consumption demands of the mine project. Only two compressors would be required in order to meet current design flow conditions; the third would function as a backup compressor.

Electrical power would be generated at the compressor station and a buried electric transmission line would be run approximately 0.4 miles to the metering station at MP 0. Two microturbines would be used for electrical power generation (a 100% unit with a 100% backup) for the compressor station and metering station operations, station yard lighting, emergency lighting, and provide for emergency uninterrupted power.

Pipeline Launcher and Receiver Terminology

Pig *–a mechanical tool used to clean and/or inspect the interior of a pipeline.*

Pig launcher *– a facility on a pipeline for inserting and launching a pig.*

Pig receiver *– a piping arrangement whereby an incoming pig can be diverted into a receiving cylinder, isolated, and then removed.*

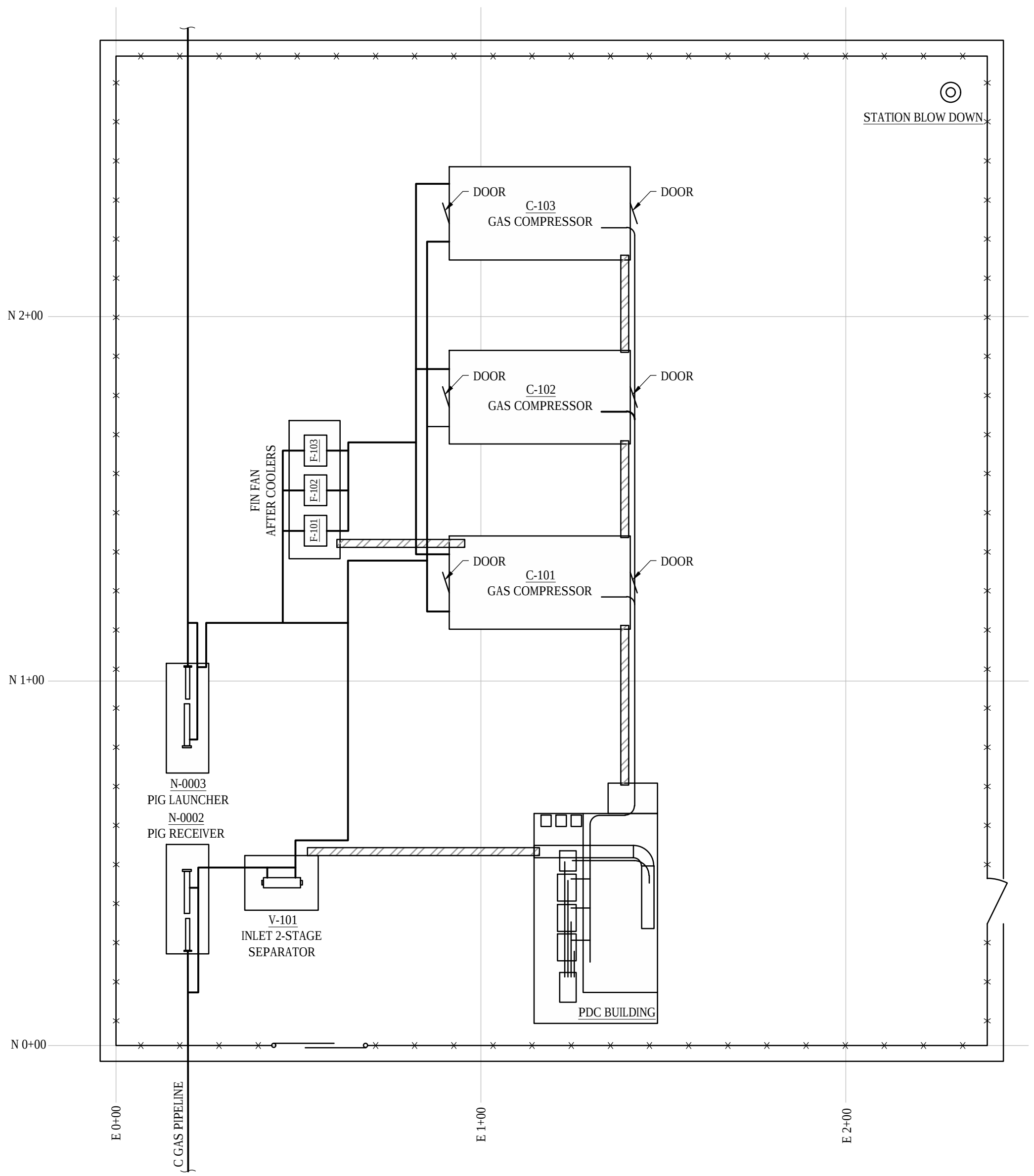
Pig Launcher and Receiver Station

Pig launcher and receiver barrels would be designed to be able to launch or receive both maintenance and in-line smart pigs. A pig launcher assembly with a compact footprint would be located at the start of the pipeline (MP 0). The launcher barrel would be configured for above-grade, permanent installation. The compressor station (MP 0.4) would have one set of standard design receiver and launcher assemblies. A midpoint receiver / launcher facility would be located near Farewell (MP 156), and the terminus of the pipeline at the Mine Site would have a pig receiver. The Farewell facility would be accessed by helicopter from the Farewell Airstrip (see Figure 2.3-18).

All of the pigging launcher and receiver sites include above-ground piping, valves, and valve controls as shown on Figure 2.3-19. The valves, valve controls, and the pig launcher and receiver doors at each location would be fitted with locks. Each launcher or receiver would have a trolley structure above the end of the barrel for hoisting the pigs into and out of the barrels. The pigging launcher and receiver sites are within above-ground facilities already proposed for use for other pipeline / project components, except the site near Farewell (MP 156). The pigging launcher and receiver site near Farewell would be approximately 0.2 acres (8,712 square feet [sf]). All these facility sites would be fenced, with sliding gates and locks to provide security.

Metering Stations

Metering stations (to measure the volume of gas) would be located at the pipeline tie-in (MP 0) and at the terminus (MP 316). The station at the Mine Site would include limited above-ground piping and a module that would house the metering equipment as shown on Figure 2.3-20. The pipeline terminus pad would be 100 feet by 100 feet and would have locking man-doors. The tie-in location at MP 0 would be 120 feet by 53 feet, fenced, with a sliding gate and lock.



SITE INFORMATION

FENCE LINE: 240'-0" x 272'-0"
AREA: APPROX 1.5 ACRES

NOTES:

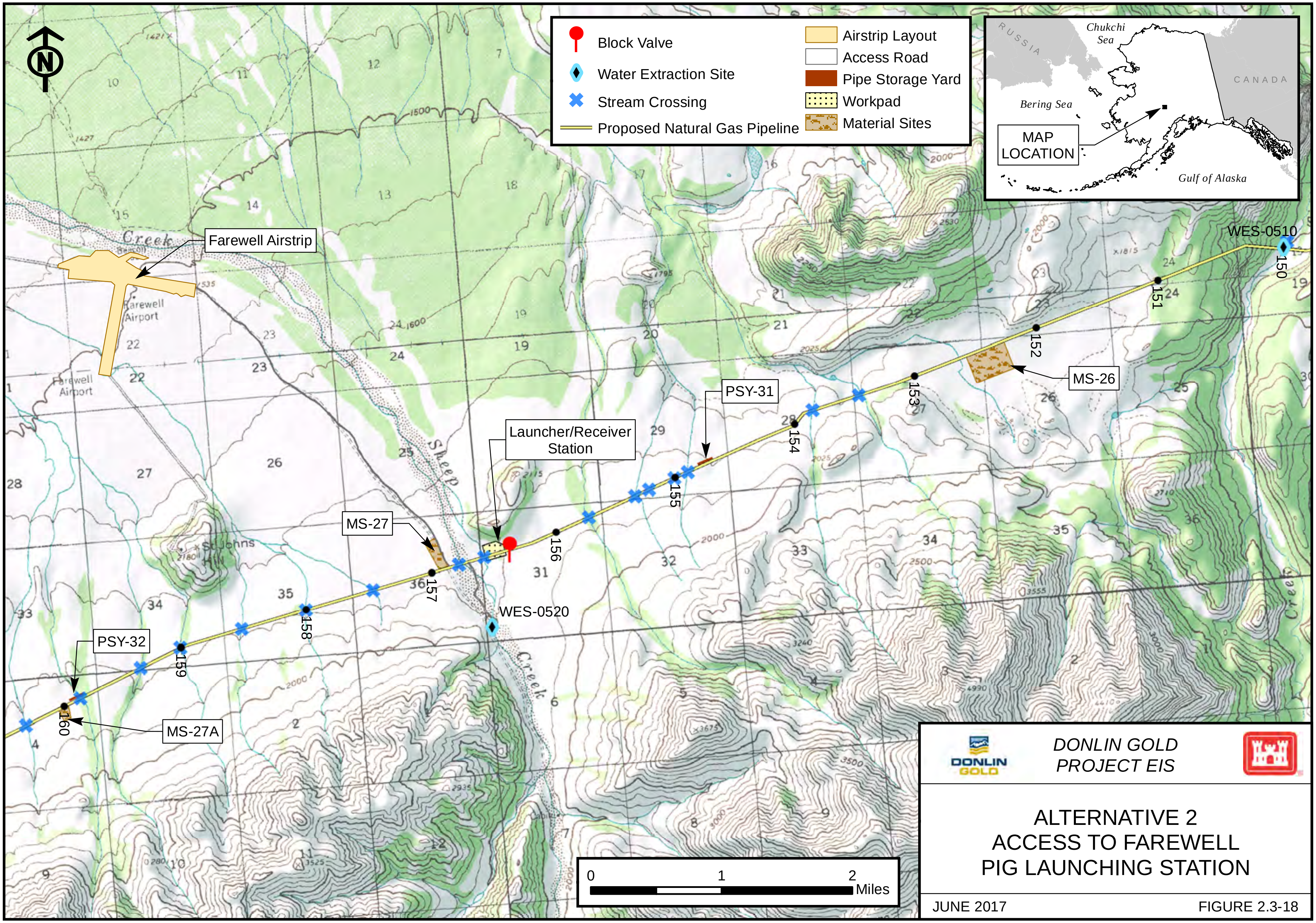
1. NO PROVISIONS MADE FOR TEMPORARY OR PERMANENT HUMAN OCCUPANCY.

DONLIN GOLD PROJECT EIS

ALTERNATIVE 2
COMPRESSOR STATION
SITE PLAN

JUNE 2017

FIGURE 2.3-17

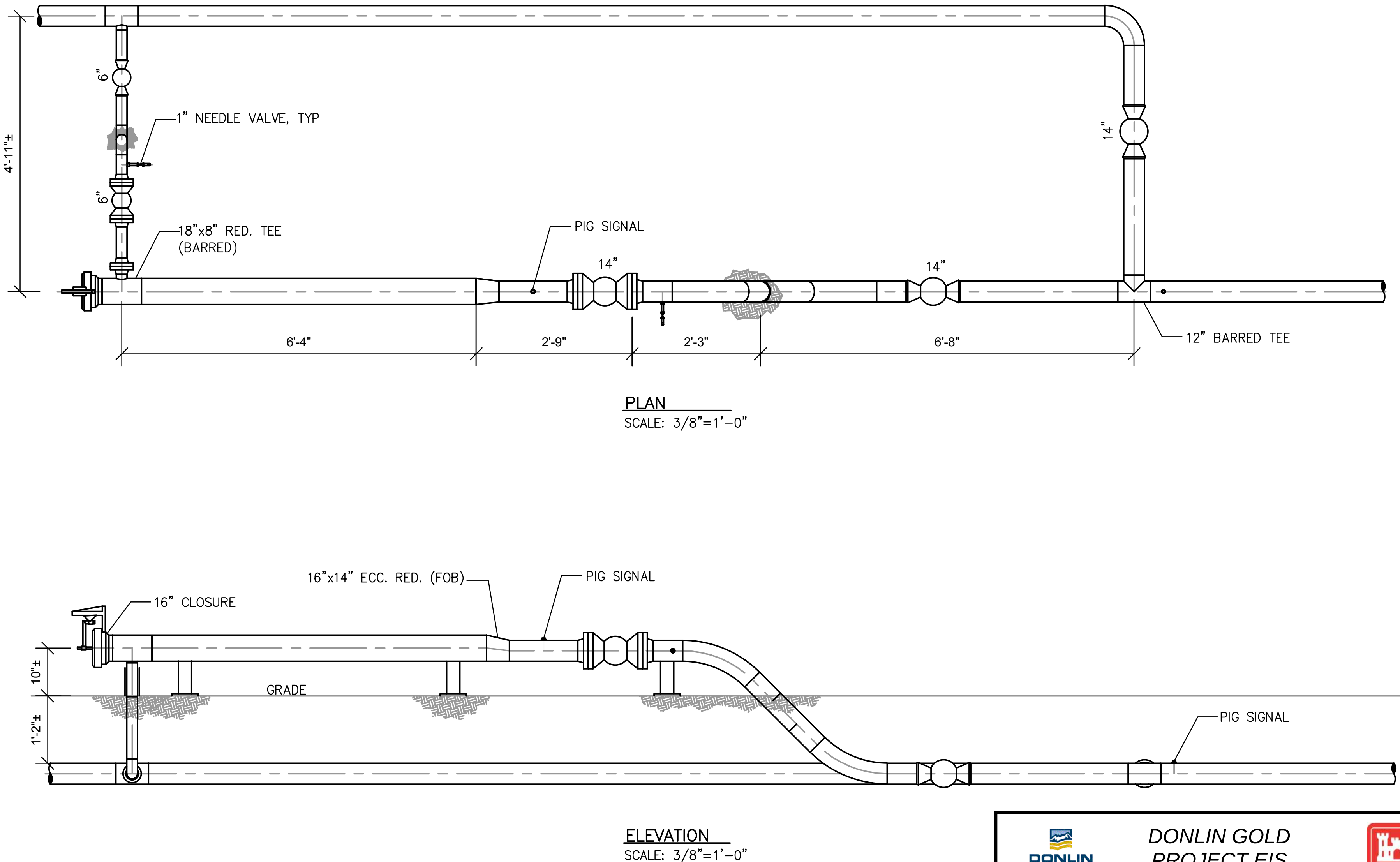


DONLIN GOLD PROJECT EIS

ALTERNATIVE 2
ACCESS TO FAREWELL
PIG LAUNCHING STATION

JUNE 2017

FIGURE 2.3-18



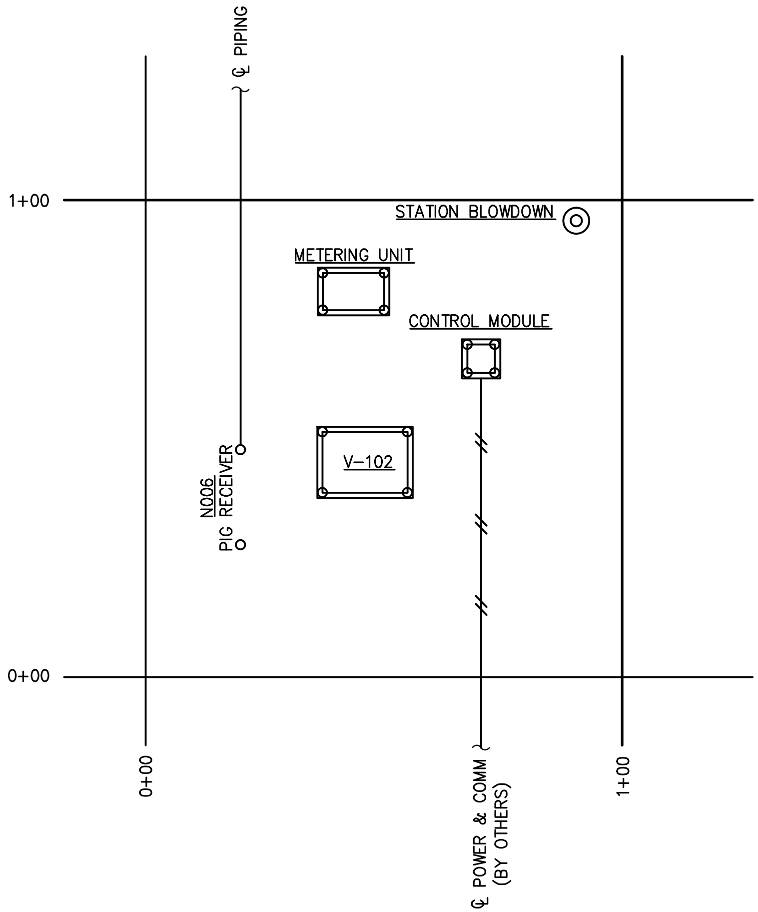
DONLIN GOLD

DONLIN GOLD
PROJECT EIS

ALTERNATIVE 2
TYPICAL PIG LAUNCHER

JUNE 2017

FIGURE 2.3-19



UNITS AND WEIGHTS:

PAD: 100'–0" x 100'–0"
AREA: APPROX. 0.25 ACRES

UNITS AND WEIGHTS:

STATION BLOWDOWN 30'x12'
PIG RECEIVER: 2500 LBS PIPING 1000 LBS RECEIVER DOOR
V–102 20'x15' PLATFORM
METERING UNIT 10'x15'x13' TALL
CONTROL MODULE 8'x8'

DONLIN GOLD
PROJECT EIS

ALTERNATIVE 2
TYPICAL METERING STATION

JUNE 2017

FIGURE 2.3-20

Mainline Valves

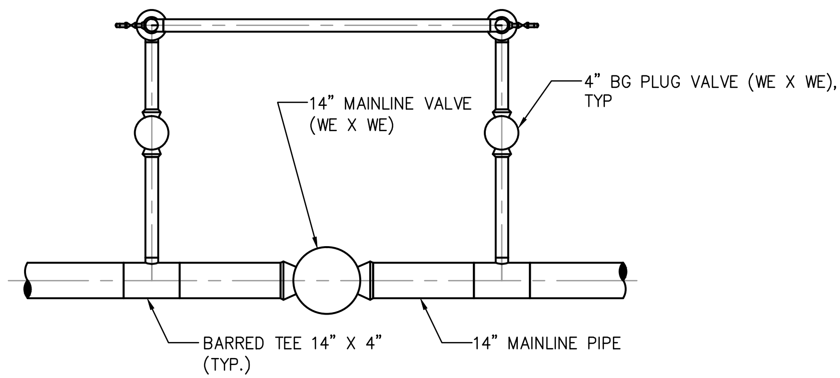
MLVs would be placed at intervals of no more than 20 miles along the length of the pipeline. A total of 20 MLVs would be installed at locations identified in Table 2.3-15. As described in Section 2.3.3.2, MLVs can be closed during a pipeline leak to minimize loss of contents.

Four of the valves would be located with other facilities: the Beluga Pipeline (BPL) tie-in, the compressor station, the Farewell pig launcher/receiver site, and the pipeline terminus at the Mine Site. Three of these, located at the Beluga Pipeline (BPL) tie-in, the compressor station, and the pipeline terminus, would function as emergency shutdown (ESD) valves, and would be able to be remotely and/or automatically operated by a Supervisory Control and Data Acquisition (SCADA) system. These ESD valves could also be manually operated by the activation of an ESD switch at any of the three sites by an on-site operator if necessary. Figure 2.3-21 shows a typical MLV assembly.

Table 2.3-15: Mainline Valve Location Summary

No.	TAG	Approximate MP
1	MLV-01	0.00
2	MLV-02	0.43
2A	MLV-2A	11.89
3	MLV-03	26.78
4	MLV-04	45.78
5	MLV-05	64.82
6	MLV-06	84.82
7	MLV-07	101.80
8	MLV-08	120.86
9	MLV-09	137.06
10	MLV-10	155.94
11	MLV-11	175.39
12	MLV-12	195.04
13	MLV-13	214.32
14	MLV-14	231.33
15	MLV-15	251.33
16	MLV-16	271.33
17	MLV-17	291.32
18	MLV-18	303.33
19	MLV-19	315.19

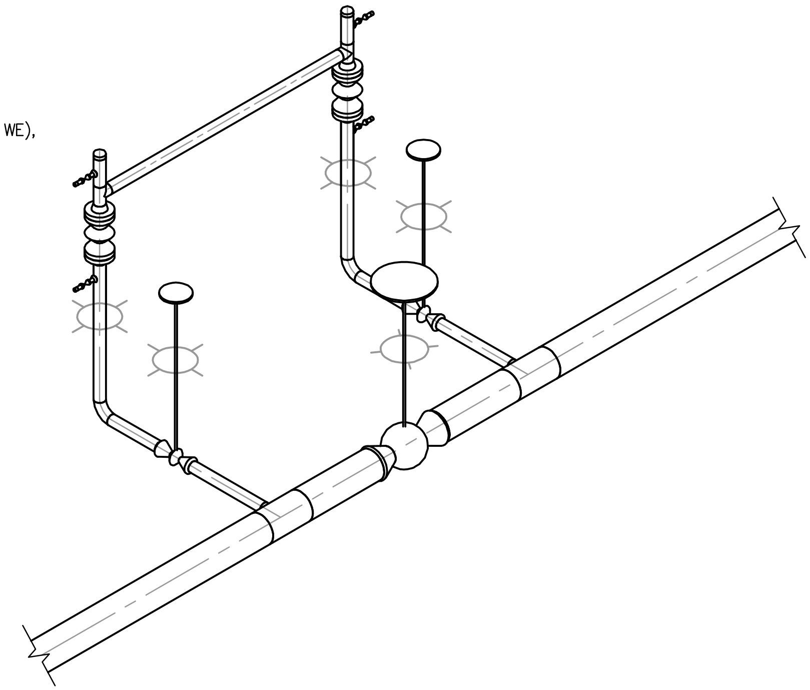
Source: SRK 2013b.

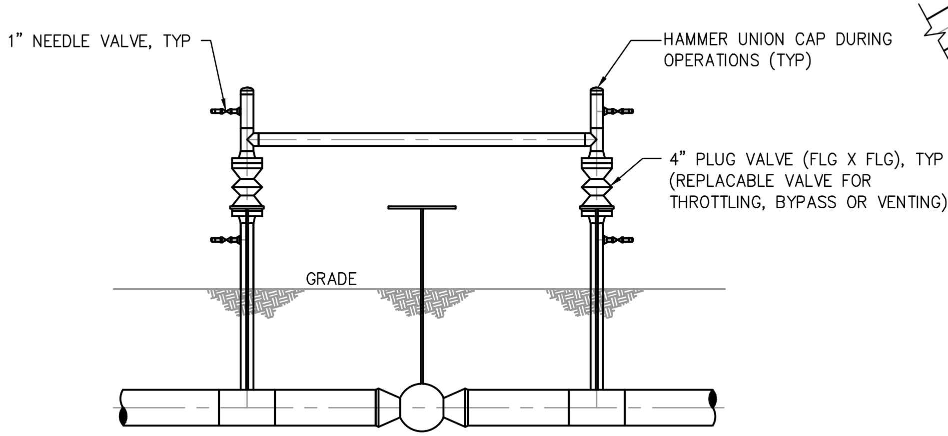


(HANDWHEELS NOT SHOWN FOR CLARITY)

PLAN

SCALE: 1/2"=1'-0"





ELEVATION

SCALE: 1/2"=1'-0"

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ALTERNATIVE 2
TYPICAL MAIN LINE BLOCK VALVE

JUNE 2017

FIGURE 2.3-21

The remaining 16 block valve locations not associated with other pipeline facilities would consist of valve operators, small-bore piping, and associated valves above-ground. All of these valves would be manually operated and fitted with locks and a signpost similar to the pipeline MP markers. These 25 X 25 foot (625 sf) block valve sites would be fenced and have sliding gates with locks; no structures are planned for these sites. The specific locations of these 16 block valves would be determined during the final pipeline design process.

2.3.2.4.4 PIPELINE – TEMPORARY WORK AREAS OUTSIDE OF RIGHT-OF-WAY

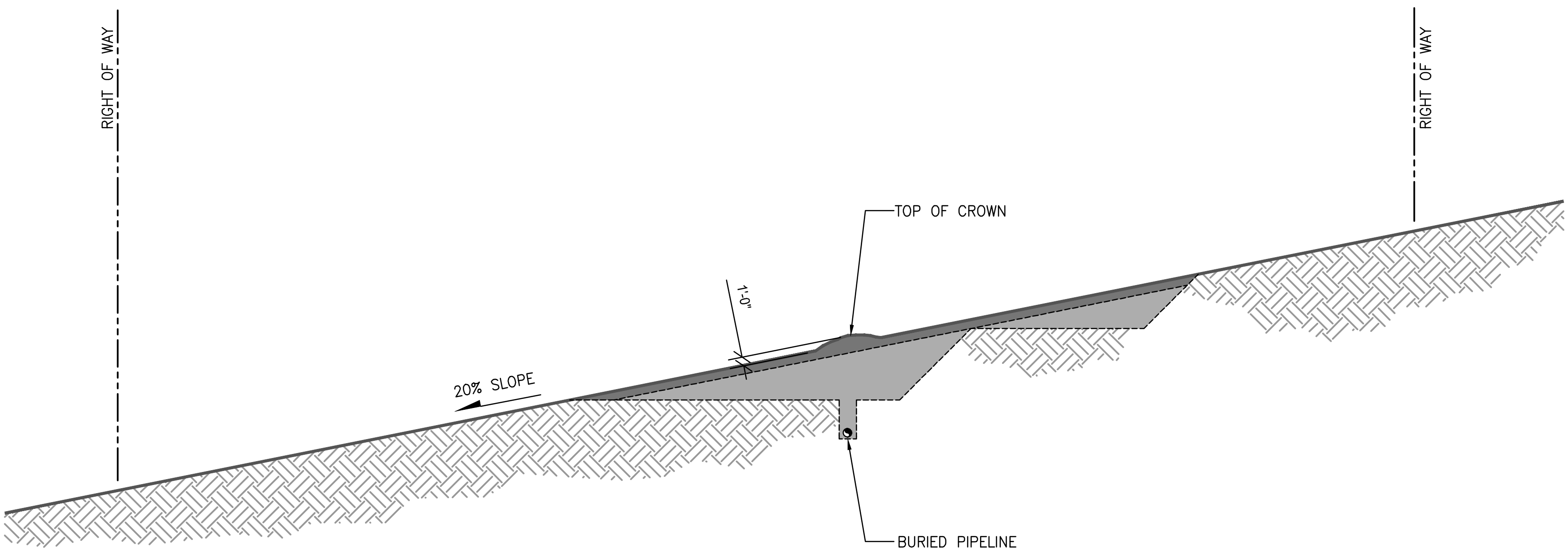
Donlin Gold would clear temporary extra workspace as required outside of the authorized 150-foot construction corridor. Temporary extra workspaces would be required at:

- Stream and river crossings, and high banks at ravines where earth cuts are required;
- Areas where pipe is being installed using HDD methods, to accommodate extra equipment;
- Sidebends;
- The beginning and end of each construction spread for spread mobilization and demobilization;
- Stringing truck turnaround areas;
- Other areas where extra space for spoil storage and construction activities are necessary;
- Areas of sideslopes where grade cuts are required to create a level work surface across the width of the ROW (the extra width needed for the cuts and/or the fills) as shown on Figure 2.3-22;
- Areas where a high water table would undermine trench walls, creating an extra-wide trench and larger spoil piles (for instance, in a gravel floodplain);
- On steep grades or for shoofly access roads, which are temporary roads used around such grades; and
- Pipe laydown areas.

Detailed maps depicting locations and areas of all temporary work spaces are provided in Appendix D. Additional details on temporary work areas are provided in SRK (2013b).

During pipeline construction, additional areas for construction camps, pipeline and construction material storage yards, material source sites and airstrips would also be required (see Appendix D). These facilities requiring upgrading or new construction would be constructed before initiation of pipeline construction. Ancillary facilities that are currently being used or planned for use by Donlin Gold and others would require negotiations and leases or use agreements. These facilities are included in the estimates of area to be cleared and the acreage totals shown in Table 2.3-14 above.

In addition to the temporary work areas, temporary access roads would be required during Construction, and these are included in this analysis. These include a winter access corridor (ice road) and gravel temporary and shoofly roads. Many of the temporary access roads lead to water extraction sites. Water use and potential extraction sites are also discussed in this section.



RECLAIMED RIGHT OF WAY
NOT TO SCALE

DONLIN GOLD
DONLIN GOLD
PROJECT EIS

ALTERNATIVE 2
TYPICAL SIDE SLOPE SECTION

JUNE 2017

FIGURE 2.3-22

Winter Access Corridor

Donlin Gold proposes to develop an approximately 46- to 50-mile long, 30-foot wide winter access corridor to transport equipment and supplies for a period of approximately three years from the Parks Highway via Petersville Road or at Willow via the Willow Creek Parkway (Figure 2.3-23). The estimated maximum usage of the road would be 135 days / year for up to three years (December through mid-April). Each of the two route options has been determined to be viable and the majority of each route has previously been utilized as commercial / industrial winter trails to support oil and gas exploration, mineral exploration and development, as well as materials and fuel transport for the numerous lodges and commercial activities in the Yentna River and Skwentna River drainages. Since each route has distinct advantages depending on specific winter snow and ice conditions, and likely, but undetermined future use by other parties, it is appropriate to carry forward two primary route options. The 46-mile long northern route alternative is identified as the “Oilwell Road Route” (OWRR). The 50-mile long southern route is identified as the “Willow Landing Route” (WLR). Each primary route includes several spur options (secondary routes) which provide for access to the pipeline corridor at several different locations. In addition each of the primary routes share the same corridor for the final approximately 12 miles approaching the pipeline corridor at its crossing of the Skwentna River (approximately MP 50). Ultimately, the project would utilize one of the primary routes and each of the spur routes that access MP 32 and MP 43. A map of proposed winter construction access route options is provided on Figure 2.3-23.

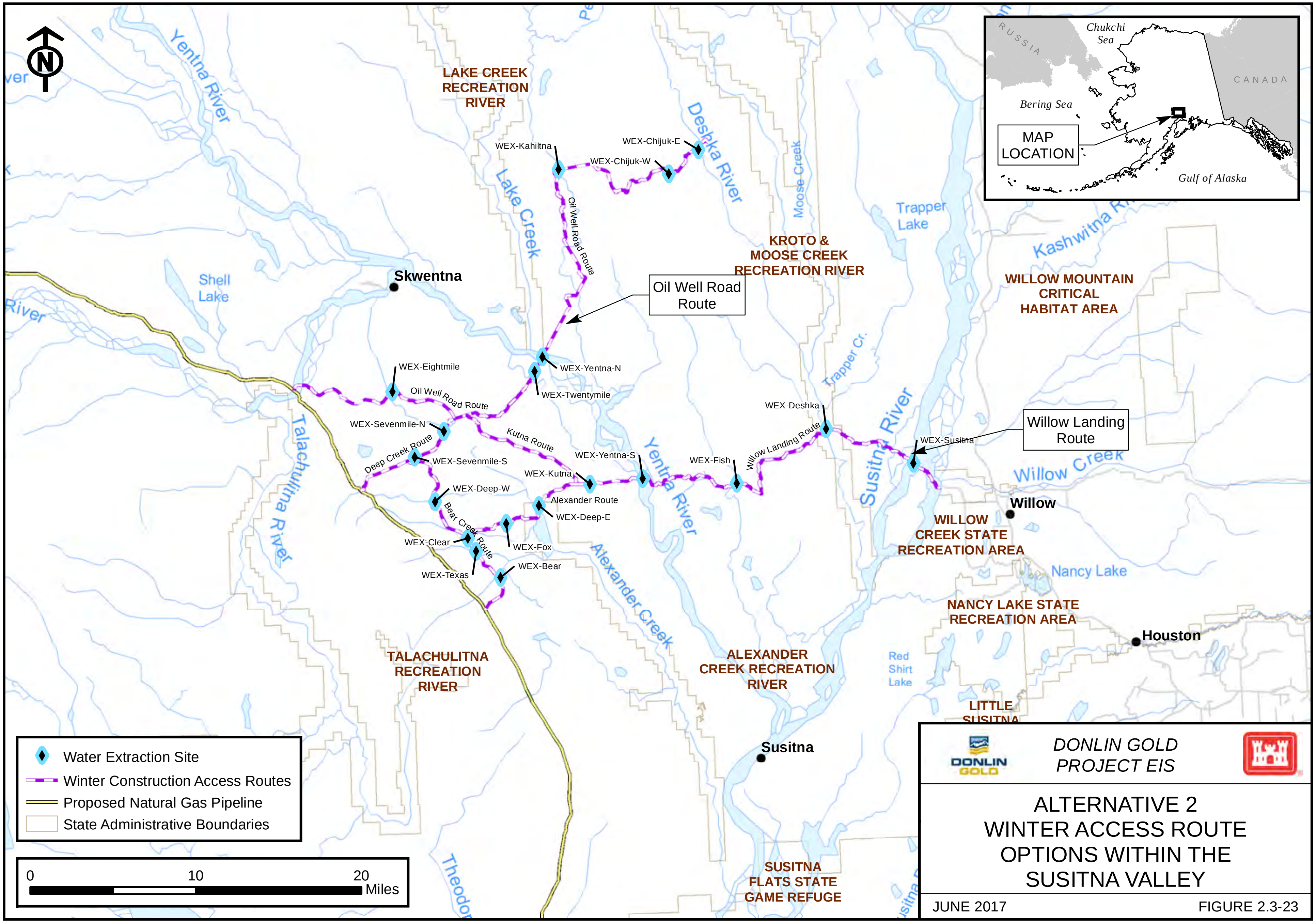
Clearing along the route chosen would begin in the winter prior to pipeline construction as soon as the ground becomes sufficiently frozen to support the weight of equipment. Clearing would be done using tracked or wheeled hydro-axes and feller / bunchers to remove above-ground portions of vegetation while leaving the root systems in place. This will reduce the impact to soils and allow shrubby and herbaceous vegetation to recover quickly, minimizing erosion or long-term vegetation loss. Maintenance of the winter access ROW would occur only during the winter months by packing, watering, and grading the snow and ice surface.

Table 2.3-16 summarizes the details regarding the potential winter access routes shown on Figure 2.3-23. Additional details on winter access roads are provided in SRK (2013b).

Table 2.3-16: Winter Access Routes within Susitna Valley

Name	Nearest Milepost (MP)	Length	Class	Season of Use		
				Summer	Winter	All Season
Big Bend Trail	MP 32	26.54 miles	Construction Access		X	
Bear Creek Route	MP 32	13.13 miles	Construction Access		X	
Deep Creek Route	MP 43	7.81 miles	Construction Access		X	
Oil Well Road Route	MP 50	45.61 miles	Construction Access		X	
Kutna Route	MP 38	12.23 miles	Construction Access		X	
Alexander Route	MP 36	8.68 miles	Construction Access		X	

Notes:
MP = milepost
Source: SRK 2013b.



ALTERNATIVE 2
WINTER ACCESS ROUTE OPTIONS WITHIN THE SUSITNA VALLEY

JUNE 2017

FIGURE 2.3-23

Water Use and Potential Water Extraction Sites

Anticipated water needs and water extraction locations for the winter use corridor are provided in Table 2.3-17 and depicted on Figure 2.3-23. Estimated annual water use requirements during Construction from other sources are shown in Table 2.3-18.

Table 2.3-19 shows the specific water requirements for each HDD crossing; locations of these water extraction sites are provided in Appendix D. Final estimated quantities for specific uses would be determined during final design. Water required for camp use during Construction would be supplied from wells or clean water sources and would be piped or trucked to a water treatment facility. There would also be water storage at each camp for fire suppression. Water would also be needed for other uses including ice road construction, dust control, reclamation and hydrostatic testing and HDD operations. Water withdrawal from lakes and streams would be planned and executed in accordance with the requirements of the appropriate permits and authorizations. Temporary water use authorizations would be applied for by either the appropriate contractor or Donlin Gold.

Table 2.3-17: Susitna Valley Winter Access Potential Water Extraction Sites for Ice Road Construction[1]

Water Extraction Site Name	Route	Season of Use			Water Body Type	Years of Use	Extraction	
		Summer	Winter	All Season			Rate (gpm)	Annual Volume (gal)
WEX-Texas	Bear Creek Route		x		Creek	2	500	1,500,000
WEX-Bear	Bear Creek Route		x		Creek	2	500	2,400,000
WEX-Susitna	Big Bend Trail		x		River	2	500	3,600,000
WEX-Deshka	Big Bend Trail		x		River	2	500	3,600,000
WEX-Fish	Big Bend Trail		x		Creek	2	500	4,200,000
WEX-Yentna-S	Big Bend Trail		x		River	2	500	4,200,000
WEX-Eightmile	Oil Well Road Route		x		Creek	2	500	4,800,000
WEX-Kutna	Big Bend Trail		x		Creek	2	500	2,400,000
WEX-Clear	Bear Creek Route		x		Creek	2	500	2,400,000
WEX-Deep-W	Bear Creek Route		x		Creek	2	500	3,000,000

Table 2.3-17: Susitna Valley Winter Access Potential Water Extraction Sites for Ice Road Construction[1]

Water Extraction Site Name	Route	Season of Use			Water Body Type	Years of Use	Extraction	
		Summer	Winter	All Season			Rate (gpm)	Annual Volume (gal)
WEX-Sevenmile-N	Deep Creek Route		x		Creek	2	500	1,800,000
WEX-Twentymile	Oil Well Road Route		x		Slough	2	500	4,800,000
WEX-Yentna-N	Oil Well Road Route		x		River	2	500	4,800,000
WEX-Kahiltna	Oil Well Road Route		x		River	2	500	7,800,000
WEX-Chijuk-E	Oil Well Road Route		x		Tributary	2	500	2,400,000
WEX-Chijuk-W	Oil Well Road Route		x		Tributary	2	500	5,400,000
WEX-Deep-E	Alexander Route		x		Creek	2	500	2,100,000
WEX-Fox	Alexander Route		x		Creek	2	500	2,100,000
WEX-Sevenmile-S	Deep Creek Route		x		Tributary	2	500	2,700,000

Notes:

gal = gallons
gpm = gallons per minute
MP = milepost
1 Extraction locations are provided on Figure 2.3-23.
Source: SRK 2013b

Table 2.3-18: Potential Water Extraction Sites for Pipeline Construction[1]

Water Extraction Site Name	Nearest Milepost (MP)	Season of Use			Water Body Type	Years of Use	Extraction	
		Summer	Winter	All Season			Rate (gpm)	Annual Volume (gal)
WES-0010	MP 0		X		River	1	500	3,430,000
WES-0020	MP 5		X		River	1	500	3,860,000
WES-0030	MP 10		X		Pond	1	500	500,000
WES-0031	MP 9		X		Pond	1	500	500,000
WES-0040	MP 12		X		Tributary	1	100	50,000
WES-0050	MP 14		X		Tributary	1	100	50,000
WES-0060	MP 17		X		Creek	1	500	1,200,000
WES-0070	MP 19		X		Tributary	1	500	1,200,000
WES-0080	MP 21		X		Tributary	1	500	1,200,000
WES-0085	MP 23		X		Creek	1	100	500,000
WES-0090	MP 26		X		Creek	1	250	1,200,000
WES-0095	MP 27		X		Creek	1	250	1,600,000
WES-0096	MP 29		X		Creek	1	500	1,200,000
WES-0100	MP 30		X		Tributary	1	100	1,200,000
WES-0110	MP 33		X		Creek	1	500	1,800,000
WES-0115	MP 35		X		Creek	1	500	1,200,000
WES-0120	MP 37		X		Creek	1	500	1,200,000
WES-0130	MP 39		X		Tributary	1	500	1,200,000
WES-0140	MP 39		X		Creek	1	500	1,200,000
WES-0145	MP 41		X		Creek	1	500	1,200,000
WES-146	MP 42		X		Creek	1	500	1,930,000
WES-0150	MP 43		X		Creek	1	500	1,200,000
WES-0160	MP 45		X		Creek	1	250	1,200,000
WES-165	MP 47		X		Pond	1	500	600,000
WES-0170	MP 48		X		Pond	1	500	1,200,000
WES-0180	MP 50		X		River	2	600	5,265,000
WES-0190	MP 53		X		Creek	2	500	900,000
WES-0200	MP 53		X		Creek	2	500	1,200,000
WES-0210	MP 56		X		River	2	500	1,200,000
WES-0220	MP 56		X		Pond	2	500	1,200,000
WES-0230	MP 59		X		Stream	2	500	1,200,000
WES-235	MP 62		X		Stream	2	500	1,200,000
WES-0240	MP 63		X		Stream	2	500	1,200,000
WES-0245	MP 64		X		Stream	2	500	1,200,000
WES-0255	MP 66		X		Stream	2	500	1,200,000
WES-0260	MP 68		X		Stream	2	100	100,000
WES-0265	MP 72		X		Stream	2	250	1,200,000
WES-0270	MP 73		X		Pond	2	500	1,200,000
WES-0275	MP 75		X		Stream	2	500	1,200,000
WES-0276	MP 75		X		Stream	2	500	1,200,000
WES-0280	MP 79		X		Creek	2	500	1,200,000
WES-0290	MP 81		X		Creek	2	500	1,200,000

Table 2.3-18: Potential Water Extraction Sites for Pipeline Construction[1]

Water Extraction Site Name	Nearest Milepost (MP)	Season of Use			Water Body Type	Years of Use	Extraction	
		Summer	Winter	All Season			Rate (gpm)	Annual Volume (gal)
WES-0300	MP 84		X		Pond	2	500	1,200,000
WES-0310	MP 86		X		River	2	600	5,475,000
WES-0320	MP 88		X		Lake	2	500	2,000,000
WES-0330	MP 90		X		Lake	2	500	3,000,000
WES-0340	MP 95		X		Creek	2	500	2,400,000
WES-0350	MP 99		X		Creek	2	250	1,200,000
WES-0360	MP 101		X		Creek	2	500	1,200,000
WES-0370	MP 103		X		Creek	2	500	3,000,000
WES-0380	MP 106		X		Creek	2	500	1,200,000
WES-0410	MP 108		X		River	2	600	1,425,000
WES-0418	MP 112	X	X	X	Stream	2	500	2,210,000
WES-0419	MP 112	X	X	X	Creek	1	500	100,000
WES-0420	MP 114	X			Tributary	1	500	100,000
WES-0425	MP 116	X			Tributary	1	500	100,000
WES-0430	MP 120	X			Tributary	1	500	100,000
WES-0435	MP 120	X			Tributary	1	500	100,000
WES-0438	MP 121	X			Tributary	1	500	100,000
WES-0440	MP 123	X			Creek	1	500	100,000
WES-0445	MP 125	X			Tributary	1	500	100,000
WES-0447	MP 126	X			Tributary	1	500	100,000
WES-0450	MP 127	X			River	1	500	3,000,000
WES-0460	MP 130	X			Pond	1	500	150,000
WES-0462	MP 131	X			River	1	500	150,000
WES-0464	MP 132	X			Tributary	1	500	600,000
WES-0466	MP 133	X			Tributary	1	500	150,000
WES-0468	MP 134	X			Spring	1	500	150,000
WES-0470	MP 137	X			River	1	500	150,000
WES-0475	MP 137	X			River	1	500	150,000
WES-0480	MP 140	X			Tributary	1	500	150,000
WES-0490	MP 145	X	X	X	Tributary	2	500	1,355,000
WES-0500	MP 146		X		River	2	500	4,075,000
WES-0505	MP 148		X		Tributary	2	500	1,800,000
WES-0510	MP 150		X		Creek	2	500	1,200,000
WES-0520	MP 156		X		Creek	2	500	2,400,000
WES-0530	MP 161		X		Creek	2	500	1,800,000
WES-0540	MP 164		X		Creek	2	500	1,800,000
WES-0545	MP 167		X		Pond	2	500	1,800,000
WES-0550	MP 168		X		River	2	500	4,290,000
WES-0560	MP 171		X		Creek	2	100	100,000
WES-0570	MP 174		X		Creek	2	100	100,000
WES-0575	MP 174		X		Creek	2	500	2,400,000
WES-0580	MP 177		X		Creek	2	100	100,000

Table 2.3-18: Potential Water Extraction Sites for Pipeline Construction[1]

Water Extraction Site Name	Nearest Milepost (MP)	Season of Use			Water Body Type	Years of Use	Extraction	
		Summer	Winter	All Season			Rate (gpm)	Annual Volume (gal)
WES-0590	MP 179		X		Creek	2	100	100,000
WES-0595	MP 180		X		Creek	2	500	2,400,000
WES-0600	MP 183		X		River	2	500	4,290,000
WES-0610	MP 185		X		Creek	2	500	4,290,000
WES-0615	MP 186		X		Pond	2	500	1,200,000
WES-0620	MP 188		X		Pond	2	500	1,200,000
WES-0625	MP 189		X		Pond	2	500	1,200,000
WES-0630	MP 191		X		River	2	500	5,290,000
WES-0640	MP 193		X		Pond	2	500	3,000,000
WES-0650	MP 197		X		Pond	2	500	3,000,000
WES-0660	MP 198		X		Pond	2	500	3,000,000
WES-0670	MP 205		X		Creek	2	250	250,000
WES-0680	MP 208		X		Creek	2	100	250,000
WES-0690	MP 211		X		Creek	2	250	250,000
WES-0710	MP 217		X		River	2	500	4,675,000
WES-0715	MP 219		X		Creek	2	500	1,200,000
WES-0720	MP 221		X		Creek	2	500	1,200,000
WES-0730	MP 224		X		Creek	2	500	1,800,000
WES-0740	MP 227		X		Creek	2	100	100,000
WES-0750	MP 227		X		Creek	2	500	1,800,000
WES-0760	MP 232		X		Creek	2	500	3,750,000
WES-0770	MP 239	X	X	X	Creek	2	500	5,490,000
WES-0780	MP 245	X	X	X	Tributary	2	500	50,000
WES-0790	MP 241	X	X	X	Creek	1	600	975,000
WES-0800	MP 243	X	X	X	Creek	1	500	50,000
WES-0810	MP 245	X	X	X	Creek	1	250	500,000
WES-0815	MP 249	X			Creek	1	500	200,000
WES-0816	MP 256	X			Creek	1	500	1,790,000
WES-0820	MP 270	X			Creek	1	500	500,000
WES-0830	MP 283	X			River	1	600	2,745,000
WES-0835	MP 286	X			Creek	1	500	350,000
WES-0836	MP 288	X			Creek	1	500	100,000
WES-0840	MP 291	X			River	1	600	850,000
WES-0850	MP 298	X			River	1	600	2,925,000

Notes:

gal = gallons
gpm = gallons per minute
MP = milepost
WES = water extraction site
1 Extraction locations are provided in Appendix D

Source: SRK 2013b

Table 2.3-19: HDD Estimated Water Use

HDD Crossing Name	Length	Estimated Total Water Requirement (gal)	Estimated Total Volume Solids/Cuttings Needing Disposal (cy)	Estimated Total Volume of Drilling Mud for Disposal (gal)
Skwentna River	2,981 ft	350,000-375,000	250-260	180,000-200,000
Happy River	3,453 ft	450,000-500,000	280-290	240,000-260,000
Kuskokwim River	7,101 ft	900,000-925,000	590-600	440,000-460,000
East Fork George River	4,532 ft	500,000-525,000	375-385	250,000-270,000
George River	2,957 ft	325,000-350,000	245-255	160,000-180,000
North Fork George River	3,281 ft	425,000-450,000	270-280	220,000-240,000

Notes:

cy = cubic yards
gal = gallons

Source: SRK 2013b

Temporary Access Roads and Shoofly Roads

Temporary site access and shoofly roads would be required for airstrips, borrow material sites, water withdrawal sites, and other authorized temporary use areas such as pipeline storage yards. A shoofly road is defined as an access road to the pipeline construction ROW or along the ROW to provide continuous access where the ROW is too steep for pipe stringing trucks and personnel carriers.

Temporary gravel access roads would be a maximum of 24 feet wide, with culverts installed as necessary to facilitate surface water flow. Road shoulders surrounding culverts would be lined with rip-rap (or equivalent per the erosion and sediment control plan). Table 2.3-20 identifies planned temporary access roads and the corresponding pipeline MP. The temporary roads would total about 16.5 miles in length and would encompass just under 49 acres. In addition to these roads, 75 shoofly roads ranging from 0.09 miles to 6.91 miles in length and totaling about 77 miles and 224.6 acres would be needed. Reclamation of these roads is described in Section 2.3.2.4.6.

Table 2.3-21 provides details on the location, season of use, and approximate length and acreage of each planned shoofly road. Assuming a maximum width of 24 feet, these shoofly roads would temporarily cover 224.6 acres.

Table 2.3-20: Access Road Identification[1]

Name	Mile Post	Length (miles)	Acres*	Description	Winter	Summer	All Season
Public Road Access	0			Existing access from Beluga Airport to MP 0	X	X	X
Public Road Access	0			Existing Pretty Creek Road	X	X	X
AWES-0030	10	0.43	1.25	Water Extraction Site Access	X		
AWES-0031	10	0.23	0.67	Water Extraction Site Access	X		
AWES-0080	21	0.82	2.38	Water Extraction Site Access	X		
AWES-0085	22	0.46	1.33	Water Extraction Site Access	X		
AWES-0115	35	1.52	5.38	Water Extraction Site Access	X		
AWES-0140	39	0.85	2.47	Water Extraction Site Access	X		
AWES-0165	47	0.10	0.29	Water Extraction Site Access	X		
AWES-0170	48	0.33	0.96	Water Extraction Site Access	X		
AWES-0190	53	0.11	0.52	Water Extraction Site Access	X		
AWES-0210	56	0.05	0.15	Water Extraction Site Access	X		
AWES-0220	56	0.32	1.48	Water Extraction Site Access	X		
AMS-11	56	0.87	2.52	Material Site Access			
AWES-0245	64	0.08	0.23	Water Extraction Site Access	X		
AWES-0270	73	0.16	0.46	Water Extraction Site Access	X		
AWES-0300	84	0.12	0.35	Water Extraction Site Access	X		
AWES-0310	86	0.09	0.26	Water Extraction Site Access	X		
AWES-0320	88	0.10	0.29	Water Extraction Site Access	X		
AWES-0330	90	0.13	0.38	Water Extraction Site Access	X		
AWES-0350	99	0.06	0.17	Water Extraction Site Access	X		
AWES-0380	106	0.26	0.75	Water Extraction Site Access	X		
AWES-0418	112	0.06	0.17	Water Extraction Site Access	X	X	X
AMS-17C	114	0.25	0.73	Material Site Access	X		
AWES-0460	130	0.05	0.15	Water Extraction Site Access	X		
AWES-0462	131	0.05	0.15	Water Extraction Site Access	X		
AWES-0490	145	0.34	0.99	Water Extraction Site Access	X	X	X
AWES-0520	156	0.60	1.74	Water Extraction Site Access	X		
AAS-Farewell	156	2.98	8.64	Airstrip Access	X	X	X
AWES-0545	167	0.07	0.20	Water Extraction Site Access	X		
AWES-0615	186	0.19	0.55	Water Extraction Site Access	X		
AWES-0620	188	0.14	0.41	Water Extraction Site Access	X		
AWES-0625	189	0.10	0.29	Water Extraction Site Access	X		
AWES-0640	193	0.40	1.16	Water Extraction Site Access	X		
AWES-0650	197	0.06	0.17	Water Extraction Site Access	X		

Table 2.3-20: Access Road Identification[1]

Name	Mile Post	Length (miles)	Acres*	Description	Winter	Summer	All Season
AWES-0660	198	0.42	1.22	Water Extraction Site Access	X		
AMS-42	213	0.24	0.69	Material Site Access	X		
AMS-44	223	0.47	1.36		X		
AMS-0730	224	0.45	1.31	Water Extraction Site Access	X		
AWES-0750	224	1.17	3.39	Water Extraction Site Access	X		
AWES-0770	227	0.10	0.29	Water Extraction Site Access	X	X	X
AMS-50	239	0.08	0.23	Water Extraction Site Access	X	X	X
AWP-Kusko NE	240	0.70	2.03	Work Pad	X	X	X
AWES-0790	241	0.14	0.41	Water Extraction Site Access	X	X	X
AWES-0810	245	0.10	0.29	Water Extraction Site Access	X	X	X
Total		16.25	48.86				

Notes:
* Based on 24-foot width
1 All access road locations are depicted on strip maps provided in Appendix D.
Source: SRK 2013b; Donlin Gold 2017k.

Table 2.3-21: Shoofly Access Routes[1]

Name	Approximate MP	Length (miles)	Acres*	Season of Use		
				Summer	Winter	All Season
SHOO-0005	MP 4.7	0.71	2.07	X	X	X
SHOO-0010	MP 11.4	0.84	2.44		X	
SHOO-0020	MP 14.3	0.48	1.40		X	
SHOO-0030	MP 16.8	0.26	0.76		X	
SHOO-0040	MP 19.8	1.06	3.08		X	
SHOO-0050	MP 45	0.31	0.90		X	
SHOO-0060	MP 49.5	0.63	1.83		X	
SHOO-0070	MP 50.6	0.24	0.70		X	
SHOO-0080	MP 51	0.85	2.47		X	
SHOO-0090	MP 59.3	0.15	0.44		X	
SHOO-0100	MP 68	0.11	0.32		X	
SHOO-0110	MP 70.5	0.09	0.26		X	
SHOO-0120	MP 75.2	0.3	0.87		X	
SHOO-0130	MP 85.8	1.64	4.77		X	
SHOO-0140	MP 87	1.19	3.46		X	
SHOO-0150	MP 88.1	0.33	0.96		X	
SHOO-0160	MP 98.2	0.2	0.58		X	
SHOO-0170	MP 102.6	0.63	1.83		X	
SHOO-0180	MP 108.3	0.64	1.86		X	
SHOO-0190	MP 108.7	0.37	1.08		X	
SHOO-0200	MP 115.9	0.68	1.98	X		
SHOO-0210	MP 116.6	0.78	2.27	X		
SHOO-0220	MP 119.7	0.30	0.87	X		
SHOO-0230	MP 120.1	0.36	1.05	X		
SHOO-0240	MP 124.9	0.39	1.13	X		
SHOO-0250	MP 126.3	0.21	0.61	X		
SHOO-0260	MP 126.7	0.86	2.50	X		
SHOO-0270	MP 127.5	1.22	3.55	X		
SHOO-0280	MP 128.5	0.64	1.86	X		
SHOO-0290	MP 137.1	0.14	0.41	X		
SHOO-0300	MP 137.7	0.74	2.15	X		
SHOO-0310	MP 139.8	0.59	1.72	X		
SHOO-0320	MP 141	0.17	0.49	X		

Table 2.3-21: Shoofly Access Routes[1]

Name	Approximate MP	Length (miles)	Acres*	Season of Use		
				Summer	Winter	All Season
SHOO-0330	MP 142	0.13	0.38	X		
SHOO-0340	MP 142.9	1.6	4.65	X		
SHOO-0350	MP 149	0.49	1.43		X	
SHOO-0360	MP 149.6	1.27	3.69		X	
SHOO-0370	MP 167.8	0.17	0.49		X	
SHOO-0380	MP 168.2	1.03	3.00		X	
SHOO-0390	MP 182.4	0.19	0.55		X	
SHOO-0400	MP 182.9	0.67	1.95		X	
SHOO-0410	MP 186	0.24	0.70		X	
SHOO-0420	MP 191.9	0.63	1.83		X	
SHOO-0430	MP 197.1	1.06	3.08		X	
SHOO-0440	MP 234.9	3.12	9.08	X	X	X
SHOO-0450	MP 236	4.8	13.9	X	X	X
SHOO-0460	MP 240.9	6.91	20.1	X	X	X
SHOO-0470	MP 246.9	0.36	1.05	X	X	X
SHOO-0480	MP 248.5.	1.92	5.59	X		
SHOO-0490	MP 255.9	1.14	3.32	X		
SHOO-0500	MP 258.8	2.99	8.70	X		
SHOO-0510	MP 262.9	2.13	6.20	X		
SHOO-0520	MP 268.8	1.68	4.89	X		
SHOO-0530	MP 270.2	1.46	4.25	X		
SHOO-0540	MP 272.9	0.72	2.09	X		
SHOO-0550	MP 274.3	0.47	1.37	X		
SHOO-0560	MP 275.9	0.38	1.11	X		
SHOO-0570	MP 276.9	0.46	1.34	X		
SHOO-0580	MP 277.6	0.35	1.02	X		
SHOO-0590	MP 278.6	0.59	1.72	X		
SHOO-0600	MP 279.4	0.41	1.19	X		
SHOO-0610	MP 280.8	0.73	2.12	X		
SHOO-0620	MP 281.6	0.85	2.47	X		
SHOO-0630	MP 282.9	1	2.91	X		
SHOO-0640	MP 283.9	1.95	5.67	X		
SHOO-0650	MP 285.9	2.71	7.88	X		
SHOO-0660	MP 288	0.88	2.56	X		
SHOO-0670	MP 288.9	0.66	1.92	X		
SHOO-0680	MP 290	1.18	3.43	X		
SHOO-0690	MP 291.4	0.37	1.08	X		

Table 2.3-21: Shoofly Access Routes[1]

Name	Approximate MP	Length (miles)	Acres*	Season of Use		
				Summer	Winter	All Season
SHOO-0700	MP 295.9	2.32	6.75	X		
SHOO-0710	MP 298.1	1.47	4.28	X		
SHOO-0720	MP 299.3	0.59	1.72	X		
SHOO-0730	MP 307.7	0.65	1.89	X		
SHOO-0740	MP 312.8	6.37	18.53	X		
Total:		77.2	224.6			

Notes:

* Based on 24-foot width; data presented represents the full disturbance footprint of roads and ancillary facilities (SRK 2013b).
MP = milepost
1 All shoofly access road locations are depicted on strip maps provided in Appendix D.

Source: SRK 2013b

Construction Camps

Mobile and stationary construction camps would be used in locations along the pipeline ROW where construction and facility crews would require temporary housing during Construction. Table 2.3-22 lists mainline campsite locations and acreage.

Construction camps would be moved as construction progresses. The camps consist of modular units and would be moved by truck along the ROW or transported in a leapfrog manner. The modular units would be moved along the construction ROW on temporary roads, and winter roads. Of the seven proposed 300-person camps, only four would be active at any given time, to support an active construction spread (Figure 2.3-24). The main campsites would be supplemented by fly-in camps without temporary road access along the ROW, to reduce travel time and commute distance. These smaller fly-in camps are not identified specifically but would be included within the disturbance footprints of other facilities, including temporary work spaces and the full construction camps. Camps would be relocated at the end of each construction season in preparation for future construction.

As pipeline construction nears completion, the pipeline construction camps would be demobilized along with the pipeline construction equipment.

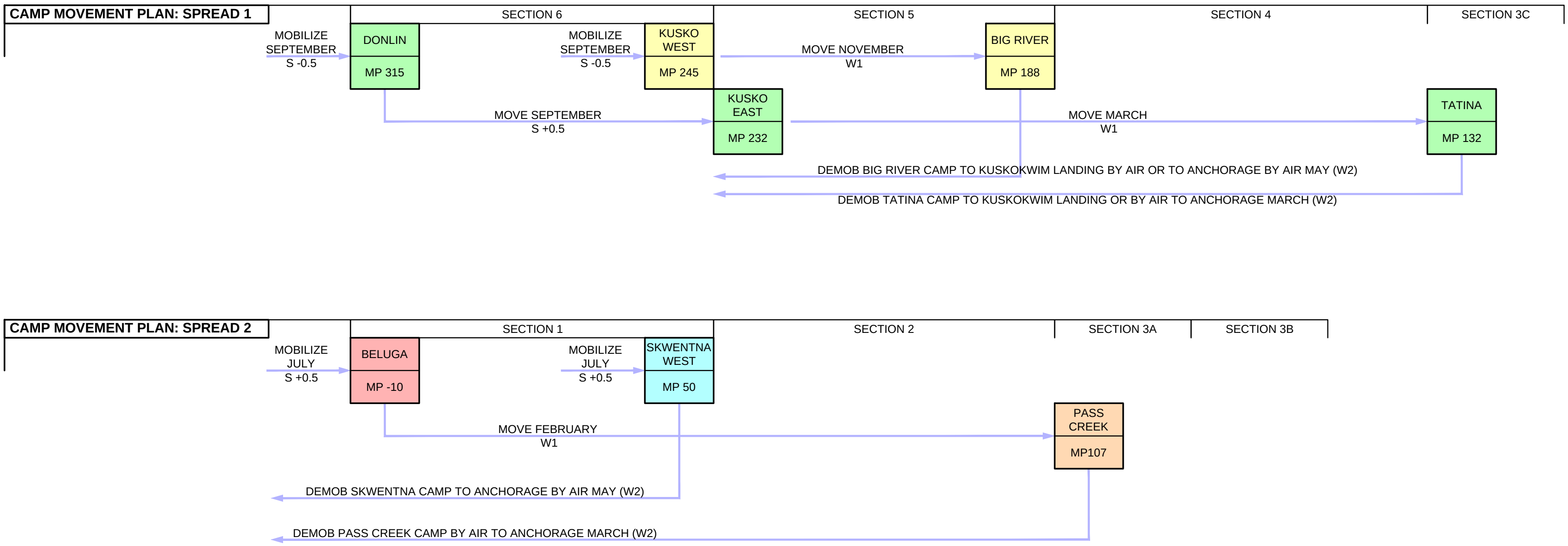
Table 2.3-22: Mainline Pipeline Campsite Locations

Campsite	Approximate Location	Land Status	Type of Camp/Site Area	Season of Use	
				Summer	Winter
Donlin Gold Camp	Mine Site	ANCSA Corporation	Main construction camp within Mine Site facilities area	X	X
Kuskokwim West Camp	MP 247	State Land	300-Person Camp / 16.3 Acres	X	X
Kuskokwim East Camp	MP 234.8	Federal (BLM) Land	300-Person Camp / 21.8 Acres	X	X
Big River Camp	MP 192	Federal (BLM) Land	300-Person Camp / 12.4 Acres		X
Jones Camp	MP 145	State Land	300-Person Camp / 30.4 Acres	X	X
Bear Paw Camp	MP 133.4	State Land	100-Person Camp / 25.1 Acres	X	
Threemile Camp	MP 111.7	State Land	300-Person Camp / 59.6 Acres	X	X
Happy River Camp	MP 85	State Land	300-Person Camp / 16.8 Acres		X
Shell Camp	MP 53	State Land	300-Person Camp / 42 Acres		X
Deep Creek Camp	MP 42	State Land	100-Person Camp / 8.1 Acres		X
Beluga Camp	Beluga	Varies	Existing camps in the Beluga area	X	X
Total Area:			232.5 Acres		

Abbreviations:

MP = milepost

Source: SRK 2013b.



DONLIN GOLD

DONLIN GOLD PROJECT EIS

ALTERNATIVE 2
CAMP MOVEMENT PLAN DIAGRAM

JUNE 2017

FIGURE 2.3-24

The main campsites would consist of cleared gravel pads with self-contained, soft- or hard-sided structures. Figure 2.3-25 depicts a typical camp layout. The following facilities would be available at the main construction camps:

- Dormitory units;
- Arctic corridor;
- First Aid unit;
- Recreation center;
- Office modules;
- Kitchen-diner;
- Laundry facility;
- Warehouse / storage (augmented by pipeline contractor as needed);
- Contractor shops (augmented by pipeline contractor as needed);
- Fuel storage and distribution system including storage tanks;
- Water storage;
- Water treatment;
- Sewage treatment;
- Lift stations;
- Generators;
- Parking for equipment and vehicles;
- Communications tower; and
- Water well.

Each 300-person camp would be capable of supporting a workforce of 250, plus maintenance, catering and housekeeping personnel. In addition to serving the living needs of the workforce, the camps would provide administrative space and communication facilities for construction management and inspection teams to conduct their activities.

In addition to the 300-person camps, 30-person camps would be used to support the construction at HDD sites and the construction of the compressor station. These 30-person camps would have the same types of facilities as the other construction camps, but everything would be sized for a maximum of 15 two-person sleeper units. HDD camp site locations are presented in Table 2.3-23.

Table 2.3-23: HDD Camps and Campsite Locations

Name	Approximate Milepost (MP)	Land Status	Season of Use		
			Summer	Winter	All Season
North Fork George HDD Site					
North Fork George (HDD Entry) 1.4 acres	MP 297.5	Federal (BLM) Land	X		
North Fork George (HDD Exit) 1.4 acres	MP 298.1	Federal (BLM) Land	X		
George River HDD Site					
George River (HDD Entry) 1.4 acres	MP 290.5	Federal (BLM) Land	X		
George River (HDD Exit) 1.4 acres	MP 291.1	Federal (BLM) Land	X		
East Fork George HDD Site					
East Fork George (HDD Entry) 1.4 acres	MP 282.9	Federal (BLM) Land	X		
East Fork George (HDD Exit) 1.4 acres	MP 283.8	Federal (BLM) Land	X		

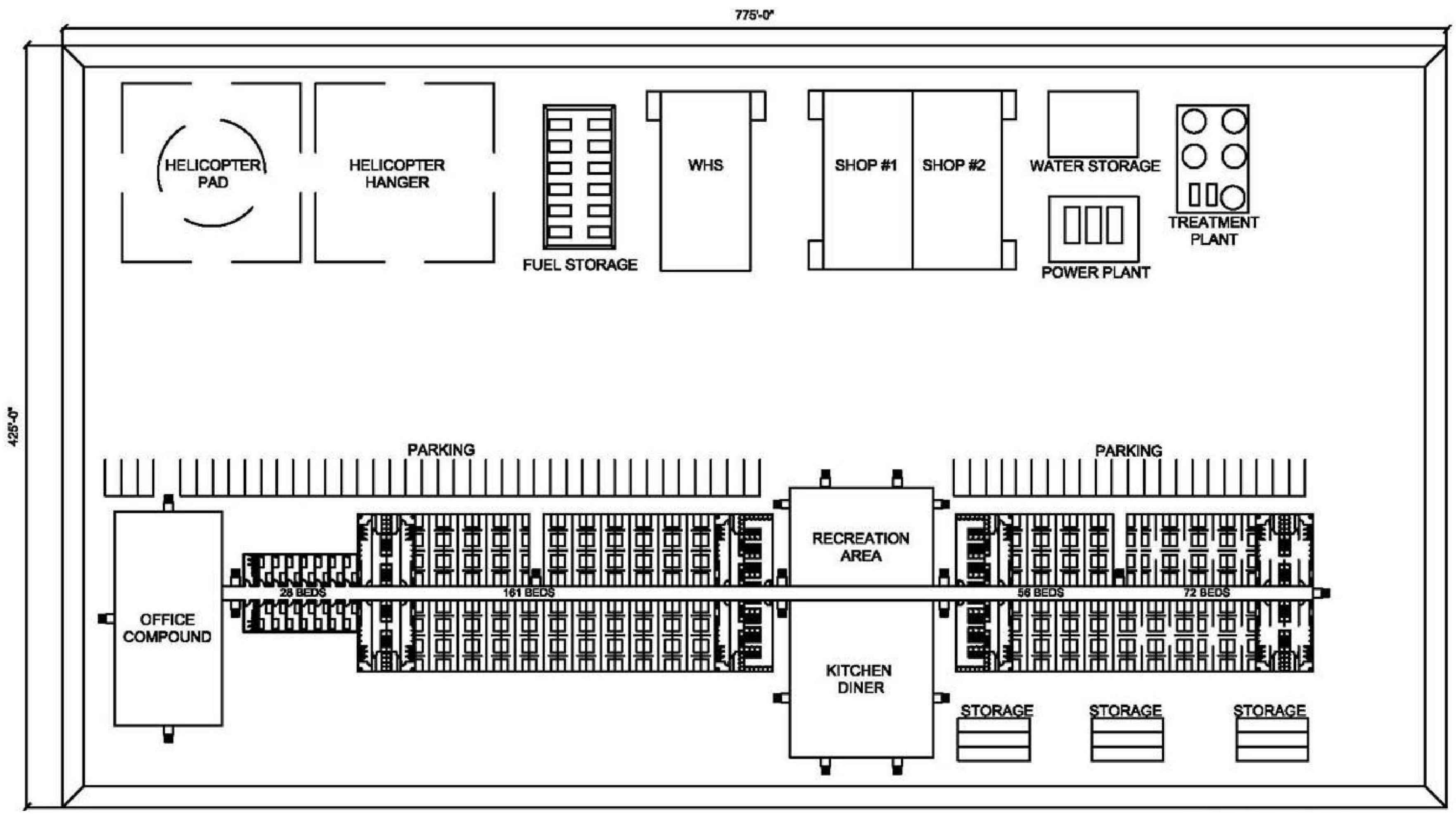
Table 2.3-23: HDD Camps and Campsite Locations

Name	Approximate Milepost (MP)	Land Status	Season of Use		
			Summer	Winter	All Season
Kuskokwim River HDD Site					
Kuskokwim River (HDD Entry) 1.4 acres	MP 240.1	State Land	X	X	X
Kuskokwim River (HDD Exit) 1.4 acres	MP 241.5	State Land	X	X	X
Kusko West Landing	MP 240.7	State Land	X		
Kusko East Landing	MP 240.4	State Land	X		
Happy River HDD Site					
Happy River (HDD Entry) 1.4 acres	MP 85.7	State Land		X	
Happy River (HDD Exit) 1.4 acres	MP 86.4	State Land		X	
Skwentna River HDD Site					
Skwentna River (HDD Entry) 1.4 acres	MP 49.9	State Land		X	
Skwentna River (HDD Exit) 1.4 acres	MP 50.5	State Land		X	
Beluga Landing	MP 10	State Land			

Notes:
HDD = horizontal directional drilling
MP = milepost
Source: SRK 2013b.

All camp waste, including sewage and gray water, would be treated as required and disposed of in accordance with a plan approved by ADEC and an APDES permit. General construction waste would be incinerated or shipped offsite; Donlin Gold has not proposed constructing landfills or permitted disposal pits along the pipeline ROW. Hazardous waste would be hauled offsite to approved hazardous waste disposal sites. Used oil from equipment maintenance would be burned on site in approved waste oil unit heaters built for that purpose. In general, the importation of grease, solvents, oils, coolants, hydraulic fluids, and other liquids or chemicals would be controlled to limit the types and amounts of waste generated. Medical hazardous waste would be handled by appropriate medical personnel and disposed of in approved sites. A Comprehensive Waste Management Plan would be developed and followed so that wastes generated by construction activities are minimized, identified, handled, stored, transported, and disposed of in a safe and environmentally responsible manner and in full compliance with applicable state, federal, and local laws and regulations.

The fuel storage facility for pipeline equipment at each camp would be provided and installed by the pipeline construction contractor. The fuel storage facility would store all diesel fuel and gasoline, depending on the specific equipment used, and would be equipped with secondary containment as required by regulations. Primary fuel storage would be located at each camp airstrip because the fuel would be mostly flown in. Table 2.3-24 shows the estimated construction fuel needs.



DONLIN GOLD PROJECT EIS

ALTERNATIVE 2
GENERAL CONSTRUCTION
CAMP CONFIGURATION

JUNE 2017

FIGURE 2.3-25

Table 2.3-24: Pipeline Construction Fuel Use Estimate

Airstrips	Gallons
Beluga Airstrip	1,000,000
Deep Creek Airstrip	500,000
Shell Airstrip	500,000
Happy River Airstrip	250,000
Threemile Airstrip	500,000
Bear Paw Airstrip	500,000
Jones Airstrip	500,000
Farewell Airstrip	750,000
Big River Airstrip	500,000
Kuskokwim East Airstrip	500,000
Kuskokwim West Airstrip	500,000
Donlin Gold Airstrip	500,000
Total:	6,500,000

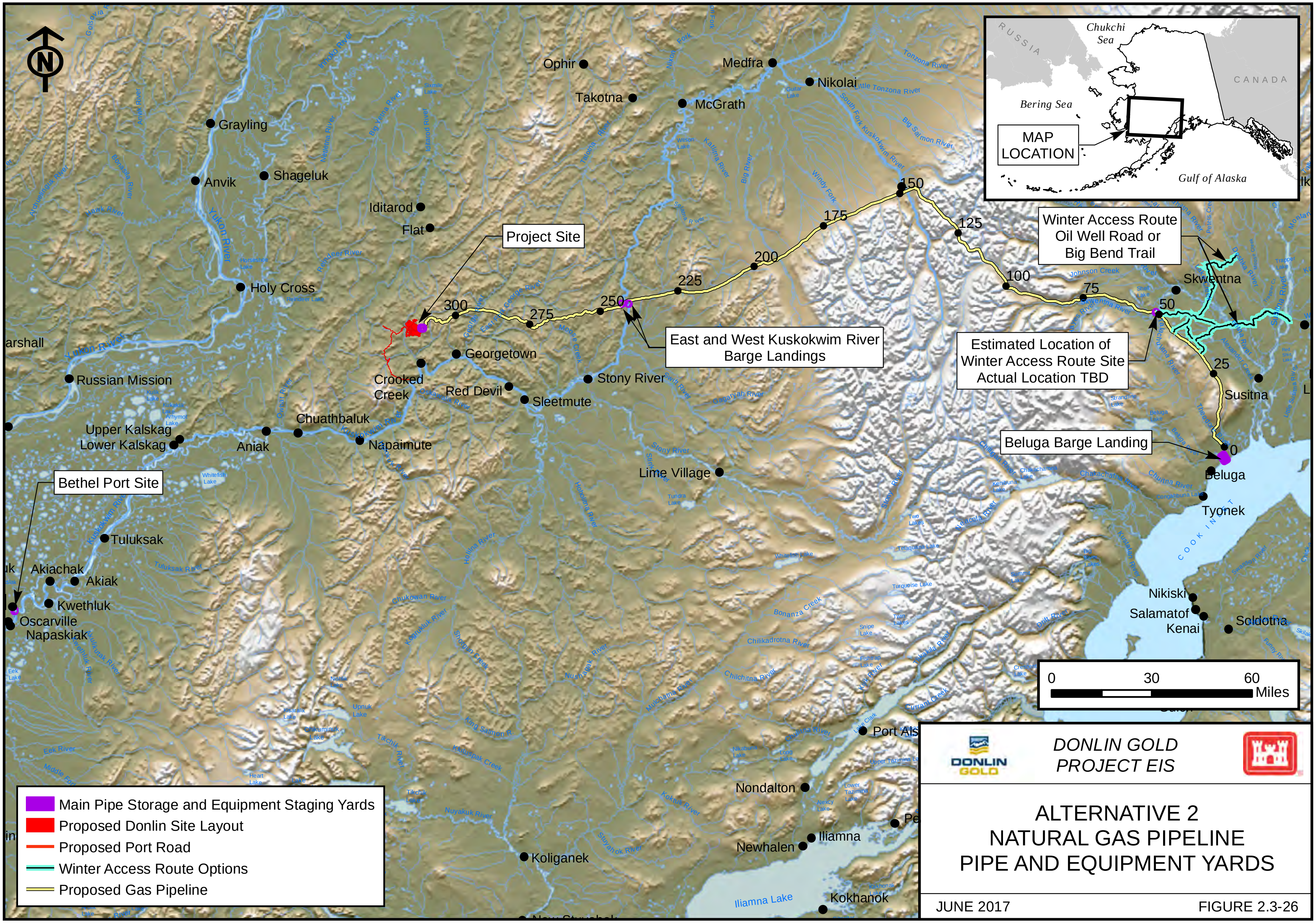
Source: SRK 2013b.

Total fuel needs are estimated at approximately 6,500,000 gallons for pipeline construction, HDD operations, and pipeline camp operations. All fuel handling, transportation, and storage would be conducted in compliance with all applicable regulations. Fuel would be delivered to the storage site by DC6 or Hercules C-130 from bulk fuel suppliers. It would be necessary to keep about five to seven days' worth of fuel supply on hand for at least the camp and essential equipment to allow for road closure or slow deliveries because of weather or road conditions. Fuel would be dispensed to the contractor's fuel trucks for fueling of construction equipment on the ROW or at camp. Pumps at the fuel storage facility can fuel light vehicles and/or on-highway trucks. There would also be a propane storage facility so that contractors can refuel their preheat equipment.

There would be a smaller capacity fuel storage facility closer to camp facilities for diesel generators and/or for heating oil that would be piped to the camps directly, depending on the type of heating system. A gross estimate of this annual fuel consumption would be on the order of 175,000 gallons. The camps may also have their own propane storage tanks for cooking fuel. There would also be small, double-walled tanks with drip liners for helicopter refueling. These would be located at the designated helipad.

Pipe and Equipment Storage Yards

During construction of the pipeline, pipe and equipment would be stored at the primary storage yards at Bethel, Beluga, the Mine Site, the Oil Well Road area, and near the barge landing sites on the Kuskokwim River, as shown on Figure 2.3-26. These yards would serve as primary staging points for pipe materials and also for the majority of the heavy equipment required for project construction. They would be used to supply the 57 pipeline storage yards (PSYs), spaced at intervals of approximately 5 miles along the pipeline construction ROW (Table 2.3-25 and Appendix D). The PSYs along the pipeline construction ROW would each be approximately 1.5 acres.



DONLIN GOLD PROJECT EIS

ALTERNATIVE 2
NATURAL GAS PIPELINE
PIPE AND EQUIPMENT YARDS

JUNE 2017

FIGURE 2.3-26

Table 2.3-25: Pipe Storage Yards

Name	Approximate Milepost (MP)	Season of Use			Planned Pipe Source
		Summer	Winter	All Season	
	Beluga Yard*				Beluga
PSY-01	MP 6.8		X		Beluga
PSY-02	MP 12.8		X		Beluga
PSY-03	MP 15.4		X		Beluga
PSY-04	MP 21.8		X		Beluga
PSY-05	MP 28.2		X		Beluga
PSY-06	MP 32.5		X		Beluga
PSY-07	MP 37.5		X		Beluga
PSY-08	MP 42.3		X		Road system then via ice road **
PSY-09	MP 46.7		X		Road system then via ice road **
PSY-10	MP 50.8		X		Road system then via ice road **
PSY-11	MP 54.2		X		Road system then via ice road **
PSY-12	MP 69.8		X		Road system then via ice road **
PSY-13	MP 63.2		X		Road system then via ice road **
PSY-14	MP 68.5		X		Road system then via ice road **
PSY-15	MP 70.8		X		Road system then via ice road **
PSY-16	MP 75.7		X		Road system then via ice road **
PSY-17	MP 79.1		X		Road system then via ice road **
PSY-18	MP 87		X		Road system then via ice road **
PSY-19	MP 90.7		X		Road system then via ice road **
PSY-20	MP 96.8		X		Road system then via ice road **
PSY-21	MP 101.9		X		Road system then via ice road **
PSY-22	MP 106.4		X		Road system then via ice road **
PSY-23	MP 112.2	X	X	X	Road system then via ice road **
PSY-24	MP 114.4	X			Road system then via ice road **
PSY-25	MP 120.6	X			Road system then via ice road **
PSY-26	MP 125.2	X			Road system then via ice road **
PSY-27	MP 132.3	X			Kusko East
PSY-28	MP 138.4	X			Kusko East
PSY-29	MP 142.7	X			Kusko East
PSY-30	MP 148		X		Kusko East
PSY-31	MP 154		X		Kusko East

Table 2.3-25: Pipe Storage Yards

Name	Approximate Milepost (MP)	Season of Use			Planned Pipe Source
		Summer	Winter	All Season	
PSY-32	MP 159.6		X		Kusko East
PSY-33	MP 162.7		X		Kusko East
PSY-34	MP 167.8		X		Kusko East
PSY-35	MP 174.3		X		Kusko East
PSY-36	MP 178.5		X		Kusko East
PSY-37	MP 184.9		X		Kusko East
PSY-38	MP 191.9		X		Kusko East
PSY-39	MP 197.7		X		Kusko East
PSY-40	MP 204.3		X		Kusko East
PSY-41	MP 210.4		X		Kusko East
PSY-42	MP 215.9		X		Kusko East
PSY-43	MP 220.9		X		Kusko East
PSY-44	MP 226.8		X		Kusko West
PSY-45	MP 231.9		X		Kusko West
PSY-46	MP 250.4	X			Kusko West
PSY-47	MP 254.3	X			Kusko West
PSY-48	MP 261.3	X			Donlin Mine
PSY-49	MP 267.9	X			Donlin Mine
PSY-50	MP 271.8	X			Donlin Mine
PSY-51	MP 276.7	X			Donlin Mine
PSY-52	MP 281.6	X			Donlin Mine
PSY-53	MP 284.9	X			Donlin Mine
PSY-54	MP 289.4	X			Donlin Mine
PSY-55	MP 295.4	X			Donlin Mine
PSY-56	MP 302.9	X			Donlin Mine
PSY-57	MP 308.5	X			Donlin Mine

Notes:

* This yard is not laid out; it is assumed there is adequate room at Beluga. Start pipe haul from Beluga.
** Actual winter access route options (Oilwell Road Route or Willow Landing Route) are still being evaluated.

Source: SRK 2013b.

Development of the pipeline storage yards would be initiated during the civil clearing and access season, which would occur generally one year before the pipe-laying season.

Most of the pipeline material and equipment would come through the staging yards located at Beluga and Bethel. Pipe would be driven overland by truck within the construction ROW on temporary roads, winter roads, and shoofly roads (outside the ROW) in summer and in winter as applicable to the given location. Hauling pipe will require between 40 and 50 truck trips per PSY.

There would be 31 PSYs (not counting the Donlin Gold Mine Site) in Spread 1 (MP 316 to MP 127), and 26 (not counting Beluga) in Spread 2 (MP 0 to MP 127). These sites would receive and store equipment during periods of no construction between seasons. Each PSY would cover about 1.5 acres (total of 84.5 acres), and would be cleared and graded before use. A gravel pad might be installed if the natural soil proved unsuitable. Upon completion of the pipeline construction, the pipeline staging yards would be reclaimed. Stockpiled overburden would be spread on the reclaimed areas to improve soil and facilitate natural revegetation. If gravel is used, the gravel would be left in place when the sites are reclaimed.

Borrow Material Sites

Borrow material sites would be needed to provide gravel fill material for access and shoofly roads; airfields; camp pads; pipeline storage yards; the compressor station and meter pads; and gravel work pads. Material sites would also be the source and location for processing plants for crushed and / or screened material for select backfill; bedding; padding; surface courses; cobbles; rock riprap; and other types of construction material. Table 2.3-26 provides the estimated borrow material source needs for the project. Borrow site boundaries would be shaped to blend with surrounding natural land patterns and each site would be reclaimed consistent with approved, site-specific reclamation plans. Details regarding reclamation of individual material sites will be determined once the volumes of material to be removed have been finalized and final contour lines projected. The amount of material estimated to be required for the pipeline and ancillary facilities is approximately 2 million cubic yards. Final volumes of these gravel materials and specific location of material sites and development plans for these sites would be part of the final project design.

Table 2.3-26: Estimated Borrow Material Source Needs

Description	Estimated Amount of Material (cy)
Access Roads	700,000-1,000,000
Ancillary Facilities[1]	800,000-1,000,000
Pipeline	55,000
Total:	~2,000,000

Notes:

1 Material source needs for compressor station, pipeline storage yards, MLVs, construction campsites, and airstrips.

cy = cubic yards

Source: SRK 2013b.

Material sites would be located, based on construction material needs, where appropriate materials can be found, and to minimize haul distances. The 70 potential material sites listed in Table 2.3-27 vary in size from 1 to nearly 50 acres and would disturb approximately 1,084 acres. These sites should provide more than sufficient gravel for the project. The following material sites would require a processing plant/crusher: MS-02, MS-03, MS-04, MS-49, MS-50, MS-52, and MS-54. Material site locations are shown in Appendix D – Pipeline Engineering Strip Maps and may be adjusted during final design to avoid areas such as wetlands, cultural sites, sensitive species habitat, and other environmentally sensitive areas.

Table 2.3-27: Potential Material Sites

Material Site	Milepost	Area (acres)	Material Type	Land Status	Est. Available Volume (cy)	Est. Usage (cy)	Season of Use
MS-00	0.0	13.3	Gravel	ANCSA Corporation Land	50,000	30,000	Winter
MS-01	5.1	14.7	Gravel	State Land	75,000	75,000	Winter
MS-02	10.2	6.2	Bedrock	State of Alaska Oil & Gas Leases	20,000	20,000	Winter
MS-03	16.6	5.6	Bedrock	State Land	20,000	20,000	Winter
MS-04	20.1	4.7	Bedrock	State Land	20,000	20,000	Winter
MS-05	26.1	16.5	Gravel	State Land	50,000	50,000	Winter
MS-06	32.5	4.7	Gravel	State Land	20,000	20,000	Winter
MS-07	36.2	3.7	Gravel	State Land	20,000	20,000	Winter
MS-08	42.3	7.0	Gravel	State of Alaska Oil & Gas Leases	150,000	150,000	Winter
MS-09	45	16.1	Gravel	State Land	100,000	50,000	Winter
MS-10	50.5	17.1	Gravel	State Land	20,000	20,000	Winter
MS-11	55.8	36.3	Gravel (alluvial)	State Land	250,000	250,000	Winter
MS-12	68.3	3.6	Gravel	State Land	20,000	20,000	Winter
MS-13	85.3	15.9	Gravel (alluvial)	State Land	100,000	100,000	Winter
MS-14	88	5.2	Gravel (alluvial)	State Land	20,000	20,000	Winter
MS-16	102.9	9.1	Gravel (alluvial)	Miscellaneous	20,000	20,000	Winter
MS-17A	108.4	31.6	Gravel (alluvial)	State Land	250,000	250,000	Winter
MS-17B	112	29.8	Gravel (alluvial)	Miscellaneous	150,000	150,000	All Season
MS-17C	114	19.7	Gravel (alluvial)	State Land	20,000	20,000	Summer
MS-18A	119.9	5.3	Coarse colluvial	State of Alaska Mining Claims	15,000	15,000	Summer
MS-18B	120.3	3.6	Gravel (alluvial)	State Land	15,000	10,000	Summer

Table 2.3-27: Potential Material Sites

Material Site	Milepost	Area (acres)	Material Type	Land Status	Est. Available Volume (cy)	Est. Usage (cy)	Season of Use
MS-18C	121.3	4.6	Gravel (alluvial)	State of Alaska - Permit or Lease	15,000	10,000	Summer
MS-19A	123.3	1.8	Gravel (alluvial)	State of Alaska Mining Claims	15,000	10,000	Summer
MS-19B	124.8	13.4	Coarse colluvial	State Land	25,000	25,000	Summer
MS-20	127	18.5	Gravel (alluvial outwash)	State Land	100,000	50,000	Summer
MS-21	130.3	26.5	Bedrock and Gravel (alluvial)	State Land	100,000	50,000	Summer
MS-22	133.7	21.5	Gravel (alluvial)	State Land	100,000	100,000	Summer
MS-23	138.5	14.6	Gravel (glacial/ alluvial)	State Land	50,000	20,000	Summer
MS-24	144.9	20.6	Gravel (alluvial)	State Land	250,000	150,000	All Season
MS-25	147.5	42.9	Gravel (alluvial)	Rights-of-Way & Easements	1,000,000	15,000	Winter
MS-26	161.5	44.1	Gravel (alluvial)	State Land	1,000,000	150,000	Winter
MS-27	156.5	11	Gravel	ANCSA Corporation Land	250,000	200,000	Winter
MS-27A	159.6	3.3	Gravel (alluvial)	State Land	100,000	100,000	Winter
MS-28	160.8	7.4	Gravel	State Land	200,000	30,000	Winter
MS-28A	162.7	8.9	Gravel (alluvial)	State Land	200,000	75,000	Winter
MS-29	164.2	7.4	Gravel	State Land	200,000	45,000	Winter
MS-30	168.2	14	Gravel	State Land	250,000	125,000	Winter
MS-31	170.8	7.5	Gravel	State Land	200,000	80,000	Winter
MS-32	174.2.0	11.1	Gravel[1]	Federal (BLM) Land	250,000	100,000	Winter
MS-33	176.7	6	Gravel[1]	Federal (BLM) Land	100,000	60,000	Winter
MS-34	178.9	5	Gravel	State Land	75,000	50,000	Winter
MS-35	182.9	13.5	Gravel	State Land	300,000	110,000	Winter
MS-36	184.9	6.9	Gravel[1]	Federal (BLM) Land	100,000	100,000	Winter
MS-38	190.9	5.2	Gravel[1]	Federal (BLM) Land	150,000	150,000	Winter
MS-39	191.8	7.4	Gravel[1]	Federal (BLM) Land	150,000	150,000	Winter
MS-40	198	18.7	Gravel[1]	Federal (BLM) Land	150,000	135,000	Winter
MS-41	204.8	11.6	Gravel[1]	Federal (BLM) Land	100,000	90,000	Winter
MS-42	213.2	39.5	Bedrock	State Land	1,000,000	350,000	Winter
MS-43	216.8	7.8	Bedrock	State Land	75,000	75,000	Winter

Table 2.3-27: Potential Material Sites

Material Site	Milepost	Area (acres)	Material Type	Land Status	Est. Available Volume (cy)	Est. Usage (cy)	Season of Use
MS-44	222.4	43.5	Bedrock	State Land	1,000,000	150,000	Winter
MS-45	225.9	24	Bedrock	State Land	500,000	240,000	Winter
MS-46	229.9	19.6	Bedrock	Federal (BLM) Land	250,000	120,000	Winter
MS-47	231.9	18.5	Bedrock	Federal (BLM) Land	150,000	60,000	Winter
MS-48	234.9	61.8	Bedrock	Federal (BLM) Land	250,000	100,000	All Season
MS-49	235.6	15.5	Bedrock	Federal (BLM) Land	150,000	150,000	All Season
MS-50	239.4	25.6	Bedrock	State Land	200,000	200,000	All Season
MS-52	241	48.6	Bedrock & Gravel	State Land	1,000,000	250,000	All Season
MS-53	243.4	23.5	Bedrock	State Land	150,000	120,000	All Season
MS-54	247	32.9	Bedrock	State Land	500,000	300,000	All Season
MS-55	254.7	3.7	Bedrock	Federal (BLM) Land	50,000	25,000	Summer
MS-56	256.8	3.3	Bedrock	State Land	50,000	25,000	Summer
MS-57	264.2	3.7	Bedrock	Federal (BLM) Land	50,000	25,000	Summer
MS-58	269.2	3.7	Bedrock	Federal (BLM) Land	50,000	25,000	Summer
MS-59	281.5	13	Bedrock	Federal (BLM) Land	200,000	50,000	Summer
MS-60	284.7	15	Bedrock	Federal (BLM) Land	200,000	50,000	Summer
MS-60A	284	9.9	Bedrock	Federal (BLM) Land	200,000	50,000	Summer
MS-61	290.4	11.6	Bedrock	Federal (BLM) Land	200,000	50,000	Summer
MS-61A	291.4	4.7	Bedrock	Federal (BLM) Land	50,000	50,000	Summer
MS-62	293.9	21.3	Bedrock	Federal (BLM) Land	300,000	100,000	Summer
MS-63	298.8	10.0	Bedrock	Federal (BLM) Land	200,000	100,000	Summer
Total:		1,083.8			13,610,000	6,175,000	

Notes:

1 Gravel is a salable mineral under the Materials Act (1947) and disposal activity on BLM land requires a BLM permit.
cy = cubic yards
MS = material site

Source: SRK 2013b; Donlin Gold 2017k.

Airstrips

Twelve airstrips would be used to support pipeline construction logistics; nine of these would be new (Table 2.3-28). Figure 2.3-27 provides the locations of the existing and proposed airstrips. Specific siting of the airstrips was conducted to reduce cut-and-fill required to create the runway surface. Existing airstrips would be used at three locations, although some would require upgrading to meet the Donlin Gold Project's needs. Public airstrips would require authorization or concurrence from USDOT and the Federal Aviation Administration prior to use. Also, authorization from the landowner to use existing airstrips will need to be verified. All twelve airstrips would require storage for air operations and staging areas for pipeline construction materials. The disturbance footprints shown in Table 2.3-28 for the 12 airstrips include space for other “facilities” associated with the individual strips, including staging areas, material sites, and camps. Table 2.3-29 provides an estimate of the number of rotary and fixed wing aircraft trips needed during pipeline Construction and Operations.

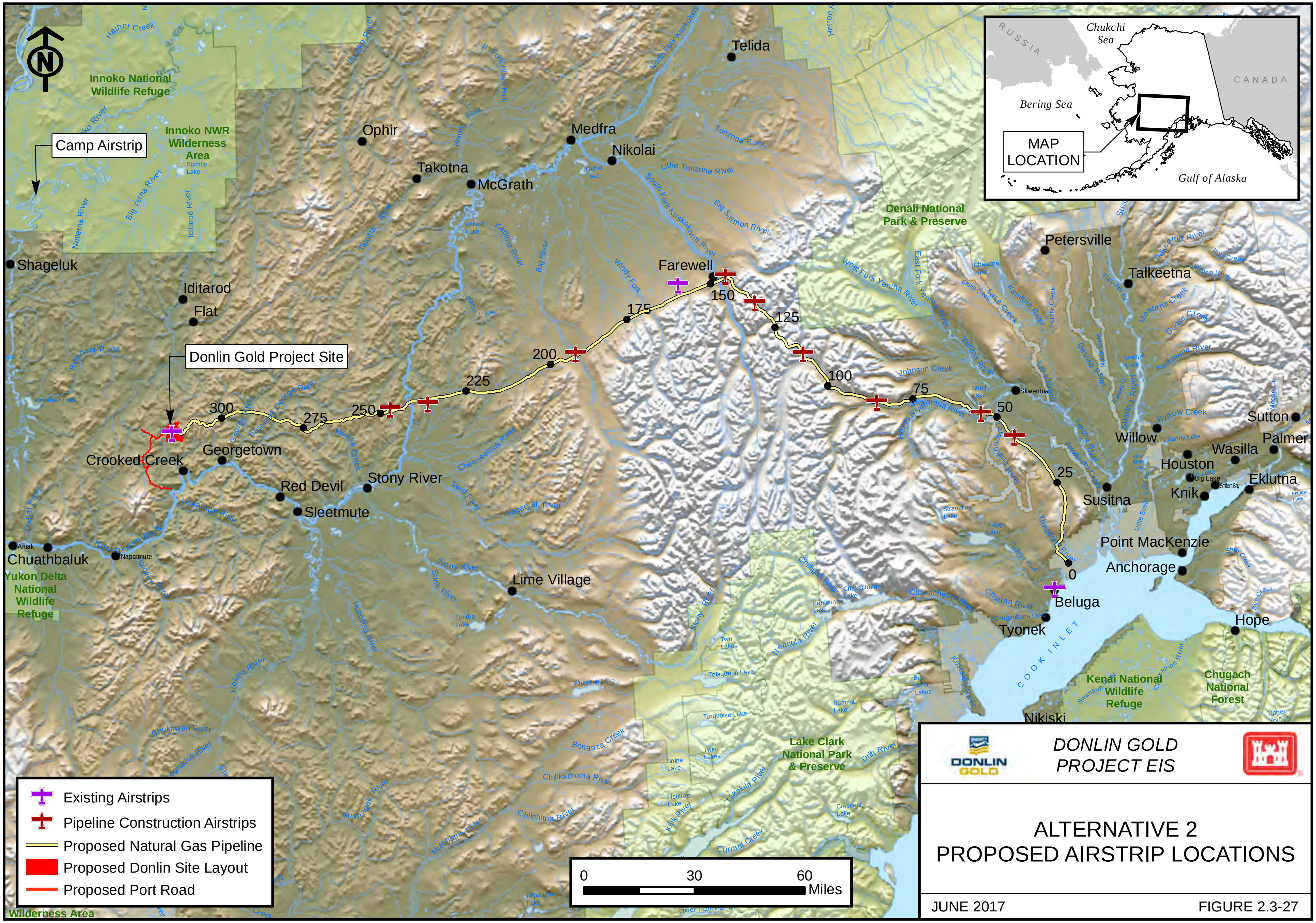
Table 2.3-28: Airstrip Locations and Construction

Name	Approx. Milepost (MP)	Length (ft/m)	Land Status	Construction/Area*	Season of Use		
					Summer	Winter	All Season
Beluga Airstrip	Beluga	5,000 ft	ANCSA Corporation Selections and Conveyances	Existing – No work	X	X	X
Deep Creek Airstrip	MP 42.1	3,500 ft	State Land	New – Grade, cut and fill 19.4 acres		X	
Shell Airstrip	MP 54	5,000 ft	State Land	New – Grade, cut and fill 103.7 acres		X	
Happy River Airstrip	MP 85.1	5,000 ft	Miscellaneous	New – Grade, cut and fill 86.7 acres		X	
Threemile Airstrip	MP 111.8	3,500 ft	State Land	New – Grade, cut and fill 27.9 acres	X	X	X
Bear Paw Airstrip	MP 133.8	4,000 ft	State Land	New – Grade, cut and fill 26.8 acres	X		
Jones Airstrip	MP 144.9	5,000 ft	State Land	New – Grade only, floodplain 84.3 acres	X	X	X
Farewell Airstrip	MP 158.2	5,000 ft	Federal (BLM) Land	Existing – Grade only, surface course 139.9 acres	X	X	X
Big River Airstrip	MP 191.6	5,000 ft	Federal (BLM) Land	New – Grade, cut and fill 62.3 acres		X	
Kuskokwim East Airstrip	MP 235.7	5,000 ft	State Land	New – Grade only, 59.3 acres	X	X	X
Kuskokwim West Airstrip	MP 246.2	5,000 ft	State Land	New – Grade only, 63 acres	X	X	X
Donlin Gold Airstrip	Donlin Gold Camp	5,000 ft	ANCSA Corporation Selections and Conveyances	Existing – No work	X	X	X
Total Area:				673.3 Acres			

Notes:

*Includes entire footprint, including vegetation clearing areas. Estimated acres may be over-estimated due to overlapping components.
ft = feet
MP = milepost

Source: SRK 2013b.



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ALTERNATIVE 2
PROPOSED AIRSTRIP LOCATIONS

JUNE 2017

FIGURE 2.3-27

Table 2.3-29: Air Operation Estimates

		Rotary Wing Aircraft														Fixed Wing Aircraft		
				Helicopter Flights per Month												Fixed Wing Demand		
Area	**Phase**	**Aircraft**	**Per Year**	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**	**Dash 8 Q300***	**Twin Otter Series 400***	**Cargo Plane**
Pipeline	Construction	2 helicopters per spread = 4 TOTAL	1,187	124	112	124	120	62	120	124	124	60	62	62	93	1 flight per day per spread	1 flight per day per spread	1 flight per day per spread
			Trips along the ROW alignment to and from camps: maximum 1-way = 50 miles average 1-way = 25 miles															
	Operations	1	24	2	2	2	2	2	2	2	2	2	2	2	2	None	1 flight / week Anchorage - Beluga	None

Source: SRK 2013b.

2.3.2.4.5 PIPELINE – DESIGN AND CONSTRUCTION PROCEDURES

The proposed pipeline facilities would be designed, constructed, operated, and maintained in accordance with USDOT regulations under 49 CFR Part 192, Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards, and other applicable federal and state regulations. Among other design standards, these regulations specify pipeline material selection; minimum design requirements; protection from internal, external, and atmospheric corrosion; and qualification procedures for welders and operations personnel.

Pipeline – Design and Wall Thickness

The 14-inch (outside diameter) pipe would have a pipe wall thickness between 0.25 inches and 0.406 inches. In areas where geotechnical hazards exist, such as occurs during thaw settlement and frost heave, pipe with 0.344-inch or 0.375-inch walls would be used. Pipe to be laid in areas requiring additional strength during pressure testing because of large elevation changes, or requiring buoyancy control in wetlands, would have 0.375-inch thick pipe wall. In areas with HDD installations, above-ground fault crossings and other high-hazard areas, pipe with 0.406-inch thick walls would be installed.

Pipeline – Delivery of Construction Materials and Equipment

Materials and equipment delivered to Bethel on ocean-capable barges would be temporarily offloaded to the storage yard in Bethel for later transfer to shallow-draft barges capable of transporting loads up the Kuskokwim River to the barge landing / material storage sites on each bank of the river (Kuskokwim East and West) and to the Angyaruaq (Jungjuk) Port. Pipe would be delivered to the Port of Anchorage, and barged to a storage yard at Beluga or sent overland to Oilwell Road / Willow Landing (depending on final access decisions). There would be 20 ocean barges transporting pipe and equipment from Anchorage to Beluga Landing during the first year of Construction. Pipe and other materials delivered to Beluga would be transported by truck on the existing Beluga area road system to the beginning of the ROW; and then to endpoints of delivery along the route. For Construction, pipe would be delivered by truck to 57 intermediate PSYs spaced along the ROW at 5-mile intervals (see Table 2.3-25) on travel lanes assumed to be 24 feet wide.

Pipeline – Standard Construction Procedures

Pipeline components include: the pipeline; compressor station; metering stations; pig launching and receiving facilities; and temporary facilities that would be used for construction such as material sites; access roads; work pads; airfields; and construction camps. Pipeline construction efforts would also require installation of a fiber optic cable. Because of the lack of developed access infrastructure and because of soft and wet soil conditions, construction would occur primarily during winter, under the frozen conditions needed to support equipment and limit environmental impacts. To address the technical aspects presented by varying terrain, seasonal conditions, and overall remoteness of the proposed pipeline project, a pipeline construction sequence and schedule has been developed by construction spread. This is a feasibility level construction plan and will be modified and updated as needed during final design.

Pipeline construction would be divided into two spreads: Spread 1 would be 188.6 miles long and would operate on the west side of the project from the Tatina River crossing at approximately MP 127 in the Alaska Range to the Mine Site; Spread 2 would be 126.6 miles long and would operate from MP 127 to the beginning of the pipeline at the tie-in point at MP 0.

Construction practices would be tailored for the installation season. The prevalence of low grade wetlands and / or permafrost on each side of the Alaska Range dictate winter construction for about 68 percent of the approximately 316 miles of pipeline.

Winter construction is planned for the following areas:

- MP 0 to MP 111.6; and
- MP 144.4 to MP 247.6.

Summer construction is planned for the following areas:

- MP 116 to MP 144.4 (major stream crossings may be completed during the shoulder season or winter); and
- MP 247.6 and MP 315.2.

The overall construction schedule would span approximately three years; with the first year including ROW civil work and mobilization of materials and equipment (see Table 2.3-30).

The construction plan and execution sequence would include: ROW clearing and grading of access roads; construction of shoofly roads where the ROW is too steep for transport of pipe and cathodic protection materials; preparation of compressor station site and campsites; camp construction; pipeline storage yard construction; airstrip upgrades; and barge landings as well as material site development and access roads. Table 2.3-30 identifies the planned MP section and planned construction season dates.

The majority of the proposed pipeline construction process would be accomplished using conventional open cut methods. The overland installation of the pipeline is best represented as a moving assembly line with a construction spread (crew and equipment) proceeding along the construction ROW in continuous operation as shown on Figure 2.3-28. The length of time a trench would remain open (i.e., trenching to backfill) during construction at any given location along the route would typically range from one to three days, while total construction efforts at any single point, from ROW surveying and clearing, to backfill and finish grading, would last three to four months.

Before initiating clearing, the ROW would be staked and flagged, using a standard construction color code system. The staking would mark the centerline, edge of working construction ROW, and additional temporary workspace to clearly delineate the area approved and authorized for construction disturbance. Staking would reflect any ROW grant or permit stipulations to avoid or minimize impacts to sensitive environmental areas such as wetlands or cultural resources.

The construction ROW and work areas would be cleared and graded, where necessary, to provide a relatively level surface for trench-excavating equipment and the movement of other construction equipment. Brush, trees, roots, and other obstructions such as large rocks and stumps would be cleared from all construction work areas. Stumps would be removed from the proposed construction ROW. Work pads would be installed to provide a level work surface during construction; see Appendix D for the location of work pads. Snow / ice, gravel, and / or graded work pads would be installed after clearing and grading.

Table 2.3-30: Pipeline Construction Execution Sequence

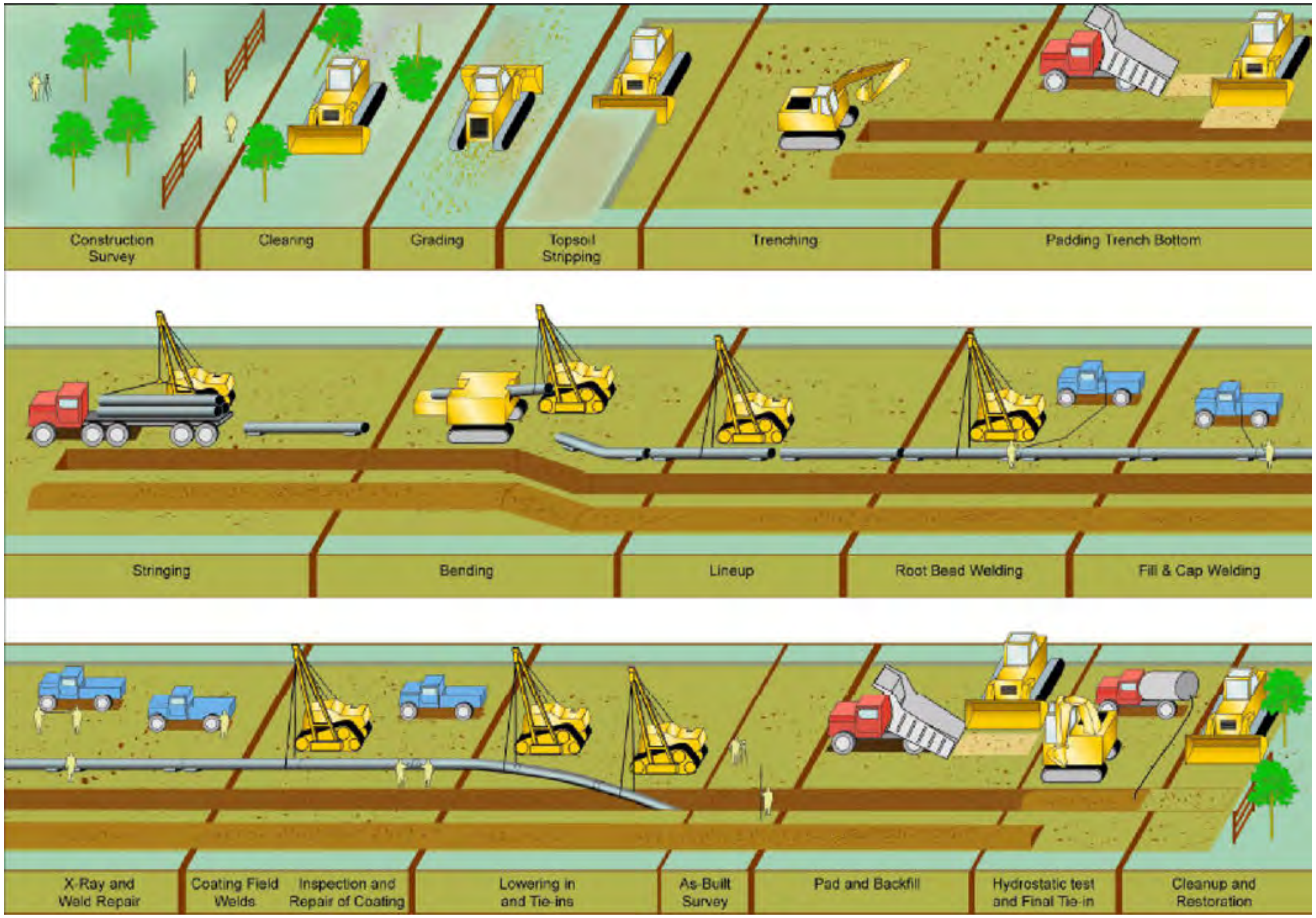
Spread	Season	From Milepost	To Milepost	Length (miles)	ROW Work Start	Pipe Lay Start	Pipe Lay Complete	End of Season
1	Summer 0.5	315.2	247.6	67.6	July – Mine Site	August	October	November – Alpine Ridge
	Winter 1	247	196.6	51	Nov. – Alpine	January	March	April – Big River
	Summer 1.5	144.4	126.6	17.8	May – S. Fork Kusko River	July	August	September – Tatina River
	Winter 2	144.4	196.6	52.2	Nov. – S. Fork Kusko River	January	March	April – Big River
Subtotal:				188.6				
2	Winter 1	0.0	50.8	50.8	Nov. – Beluga	January	March	April – Skwentna River
	Winter 1	101.8	111.6	9.8	March – Puntilla :Lake	March	April	April – Threemile Creek
	Summer 1.5	111.6	126.6	15	June – Threemile Creek	July	August	September – Tatina River
	Winter 2	101.8	5.08	51	Nov. – Puntilla Lake	January	March	April – Skwentna River
Subtotal:				126.6				

Notes:

Pipeline mobilization is scheduled for S-05 and pipeline commissioning is scheduled for S-2.5. Preliminary Civil Construction of access roads, airstrips, barge landings, pipe storage yards, campsites, etc., begins in W-0, one year before the first winter of pipeline construction.

Daily pipe lay rate (in linear feet) and pipe lay duration (in number of days) for each construction section would be estimated during final design.

Source: SRK 2013b



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TYPICAL PIPELINE CONSTRUCTION SEQUENCE

JUNE 2017

FIGURE 2.3-28

Standard Trenching Procedures

The pipeline would be buried below the ground surface to a depth that would meet or exceed USDOT standards at 49 CFR 192.327. The minimum depth of cover for the pipeline, in accordance with 49 CFR Part 192, is between 18 and 48 inches (see Table 2.3-31).

Table 2.3-31: Minimum Cover Requirements

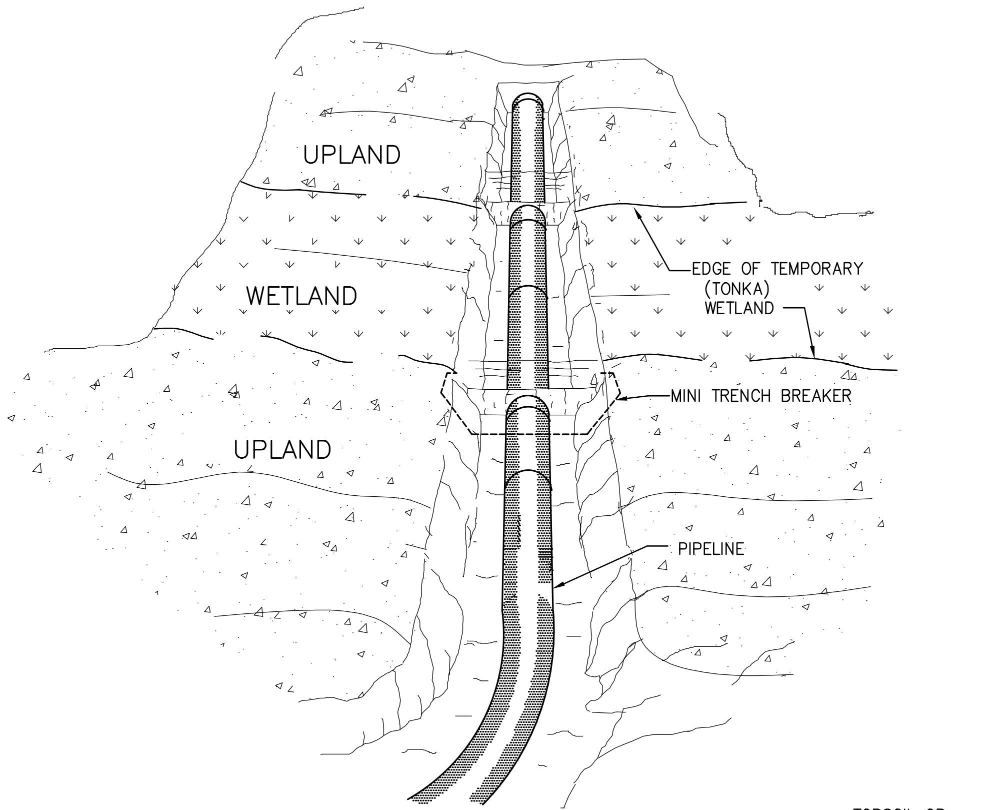
Pipeline area	Minimum Cover (inches)	
	Soil Trench	Rock Trench
Standard trench	30	18
Drainage or ephemeral waterways	48	24

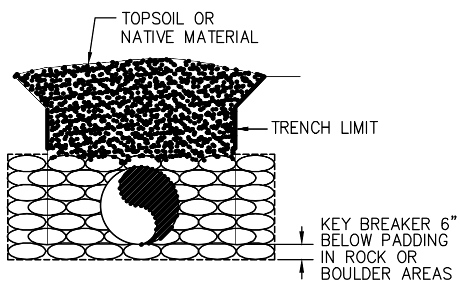
Source: SRK 2013b

The actual installation depth of the pipeline would vary, ranging from the minimum depth requirements to the depth required for safe crossing of a feature such as a water body. Final design depth would be based on detailed site evaluations.

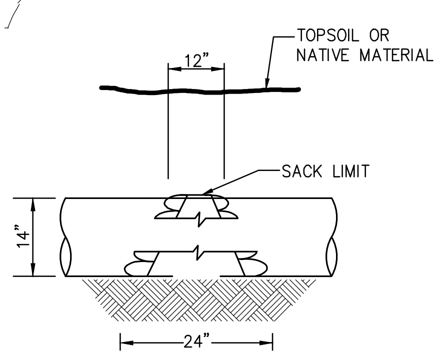
The pipeline would be buried in trenches or through HDD. The latter is generally used on major river crossings or in locations where the pipeline would cross waters that support high-value or sensitive fish habitats, and in geological hazard areas where trenching is not feasible because of unstable slopes. A trench would be excavated using chain excavators, wheel trenchers, and/or backhoes. Trenching crews would excavate a trench deep enough to provide the design soil cover depth over the top of the pipe. Construction methods used to excavate the trench would vary, depending on soil type and terrain. Excavators would generally be used in areas of steep slopes, high water table, soils with cobbles and boulders, or deep trench areas such as river and stream crossings.

Excavated materials would normally be stored on the spoil side of the trench, away from construction traffic and pipe assembly areas. Subsoil would not be stored in flowing water bodies, dry drainages, or washes that cross the ROW. Subsoil would be placed on the banks of the drainage in such a manner as to prevent sedimentation from occurring, or placed in another location. "In areas where significant organic surface mat is present, efforts would be made to separate this material from mineral soils during excavation of the trench and to stockpile it separately for use in final cover and reclamation of the trench line after pipe installation" (SRK 2013b). Where required, temporary mini trench breakers or barriers would be used to create segments within the open trench to reduce erosion, as shown on Figure 2.3-29. Trench breakers would typically consist of polyurethane foam, sandbags and/or gravel placed across the ditch. Trench dewatering may also be required along portions of the route.





CROSS SECTION



SIDE VIEW

NOTES:

1. MINI-TRENCH BREAKERS SHALL BE INSTALLED AT EDGE OF EACH TEMPORARY (TONKA) WETLAND.
2. OPEN WEAVE HEMP OR JUTE SACKS SHALL BE FILLED WITH A MINIMUM OF 55lbs. OF SAND OR SUBSOIL.
3. BREAKER CONFIGURATION MAY BE CHANGED TO INCLUDE KEYING AS DETERMINED BY COMPANY ENGINEER.

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ALTERNATIVE 2
TYPICAL TRENCH BARRIER

JUNE 2017

FIGURE 2.3-29

Standard Pipe Stringing, Bending, Welding, and Inspecting

Sections of 60-foot pipe would be delivered in straight sections. The straight sections of pipe would be temporarily placed or "strung" along the excavated pipeline trench, where they would be bent as necessary to follow the natural grade and direction changes of the ROW. Stringing operations would be coordinated with all other installation activities to ensure that the pipe is available for bending, welding, and lowering-in to minimize the amount of time the trench is open. The longer a trench is open, the higher the chance of the trench filling with snow and having to remove snow. Following stringing and bending, the ends of the pipeline would be carefully aligned and girth-welded together. The girth welds would be visually inspected and tested to ensure their structural integrity, using non-destructive examination methods such as radiography (x-ray), gamma ray, or ultrasound. Those girth welds that do not meet established specifications would be repaired or replaced.

Because much of this project would be constructed in winter, the contractor may elect to trench after the pipe is strung. This would mean that the trench would have to be dug to fit the bent pipe. The bending engineer would work off the profiles and plans on the alignment sheets and would survey the original ground. From that information and knowing the intended depth of cover, the bending engineer can calculate the bends. The trenching crew would make sure that sags, overbends, sidebends, and combinations are dug to match the pipe.

Standard Lowering-In and Backfilling

To prevent corrosion, the majority of the pipe would be externally coated with a three-layer polyethylene coating if deemed compatible with the pipeline cathodic protection system, otherwise a fusion bonded epoxy (FBE) coating will be used. Following welding, field joints would be coated with a field-applied liquid epoxy, or with polyethylene shrink sleeves on any section utilizing three-layer polyethylene coating. The coating on the remainder of the completed pipe section would be inspected for defects, and any damaged areas would be repaired prior to lowering the pipe into the trench. At locations with saturated soils, the pipeline would be coated with concrete, bolt-on river weights, or saddle bags to provide negative buoyancy, if required.

Before the pipe section is lowered into the trench, inspection would be conducted to verify that the trench bottom is free of rocks and other debris that could damage the external pipe coating. Dewatering may be necessary where water has accumulated in the trench. This would occur in accordance with permit requirements. Sideboom tractors would be used to lift the pipe, position it over the trench, and lower it into place. Specialized padding (soil screening equipment) machines may be used to screen previously excavated mineral soils to provide a padding and bedding material free of larger material (>1 inch in size) to line the bottom of the trench before lowering-in pipe, and to provide backfill material next to the sides and the top of the pipe that would not damage the pipe coating. The coating would be inspected again just before the pipe is placed in the trench.

<u>Pipeline – Site-Specific Construction Procedures</u>

Certain locations along the ROW will require specialized construction techniques for crossing water bodies or fault lines, and in areas of permafrost or steep terrain.

Water Body and Wetland Crossings

Pipeline stream crossings would be accomplished using one of the following or similar crossing methods: HDD, open cut, dry flume, open cut dam and pump, flowing water open cut, non-flowing water open cut, or small creek crossing. Typical winter crossings of water courses where there is no surface flow would be by open cut. Where feasible, the crossing would be open cut; otherwise, the crossing would be achieved by HDD based on the evaluation criteria below. Smaller drainages would be installed by open cut, where practical.

Construction effects on fish and fish habitat areas would be minimized by selecting stream crossing techniques that provide the appropriate level of protection for the specific habitat sensitivity. In-water work windows would be used to minimize effects on fishery resources during sensitive life-cycle stages. Appropriate stream bank rehabilitation and reclamation techniques and BMPs would be used.

Installation techniques used to cross water courses are described below and would depend on the season of crossing, terrain, geotechnical and environmental conditions, the presence of fish resources, and engineering needs. Each stream crossing would be conducted in a manner and during a time period that avoids or minimizes potential fishery effects.

There are a number of stream-crossing techniques that can be used to protect fishery resources during sensitive periods. These techniques attempt to isolate the in-water work area from the flowing water of the stream being crossed and include the measures listed below:

- HDD beneath large rivers and critical fish habitat;
- Damming and pumping streams around crossing sites;
- Diverting streams to dewater crossing sites;
- Crossing when streams are completely frozen;
- Fluming streams through temporary culverts and placing the pipeline beneath the culverts; and
- Surveying for fish overwintering areas and avoidance of these locations.

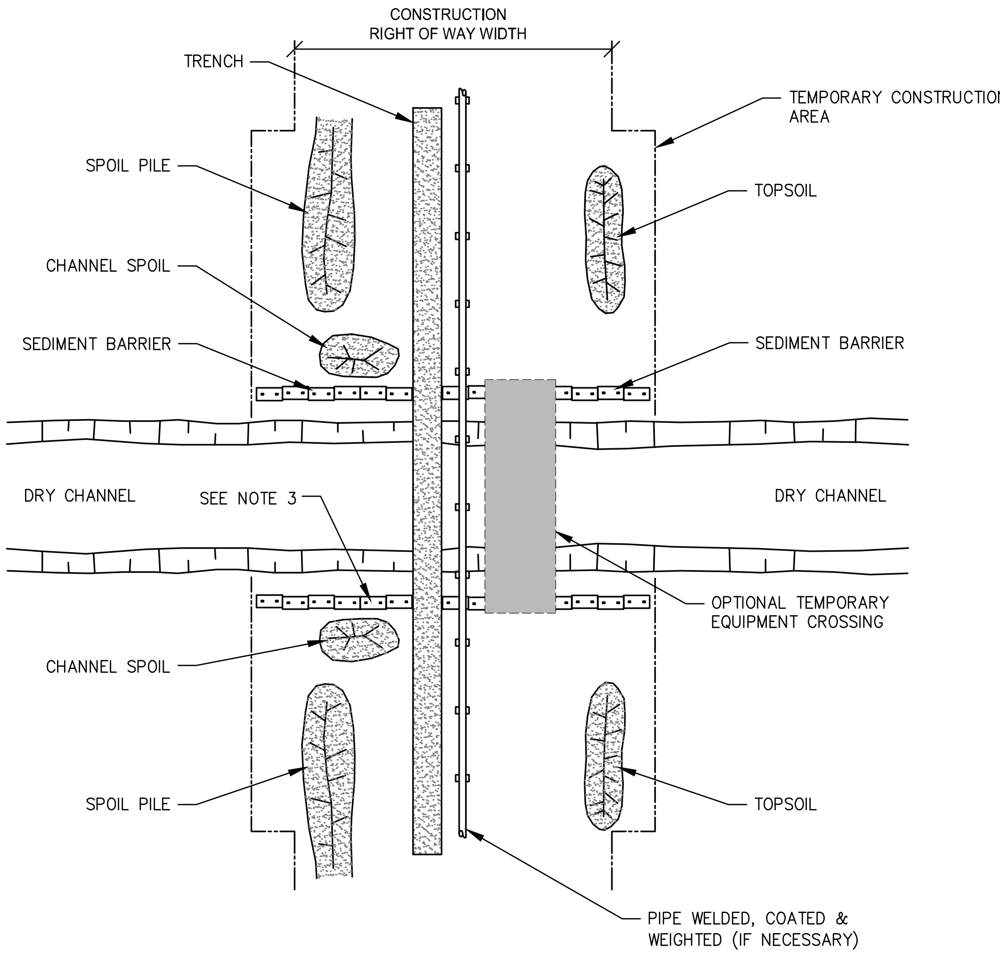
The method of crossing would be determined during final design and confirmed at the time of construction.

Open Cut Method

Typical winter crossings of water courses where there is no surface flow would be by open cut. A typical, non-flowing, open-cut water body crossing is shown on Figure 2.3-30.

In general, the open cut method would be used for three different types of water bodies. This would be the preferred method for the crossing of the following:

- Intermittent streams, ditches, and non-sensitive water bodies where sedimentation is not a significant factor.
- Frozen rivers or streams in winter that have no surface flow. A large number of streams that would be crossed in winter will fit this category.



PLAN VIEW

NOT TO SCALE

NOTES:

1. METHOD APPLIES TO CROSSING WHERE NO FLOWING WATER IS PRESENT AT THE TIME OF CROSSING.
2. CONTRACTOR MAY "MAINLINE THROUGH" THE CROSSING OR UP TO BOTH SIDES OF THE CROSSING; STRING, WELD, COAT, AND WEIGHT (IF NECESSARY), USING THE MAINLINE CREW WITH THE PIPE SKIDDED OVER THE CROSSING.
3. CONSTRUCT SEDIMENT BARRIERS ACROSS THE ENTIRE CONSTRUCTION R.O.W. FOLLOWING CLEARING AND GRADING AND MAINTAIN UNTIL CONSTRUCTION OF THE CROSSING. EROSION CONTROL MEASURES SHALL BE REINSTALLED IMMEDIATELY FOLLOWING BACKFILLING OF TRENCH AND STABILIZATION OF BANKS.
4. TOPSOIL AND SPOIL WILL NOT BE STOCKPILED IN THE CROSSING CHANNEL.
5. MAINTAIN STREAM FLOW THROUGHOUT CROSSING CONSTRUCTION.
6. BACKFILL WITH NATIVE MATERIAL.
7. RESTORE CROSSING CHANNEL TO APPROXIMATE PRE–CONSTRUCTION PROFILE AND SUBSTRATE.
8. RESTORE CROSSING BANKS TO APPROXIMATE ORIGINAL CONDITION AND STABILIZE, AS REQUIRED.

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ALTERNATIVE 2
TYPICAL NON FLOWING OPEN CUT
WATER BODY CROSSING

JUNE 2017 FIGURE 2.3-30

- Streams and rivers so large that no isolation method can be used. The open cut method would be preferred for larger streams and rivers, depending on several factors including the crossing season, flow volume, water velocity, type of bed material or substrate, width, depth, amount of cover, type, and extent of buoyancy control.
  - The South Fork of the Kuskokwim River would be a winter open cut and the Tatina River would be open cut during the July-August time frame.
  - The crossings of the Big River, the Middle Fork of the Kuskokwim River, Windy Fork, Sheep Creek, and Tatlawiksuk River would be by winter open cut.
  - For larger rivers, the trench would be excavated through the water body, using backhoes operating from the banks, or within the water body if it is too wide. For wide, braided rivers, backhoe operators would have to install some channel diversion to provide safe work access. Spoil from intermittent streams, trenches, and non-sensitive water bodies would be placed at least 10 feet from the water's edge on the construction ROW or in the extra workspace. The spoil would be contained as necessary by silt fence to minimize sediment movement. A tie-in crew would be used to execute open cuts on intermittent or small streams.
  - For water bodies other than non-flowing streams or drainage ditches, a trench plug would be left between the upland trench and the in-stream activities to prevent diversion of water into upland portions of the pipeline trench and to keep accumulated trench water out of the water body. The trench plug would be removed to allow installation of pipe.

Dam-and-Pump Method

The dam-and-pump method is a dry crossing method that is suitable for low-flow streams that have a streambed contour suitable for dam installation. The dam-and-pump method has severe limitations for use in winter because discharge hoses would freeze, reducing or shutting down pump output.

The dam-and-pump method involves damming the stream with sandbags or water bladders upstream and downstream of the proposed crossing before excavation and pumping water around the construction area. Pumping the water body across the ROW would begin simultaneously with dam construction to prevent interruption of downstream flow. Water body flow would be pumped across the construction area through hoses and discharged onto an energy-dissipation device where required to prevent scouring of the streambed.

Some streams or rivers that have low flows in the winter are candidates for dam-and-pump. No specific dam-and-pump crossings have been identified at this stage of design.

Flume Method

The flume method would be suitable for crossing sensitive, relatively narrow water bodies that have straight channels and are relatively free of large rocks and bedrock at the point of crossing. The flume method would not be appropriate for wide or heavily flowing streams. This method involves placement of flume pipes in the water body bed to convey water flow across the construction area, isolating the stream flow from the trench water.

Flumes would be selected with sufficient diameter to transport the maximum flows anticipated at the respective crossings. The flumes, typically 40 to 60 feet long, would be installed before trenching and would be aligned so as not to impound water upstream of the flumes. The flumes would not be removed until after the trench has been dug, the pipeline has been installed, and the trench has been backfilled.

The upstream and downstream ends of the flumes would be incorporated into dams made of sandbags and plastic sheeting (or other suitable material). The upstream dam would be constructed first and would funnel stream flow into the flumes. The downstream dam would prevent backwash of water into the trench and construction work area. The dams would be monitored and adjusted to minimize leakage.

After the flume has been installed and is functioning properly, backhoes located on one or both streambanks (or within the streambed itself if it is too wide) would excavate the trench. Spoil from the stream or riverbed and banks would be placed at least 10 feet from the water's edge or in the extra workspace. The spoil would be contained as necessary by a silt fence to minimize sediment movement.

Standing water that is isolated in the construction area by the dams or any water that leaks through the dams or seeps from the ground into the trench during construction would be pumped to an area in a manner designed to prevent the flow of heavily silt-laden water back into the stream, and applicable permits would be acquired. Sediment control devices would be used as necessary at the outlets of trench pumps.

After the trench has been excavated, the pipe would be installed. There may be some crossings where the pipe section would be short and straight enough for it to be pulled or lowered in under the flume. However, there would be many crossings where the sagbends on the crossing pipe or the length and weight of the pipe would require the flume to be pulled temporarily. In such cases, the flume would be reinstalled as soon as the pipe is in place.

This is a very common method for water body crossing installation; however, the route would not include many rivers with characteristics that favor the use of this method. The Tatlawiksuk River is one possibility. In winter, this method can be used on large rivers that have very low flow. In summer, its use would be limited to small streams.

Channel Diversion

The channel diversion method diverts a stream or river from its natural channel to a temporary channel excavated for that purpose. It can also involve diverting a stream or river flow into another natural stream channel. This can be accomplished by constructing dams both upstream and downstream of the pipeline crossing area in the water body to cause the flow to be diverted through the temporary diversion channel. Excavation and pipe installation can then proceed across the natural channel while being isolated from the flow. After the pipe has been backfilled and the banks have been restored and protected as required, the dams would be removed while the ends of the diversion channel are simultaneously being backfilled to allow the flow to return to the original channel. This method requires suitable flat terrain adjacent to the stream or river. Diverting flow into a newly excavated channel would produce some sedimentation, so the use of a natural channel is preferable.

Horizontal Directional Drilling

HDD is a trenchless crossing method that may be used to avoid direct impacts on sensitive resources, such as water bodies, by directionally drilling beneath them. HDD involves installation of the pipeline beneath the ground surface by pulling the pipeline through a pre-drilled bore hole. HDD installation is typically carried out in three stages: 1) directional drilling of a small-diameter pilot hole; 2) enlarging the pilot hole to a sufficient diameter to accommodate the pipeline; and 3) pulling the prefabricated pipeline, or pull string, into the enlarged bore hole. Figure 2.3-31 depicts a typical HDD crossing schematic. Figure 2.3-32 depicts a typical HDD entry site equipment layout.

Six of the 42 major water body crossings are proposed as HDD crossings:

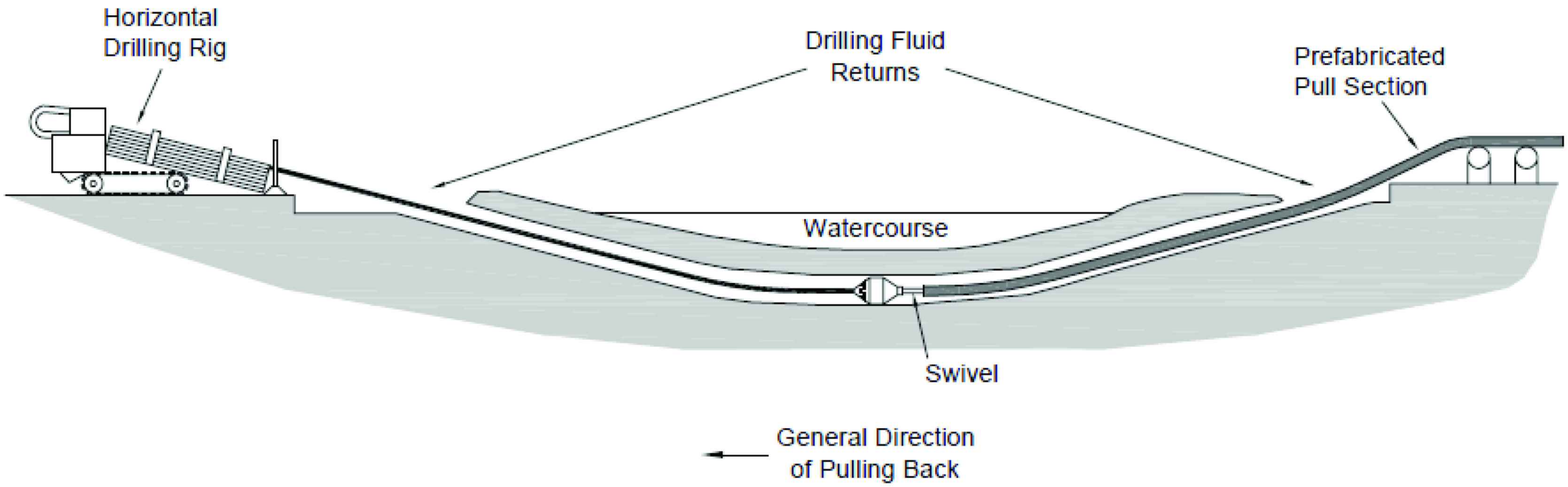
- Skwentna River (MP 50) 2,981 feet;
- Happy River (MP 86) 3,453 feet;
- Kuskokwim River (MP 240) 7,101 feet;
- East Fork of the George River (MP 283) 4,532 feet;
- George River (MP 290) 2,957 feet; and
- North Fork of the George River (MP 298) 3,281 feet.

According to the Natural Gas Pipeline Plan of Development (SRK 2013b), HDD crossing locations were determined based on the following criteria:

- Is this a significant sized river that presents engineering / other challenges for trenching?
- What is the technical feasibility of drilling, can it be done with current technology?
- Is there significant traffic on the river?
- What is the proposed season for construction and trenching (if not drilled), summer or winter?
- Is this a river that has environmental or engineering considerations that would mandate evaluating the use of HDD?
- What are the environmental, engineering, and schedule impacts associated with HDD at the crossing?

Estimated water use requirements at a rate of 4,050 to 6,000 gpm withdrawal rate and drilling cuttings and mud disposal at HDD crossings are summarized in Table 2.3-19.

HDD operations would be addressed in the HDD Plan which would be prepared to meet regulatory requirements including management and disposal of drill cuttings and drill mud generated as a result of HDD operations. HDD drill cuttings and drilling mud disposal options include disposal in onsite ADEC permitted pits or offsite disposal depending in part on the types of additives that are needed to complete the drilling.



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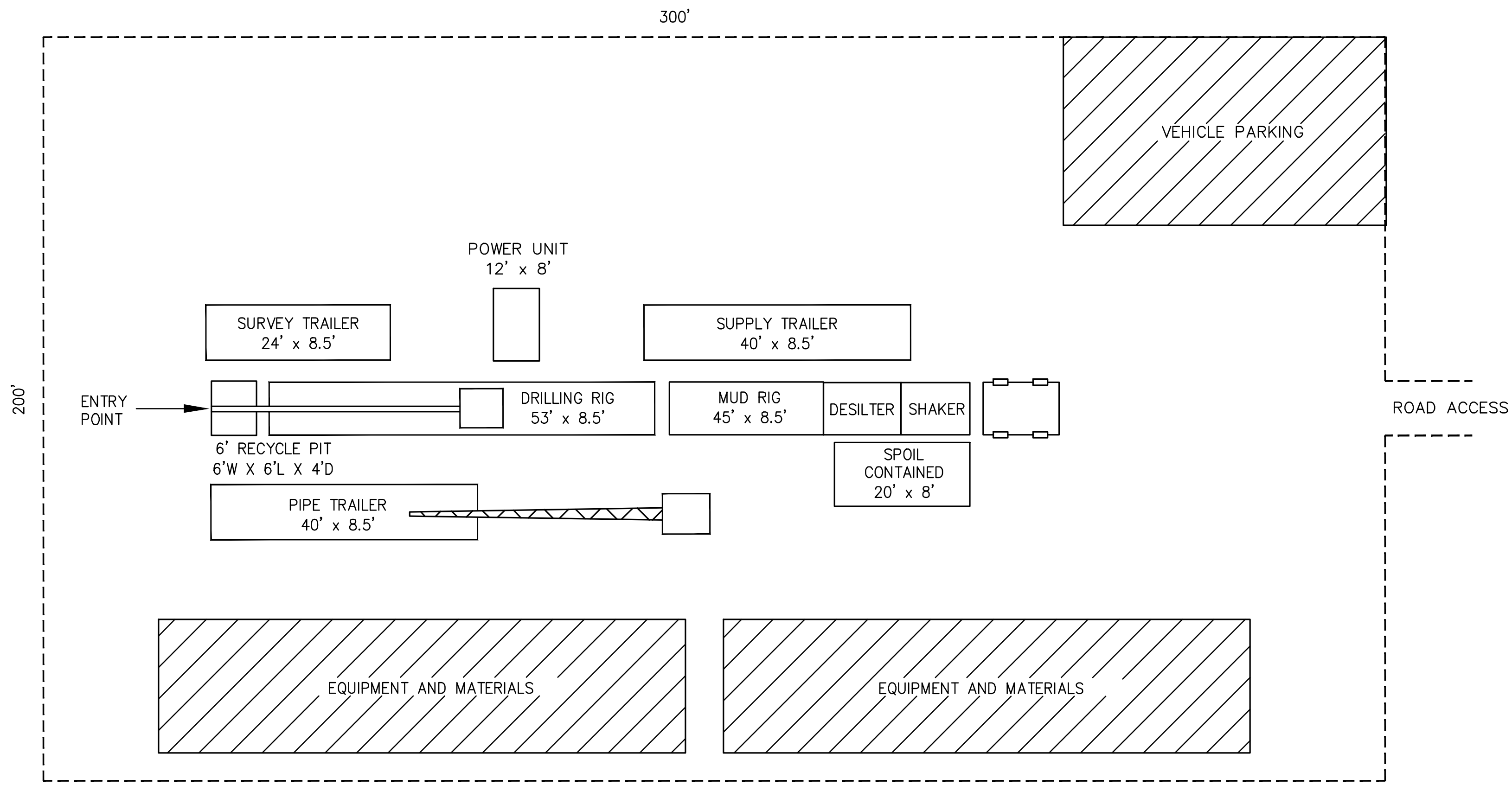
ALTERNATIVE 2
TYPICAL HDD CROSSING

JUNE 2017

FIGURE 2.3-31



NOTE:
THIS IS A TYPICAL SITE SET-UP. THERE ARE VARIOUS CONFIGURATIONS USED DEPENDING UPON SITE RESTRICTIONS. FIELD MODIFICATIONS TO SUIT SITE.

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ALTERNATIVE 2
TYPICAL HDD ENTRY SITE
EQUIPMENT LAYOUT

JUNE 2017

FIGURE 2.3-32

Surface Water Crossing Mitigation

Potential impacts to surface water resources would be mitigated during pipeline construction by following general procedures designed to minimize alterations to stream channel bed and banks that could lead to increased erosion and sedimentation in the channel. The following BMPs would be implemented at surface water crossings as necessary (SRK 2013b):

- Construction precautions would be taken for activities across water bodies to minimize terrain disturbance;
- Maintaining, to the maximum extent practicable, the existing surface hydrology at all water body crossings;
- Trench plugs would be used to prevent sediment-laden water from entering a surface water body;
- Trench spoil would be placed at least 30 feet from the edge of a receiving water body;
- Locating fuel storage, equipment refueling, and equipment maintenance operations at least 100 feet from surface waters;
- Stabilization of the water body shoreline would include installation of erosion control matting to armor the approach where disturbance has occurred;
- Wattles, silt fences, brush berms, or rolled erosion control products would be installed parallel to the shoreline across the entire construction ROW to minimize sediment before it enters the receiving water body (see Section 3.2, Soils, for additional erosion control measures);
- If required, temporary silt curtains would be installed and used as a turbidity barrier along the edge of water bodies. The curtains would be installed during periods of active construction;
- Stream channel banks would be revegetated and graded to their original configuration, or to a more stable configuration if original stream banks were unstable; and
- Silt-laden water produced from trench dewatering would be pumped through filter bags and discharged into an energy dissipater before entering any surface water.

At stream and river crossing approaches, temporary erosion control measures would be removed only when vegetation on the bank has progressed to the point where it can prevent erosion and keep sediment from entering the receiving water body.

Summary – Surface Water Crossings

Potential impacts to surface water from clearing and grading within the construction ROW at stream crossings includes increased runoff, erosion, and sedimentation due to removal of vegetation and soil compaction from equipment. Pipeline construction would not result in long-term alterations to stream flow, stream profile, or structural components of streams and other water bodies crossed by the pipeline (see Section 3.11, Wetlands, for description of wetlands crossing). For most stream crossings, temporary disturbances to water bodies would be limited to the Construction Phase. Stream beds, banks, and riparian areas would be restored to pre-project contours and configurations to the maximum extent possible. Channel banks and riparian areas would be revegetated to prevent erosion and to maintain bank stability.

Design and implementation of erosion control procedures and BMPs at each water body crossing would minimize potential impacts to surface water flow and sediment load. Additionally, potential impacts to surface water are reduced by installing the pipeline across most water bodies during winter months and low stream flow conditions. Therefore, the magnitude of the impact of pipeline construction on surface water flow and sediment load at pipeline crossings is expected to be low. The magnitude of potential scour effects would be low to medium (design adequate for conditions), and would be minimized through increased depth of cover in high hazard areas and bank stabilization techniques. The duration of the ROW runoff and erosion impacts is expected to be temporary (primarily lasting through the Construction Phase of three to four years), and the duration of scour impacts could be long-term to permanent. Some stream crossings would require water diversion around the construction area; however, the potential impacts to stream flow are expected to be negligible to minor, and the geographic extent is expected to be local. The context is considered common to important for this abundant but shared and regulated resource.

Wetland Crossings

The method of pipeline construction to be used in wetlands and the required width of the construction ROW would depend on the season, the presence or absence of permafrost, the classification of the wetland, access, and environmental conditions at the time. There would be three basic approaches to crossing wetlands. The most common method would be winter construction, but some summer crossing of wetlands will be required. These may be crossed using a gravel fill workpad or using a temporary workpad over geotextile, or other method of separation that would supplement the pad.

Winter construction is planned for a majority of the route. In winter, wetlands that are underlain by permafrost would be crossed using an ice or snow pad. Wetlands without permafrost would be frost packed to freeze them down to more competent soils or deep enough to support the pipe and construction equipment. There may also be wetlands with a deep active layer that would be frost packed because the active layer does not need an ice pad. In deep wetlands or in mild winters, it may be necessary to place timber corduroy or mats in the wetland, even in winter, to support the pipe and/or equipment. Winter matting would be used for warm or short winters. As a last resort, in some areas along the north flank of the Alaska Range, the placement of some fill may be required to provide a level running surface in low snow years if there is not enough snow and water available to support the development of a frost-packed road.

For summer construction in wetlands without permafrost, workpads can be temporary. They would be made from imported fill and/or trench spoil (if suitable) or timber mats. A layer of geotextile or mats would be used to separate fill from vegetation. Upon completion, the fill and other materials would be removed.

Vegetation within wetlands would be cut to ground level, and stump removal would be restricted to the trench line, except where necessary to maintain safety. The upper 12 inches (30 cm) of organic material would be segregated from the area to be disturbed by the trench except in winter.

During typical winters, no sediment barriers would be necessary at wetland boundaries or along the edge of the ROW or spoil piles. In summer, sediment barriers would be installed immediately upslope of wetland boundaries as necessary to prevent sediment flow into the wetland. Where the ROW is located through or adjacent to wetlands, sediment barriers would be installed along the edge of the ROW to contain spoil and sediment within the ROW as needed.

During typical winters, temporary workspace setbacks would not be necessary and can be limited to 10 feet. Sometimes it would be necessary to have temporary extra workspace for a river crossing located in the adjacent wetland. In summer, extra temporary workspaces would generally be set back at least 50 feet from the edge of delineated wetlands where topographic conditions permit.

After the pipeline has been lowered into the trench, the trench would be backfilled with excavated trench spoil. A permanent slope breaker and trench breaker would be installed at the boundary to the wetland. Trench breakers would also be used to prevent the pipeline trench from draining a wetland and as necessary to maintain the original wetland hydrology.

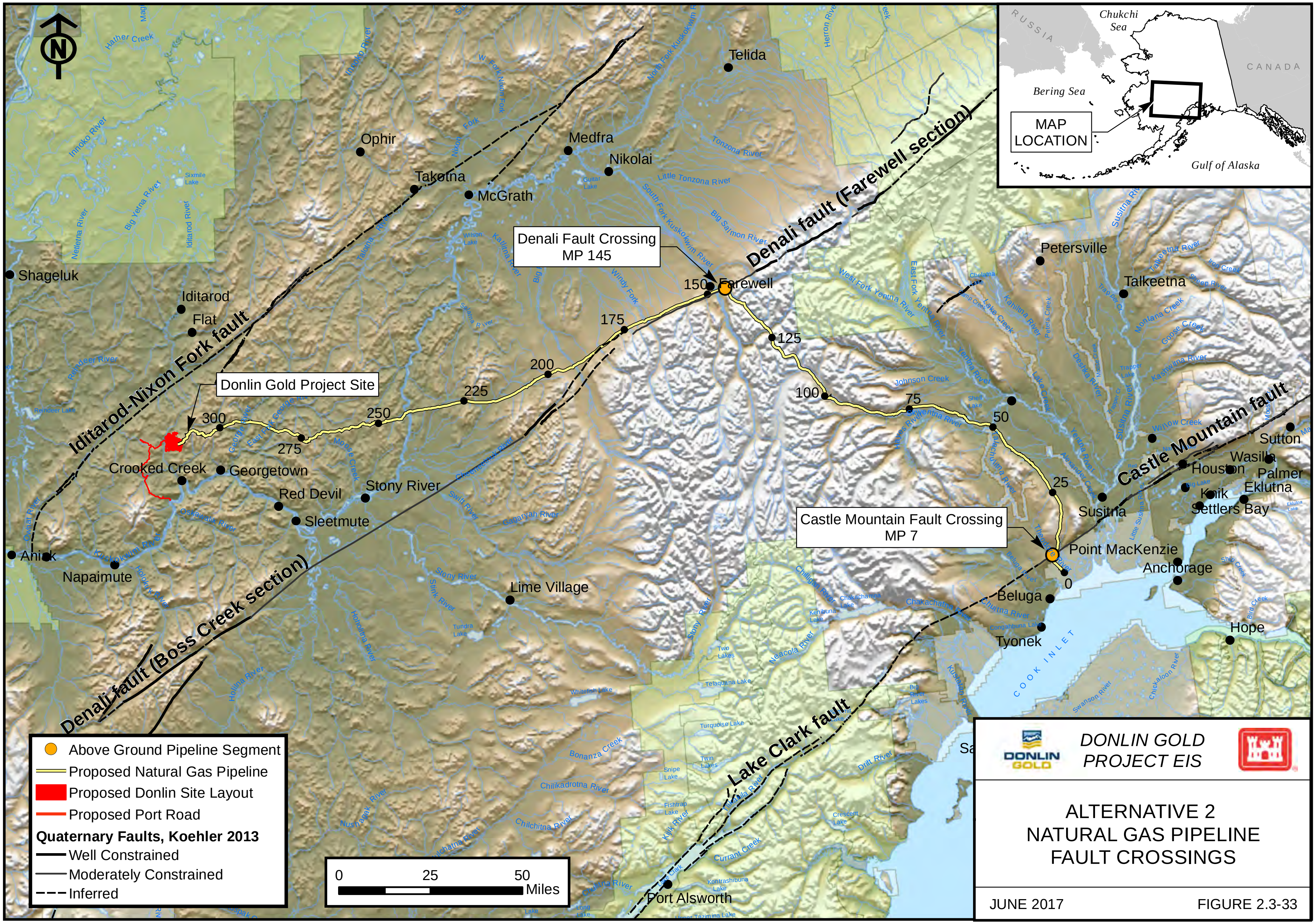
Active Fault Crossings

There are two identified active faults that the pipeline route would cross using above ground methods. These are the Denali-Farewell Fault and the Castle Mountain Fault as shown on Figure 2.3-33. The pipeline would cross the western end of the Castle Mountain Fault at approximately MP 7.5, where the slip rate is relatively low and the most recent movement identified during geologic studies was Pleistocene or older.

The Denali-Farewell Fault intersects the pipeline route near MP 148.5, west of the South Fork of the Kuskokwim River on the northern edge of the Alaska Range. The pipeline route crosses the western end of the central Denali Fault near Farewell, where the slip rate is lower. During any future seismic event on these faults, permanent ground displacement from fault movement is expected to be primarily horizontal rather than vertical. The most recent surface rupture of the Denali-Farewell fault system is considered to be mid-Quaternary.

A preliminary fault-crossing stress analysis conducted for both crossings produced a recommendation for an above-grade design with the pipeline in a "Z" configuration at each end of the potential movement zone to ensure flexibility. Final designs for the above-ground crossings at the Denali-Farewell and Castle Mountain Faults would allow the pipe to move freely above ground on grade beams and/or vertical support beams during seismic shifting without overstressing the pipe. The fault crossing design is based on the Trans-Alaska Pipeline System design for crossing the Denali Fault.

At both of the above-ground fault crossings the thickness of the pipe wall would be increased, and a steel plate shroud would cover 75 percent of the pipe. This shroud would protect the pipe from accidental bullet strikes and would still allow the pipe to move on the horizontal supports to alleviate stress from seismic events at these locations.


N
Telida
Ophir
Medfra
Nikolai
Takotna
McGrath
Shageluk
Iditarod
Flat
Petersville
Talkeetna
Denali Fault Crossing
MP 145
150
Farewell
175
125
200
100
225
75
50
250
300
275
25
0
Donlin Gold Project Site
Crooked Creek
Georgetown
Red Devil
Stony River
Sleetmute
Aniak
Napaimute
Lime Village
Castle Mountain Fault Crossing
MP 7
Point MacKenzie
Anchorage
Beluga
Tyonek
Hope
Susitna
Houston
Wasilla
Sutton
Palmer
Knik
Eklutna
Settlers Bay
Port Alsworth
Denali fault (Farewell section)
Iditarod-Nixon Fork fault
Denali fault (Boss Creek section)
Castle Mountain fault
Lake Clark fault
COOK INLET
Chukchi Sea
RUSSIA
CANADA
Bering Sea
Gulf of Alaska
MAP LOCATION
Above Ground Pipeline Segment
Proposed Natural Gas Pipeline
Proposed Donlin Site Layout
Proposed Port Road
Quaternary Faults, Koehler 2013
Well Constrained
Moderately Constrained
Inferred
0
25
50
Miles
DONLIN GOLD
DONLIN GOLD
PROJECT EIS
ALTERNATIVE 2
NATURAL GAS PIPELINE
FAULT CROSSINGS
JUNE 2017
FIGURE 2.3-33

Pipeline Construction – Blasting

Some material sites, such as Kuskokwim West, where bedrock sources would be used for granular rock fill for road and pad construction, would potentially require blasting. Details regarding the methodology, timing, and location of blasting sites potentially required for pipeline construction are provided in SRK (2013). Blasting may be required to develop material sites at the same locations where a crusher would be needed (MS-02, MS-03, MS-04, MS-49, MS-50, MS-52, and MS-54). It is not anticipated that blasting would be necessary for pipeline installation; however, certain locations that require blasting to excavate the pipeline trench may be identified once detailed designs are undertaken, or possibly only when the actual trench is excavated during Construction.

In all cases, a Blasting Plan would be developed prior to construction for agency review, and would apply in all situations where blasting occurs. All blasting would conform to the rules and regulations of Occupational Safety & Health Administration (OSHA) and of all other relevant federal, state, and local agencies. Federal regulations that apply include, but are not limited to:

- 27 CFR Part 181 – Commerce in Explosives;
- 49 CFR Part 177 – Carriage by Public Highway;
- 29 CFR 1926.900 et seq., Subpart U – Safety and Health Regulations for Constructions – Blasting and Use of Explosives; and
- 29 CFR 1910.109 – Explosives and Blasting Agents OSHA.

Specifications for both ROW grade and trench blasting would be included in the construction documents and would require that detailed blasting procedures be developed before conducting any blasting. Areas of frozen soil and / or bedrock that might be encountered along the proposed pipeline route may also require blasting. Safety controlled blasting techniques would be used in accordance with a Blasting Plan, and would follow all applicable requirements for health, safety, and environmental protection, including standard permit conditions for blasting near fish-bearing water bodies.

Pipeline Construction – Soils, Permafrost and Slope Stability

In areas where the uppermost organic soil can be separated from mineral soils during trench excavation, this material would be recovered and used as the surface portion of the backfill in the trench. Where this material is either nonexistent or not recoverable, an attempt would be made to place finer-grained soils at the top of the trench backfill, in order to facilitate revegetation. In all cases, the trench would be mounded to account for future settlement of trench backfill and to prevent water from ponding over the trench line.

The pipeline route includes more than 100 miles of discontinuous permafrost terrain from approximately MP 100 to MP 205, as shown on Figure 2.3-34. A narrower working surface would be used in areas with steep side slopes. Gravel or granular rock work pads or snow and ice pads would be used in areas of thaw-unstable permafrost or over soft soils that would be unable to support construction equipment, and in areas where removal of the organic layer could allow the permafrost to thaw. This would also apply to wetlands overlaying thaw-unstable permafrost. Narrow working surfaces would be used to minimize cuts in thaw-unstable permafrost and to minimize imported fill for winter work pad on side slopes where ice pads cannot be constructed. Work pads would be left in place after the Construction Phase, leaving the organic layer intact beneath.

Frost packing would be done in winter in locations where soils must be frozen to support construction equipment. Frost packing is usually done on muskeg, wetlands, or other weak soils to accelerate frost penetration. The depth of freezing that would be required would depend on surface and subsurface soil types. Frost packing to depths of three to five feet is accomplished by packing down the snow to drive the frost deeper into the soil.

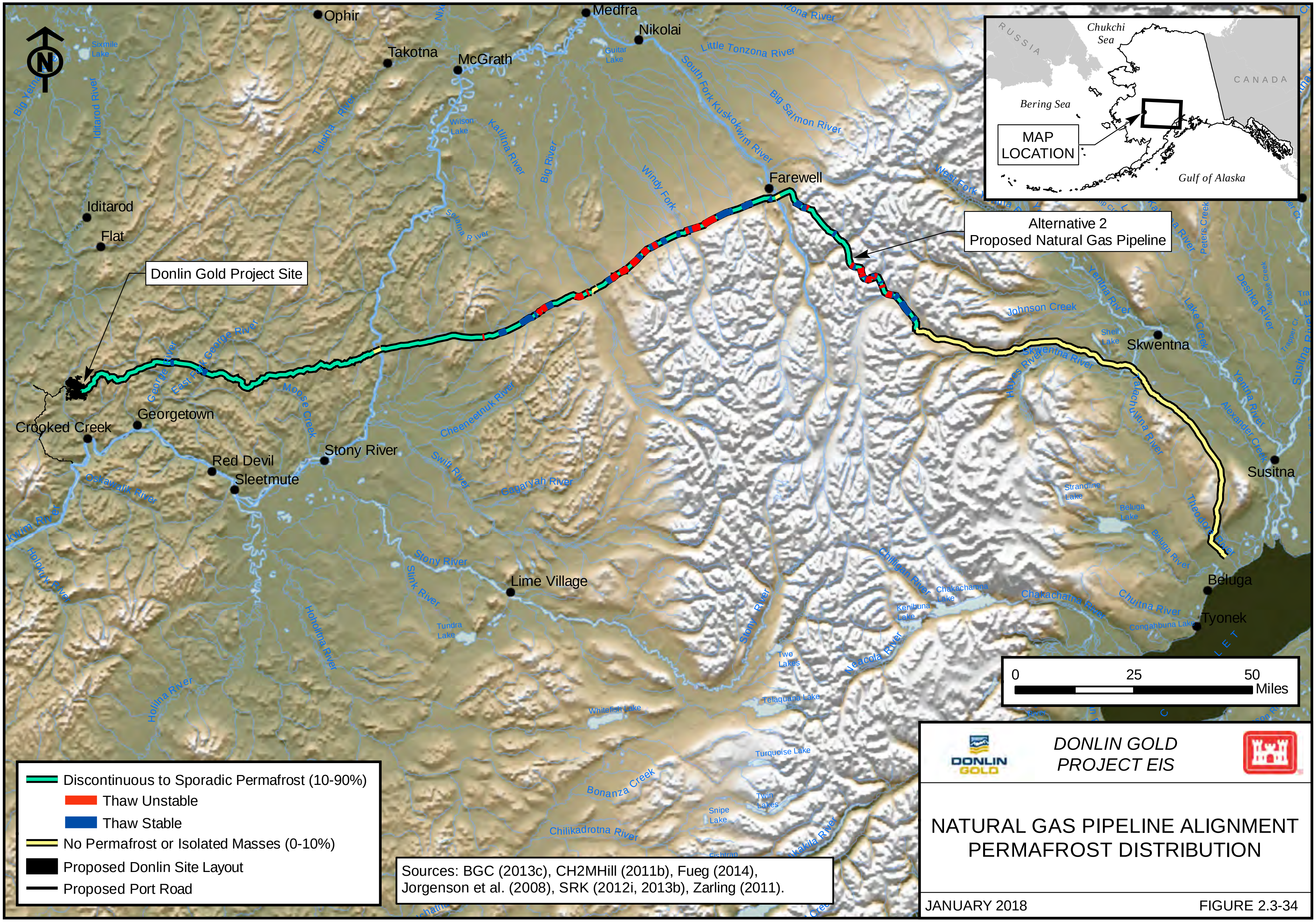
Pipeline – Drainage and Erosion Control

Drainage and erosion control measures, both temporary and permanent, would be implemented along the pipeline ROW and at facilities such as camps, storage yards, material sites, and airstrips and roads. Permanent facilities would also require such measures and would include the metering station, compressor station, fiber optic repeater station, pigging station, and MLV locations.

During pipeline installation, a cleanup crew would follow behind the backfill crew and perform all cleanup, rehabilitation, and reclamation of cuts as well as planned erosion control, during the same season as pipe installation whenever possible. A reclamation crew would go back over the ROW during the summer after a winter season to fix any erosion control problems that have developed during breakup, rehabilitate the trench line and working side as needed to facilitate natural revegetation, and then fix any permafrost degradation that may not occur until later in summer. In a summer section, the reclamation crew would follow the cleanup crew during the same summer. This double coverage of erosion control and reclamation efforts in permafrost terrain would provide additional protection of these sensitive areas.

Stabilization of the backfilled trench may be a multi-year process in some areas, particularly areas with fine-grained, ice-rich soils and wetlands. The proposed pipeline trench may intercept overland flow if not properly addressed and change flow patterns that could erode backfill material from the pipeline trench and could potentially serve to channel water into nearby water bodies and wetlands. Some areas may be covered with geofabric or other material to prevent erosion. In disturbed areas where the vegetated mat is not available, the surface would be prepared for natural revegetation or seeded with native species at the earliest opportunity to minimize erosion and siltation. In wetland areas where the native vegetated mat is side-cast during ditch excavation, a temporary platform/holding structure may need to be constructed/employed and used as a holding containment device to allow the material to be recovered and put back into place on top of the trench (the preferred method of natural revegetation).

Slash, chips, stumps, or other wooden materials, including unused tree trunks generated during the clearing process, would be scattered on the ROW to enhance revegetation and create habitat. Tree trunks used to develop corduroy road beds during Construction would be left in place on the workpad surface.


Donlin Gold Project Site
Alternative 2
Proposed Natural Gas Pipeline
MAP LOCATION
Chukchi Sea
RUSSIA
CANADA
Bering Sea
Gulf of Alaska
Ophir
Medfra
Nikolai
Takotna
McGrath
Iditarod
Flat
Farewell
Skwentna
Susitna
Beluga
Tyonek
Crooked Creek
Georgetown
Red Devil
Sleetmute
Stony River
Lime Village
Little Tonzona River
South Fork Kuskokwim River
Big Salmon River
Windy Fork
Katlitna River
Big River
Iditarod River
Takotna River
George River
East Fork George River
Moose Creek
Cheeneetnuk River
Swift River
Gagaryah River
Oskawalik River
Stony River
Stink River
Hoholitna River
Holitna River
Holokuk River
Johnson Creek
Yentna River
Skwentna River
Hayes River
Lake Creek
Deshka River
Alexander Creek
Yentna River
Beluga River
Chuitna River
Chakachatna River
Chilligan River
Neacola River
Bonanza Creek
Chilikadrotna River
Telaquana Lake
Turquoise Lake
Whitefish Lake
Tundra Lake
Strandline Lake
Beluga Lake
Chakachamna Lake
Kenibuna Lake
Two Lakes
Twin Lakes
Snipe Lake
0
25
50
Miles
Discontinuous to Sporadic Permafrost (10-90%)
Thaw Unstable
Thaw Stable
No Permafrost or Isolated Masses (0-10%)
Proposed Donlin Site Layout
Proposed Port Road
Sources: BGC (2013c), CH2MHill (2011b), Fueg (2014), Jorgenson et al. (2008), SRK (2012i, 2013b), Zarling (2011).
DONLIN GOLD
DONLIN GOLD PROJECT EIS
NATURAL GAS PIPELINE ALIGNMENT PERMAFROST DISTRIBUTION
JANUARY 2018
FIGURE 2.3-34

For summer construction, temporary erosion control measures such as sediment barriers (for example, brush berms) and temporary slope breakers would be installed as needed to contain disturbed soils on the construction ROW and to minimize the potential for soil to enter wetlands or water bodies. After installation, temporary erosion control measures would be regularly inspected and maintained throughout the duration of the Construction Phase, until permanent erosion control measures have been installed and reclamation is complete.

During winter construction, temporary erosion control measures would only be necessary should conditions remain warm. Sediment diversion channels would be put in place and applicable temporary erosion control measures used for summer construction on a case-by-case basis.

Trench plugs would be used in the trench in hilly terrain to prevent water from eroding the trench bottom. Trench plugs would also be used on each side of water body crossings to prevent trench water from entering a stream, river, or wetland.

In addition to reclamation of the ROW, material sites, PSYs, barge landing areas, airstrips, campsites, and temporary access roads would be recontoured and reclaimed to an acceptable condition as required by applicable permits and the approved Stabilization, Rehabilitation, and Reclamation Plan. Revegetation of these disturbed areas would proceed in the same manner as in the ROW.

Donlin Gold would develop an Erosion Sediment Control Plan and a Storm Water Pollution Prevention Plan (SWPPP) prior to the commencement of construction. These plans would outline erosion control BMPs which can include the use of silt fences; bale checks; swales; roots; trench and ditch reinforcement with geotextile fabric or rock; and gabions and sediment traps. Figure 2.3-35 provides an example of a typical silt fence sediment barrier. Where present, topsoil would be segregated from subsoil along the pipeline route.

To contain disturbed soils in upland areas and minimize the potential for sediment loss to wetlands and water bodies, temporary erosion controls would be installed in accordance with Donlin Gold's Erosion and Sediment Control Plan and SWPPP prior to initial disturbance of soils, and would be maintained throughout Construction. These could include erosion control matting on stream banks (Figure 2.3-36), and temporary soil containment berms (Figure 2.3-37).

Pipeline – Corrosion Protection and Detection Systems

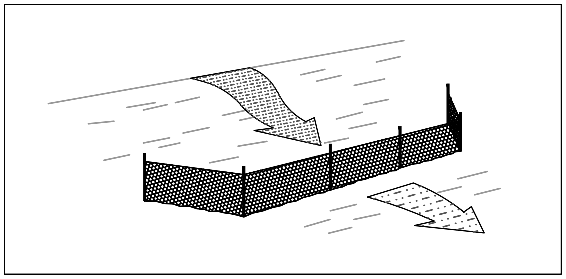
In addition to the coating described above under Standard Lowering-In and Backfilling, the proposed pipeline would use a zinc ribbon for cathodic corrosion protection of the steel pipe. The zinc sacrificial anodes are sometimes referred to as a galvanic system because the anodes used are higher (more active) in the galvanic series than the steel they are protecting. A ribbon of zinc is placed in the pipeline trench and connected to the pipeline through a test station via an insulated wire. Zinc ribbon would be installed after pipe lowering-in and before backfill. Galvanic anodes will not be directly connected to the pipeline and the galvanic anodes will be installed with a means to disconnect the galvanic anodes for the pipeline such that accurate pipe-to-soil potentials can be determined. The cathodic protection system for HDD sections will be determined in final design.

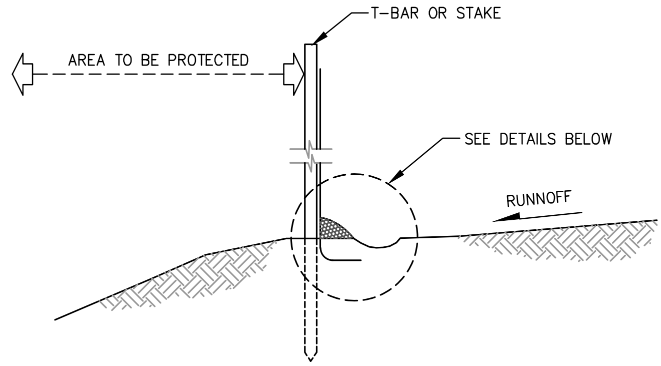
Cathodic protection stations for continuity checks would be installed at approximate 1-mile intervals. Cathodic protection system test sites are often located adjacent to pipeline markers. Land impacts for the cathodic protection system test stations have been accounted for within the temporary construction easement, operations ROW, and permanent workspace requirements for the proposed facilities.

The pipeline would be surveyed at least once each calendar year, but at intervals not exceeding 15 months, to determine whether cathodic protection levels are adequate. The degree of cathodic protection would be controlled to prevent damage to the protective coating of the pipe:

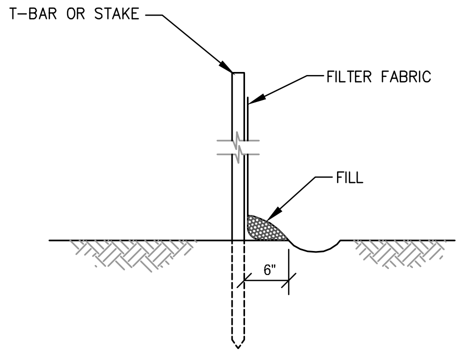
- All pipeline test site corrosion survey data would be analyzed to verify that potentials meet minimum standards of compliance.
- Atmospheric corrosion surveys would be conducted on each pipeline and facility every three years.
- Non-critical interference bonds would be checked at least once each calendar year, at intervals not exceeding 15 months.
- When low pipe-to-soil potentials are found during cathodic protection surveys, remedial measures would be implemented.

The cathodic protection system would be operational as soon as possible after commissioning and startup of the proposed pipeline. The design, installation, and implementation would meet all regulatory requirements to assess the adequacy of the cathodic protection system.

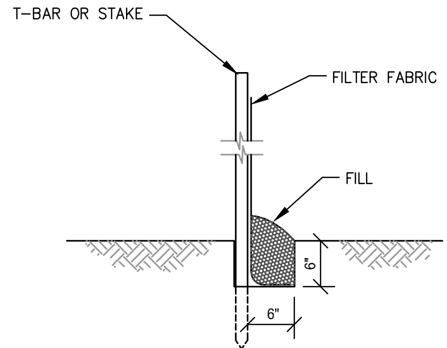




SIDE VIEW
OF SILT FENCE



WITHOUT TRENCH
ROCKY AREAS ONLY



WITH TRENCH

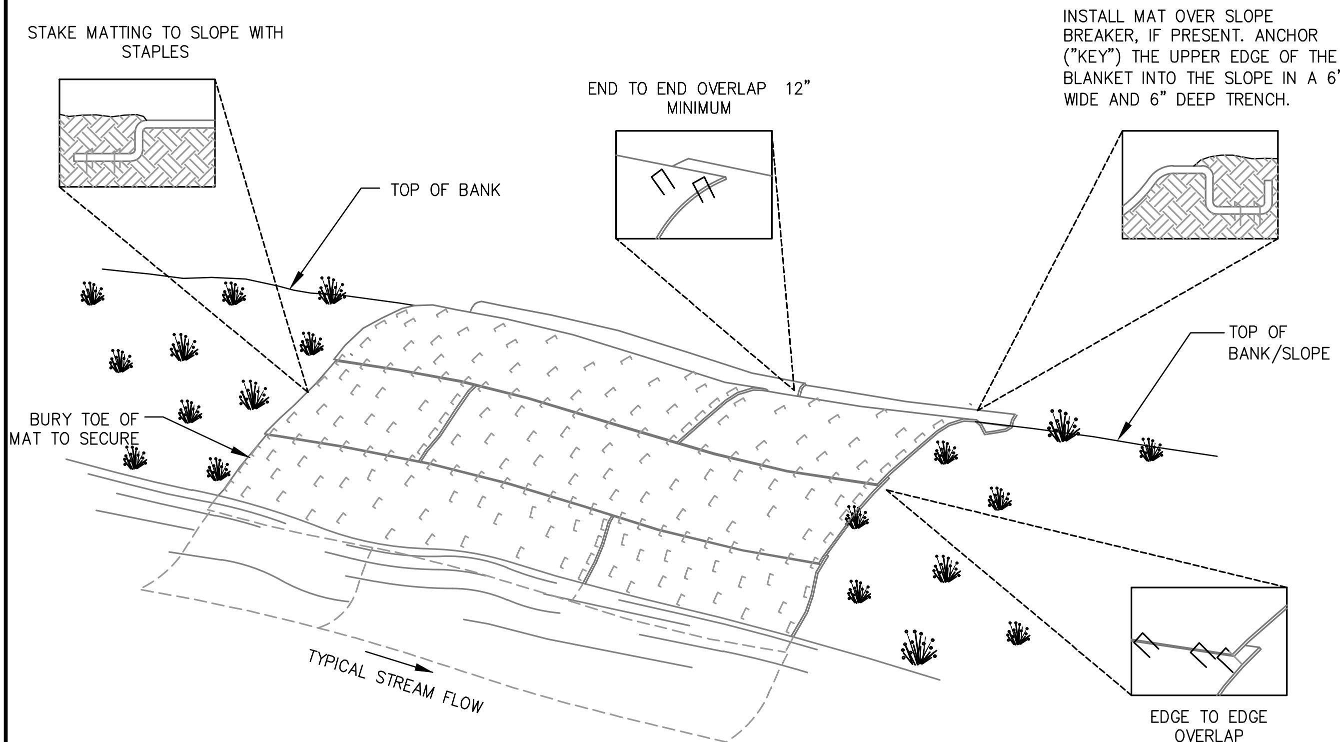
NOTES:

1. SILT FENCE COULD BE UTILIZED AT:
   * THE BASE OF ALL SLOPES ABOVE WETLANDS AND WATERBODIES
   * THE DOWNSLOPE RIGHT–OF–WAY EDGE WHERE ANY OF THE ABOVE–MENTIONED LOCATIONS ARE ADJACENT TO THE RIGHT–OF–WAY.
   * BETWEEN TOPSOIL/SPOIL STOCKPILES AND WATERBODIES OR WETLANDS AS NEEDED.
   * ALONG R.O.W. BOUNDARIES IN WETLAND CONSTRUCTION, AS NEEDED.
   * AS DIRECTED BY THE COMPANY'S REPRESENTATIVE.
2. THE SILT FENCE SHALL BE CONSTRUCTED AS FOLLOWS:
   * FABRIC USED FOR THE SILT FENCE SHALL BE A "STANDARD STRENGTH" GEOTEXTILE.
   * THE HEIGHT OF THE FENCE SHALL BE DONE AT POSTS AND OVERLAP WITH BOTH ENDS SECURED TO THE POST.
3. THE SILT FENCE SHALL BE INSTALLED AS SPECIFIED BY THE MANUFACTURER OR AS FOLLOWS:
   * A TRENCH, 6" WIDE AND 6" DEEP, SHALL BE EXCAVATED ALONG THE CONTOUR. THE POST SHALL BE DRIVEN INTO THE BOTTOM OF THE TRENCH ON THE DOWNSTREAM SIDE OF THE FILTER FABRIC. THE TRENCH SHALL BE BACK FILLED AND COMPACTED, ENSURING 6" OF FENCE IS BURIED WITHIN THE TRENCH.
   * IN AREAS WHERE THE TERRAIN IS TOO ROCKY FOR TRENCHING, A 6" GROUND FLAP WITH ROCK FILL TO HOLD IT IN PLACE SHALL BE USED.

DONLIN GOLD PROJECT EIS

ALTERNATIVE 2
TYPICAL SILT FENCE
SEDIMENT BARRIER

JUNE 2017 | FIGURE 2.3-35



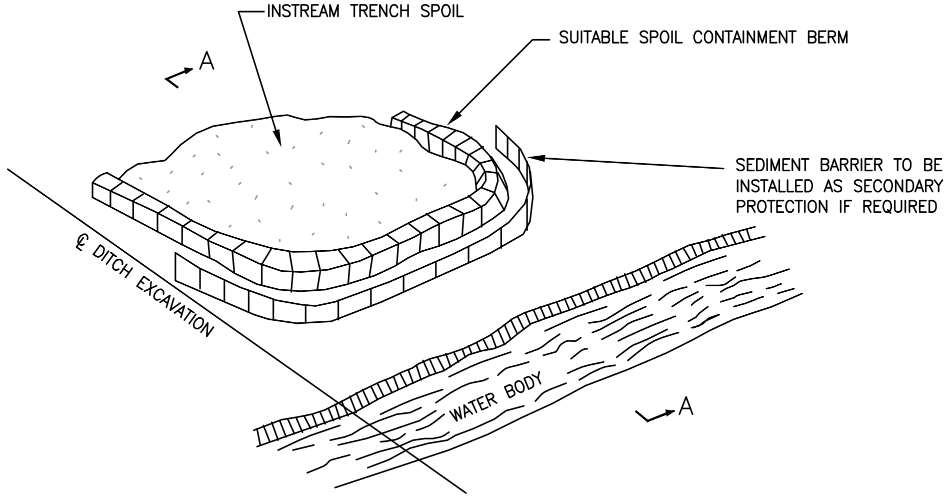
NOTE:

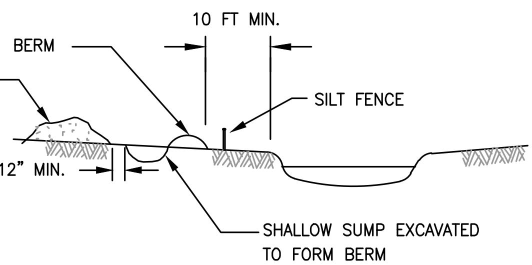
1. EROSION CONTROL MATTING (BLANKETS) COULD BE USED AT THE BANKS OF ALL WATERBODIES AND ON STEEP SLOPES.
2. THE EROSION CONTROL MATTING SHALL MAKE UNIFORM CONTACT WITH THE SOIL UNDERNEATH WITH NO BRIDGING OF RILLS OR GULLY. JOINING MATS SHOULD OVERLAP.
3. MONITOR FOR WASHOUTS, STAPLE INTEGRITY OR MAT MOVEMENT PRIOR TO COMPLETION OF CONSTRUCTION. REPLACE OR REPAIR AS NECESSARY.

DONLIN GOLD PROJECT EIS

ALTERNATIVE 2
EROSION CONTROL MATTING
STREAM BANKS

JUNE 2017 FIGURE 2.3-36





SECTION A–A

NOTES:

1. SOIL CONTAINMENT BERMS ARE TO BE USED WHERE INSTREAM TRENCH SPOIL COULD REENTER THE WATERBODY DIRECTLY OR INDIRECTLY AND WITH SIMULTANEOUS UTILIZATION OF SEDIMENT BARRIERS IF REQUIRED.
2. MATERIAL USED FOR THE CONTAINMENT BERM SHOULD BE KEPT TO A HEIGHT WHICH REMAINS STABLE DURING THE CONSTRUCTION PERIOD.
3. CARE SHOULD BE TAKEN THAT THE SPOIL PILE DOES NOT OVERTOP THE CONTAINMENT BERM.
4. THE CONTAINMENT BERM SHOULD BE DISMANTLED AND THE SITE RESTORED TO THE ORIGINAL CONDITION UPON COMPLETION OF THE WATER CROSSING.
5. CARE AND ATTENTION MUST BE TAKEN TO ENSURE SPOIL CONTAINMENT BERMS ARE MAINTAINED.
6. FULL CONSIDERATION FOR OVERALL SLOPE STABILITY IS REQUIRED WHEN SELECTING A SPOIL CONTAINMENT LOCATION.

DONLIN GOLD
PROJECT EIS

ALTERNATIVE 2
TEMPORARY SOIL
CONTAINMENT BERM

JUNE 2017

FIGURE 2.3-37

Pipeline – Pressure Testing

The entire pipeline would be pressure tested before it is put into service to verify its integrity and its ability to withstand maximum operating pressures. The test would be conducted in compliance with USDOT regulations (49 CFR Part 192). Before the pressure test, each section of pipe would be cleaned. A detailed Pressure Test Plan would be developed during final design to address all aspects of pressure testing.

The pipeline would be pressure tested using water (hydrostatic testing or hydrotesting). Incremental segments of pipe would be filled with water, pressurized, and held for the required duration of the test. The length of each segment tested would depend on topography. Hydrotesting would be conducted in summer, since winter hydrotesting is difficult because of freezing of water in pipe.

As a result, all pressure testing would most likely be done in the summer to avoid the need for antifreeze. To conduct hydrotesting, tests of individual segments typically would be conducted in a sequence in which the test water would be transferred from one segment to another. Test water would be obtained from approved sources in accordance with permit requirements; screens on the intake hoses at surface water sources would be used to prevent entrainment of fish or other aquatic species and to monitor the withdrawal rate to maintain adequate downstream flow to support aquatic life. Volumes of water required would vary depending on hydrotest segment length but could be up to 15 Mgal. An APDES permit would be acquired for the discharge of hydrostatic testing water.

Once hydrostatic testing has been completed, test water would be discharged back to an approved location through a filtration device. Water used for pipeline test purposes would be tested before discharge, as required by project permits. Energy-dissipating devices and / or filter bags would be used to prevent scour, erosion, suspension of sediment, and damage to vegetation. Discharge rates would be monitored and kept within a range appropriate to maintain the effectiveness of the energy-dissipating devices.

Pipeline – Commissioning

After pressure testing, any necessary tie-ins would be made. The welds on the tie-ins would be inspected and the pipeline dried (if required) before commissioning begins. Commissioning would include testing of controls and communication systems before pipeline operation.

Pipeline – Construction Work Force and Schedule

The pipeline construction workforce size is expected to peak during the two winter construction seasons, at approximately 650 people. Refer to Table 2.3-30 for timing related to mobilizing and demobilizing these camps. For summer seasons, the effort would be similar. During the first summer, workers would mobilize to the Mine Site.

Pipeline – Vehicles and Equipment Required for Construction

Estimates for the number of vehicles required for ice road building and construction of pipeline segments are provided in Table 2.3-32.

Table 2.3-32: Equipment Type, Usage Factor and Schedule/Period for Pipeline Construction

Equipment	No. of Units	Usage Factor (%)	Utilization	Schedule/Period of Use
D5G Mulchers	4	50	Ice road building	Winter
Cat D6 LGP Dozer	4	50	Ice road building	Winter
Tracked Excavators	6	50	Ice road building	Winter
Tracked Feller/Buncher	4	50	Ice road building	Winter
Tracked carriers	4	50	Ice road building	Winter
Cat 977	1	50	Ice road building	Winter
Trail Groomers	2	100	Ice road building and maintenance	Winter
Snowmachines	10	25	Ice road building and maintenance	Winter
Water tanker	2	100	Ice road building and maintenance	Winter
Pipeline Spread 1				
Air Compressor 1750 cfm	4	10	Pressure Testing & Drying	Summer
Air Compressor 450 cfm	2	50	Utility	Winter & Summer
Ambulance	1	10	Utility	Winter & Summer
Backhoe 330	14	100	ROW Grade & Ditch Excavation	Winter & Summer
Backhoe 345	2	100	ROW Grade & Ditch Excavation	Winter & Summer
Backhoe Rubber-Tired	2	100	Utility	Winter & Summer
Bending Machine 6-20	2	50	Pipelaying	Winter & Summer
Beveling Machine	2	100	Pipelaying	Winter & Summer
Booster Air Compressor	2	100	Pipelaying	Winter & Summer
Buffing Machine	1	100	Pipelaying	Winter & Summer
Bus	16	100	All activities	Winter & Summer
Chain Trencher	2	100	Ditch Excavation	Winter & Summer
Challenger w/Welding Shelter	3	100	Pipelaying	Winter & Summer
Chisel Plow	1	100	Ditch Excavation	Winter & Summer
Commander w/Pole Trailer	4	100	Pipelaying	Winter & Summer
Crane LS-318 (60 ton)	1	50	River Crossings	Winter & Summer
Crane LS-98A (35 ton)	1	100	Ditch Excavation	Winter & Summer
Crew Boats	1	10	River Crossings	Summer
Ditch Witch	2	50	ECD installation	Winter & Summer
Dozer D6	11	100	ROW Grade & Ditch Backfill	Winter & Summer
Dozer D7	2	100	ROW Grade & Ditch Backfill	Winter & Summer

Table 2.3-32: Equipment Type, Usage Factor and Schedule/Period for Pipeline Construction

Equipment	No. of Units			Usage Factor (%)	Utilization	Schedule/Period of Use
Dozer D8	10			100	ROW Grade	Winter & Summer
Dump Truck	6			25	Pipe Backfill	Winter & Summer
Farm Tractor	1			25	Restoration	Summer
Farm Tractor - Harrow	1			25	Restoration	Summer
Farm Tractor - Spreader	1			25	Restoration	Summer
Field Office Trailer & Equip	4			100	Utility	Winter & Summer
Flatbed Truck 1 ton	6			100	Utility	Winter & Summer
Flatbed Truck 5 ton	2			100	Utility	Winter & Summer
Fork Lift 992	1			100	Utility	Winter & Summer
Fork Lifts-980	1			100	Snow Removal	Winter & Summer
Frontend Loader 966	1			100	Utility	Winter & Summer
Fuel Truck	1			100	Utility	Winter & Summer
Generator - 100 kw	2			100	Utility	Winter & Summer
Generator - 50 kw	1			100	Utility	Winter & Summer
Grease Truck	1			100	Utility	Winter & Summer
Hydro Fill & Test Package	1			50	Pressure Testing & Drying	Summer
Ice Making Machine	2			100	Winter Ice Road	Winter
Loader, CAT IT-28	1			100	Utility	Winter & Summer
John Henry Drill	1			25	Drill & Blast	Winter & Summer
Light Plant- Tower	2			100	Utility	Winter
Mechanic Rig	8			100	Utility	Winter & Summer
Morooka Carrier	2	0	0	100	Utility	Winter & Summer
Motor Grader 14G	5	0	0	100	ROW Maintenance & Restoration	Winter & Summer
Motor Grader 16	1	0	0	100	ROW Maintenance & Restoration	Winter & Summer
Pickup	60	0	0	100	All activities	Winter & Summer
Preheat Tractor D6	1	0	0	75	Pipelaying	Winter & Summer
Sandblasting Rig	3	0	0	75	Pipelaying	Winter & Summer
Sideboom 561	4	0	0	100	Pipelaying	Winter & Summer
Sideboom 571	1	0	0	100	Pipelaying	Winter & Summer
Sideboom 572	9	0	0	100	Pipelaying	Winter & Summer

Table 2.3-32: Equipment Type, Usage Factor and Schedule/Period for Pipeline Construction

Equipment	No. of Units			Usage Factor (%)	Utilization	Schedule/Period of Use
Sideboom 583	1	0	0	100	Pipelaying	Winter & Summer
Skid Truck	1	0	0	100	Pipelaying	Winter & Summer
Sub. Trash Pump - 3"	2	0	0	50	Ditch Excavation	Winter & Summer
Sub. Trash Pump - 4"	6	0	0	50	Ditch Excavation	Winter & Summer
Sub. Trash Pump - 6"	5	0	0	50	Ditch Excavation	Winter & Summer
Tire Truck	1	0	0	100	Utility	Winter & Summer
Tractor w/Float	2	0	0	100	Utility	Winter & Summer
Tractor w/Lowboy	1	0	0	100	Utility	Winter & Summer
Tractor w/Pole Trailer	3	0	0	75	Pipelaying	Winter & Summer
Vacuum Hoe 345	2	0	0	100	Pipelaying	Winter & Summer
Water Pump - 2"	2	0	0	50	Utility	Winter & Summer
Water Truck 4000 gal	5	0	0	50	Ice roads & Dust control	Winter & Summer
Welding Rig	18	0	0	100	Pipelaying	Winter & Summer
Welding Tractor D6	1	0	0	100	Pipelaying	Winter & Summer
Winch Truck	1	0	0	100	Utility	Winter & Summer
Wheeled Hydro Ax	2	2	0	100	Clearing/Prep ROW	Winter & Summer
Tracked Feller/Buncher	1	1	0	100	Clearing/Prep ROW	Winter & Summer
Wheeled Feller/Buncher	1	0	0	100	Clearing/Prep ROW	Winter & Summer
Pipeline Spread 2						
Air Compressor 1750 cfm	4	0	0	10	Pressure Testing & Drying	Summer
Air Compressor 450 cfm	2	0	0	50	Utility	Winter & Summer
Ambulance	1	0	0	10	Utility	Winter & Summer
Backhoe 330	14	0	0	100	ROW Grade & Ditch Excavation	Winter & Summer
Backhoe 345	2	0	0	100	ROW Grade & Ditch Excavation	Winter & Summer
Backhoe Rubber-Tired	2	0	0	100	Utility	Winter & Summer
Bending Machine 6-20	2	0	0	50	Pipelaying	Winter & Summer
Beveling Machine	2	0	0	100	Pipelaying	Winter & Summer
Booster Air Compressor	2	0	0	100	Pipelaying	Winter & Summer
Buffing Machine	1	0	0	100	Pipelaying	Winter & Summer
Bus	16	0	0	100	All activities	Winter & Summer

Table 2.3-32: Equipment Type, Usage Factor and Schedule/Period for Pipeline Construction

Equipment	No. of Units			Usage Factor (%)	Utilization	Schedule/Period of Use
Chain Trencher	2	0	0	100	Ditch Excavation	Winter & Summer
Challenger w/Welding Shelter	3	0	0	100	Pipelaying	Winter & Summer
Chisel Plow	1	0	0	100	Ditch Excavation	Winter & Summer
Commander w/Pole Trailer	4	0	0	100	Pipelaying	Winter & Summer
Crane LS-318 (60 ton)	1	0	0	50	River Crossings	Winter & Summer
Crane LS-98A (35 ton)	1	0	0	100	Ditch Excavation	Winter & Summer
Crew Boats	1	0	0	10	River Crossings	Summer
Ditch Witch	2	0	0	50	ECD installation	Winter & Summer
Dozer D6	11	0	0	100	ROW Grade & Ditch Backfill	Winter & Summer
Dozer D7	2	0	0	100	ROW Grade & Ditch Backfill	Winter & Summer
Dozer D8	10	0	0	100	ROW Grade	Winter & Summer
Dump Truck	6	0	0	25	Pipe Backfill	Winter & Summer
Farm Tractor	1	0	0	25	Restoration	Summer
Farm Tractor - Harrow	1	0	0	25	Restoration	Summer
Farm Tractor - Spreader	1	0	0	25	Restoration	Summer
Field Office Trailer & Equip	4	0	0	100	Utility	Winter & Summer
Flatbed Truck 1 ton	6	0	0	100	Utility	Winter & Summer
Flatbed Truck 5 ton	2	0	0	100	Utility	Winter & Summer
Fork Lift 992	1	0	0	100	Utility	Winter & Summer
Fork Lifts-980	1	0	0	100	Snow Removal	Winter & Summer
Frontend Loader 966	1	0	0	100	Utility	Winter & Summer
Fuel Truck	1	0	0	100	Utility	Winter & Summer
Generator - 100 kw	2	0	0	100	Utility	Winter & Summer
Generator - 50 kw	1	0	0	100	Utility	Winter & Summer
Grease Truck	1	0	0	100	Utility	Winter & Summer
Hydro Fill & Test Package	1	0	0	50	Pressure Testing & Drying	Summer
Ice Making Machine	2	0	0	100	Winter Ice Road	Winter
Loader, CAT IT-28	1	0	0	100	Utility	Winter & Summer
John Henry Drill	1	0	0	25	Drill & Blast	Winter & Summer
Light Plant- Tower	2	0	0	100	Utility	Winter
Mechanic Rig	8	0	0	100	Utility	Winter & Summer

Table 2.3-32: Equipment Type, Usage Factor and Schedule/Period for Pipeline Construction

Equipment	No. of Units			Usage Factor (%)	Utilization	Schedule/Period of Use
Morooka Carrier	2	0	0	100	Utility	Winter & Summer
Motor Grader 14G	5	0	0	100	ROW Maintenance & Restoration	Winter & Summer
Motor Grader 16	1	0	0	100	ROW Maintenance & Restoration	Winter & Summer
Pickup	60	0	0	100	All activities	Winter & Summer
Preheat Tractor D6	1	0	0	75	Pipelaying	Winter & Summer
Sandblasting Rig	3	0	0	75	Pipelaying	Winter & Summer
Sideboom 561	4	0	0	100	Pipelaying	Winter & Summer
Sideboom 571	1	0	0	100	Pipelaying	Winter & Summer
Sideboom 572	9	0	0	100	Pipelaying	Winter & Summer
Sideboom 583	1	0	0	100	Pipelaying	Winter & Summer
Skid Truck	1	0	0	100	Pipelaying	Winter & Summer
Sub. Trash Pump - 3"	2	0	0	50	Ditch Excavation	Winter & Summer
Sub. Trash Pump - 4"	6	0	0	50	Ditch Excavation	Winter & Summer
Sub. Trash Pump - 6"	5	0	0	50	Ditch Excavation	Winter & Summer
Tire Truck	1	0	0	100	Utility	Winter & Summer
Tractor w/Float	2	0	0	100	Utility	Winter & Summer
Tractor w/Lowboy	1	0	0	100	Utility	Winter & Summer
Tractor w/Pole Trailer	3	0	0	75	Pipelaying	Winter & Summer
Vacuum Hoe 345	2	0	0	100	Pipelaying	Winter & Summer
Water Pump - 2"	2	0	0	50	Utility	Winter & Summer
Water Truck 4000 gal	5	0	0	50	Ice roads & Dust control	Winter & Summer
Welding Rig	18	0	0	100	Pipelaying	Winter & Summer
Welding Tractor D6	1	0	0	100	Pipelaying	Winter & Summer
Winch Truck	1	0	0	100	Utility	Winter & Summer
Wheeled Hydro Ax	2	2	0	100	Clearing/Prep ROW	Winter & Summer
Wood Chipper	1	1	0	100	Clearing/Prep ROW	Winter & Summer
Tracked Feller/Buncher	1	0	0	100	Clearing/Prep ROW	Winter & Summer
Wheeled Feller/Buncher	1	0	0	100	Clearing/Prep ROW	Winter & Summer

Source: Donlin response to RFAI 43, January 2014

2.3.2.4.6 PIPELINE – DECOMMISSIONING, ABANDONMENT, AND RECLAMATION

Donlin Gold plans to decommission and abandon the natural gas pipeline at the conclusion of the Operations Phase. Donlin Gold would develop and follow a detailed Pipeline Abandonment Plan based on regulatory requirements at the end of decommissioning. However, the State of Alaska has not determined the future of the pipeline on state lands past the mine life. As a condition of the pipeline ROW lease, the State may choose to maintain the pipeline for another purpose (statutory authority AS 38.35.030). If the State chooses to maintain the pipeline in its entirety for another purpose, they would apply for reassignment of the pipeline ROW from other land managers.

In general, pipes would be purged and cleaned. All above-ground facilities would be removed, including compressor stations, piping, equipment, buildings, fencing, above-ground river crossing structures, access road culverts, and tanks. Above-ground pipelines would be removed to 1 foot below grade and underground pipelines would be capped and abandoned in place. Unless required by regulations in place at the time of abandonment, monitoring of the abandoned in-place pipeline would not be conducted. Some below-ground facilities, such as valves, may be excavated at certain locations. Gravel pads would be left in place and scarified and prepared for natural revegetation. Materials that could be salvaged or recycled would be transported to in-state and out-of-state facilities. Hazardous solid and liquid wastes would be properly disposed. After removal of facilities, cleared land would be contoured to restore appropriate grades, and revegetated.

Above-Ground Facilities

Donlin Gold would develop a Stabilization, Rehabilitation, and Reclamation Plan that also would include final reclamation actions at termination and costs / surety estimates applicable to project final reclamation. The Abandonment Plan and procedures would be based on applicable regulatory requirements at the time, and would be designed to minimize impacts to public and private property in coordination with the appropriate agencies and landowners, unless required otherwise as listed below. Steps for decommissioning follow:

- All above-grade pipeline structural facilities would be removed. Gravel pads would remain in place and be scarified and prepared for natural revegetation.
- All pile foundations would be excavated to a minimum of 12 inches below grade, cut off, capped, and backfilled to grade.
- All aerial markers would be removed; aerial marker foundation posts would be excavated to a minimum of 12 inches, cut off, and backfilled to grade.
- All Carsonite-style pipeline markers would be removed.
- Terminus facilities at the mine would be removed as part of mine demolition.
- Inlet metering facilities at the tie-in would be removed concurrently with removal of the compressor station. The metering modules would be removed from their foundations and transported to Anchorage by truck and barge, where they would be dismantled, salvaged, recycled, or disposed of as appropriate.

- The compressor station site would be dismantled to transportable units, and then trucked and barged to Anchorage where they would be further dismantled for salvage, recycle, or disposal as appropriate.
- Any other signs or markers would be removed.
- All fencing around facilities would be removed and transported back to Anchorage for salvage or recycle.
- Purging of any remaining natural gas by pigging the line with a cleaning pig and nitrogen, after followed by air.
- Capping and burying all open ends of the pipeline including the tie-in point, terminus, above-ground pipe sections, and pigging facilities.
- Cutting the above-ground sections of the pipeline at fault crossings into manageable lengths and hauling them away for recycling. This would include the horizontal steel support beams at these locations.
- Cutting off the support piles for horizontal beams at fault crossings 12 inches below grade, then capping them and covering with soil.
- Removing all above-grade ancillary piping at the MLV locations, including valves, fittings, and appurtenances.
- Abandoning in place all below-grade pipe, including pipe at HDD locations.
- Excavating pipe that transitions from above grade to below grade to a minimum of 12 inches below grade, then cutting the pipe off, capping with 0.25-inch steel plate, seal welding, and backfilling to grade. Below-grade valves would remain in place, but valve operator extensions would be excavated and removed.
- Abandoning in place the valve vault at the tie-in to the BPL; removing the pipe at the hot tap valve, and blinding the valve.

The Castle Mountain Fault above-ground fault pipeline crossing would be removed prior to, or concurrently with, removal of the compressor station, and materials from the fault crossing would be staged at or near the compressor station or Beluga for removal with compressor station materials. The Denali-Farewell Fault above-ground fault crossing would be removed as would be the Farewell launcher / receiver, and materials from the crossing would be staged at the existing Farewell strip for removal with launcher / receiver site materials.

Fiber Optic Cable

All buried fiber optic cable would be abandoned in place at the termination of the project as specified in the Stabilization, Rehabilitation, and Reclamation Plan including any cable installed with the pipe using HDD. Fiber optic cable would be excavated to a minimum of 12 inches below grade, cut off, and appropriately located and preserved in a manner that would allow future use. Any above grade cable would be removed at the same time as removal of the above grade pipe, and salvaged or disposed of at an appropriate facility. The repeater station would also be removed.

Roads, Airstrips and Material Sites

No new roads would be retained for operation and maintenance purposes following construction. All temporary access roads and shoofly roads would be stabilized, recontoured, reclaimed, and revegetated as required following established procedures and the approved Stabilization, Rehabilitation, and Reclamation Plan. Temporary bridges and culverts would be removed. This would include, for example, the access roads from the two Kuskokwim River barge landings to the Kuskokwim East and Kuskokwim West camps and airstrips.

Under Alternative 2, none of the nine new airstrips constructed for pipeline construction purposes would be retained. Following the Construction Phase, these new temporary airstrips would be "decommissioned in a way to prevent future use," according to the Donlin Gold Natural Gas Pipeline Plan of Development (SRK 2013b). Facilities and equipment would be removed, the sites stabilized, rehabilitated, and reclaimed, including redistribution of the vegetative mat where it was stripped and stockpiled during Construction. Any of the temporary airstrips that may be reopened during the Operations Phase for maintenance purposes of the pipeline would be reclaimed as required following established procedures and the approved Stabilization, Rehabilitation, and Reclamation Plan and the authorization allowing for such use. This would include any temporary roads for access to the airstrip.

Retention of material sites beyond Construction is not expected under Alternative 2. However, any new material sites or any reopened during operation of the pipeline or that may be retained for operations and maintenance purposes following Construction would be stabilized, rehabilitated, and reclaimed as required following established procedures and the approved site reclamation plan for the specific material site that would be individually authorized by a material sale.

Any material stockpiles remaining either at a material site or elsewhere would be reconfigured by contouring to the surrounding area, scarified, and prepared to allow for natural revegetation.

Disposition of Salvageable Materials

Donlin Gold does not anticipate transferring any excess materials, equipment, fuel, or other goods to any homesite, homestead, lodge owner or others along the proposed pipeline.

- All salvaged materials from the west side of the Alaska Range would be transported to the Donlin Gold Mine Site for disposal as part of the mine salvage materials.
- All salvage materials from the east side of the Alaska Range would be transported to Anchorage for salvage, recycle, or disposal.
- A storage yard may be required in Anchorage to manage the salvage, recycle, or disposal of materials brought back to Anchorage.

Final Stabilization, Rehabilitation and Reclamation of Disturbed Areas

All final demolition, removal, and reclamation of the proposed Donlin Gold pipeline and structures, and fiber optics cable and adjunct areas would be subject to the approved Stabilization, Rehabilitation, and Reclamation Plan, applicable requirements of the Federal Pipeline ROW Grant, the State Pipeline ROW Lease, and any other applicable landowner authorizations or agreements for the project.

2.3.2.4.7 ALTERNATIVE 2 - NORTH OPTION

Based on comments on the Draft EIS from agencies and the public, one route option has been included in Alternative 2 to address concerns due to pipeline crossings of the Iditarod National Historic Trail (INHT):

- North Option: The MP 84.8 to 112 North Option would realign this segment of the natural gas pipeline crossing to the north of the INHT before the Happy River crossing and remain on the north side of the Happy River Valley before rejoining the alignment near MP-112 where it enters the Three Mile Valley. The North Option alignment is 26.5 miles in length, compared to the 27.2-mile length of mainline Alternative 2 alignment it would replace, with one crossing of the INHT and only 0.1 mile of the pipeline would be physically located in the 400-ft easement for the INHT. The average separation distance from the INHT would be 1 mile (Donlin Gold 2017k).

Differences between Alternative 2 and Alternative 2 – North Option are described below. An overview of the North Option gas pipeline route is shown on Figure 2.3-38. Detailed maps showing the pipeline alignment as well as locations and areas of above ground appurtenances for both the mainline and North Option are included in Appendix D – Pipeline Engineering Strip Maps. The overall construction impact for the North Option would be about 62 acres less than Alternative 2.

North Option – Right-of-Way

North Option would realign a segment of the proposed natural gas pipeline from MP-84.8 to MP-112, which would run along the north side of the Happy River Valley as shown on Figure 2.3-38. The total pipeline length with incorporation of the North Option is less than one mile shorter than Alternative 2. The North Option segment crosses only state lands.

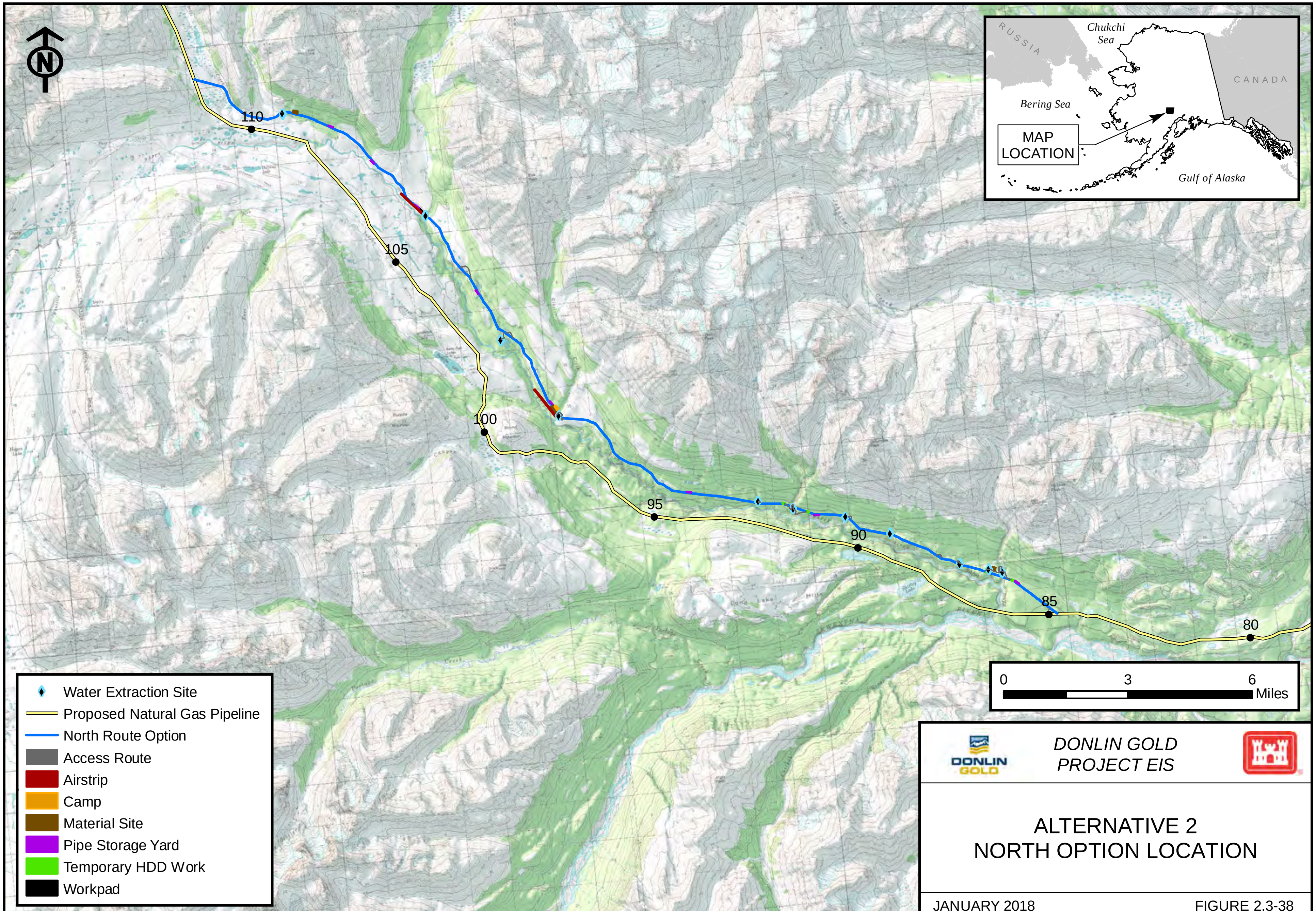
North Option – Above Ground Facilities

The mainline valve location at approximately MP 101.8 would be relocated to the North route at approximately MP 100.1. Table 2.3-33 shows the repositioning of this MLV. See Table 2.3-15 for a complete list of MLVs for Alternative 2. There are no other changes to above-ground pipeline facilities associated with this option.

Table 2.3-33: Mainline Valve Location Summary (North Option)

No.	TAG	MP (Approx.)
7	MLV-07	101.80 (no longer required)
7	MLV-07	MP 100.13 (new North Route)

Source: Donlin Gold 2017k



DONLIN GOLD PROJECT EIS

ALTERNATIVE 2
NORTH OPTION LOCATION

JANUARY 2018

FIGURE 2.3-38

North Option – Temporary Work Areas Outside of Right-of-Way

During pipeline construction, additional areas for construction camps, pipeline and construction material storage yards, temporary work areas, temporary access roads and shoofly roads, material source sites and airstrips would be required. North Option requirements are described below. Detailed maps depicting locations and areas of all temporary work spaces are provided in Appendix D.

North Option - Water Use and Potential Water Extraction Sites

New potential water extraction sites are proposed for the North Option and some proposed for the main line route would no longer be required (Table 2.3-34; see Table 2.3-18 for a summary of all water extraction sites for Alternative 2). Details for North Option extraction sites would be developed during final design but are assumed to be roughly similar to water extraction details for sites that would no longer be required (see Table 2.3-18). Table 2.3-35 shows the changes to water requirements for each affected HDD crossing for the North Option (see Table 2.3-19 for a complete summary of water requirements for water extraction sites associated with Alternative 2).

Table 2.3-34: Potential Water Extraction Sites for Pipeline Construction (North Option)

Water Extraction Site Name	Nearest MP	Season of Use			Water Body Type
		Summer	Winter	All Season	
WES-0310 (no longer required)	MP 86		X		River
WES-0320 (no longer required)	MP 88		X		Lake
WES-0330 (no longer required)	MP 90		X		Lake
WES-0340 (no longer required)	MP 95		X		Creek
WES-0350 (no longer required)	MP 99		X		Creek
WES-0360 (no longer required)	MP 101		X		Creek
WES-0370 (no longer required)	MP 103		X		Creek
WES-0380 (no longer required)	MP 106		X		Creek
WES-0410 (no longer required)	MP 108		X		River
WES-0310 (new – North Option)	MP 86.4	X			Creek

Table 2.3-34: Potential Water Extraction Sites for Pipeline Construction (North Option)

Water Extraction Site Name	Nearest MP	Season of Use			Water Body Type
		Summer	Winter	All Season	
WES-0320 (new – North Option)	MP 86.7	X			Creek
WES-0330 (new – North Option)	MP 87.4	X			Creek
WES-0340 (new – North Option)	MP 89.3	X			Creek
WES-0350 (new – North Option)	MP 90.5	X			Creek
WES-0360 (new – North Option)	MP 91.8	X			Creek
WES-0370 (new – North Option)	MP 92.6	X			Creek
WES-0380 (new – North Option)	MP 98.2	X			Creek
WES-0390 (new – North Option)	MP 100.7	X			Creek
WES-0400 (new – North Option)	MP 104.2	X			Creek
WES-0410 (new – North Option)	MP 108.6	X			Creek

Table 2.3-35: HDD Estimated Water Use (North Option)

HDD Crossing Name	Length	Estimated Total Water Requirement (gal)	Estimated Total Volume Solids/Cuttings Needing Disposal (cy)	Estimated Total Volume of Drilling Mud for Disposal (gal)
Happy River (no longer required)	3,453 ft	450,000-500,000	280-290	240,000-260,000
Unnamed Tributary #1 to Happy River - McDoel (new – North Option)	3,220.8 ft	450,000-500,000	280-290	240,000-260,000
Unnamed Tributary #2 to Happy Rover – Distin (new – North Option)	3,094.4 ft	450,000-500,000	280-290	240,000-260,000

Notes:

cy = cubic yards
gal = gallons

Source: Donlin Gold 2017k

North Option - Temporary Access Roads and Shoofly Roads

Temporary site access and shoofly roads would be required for construction of the North Option route, such as for access to water extraction sites, borrow material sites, and water withdrawal sites. Tables 2.3-36 and 2.3-37 detail the changes to temporary access roads and shoofly roads, respectively, with incorporation of the North Option. See Tables 2.3-20 and 2.3-21 for details on all access roads and shoofly roads, respectively, for Alternative 2. The overall length and footprint of access and shoofly roads would be slightly less for the North Option (less than 1 mile for each access and shoofly roads and less than 0.5 acres total).

Table 2.3-36: Access Road Identification (North Option)

Name	MP	Length (miles)	Acres*	Description	Winter	Summer	All Season
AWES-0310 (no longer required)	86	0.09	0.26	Water Extraction Site Access	X		
AWES-0320 (no longer required)	88	0.10	0.29	Water Extraction Site Access	X		
AWES-0330 (no longer required)	90	0.13	0.38	Water Extraction Site Access	X		
AWES-0350 (no longer required)	99	0.06	0.17	Water Extraction Site Access	X		
AWES-0380 (no longer required)	106	0.26	0.75	Water Extraction Site Access	X		
AWES-0390 (new – North Option)	100	0.26	0.85	Water Extraction Site Access		X	
AWES-0410 (new – North Option)	108	0.04	0.03	Water Extraction Site Access		X	

Notes:

* Based on 24-foot width

Source: Donlin Gold 2017k

Table 2.3-37: Shoofly Access Routes (North Option)

Name	Approximate MP	Length (miles)	Acres*	Season of Use		
				Summer	Winter	All Season
SHOO-0125 (new – North Option)	MP 86.5	1.09	3.80	X		
SHOO-0130 (no longer required)	MP 85.8	1.64	4.77		X	
SHOO-0130 (new – North Option)	MP 87.4	0.25	1.10	X		

Table 2.3-37: Shoofly Access Routes (North Option)

Name	Approximate MP	Length (miles)	Acres*	Season of Use		
				Summer	Winter	All Season
SHOO-0140 (no longer required)	MP 87	1.19	3.46		X	
SHOO-0140 (new – North Option)	MP 88.0	0.21	1.09	X		
SHOO-0150 (no longer required)	MP 88.1	0.33	0.96		X	
SHOO-0150 (new – North Option)	MP 90.4	0.18	0.99	X		
SHOO-0160 (no longer required)	MP 98.2	0.2	0.58		X	
SHOO-0160 (new – North Option)	MP 91.7	0.94	1.83	X		
SHOO-0170 (no longer required)	MP 102.6	0.63	1.83		X	
SHOO-0170 (new – North Option)	MP 92.6	0.15	0.35	X		
SHOO-0180 (no longer required)	MP 108.3	0.64	1.86		X	
SHOO-0180 (new – North Option)	MP 98.2	0.44	1.02	X		
SHOO-0190 (no longer required)	MP 108.7	0.37	1.08		X	
SHOO-0190 (new – North Option)	MP 100.6	0.27	0.99	X		
SHOO-0195 (new – North Option)	MP 102.4	0.48	1.82	X		

Notes:
* Based on 24-foot width; data presented represents the full disturbance footprint of roads and ancillary facilities (SRK 2013b).
MP = milepost
Source: Donlin Gold 2017k

North Option - Construction Camps

One additional construction camp, Glacier Creek Camp, would be constructed for this option. Table 2.3-38 identifies this camp and provides updated acreages with incorporation of the North Option.

The North Option would require HDD crossings of two unnamed tributaries of the Happy River but would eliminate the HDD crossing of Happy River itself. Changes to the HDD camps and campsite locations with incorporation of the North Option are presented in Table 2.3-39.

See Table 2.3-23 for a complete list of HDD camps and campsite locations for Alternative 2. The overall footprint for HDD sites would increase by approximately 2.8 acres.

Fuel needs for pipeline construction with incorporation of the North Option would increase with the additional camp and airstrip at Glacier Creek, although the specific fuel amount for this location would be determined during final design. See Table 2.3-24 for estimated fuel use for Alternative 2.

North Option - Pipe and Equipment Storage Yards

New potential pipe storage yards are proposed for the North Option and five proposed for the main line route would no longer be required. These are identified in Table 2.3-40 below. See Table 2.3-25 for a complete list of pipe storage yards associated with Alternative 2. Additional PSYs for the North Option would result in an increase of approximately 7.5 acres.

North Option - Borrow Material Sites

New material sites are proposed along the North Option route and some of those identified for the main route would no longer be required; with the same total number of material sites required for construction of the pipeline. These are identified in the Table 2.3-41 below. See Table 2.3-27 for a complete list of potential material sites for Alternative 2. Material sites for the North Option would result in approximately 1,053 acres; about 31 acres less than Alternative 2.

North Option - Airstrips

One additional airstrip would be constructed at approximately MP 98.74 in support of construction activities for the North Route. Table 2.3-42 identifies this airstrip and provides updated acreages with incorporation of the North Option.

Table 2.3-38: Mainline Pipeline Campsite Locations (North Option)

Campsite	Approximate Location	Land Status	Type of Camp/Site Area	Season of Use	
				Summer	Winter
Glacier Creek Camp	MP 98.5	State Land	300 Person Camp/ 4.0 Acres	X	

Notes:
MP = milepost
Source: Donlin Gold 2017k

Table 2.3-39: HDD Camps and Campsite Locations (North Option)

Name	Approximate MP	Land Status	Season of Use		
			Summer	Winter	All Season
Happy River HDD Site (Eliminated – Main Route)					
Happy River (HDD Entry) 1.4 acres (no longer required)	MP 85.7	State Land		X	
Happy River (HDD Exit) 1.4 acres (no longer required)	MP 86.4	State Land		X	
Unnamed Tributary #1 of Happy River HDD Site (New – North Option) (McDoel)					
Unnamed Tributary #1 (HDD Entry) 1.4 acres	MP 86.1	State Land	X		
Unnamed Tributary #1 (HDD Exit) 1.4 acres	MP 86.7	State Land	X		
Unnamed Tributary #2 of Happy River HDD Site (New – North Option) (Distin)					
Unnamed Tributary #2 (HDD Entry) 1.4 acres	MP 91.4	State Land	X		
Unnamed Tributary #2 (HDD Exit) 1.4 acres	MP 92.0	State Land	X		

Notes:
HDD = horizontal directional drilling
MP = milepost
Source: Donlin Gold 2017k

Table 2.3-40: Pipe Storage Yards (North Option)

Name	Approximate MP	Season of Use			Planned Pipe Source
		Summer	Winter	All Season	
PSY-18 (no longer required)	MP 87		X		Road system then via ice road **
PSY-19 (no longer required)	MP 90.7		X		Road system then via ice road **
PSY-20 (no longer required)	MP 96.8		X		Road system then via ice road **
PSY-21 (no longer required)	MP 101.9		X		Road system then via ice road **
PSY-22 (no longer required)	MP 106.4		X		Road system then via ice road **
PSY-18 (new – North Option)	MP 86.0			X	Road system then via ice road **
PSY-18A (new – North Option)	MP 91.2			X	Road system then via ice road **
PSY-19 (new – North Option)	MP 94.3			X	Road system then via ice road *
PSY-20	MP 98.6			X	Road system then via ice road *

Table 2.3-40: Pipe Storage Yards (North Option)

Name	Approximate MP	Season of Use			Planned Pipe Source
		Summer	Winter	All Season	
(new – North Option)					
PSY-20A (new – North Option)	MP 101.9			X	Road system then via ice road *
PSY-21 (new – North Option)	MP 104.5			X	Road system then via ice road *
PSY-22 (new – North Option)	MP 106.0			X	Road system then via ice road *
PSY-22A (new – North Option)	MP 107.4			X	Road system then via ice road *
PSY-23 (new – North Option)	MP 111.2			X	Road system then via ice road *
PSY-24 (new – North Option)	MP 113.8			X	Road system then via ice road *

Notes:

*Actual winter access route options (Oilwell Road Route or Willow Landing Route) are still being evaluated.

Source: Donlin Gold 2017k

Table 2.3-41: Potential Material Sites (North Option)

Material Site	MP	Area (acres)	Material Type	Land Status	Est. Available Volume (cy)	Est. Usage (cy)	Season of Use
MS-14 (no longer required)	88	5.2	Gravel (alluvial)	State Land	20,000	20,000	Winter
MS-16 (no longer required)	102.9	9.1	Gravel (alluvial)	Miscellaneous	20,000	20,000	Winter
MS-17A (no longer required)	108.4	31.6	Gravel (alluvial)	State Land	250,000	250,000	Winter
MS-17B (no longer required)*	112	29.8	Gravel (alluvial)	State Land	150,000	150,000	All Season

Table 2.3-41: Potential Material Sites (North Option)

Material Site	MP	Area (acres)	Material Type	Land Status	Est. Available Volume (cy)	Est. Usage (cy)	Season of Use
MS-14A (new - North Option)	86.6	5.32	Gravel	State Land	75,000	50,000	Summer
MS-15A (new - North Option)	98.4	11.19	Gravel	State Land	200,000	75,000	Summer
MS-16A (new - North Option)	108.3	4.94	Gravel	State Land	80,000	40,000	Summer
MS-17B (new - North Option)*	111.4	23.63	Gravel	State Land	150,000	80,000	Summer

Notes:

* Same material site for Alternative 2 and North Option but differences in the size, estimated usage, and season of use. Mileposts are different due to the different segments.

cy = cubic yards
MS = material site

Source: Donlin Gold 2017k

Table 2.3-42: Airstrip Locations and Construction (North Option)

Name	Approximate MP	Length (ft/m)	Land Status	Construction/Area	Season of Use		
					Summer	Winter	All Season
Glacier Creek Airstrip (New – North Option)	MP 98.7	4,000 ft	State Land	New – Grade, cut and fill 14.7 acres			X

Notes:
ft = feet
MP = milepost
Source: Donlin Gold 2017k

North Option – Water Body Crossings

The North Option would cross 15 streams. Two new HDD crossings are proposed at tributaries to Happy River but the Happy River HDD crossing would be eliminated with the North Option (see Table 2.3-35).

North Option – Standard Construction Procedures

Construction procedures would be similar to those described for Alternative 2. The North Option segment would likely be constructed during the summer.

2.3.2.5 MONITORING ACTIVITIES

The objective of monitoring is to provide long-term assessment of resources, particularly for water resources that could be affected by the mine, and to document that compliance goals are being achieved. Monitoring activities are considered part of Donlin Gold's Proposed Action (SRK 2012d, 2013b, 2016d, 2016e, 2016h, 2017c; Donlin Gold 2017d; ADEC 2017h). Monitoring activities proposed during Construction, Operations, and Closure are based on the current Plan of Operations and draft permits; however, final monitoring requirements would be established in final permits and approvals required for the project.

2.3.2.5.1 CONSTRUCTION AND OPERATIONS

Surface Water and Groundwater

A portion of the surface water and groundwater monitoring program initiated prior to Construction would be refined and continued during Construction and Operations. Several established surface water monitoring stations on Crooked and Anaconda creeks downstream of the mine would continue to be sampled on a quarterly basis (Figure 2.3-39). Additional monitoring of surface water would be conducted at new mine facilities such as the lower CWD, Snow Gulch Reservoir, SRS pond, and tailings pond water; seepage water would be monitored at the WRF; and groundwater would be monitored at wells downstream of the TSF (see Table 2.3-43).

The type and frequency of monitoring would vary for: contact water, non-contact water, dewatering water, process water, and effluent. Constituents to be analyzed vary with each of these categories, but may include metals, cyanide, and general water quality parameters such as pH, total dissolved solids, anions, cations, and nutrients. The frequency of monitoring would vary from daily for specific parameters at the process plant, to quarterly for most surface and groundwater monitoring locations. The monitoring frequency for treated water from the pit dewatering wells would vary depending on APDES permit requirements for discharge to Crooked Creek. Monitoring parameters and frequency would be updated based on regulatory or permit changes, process modifications, and monitoring results. All sampling and analytical work would be conducted in accordance with an ADEC-approved Quality Assurance Project Plan.

Routine sampling and analysis of sewage and potable groundwater would be in accordance with Alaska and EPA regulations. Potable water supplies would also be monitored to detect free chlorine and chlorine byproducts. The use of disinfectants such as chlorine can react with naturally occurring materials in the water to form unintended organic and inorganic byproducts which may pose health risks. ADEC requirements for monitoring frequency range from monthly to annually depending upon the substance monitored and monitoring results.

Other Monitoring Programs

Waste characterization monitoring would be performed on rock removed from the pit to determine its ultimate destination (for example, ore stockpiles/process plant, PAG 7 temporary storage, PAG 6 cells, or WRF). Acid-base accounting would be used as a primary diagnostic tool for determining waste management category and destination. Tailings solids and liquor (filtrate) would also be monitored at the process plant. Details of waste characterization and monitoring are detailed the Integrated Waste Management Plan (SRK 2016b), Integrated Waste Management Waste Rock Management Plan (SRK 2016d), and the Integrated Waste Management Monitoring Plan (SRK 2016e).

Monitoring during Construction and Operations phases would also include visual inspections of the TSF, WRF, dams, and solid waste landfill for erosion, mass stability, seepage areas, debris, and stormwater control structures. Instrumental monitoring of mass stability would also occur. Visual inspections of the mine access road and Angyaruaq (Jungjuk) Port, airstrip, and material sites would be conducted for stormwater and erosion control purposes in accordance with Stormwater Pollution Prevention Plan (SWPPP) requirements.

Visual inspections of the tailings impoundment pool and depositional areas will be made during each operations shift to observe any unusual circumstances involving birds or other wildlife. If possible, birds or other wildlife mired in unconsolidated tailings would be extracted or herded to a safe area, and all mortalities would be collected and reported to U.S. Fish & Wildlife Service (FWS) and Alaska Department of Fish & Game (ADF&G) within 24 hours.

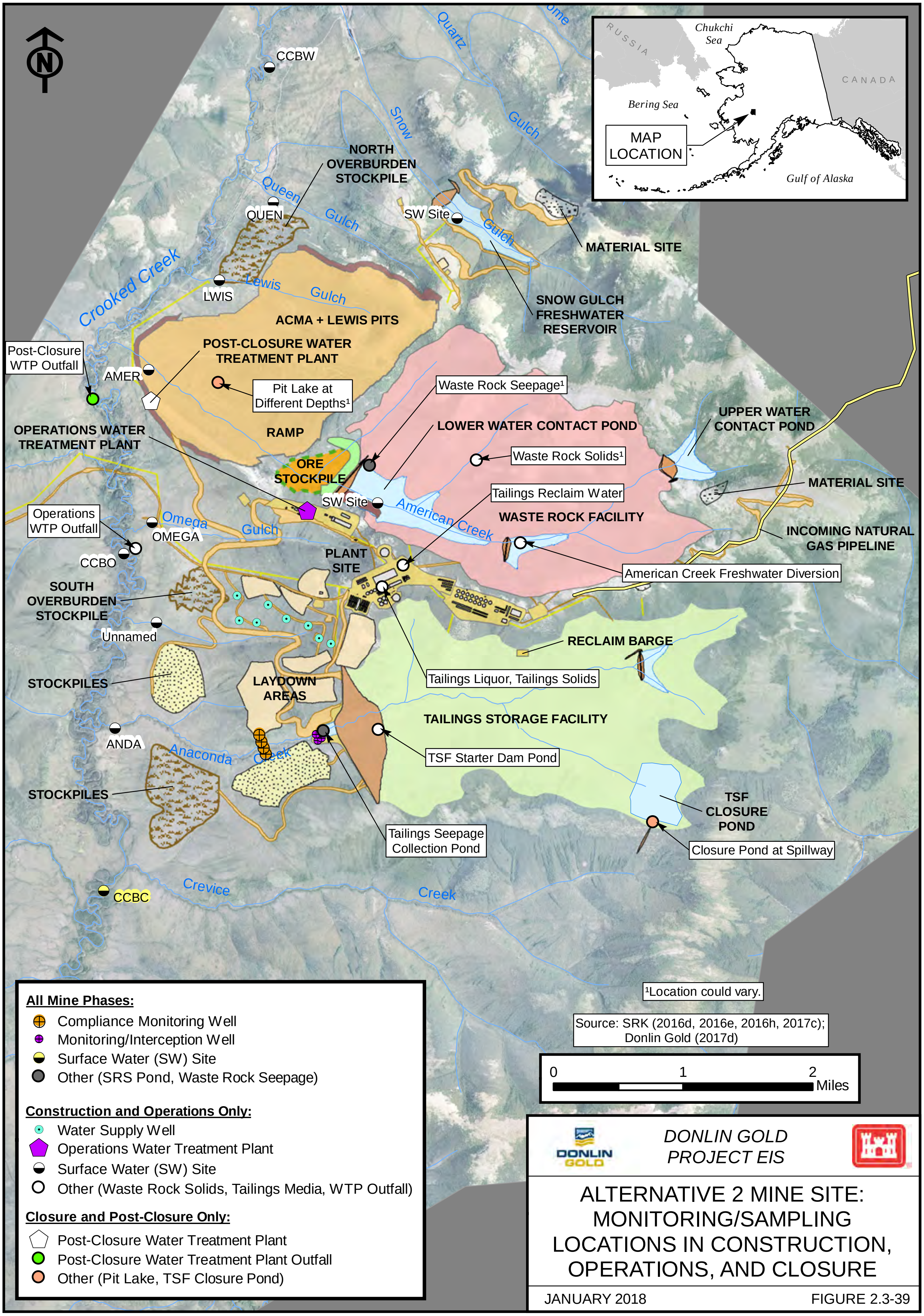
Other monitoring activities include cultural resources, revegetation, and invasive species monitoring. Donlin Gold will implement a Cultural Resources Management Plan (CRMP). Donlin Gold will have an archaeologist meeting the qualifications of the Standards and Guidelines (48 FR 44738-44739) available in activities involving areas of ground disturbing activity designated as high potential consistent with the CRMP (the CRMP will be included in the Programmatic Agreement as an appendix, which will be included in Appendix Y if available at the time of publication of the Final EIS). Donlin Gold has developed a draft Invasive Species Prevention and Management Plan (ISPMP) to guide mitigation activities associated with nonnative invasive species (NNIS) prevention and management (Appendix U).

2.3.2.5.2 CLOSURE AND POST-CLOSURE

Several surface water and groundwater monitoring locations established in Operations would continue in Closure and Post-Closure (Table 2.3-43 and Figure 2.3-39). These include Crooked Creek below Crevice Creek, SRS pond water, WRF seepage, and groundwater wells downgradient of the TSF. During Closure and post-Closure, the monitoring program for TSF components would include the seepage reclaim system, groundwater monitoring wells, and the LLDPE-lined pond remaining after tailings are covered. As noted above, the goal would be to demonstrate that pond water can be safely discharged to Crevice Creek. The frequency of surface and groundwater sampling would range from quarterly to five-year intervals depending on the number of years after Closure. Discharge water monitoring would continue, depending on compliance history, up to or beyond 30 years after mine Closure, or until each component has stabilized, physically and chemically, to the satisfaction of the State of Alaska.

Water in the pit lake would be monitored for 50-55 years after Closure or until the pit lake has filled with water. Runoff and seepage from the reclaimed WRF would report to the pit lake after Closure. Pit lake monitoring would include annual water level data collection and water quality sampling at different depths every five years. The pit lake model would be recalibrated as data become available to update estimates of pit filling. Approximately five years before the pit water is anticipated to reach an elevation at risk of free flow into Crooked Creek, a WTP would be built at the site. Water would be pumped from the pit to the post-Closure WTP to maintain the pit as a hydrologic sink (i.e., water level such that groundwater flows towards the pit), and sufficient freeboard is present for high runoff events including a sequence of years with above-average precipitation. The WTP would be operated in perpetuity. Pit lake water quality would be analyzed every five years until analyses indicate stable condition. Pit water quality of discharge would be analyzed monthly while the WTP is operating and until analyses indicate a stable condition that meets water quality standards if WTP operation is discontinued, or per APDES permit requirements.

As well as monitoring the TSF and the pit lake, surface water and groundwater monitoring would continue at Closure and post-Closure based on approved Reclamation and Closure Plan requirements.



DONLIN GOLD PROJECT EIS

ALTERNATIVE 2 MINE SITE: MONITORING/SAMPLING LOCATIONS IN CONSTRUCTION, OPERATIONS, AND CLOSURE

JANUARY 2018

FIGURE 2.3-39

Table 2.3-43: Construction, Operations, and Post-Closure Monitoring Summary

Phase	Component	Media	Parameters	Frequency	Project Plan/Permit
Construction	Project Area streams (sample sites at Anaconda Creek, Crooked Creek below Omega Gulch, Crooked Creek below Crevice Creek, Crooked Creek below Lyman's Wash Plant, Queen Gulch, Lewis Gulch, American Creek, Omega Gulch, Unnamed tributary)	Surface water	Water quality, flow	Quarterly	Integrated Waste Management Monitoring Plan (Donlin Gold Project Plan of Operations Volume VII A) / APDES permit
	Pit dewatering (Water Treatment Plant -1 prior to discharge into Crooked Creek)	Groundwater feed to WTP and Treated groundwater	Water quality, flow	Per APDES permit	APDES Permit / Integrated Waste Management Monitoring Plan (Donlin Gold Project Plan of Operations Volume VII A)
	WRF	Waste rock (sampling occurs in development of ACMA and Lewis pits)	Acid-Base Accounting	Annual	Integrated Waste Management Monitoring Plan (Donlin Gold Project Plan of Operations Volume VII A) / Integrated Waste Management Waste Rock Management Plan (Donlin Gold Project Plan of Operations Volume III B)
	Lower CWD	Surface water (contact water collected in contact water dam)	Water quality	Quarterly	Integrated Waste Management Monitoring Plan (Donlin Gold Project Plan of Operations Volume VII A)

Table 2.3-43: Construction, Operations, and Post-Closure Monitoring Summary

Phase	Component	Media	Parameters	Frequency	Project Plan/Permit
	Stripped areas (ACMA and Lewis pits WRF, TSF)	Overburden	Acid-Base Accounting	Annual	Integrated Waste Management Monitoring Plan (Donlin Gold Project Plan of Operations Volume VII A) / Integrated Waste Management Waste Rock Management Plan (Donlin Gold Project Plan of Operations Volume III B)
	TSF starter dam	Surface water	Water quality	Quarterly	Integrated Waste Management Monitoring Plan (Donlin Gold Project Plan of Operations Volume VII A)
	TSF (seepage recovery system), groundwater interceptor wells)	Groundwater/Surface Water	Water quality	Quarterly	Integrated Waste Management Monitoring Plan (Donlin Gold Project Plan of Operations Volume VII A)
	TSF compliance monitoring wells	Groundwater	Water quality	Quarterly	Integrated Waste Management Monitoring Plan (Donlin Gold Project Plan of Operations Volume VII A)
	Mine Site	Emissions source testing	Air quality	Per ADEC permit	ADEC Air Quality Control Construction Permit
	Mine Site	Fugitive dust performance assessments	Air quality	Routine inspections	ADEC Air Quality Control Construction Permit

Table 2.3-43: Construction, Operations, and Post-Closure Monitoring Summary

Phase	Component	Media	Parameters	Frequency	Project Plan/Permit
	Sanitary facilities Construction camp (Sanitary Treatment Plant prior to discharge into TSF)	Surface water	Water quality, flow	Monthly	APDES permit
	Potable water	Drinking water	Free chlorine, total coliform bacteria, combined total trihalomethanes, haloacetic acids, cross-connections	Varies	ADEC permit requirements
	Solid waste landfill (Mine Site)	Debris, contents	Visuals	Weekly inspection (other actions vary)	Integrated Waste Management Plan (Donlin Gold Project Plan of Operations Volume III)
	Mine Access Road, airstrip, borrow pits, etc. (disturbed areas ≧ one acre)	Storm water	BMP Performance/water quality per SWPPP	Per SWPPP	Construction General Permit (stormwater) / SWPPP
	Natural Gas Pipeline	Construction activities (general)	Compliance with Pipeline Integrity Management System, QA/QC Plan	Ongoing	Natural Gas Pipeline Plan of Development (POD)
	Natural Gas Pipeline	Construction activities (wetlands and water crossings)	Compliance with Pipeline Surveillance and Monitoring Plan	Ongoing	Plan of Development
	Natural Gas Pipeline	Avalanches	Stability/safety	As necessary	Plan of Development
	Natural Gas Pipeline	Reclamation (vegetation)	Success	Post-reclamation (construction)	Stabilization and Rehabilitation Plan, Pipeline Surveillance and Monitoring Plan

Table 2.3-43: Construction, Operations, and Post-Closure Monitoring Summary

Phase	Component	Media	Parameters	Frequency	Project Plan/Permit
	Natural Gas Pipeline	Surface Water	Stream Crossings	As necessary during Construction	Plan of Development / Pipeline Surveillance and Monitoring Plan
	Natural Gas Pipeline	Surface Water	Flow (withdrawal)	During water withdrawal for pressure testing (protect aquatic life)	Plan of Development / Pipeline Surveillance and Monitoring Plan / Temporary Water Use Permit
	Natural Gas Pipeline	Surface Water	Flow (discharge)	During discharge of pressure test water to protect energy-dissipating devices	Plan of Development / Pipeline Surveillance and Monitoring Plan /APDES General Permit
Operations	Project Area surface water sites (sample sites at Anaconda Creek, Crooked Creek below Lyman's Wash Plant, Crooked Creek below Omega Creek, Crooked Creek below Crevice Creek, Queen Gulch, Lewis Gulch, American Creek, Omega Gulch, Unnamed tributary)	Surface water	Water quality (long list[1]), flow	Quarterly	Integrated Waste Management Monitoring Plan (Donlin Gold Project Plan of Operations Volume VII A) / APDES permit
	Project Area surface water sites (sample sites at Anaconda Creek, Crooked Creek below Lyman's Wash Plant, Crooked Creek below Omega Creek, Crooked Creek below Crevice Creek)	Aquatic resources	Biomonitoring – fish populations/habitat, periphyton, invertebrates	To be determined	To be determined

Table 2.3-43: Construction, Operations, and Post-Closure Monitoring Summary

Phase	Component	Media	Parameters	Frequency	Project Plan/Permit
	Snow Gulch freshwater reservoir	Surface water	Water quality (long list[1])	Quarterly	Integrated Waste Management Monitoring Plan (Donlin Gold Project Plan of Operations Volume VII A)
	WRF	Visual, seepage flow and quality, operational waste rock sampling	mass stability, static water level, geochemical characterization, volume placed (monthly)	Weekly (visual), monthly, variable	Integrated Waste Management Monitoring Plan (Donlin Gold Project Plan of Operations Volume VII A) / Integrated Waste Management Waste Rock Management Plan (Donlin Gold Project Plan of Operations Volume III B)
	Lower CWD	Surface water	Water quality (long list[1])	Quarterly	Integrated Waste Management Monitoring Plan (Donlin Gold Project Plan of Operations Volume VII A)
	TSF Embankment	Visual inspections, Stability	Water level, mass stability	Daily, weekly, monthly	Tailings Dam Operations and Maintenance Manual
	TSF Reclaim Water System	Visual inspection	Equipment condition, evidence of leaks TSF barge inspected annually	Daily, annually	Integrated Waste Management Monitoring Plan (Donlin Gold Project Plan of Operations Volume III A)
	TSF Tailings Discharge Lines	Visual inspection	Erosion, leaks Tailings pipelines inspected annually	Daily, annually	Integrated Waste Management Monitoring Plan (Donlin Gold Project Plan of Operations Volume III A)

Table 2.3-43: Construction, Operations, and Post-Closure Monitoring Summary

Phase	Component	Media	Parameters	Frequency	Project Plan/Permit
	TSF Seepage Recovery System	Surface water (seepage)	Water quality (short list[2]) Seepage flow volume	Daily, quarterly	Integrated Waste Management Monitoring Plan (Donlin Gold Project Plan of Operations Volume VII A)
	TSF Seepage Recovery System (Interceptor Wells)	Groundwater	Water quality (long list) Static Water Depth Pumped volume	Daily, weekly, quarterly	Integrated Waste Management Monitoring Plan (Donlin Gold Project Plan of Operations Volume VII A)
	TSF Seepage Recovery System (Compliance Monitoring Wells)	Groundwater	Water quality (long List[1]) Pumped volume	Daily, weekly, quarterly	Integrated Waste Management Monitoring Plan (Donlin Gold Project Plan of Operations Volume VII A)
	TSF Diversion Ditches	Visual inspection	Mass stability, erosion	Weekly, after large storms	Integrated Waste Management Monitoring Plan (Donlin Gold Project Plan of Operations Volume III A)
	ACMA and Lewis Pits (perimeter dewatering wells when discharging from Wastewater Treatment Plant -1 into Crooked Creek via Outfall 001)	Groundwater feed to WTP and treated groundwater	Water quality and flow rates to Wastewater Treatment Plant -1	Per APDES permit	APDES permit
	Wastewater Treatment Plant -1 seasonal discharge into Crooked Creek	Surface water	Water quality, flow	Per APDES permit	APDES permit

Table 2.3-43: Construction, Operations, and Post-Closure Monitoring Summary

Phase	Component	Media	Parameters	Frequency	Project Plan/Permit
	Sanitary Treatment Plant sanitary facilities - mine/mill complex, discharge into Tailings Storage Facility	Surface water	Water quality, flow	Monthly	APDES permit
	Potable water	Water	Free chlorine, bacteria, trihalomethanes, haloacetic acids, cross-connections	Varies	ADEC requirements/ Integrated Waste Management Monitoring Plan (Donlin Gold Project Plan of Operations Volume VII A)
	Solid waste landfill	Debris, contents	Visual per waste permit	Weekly inspection (other actions vary)	Integrated Waste Management Plan (Donlin Gold Project Plan of Operations Volume III)
	Mine Site	Wildlife	Report presence/mortality observations; water quality sampling (for Weak Acid Dissociable Cyanide with mortality in reclaim pool)	As necessary (report circumstances)	Integrated Waste Management Monitoring Plan (Donlin Gold Project Plan of Operations Volume VII A)
	Overburden, waste rock, ore	Waste Characterization	Acid-Base Accounting	Monthly	Integrated Waste Management Waste Rock Management Plan (Donlin Gold Project Plan of Operations Volume III B)
	Mine Access Road, airstrip, borrow pits, etc. (disturbed areas ≧ one acre)	Storm water	Per SWPPP requirements	Per SWPPP requirements	SWPPP / Construction General Permit (storm water) / Multi-Sector General Permit (storm water) as applicable

Table 2.3-43: Construction, Operations, and Post-Closure Monitoring Summary

Phase	Component	Media	Parameters	Frequency	Project Plan/Permit
	Particulate Matter	Air (visual with instrumentation potential)	Opacity	To be determined	Air permit
	Power Plant Emissions	Air	Startup parameters	Once at startup (commissioning)	Air permit
	Emission Control Vents	Air	Stack testing constituents	To be determined	Air Permit
	Natural Gas Pipeline	Leaks; non-Donlin related construction activity	Occurrences	Twice per year (post breakup and before-deep snowfall); variable	Pipeline Surveillance and Monitoring Plan
	Natural Gas Pipeline	River/stream crossings, geohazards, fault crossings, ice-rich permafrost	Stability (erosion, scour, movement)	Twice per year (post breakup and before-deep snowfall); variable	Pipeline Surveillance and Monitoring Plan
	Natural Gas Pipeline	Reclamation (vegetation)	Revegetation success, NNIS	Twice per year (post breakup and before-deep snowfall); variable	Pipeline Surveillance and Monitoring Plan
	Natural Gas Pipeline	Vegetation (NNIS)	Early Detection Rapid Response	To be determined	Invasive Species Prevention and Management Plan
	Natural Gas Pipeline	Pipeline Integrity	Curvature, position, strain, wall thickness, corrosion	Per Special Permit conditions or as warranted (annually)	Operations and Maintenance Plan/Manual
	Natural Gas Pipeline	Cathodic protection	Integrity	Annually	Plan of Development
	Natural Gas Pipeline	Pipeline valves	Integrity/Functionality	Annually	Plan of Development
	Natural Gas Pipeline	Overpressure safety devices	Functionality	Twice per calendar year	Plan of Development

Table 2.3-43: Construction, Operations, and Post-Closure Monitoring Summary

Phase	Component	Media	Parameters	Frequency	Project Plan/Permit
Closure/Post-Closure	Surface water (sample site – Crooked Creek below Crevice Creek)	Surface Water	Water quality, flow, static water level	Quarterly first 5 years, annually next 5 years, then once every 5 years	Integrated Waste Management Monitoring Plan (Donlin Gold Project Plan of Operations Volume VII A)
	Tailings Storage Facility Closure Pond and Seepage Collection Pond	Surface water	Water quality	Quarterly years 6-10	Integrated Waste Management Monitoring Plan (Donlin Gold Project Plan of Operations Volume VII A)
	TSF Seepage Recovery System (Compliance Monitoring Wells)	Groundwater	Water quality Pumped volume	Quarterly first 5 years, annually next 5 years, then once every 5 years	Integrated Waste Management Monitoring Plan (Donlin Gold Project Plan of Operations Volume VII A)
	Pit lake	Surface water	Water level, water quality by depth, water quality of discharge	Varies	Integrated Waste Management Monitoring Plan (Donlin Gold Project Plan of Operations Volume VII A) / APDES Permit once discharging starts
	WRF	Visual, seepage, erosional stability	Water quality, flow, stability	Quarterly first 5 years, annually next 5 years, then once every 5 years	Integrated Waste Management Monitoring Plan (Donlin Gold Project Plan of Operations Volume VII A), Integrated Waste Management Waste Rock Management Plan (Donlin Gold Project Plan of Operations Volume III B)

Table 2.3-43: Construction, Operations, and Post-Closure Monitoring Summary

Phase	Component	Media	Parameters	Frequency	Project Plan/Permit
	Revegetation	Vegetation, reclaimed surfaces	Erosionally stable, biologically self-sustaining	Annually for 5 years or until observations indicate stable conditions	Integrated Waste Management Monitoring Plan (Donlin Gold Project Plan of Operations Volume VII A)
	Mine Access Road and other disturbed facilities areas not fully reclaimed	Storm water	Per SWPPP requirements	Per Storm Water Pollution Prevention Plan requirements	Multi-Sector General Permit (storm water) to extent applicable

Notes:

1 Refers to the Long List of parameters identified in the Donlin Gold Quality Assurance Project Plan Water Quality Monitoring, Sampling, and Analysis Activities (December 2016)
2 Refers to the Short List of parameters identified in the Donlin Gold Quality Assurance Project Plan Water Quality Monitoring, Sampling, and Analysis Activities (December 2016)

Source: SRK 2012d, 2013b, 2016b, 2016d, 2016e, 2016f, 2016h; Donlin Gold 2017d; ADEC 2017h

Other Monitoring Programs

Visual inspections during Closure and post-Closure would include monitoring of the TSF and WRF, mine access road and other remaining non-reclaimed areas for erosion, seepage, and stormwater control in accordance with SWPPP permit requirements. Mass stability inspections of the tailings dam would be conducted according to ADEC requirements; inspections would occur annually for the first five years and every five years thereafter until observations indicate a stable condition. Seepage and stormwater inspections of the reclaimed WRF would be carried out every year for five years or more after Closure, until conditions stabilize, with inspections at least annually in the spring and following storms that exceed the 25-year, 24-hour storm event. Remedial action to correct instability would be taken as soon as feasible following detection of substantial erosion or loss of growth media.

The mine access road and other disturbed facilities that would not be fully reclaimed would be monitored for storm water runoff, as per a SWPPP.

Revegetation progress of reclaimed facilities would be monitored annually for the first five years after Closure or until observations indicate stabilized conditions. Should vegetative cover not meet criterion established by ADNR, ADF&G, BLM, and Donlin Gold further action could include reseeding the area, additional application of soil amendments, and/or incorporation of additional growth media on a particular site or facility.

2.3.3 ALTERNATIVE 3A – REDUCED DIESEL BARGING: LNG-POWERED HAUL TRUCKS

Alternative 3A would use liquefied natural gas (LNG) instead of diesel to power the large (+300-ton payload) trucks that would move waste rock and ore from the open pits. These large trucks would account for approximately 75 percent of the total annual diesel consumption under Alternative 2. This alternative does not propose using LNG for the trucks hauling cargo and fuel on the mine access road from Angyaruaq (Jungjuk) port.

Alternative 3A would reduce the barging of diesel fuel on the river to a peak of 19 fuel barge tow round trips per year, compared to the peak of 58 required under Alternative 2 during Operations. There would still be 64 cargo barge tow round trips per year during Operations, for a total of 83 river barge trips per year during Operations (Table 2.3-44). Peak values would be realized late in the mine life.

The primary differences between this alternative and Alternative 2 are the addition of the LNG plant and storage tanks near the processing plant, reduced consumption of diesel, reduced barge trips, reduced on-site diesel storage, and increased natural gas consumption. The description of this alternative was prepared by Donlin Gold (Krall 2013) and subject to independent review by the EIS team.

At present, LNG powered haul trucks are not commercially available. However, the technology to use natural gas products (such as LNG or compressed natural gas) in other industrial applications is proven and equipment manufacturers, such as Caterpillar, are actively developing dual fuel (diesel and natural gas) options for the mining industry (Caterpillar 2012). While Caterpillar expects to have equipment such as haul trucks proven commercially available and proven suitable for arctic conditions before mining equipment would be procured, if that did not occur, this alternative would not be feasible.

2.3.3.1 ALTERNATIVE 3A – MINE SITE

For either Alternative 2 or 3A, the natural gas pipeline would approach the project site from the east, run past the fuel and container storage facility and terminate at the power plant. For Alternative 3A, a 220,000-gallon per day LNG plant would be constructed near the terminus of the gas line at the Mine Site (Figure 2.3-40). Conceptually, the LNG plant would consist of four truckable modules, each about 9 feet by 30 feet and occupy approximately 2,405 sf of land (less than 0.1 acre). LNG would be stored in a series of eight tanks; conceptually, the storage tanks would be 43 feet in diameter and 118 feet long, constructed offsite, shipped using the same river barges and trucks proposed under Alternative 2 and, when installed, occupy approximately 71,732 sf of land (1.6 acres). Distribution and fueling infrastructure would be installed.

The LNG plant, storage containers, and distribution infrastructure footprint would be within an area that would be disturbed under Alternative 2. These LNG-related features would displace some laydown area near the plant site. However, reduced need for diesel storage would allow for displaced laydown capacity to be relocated near the fuel storage area.

Under Alternative 3A, the haul trucks would run on an assumed mix of 95 percent LNG and 5 percent diesel. This would reduce the peak annual diesel consumption from 42.3 Mgal to 13.3 Mgal (a 69 percent reduction). Natural gas usage would increase from 11.2 billion standard cubic feet per year (BSCF / year) to an annual peak of 15.5 BSCF (a 38 percent increase).

Under Alternative 3A, there would be no other changes to Mine Site components when compared to Alternative 2. The mining process, WRF, TSF, ore processing, camps, and water use and treatment would not change. Closure Phase would be the same as Alternative 2.

2.3.3.2 ALTERNATIVE 3A – TRANSPORTATION CORRIDOR

The transportation infrastructure to support mine and pipeline construction and mine operation under Alternative 3A are similar to those under Alternative 2. The LNG facility would be constructed of truckable modules and could be accommodated by the barge trips planned during Construction for Alternative 2. The amount of diesel fuel transported by barge to Dutch Harbor, to Bethel and to the Angyaruaq (Jungjuk) Port site storage space would be reduced from a peak of 42.3 Mgal / year to 13.3 Mgal / year, a reduction of about 69 percent.

Under Alternative 3A, fuel sourced from refineries in the Pacific Northwest would be transported to Dutch Harbor by chartered 6.5-Mgal capacity double-hull ocean barges, making two round trips in a shipping season. This would be a reduction from Alternative 2 which would require seven round trips per year. Alternative 2 may indirectly require increased tank storage capacity in Dutch Harbor; under Alternative 3A this would probably not be required.

In Dutch Harbor, the fuel would be pumped ashore to storage tanks, and ultimately into a double-hull 2.94-Mgal capacity ocean fuel barge for delivery to Bethel. Under Alternative 3A it would require five barge trips between Dutch Harbor and Bethel instead of the 14 trips that would be required under Alternative 2. The total number of ocean barges to Bethel would therefore be 30 during Construction (16 cargo barges plus 14 fuel barges), and 17 during Operations (12 cargo barges plus 5 fuel barges).

Alternative 2 proposes to build additional diesel storage in Bethel and this could be reduced or eliminated under Alternative 3A.

The number of river barge trips departing Bethel for Angyaruaq (Jungjuk) Port is also reduced under Alternative 3A during Operations. This alternative would reduce peak annual Donlin Gold Project related barge traffic, both fuel and cargo, on the Kuskokwim River from an estimated 122 round trips to 83 (approximately 1.1 round trips per day to approximately 0.8 round trips per day) (Table 2.3-45). The total number of river barges would remain the same during Construction as in Alternative 2, with 89 barges per year (50 cargo barges, plus 19 fuel barges to Angyaruaq [Jungjuk] Port Site, plus 20 pipe and equipment barges during the first two years of Construction to the staging area near Devil's Elbow, above Stony River).

An increase of four ocean fuel barges from Pacific Northwest (Seattle, WA and Vancouver, BC) ports to Dutch Harbor is estimated to occur during Construction, but there would be only two fuel barges estimated during Operations (compared to seven estimated under Alternative 2).

The diesel storage capacity at Angyaruaq (Jungjuk) Port would be reduced. Compared to Alternative 2, tanker truck traffic on the port access road would be the same during Construction and reduced by approximately 75 percent during Operations.

All ocean and river barge dimensions would remain the same as Alternative 2 but fewer barges and tugs would be required. All other transportation facility components such as docks in Bethel and Angyaruaq (Jungjuk), the Angyaruaq (Jungjuk) Port road, and the airstrip would be the same as Alternative 2. There would be fewer trucks hauling diesel on the Angyaruaq (Jungjuk) Port road.

2.3.3.3 ALTERNATIVE 3A – NATURAL GAS PIPELINE

Under Alternative 3A, natural gas usage would increase from 11.2 BSCF/year to a peak of 15.5 BSCF/year. The natural gas pipeline proposed under Alternative 2 has an engineered capacity to accommodate 26 BSCF/year with additional compression (i.e., higher operating pressure) and would not require any modifications to transport the increased amount. Because the increased pressure is still within the engineered capacity of the pipeline, there would not be additional risks to operations from the higher pressure. Other than increased throughput, the natural gas pipeline component would be identical to Alternative 2.

2.3.4 ALTERNATIVE 3B – REDUCED DIESEL BARGING: DIESEL PIPELINE

Under Alternative 3B, an 18-inch diameter diesel pipeline would be constructed from Cook Inlet to the Mine Site to reduce diesel barging on the Kuskokwim River. The diesel pipeline would be buried and located in the same corridor proposed for the natural gas pipeline under Alternative 2 (Figure 2.3-14), with an additional 19-mile segment between Tyonek and the start of the proposed corridor for the natural gas line (Michael Baker Jr. 2013a), for a total of 334 miles. This additional segment would cross the Beluga River using HDD. A natural gas pipeline would not be constructed; natural gas would not be used in Alternative 3B.

Alternative 3B would require improvements to the existing Tyonek North Foreland Barge Facility and transportation of diesel fuel in Cook Inlet. It would also require a robust leak detection system and pre-positioned response infrastructure and equipment along the pipeline route.

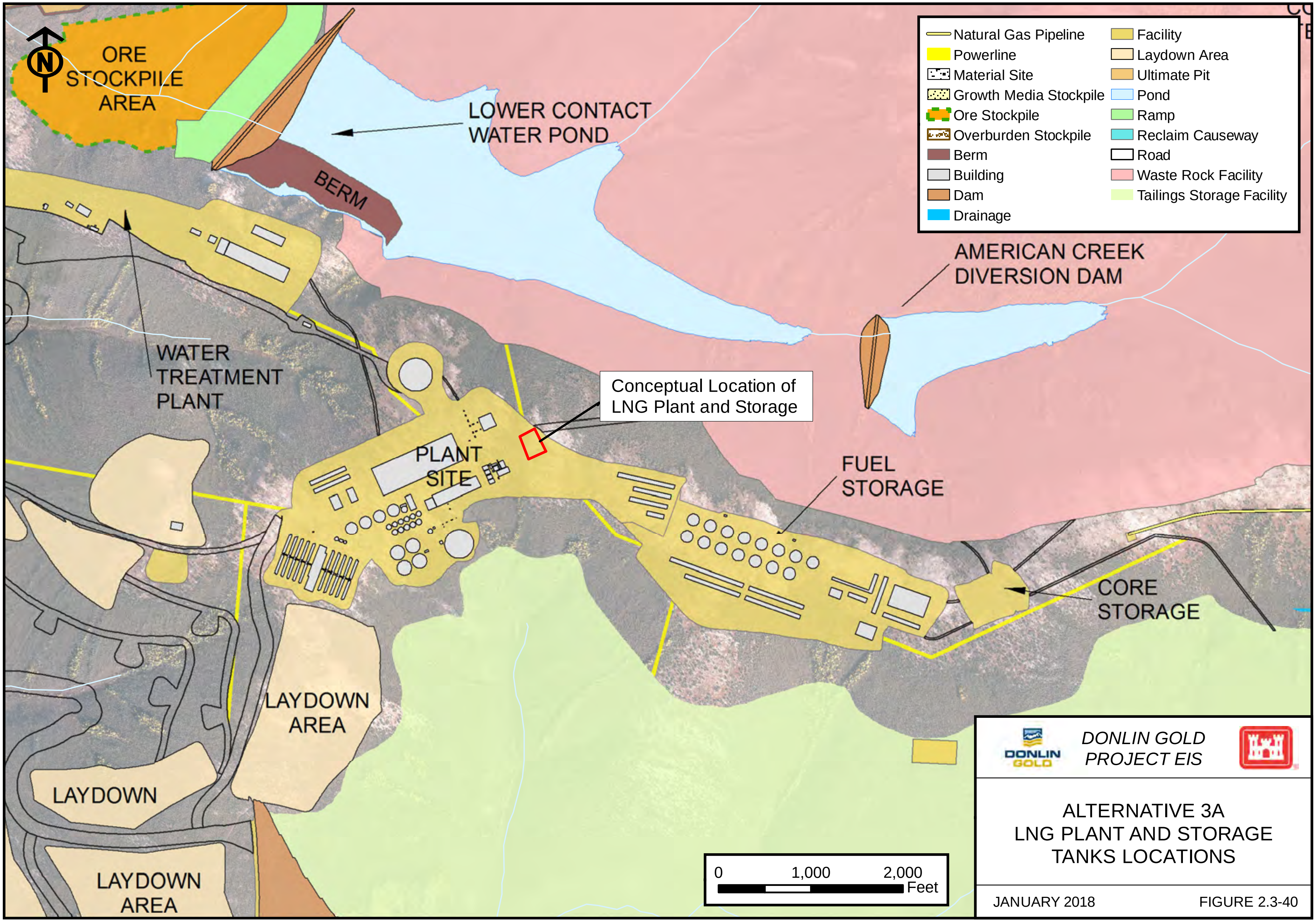

N
ORE STOCKPILE AREA
LOWER CONTACT WATER POND
BERM
WATER TREATMENT PLANT
PLANT SITE
Conceptual Location of LNG Plant and Storage
AMERICAN CREEK DIVERSION DAM
FUEL STORAGE
CORE STORAGE
LAYDOWN AREA
LAYDOWN
LAYDOWN AREA
Natural Gas Pipeline
Powerline
Material Site
Growth Media Stockpile
Ore Stockpile
Overburden Stockpile
Berm
Building
Dam
Drainage
Facility
Laydown Area
Ultimate Pit
Pond
Ramp
Reclaim Causeway
Road
Waste Rock Facility
Tailings Storage Facility
0
1,000
2,000
Feet
DONLIN GOLD PROJECT EIS
ALTERNATIVE 3A
LNG PLANT AND STORAGE
TANKS LOCATIONS
JANUARY 2018
FIGURE 2.3-40

Table 2.3-44: Estimated Annual Ocean and River Barge Traffic Under Alternative 3A

Barge	Transporting	From	To	Number of Round Trips per season	
				During Construction	During Operations
Ocean	Cargo	Seattle WA or Vancouver, B.C. area	Bethel	16	12
Ocean	Fuel	Dutch Harbor	Bethel	14	5
Total cargo and fuel barges to Bethel				**30**	**17**
Ocean	Fuel	Seattle WA or Vancouver, B.C. area	Dutch Harbor	4	2
Total fuel barges to Dutch Harbor				**4**	**2**
River	Cargo	Bethel	Angyaruaq (Jungjuk) Port Site	50[a]	64
River	Fuel	Bethel	Angyaruaq (Jungjuk) Port Site	19[b]	19
River	Pipe and Equipment	Bethel	Staging area near Devil's Elbow, above Stony River	20 during first two years of pipeline construction	0
Total river barges, Transportation Corridor Component				**89**	**83[c]**

Notes:

a Total would be 200 trips over four years. Exact distribution by year would be determined during final design.

b Average number. Actual number would range from 9 to 29 annually.

c Number represents peak years.

Source: Developed from Krall 2013

Alternative 3B would also eliminate the barging of diesel fuel after Construction, eliminating the 58 fuel barge tow round trips per year required under Alternative 2 to zero fuel barge tow round trips per year during Operations. There would still be 64 cargo barge tow round trips per year. There would therefore be a total of 64 barge tow trips per year during Operations (Table 2.3-45).

The primary differences between this alternative and Alternative 2 are the replacement of the natural gas pipeline with a diesel fuel pipeline, reduced barge trips due to elimination of diesel barging, increased consumption of diesel, and no natural gas consumption. Diesel from the pipeline would be used to fuel the mine's power generation facilities, mobile vehicle fleet, and equipment. The estimated demand for diesel fuel under Alternative 3B is 120 Mgal of diesel per year; there would be no consumption of natural gas for this alternative. In comparison, Alternative 2 would require a peak of 42.3 Mgal of diesel and 11.2 BSCF of natural gas per year.

Two options to Alternative 3B have been added based on Draft EIS comments from agencies and the public:

- Port MacKenzie Option: The Port MacKenzie Option would utilize the existing Port MacKenzie facility to receive and unload diesel tankers instead of the Tyonek facility considered under Alternative 3B. A pumping station and tank farm of similar size to the Tyonek conceptual design would be provided at Port MacKenzie. A pipeline would extend northwest from Port MacKenzie, route around the Susitna Flats State Game Refuge, cross the Little Susitna and Susitna rivers, and connect with the Alternative 3B alignment at approximately MP 28. In this option, there would be no improvements to the existing Tyonek dock; a pumping station and tank farm would not be constructed near Tyonek; and the pipeline from the Tyonek tank farm considered under Alternative 3B to MP 28 would not be constructed.

- Collocated Natural Gas and Diesel Pipeline Option: The Collocated Natural Gas and Diesel Pipeline Option (Collocated Pipeline Option) would add the 14-inch-diameter natural gas pipeline proposed under Alternative 2 to Alternative 3B. Under this option, the power plant would operate primarily on natural gas instead of diesel as proposed under Alternative 3B. The diesel pipeline would deliver the diesel that would be supplied using river barges under Alternative 2 and because it would not be supplying the power plant, could be reduced to an 8-inch-diameter pipeline. The two pipelines would be constructed in a single trench that would be slightly wider than proposed under either Alternative 2 or Alternative 3B and the work space would be five feet wider. The permanent pipeline ROW would be approximately two feet wider. This option could be configured with either the Tyonek or Port MacKenzie dock options.

2.3.4.1 ALTERNATIVE 3B – MINE SITE

The infrastructure required at the Mine Site would be essentially the same as in Alternative 2, with the exception of fuel storage tanks. Under Alternative 2, 37.5 Mgal of diesel (representing 11 months' supply) would be stored at the Mine Site. Alternative 3B would deliver diesel year round and the on-site storage would be reduced to approximately 10 Mgal (representing one month's supply). This would allow some reduction in the spill response equipment prepositioned at the Mine Site. Under Alternative 3B, there would be no other changes to Mine Site components when compared to Alternative 2. The mining process, WRF, TSF, ore processing, camps, and water use and treatment would not change. Closure Phase would be the same as Alternative 2.

2.3.4.2 ALTERNATIVE 3B – TRANSPORTATION CORRIDOR

The Transportation Corridor to support mine and pipeline construction and mine operation under Alternative 3B are similar to those under Alternative 2. Delivery of diesel to the Mine Site during Construction would also be similar to Alternative 2.

Diesel fuel would be transported directly from the Pacific Northwest or from the Tesoro refinery in Nikiski to Tyonek in the Pipeline component via chartered 10.5 Mgal capacity tankers, making an estimated 12 round trips annually. The existing dock at the Tyonek North Foreland Facility currently extends 1,500 feet from shore to a water depth of approximately 21 feet. The dock would need to be extended an additional 1,500 feet to accommodate vessels in excess of 30,000 gross tons, approximately 600 feet long and 105 feet wide with drafts approaching 40 ft. In addition, a fuel unloading system would need to be installed (see Figure 2.3-41). This would require an estimated additional 12 ocean barge trips per year during Operations (Table 2.3-45).

Fuel delivery via tanker to the Tyonek North Forelands Facility would occur year round. Storms, extreme tides, icing and strong currents are continual challenges to safe navigation. In addition, tankers berthed during winter months must be able to withstand the increased ice load. Fuel transfers under conditions experienced at the Tyonek facility have the potential for spills and other risks during docking procedures. The use of tug boats would reduce the risk of grounding; however, the west side of Cook Inlet does not have mooring facilities for tugs. Tug boat support would likely come from Kenai, Nikiski, or Anchorage on the east side of Cook Inlet. Similar tank ships of this capacity regularly berth at Nikiski docks on the east side of Cook Inlet. These vessels include the Overseas Nikiski, Overseas Martinez, and Overseas Boston. These vessels are 600 feet long, 105 feet wide, with drafts of 40 feet. Water depth at the face of the extended dock would need to be about 45 feet mean lower low water (MLLW) to allow for the vessel draft and design clearance to the floor of Cook Inlet at low tide levels.

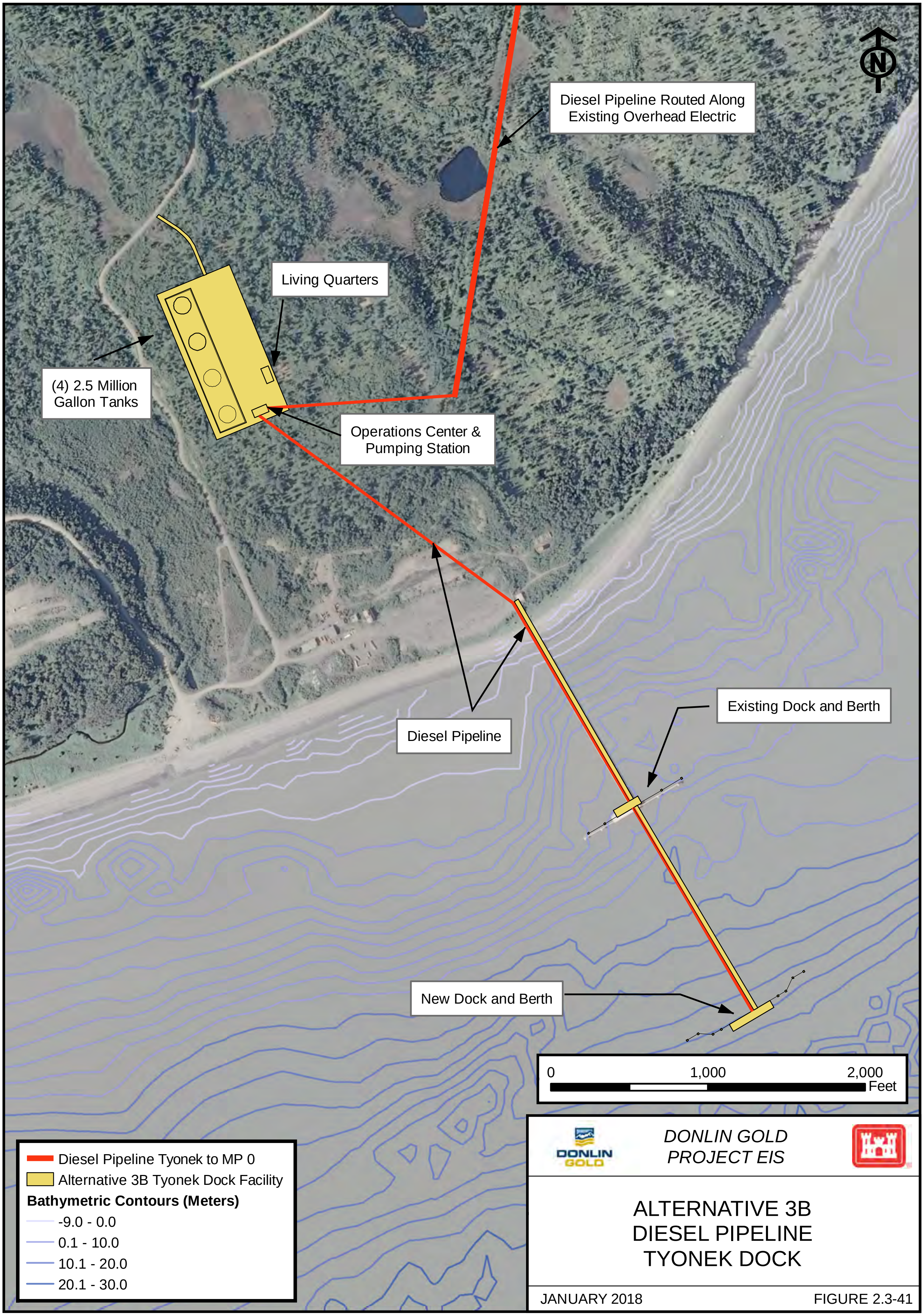
A new tanker berth and pile support system would be designed to accommodate site-specific tide, ice, seismic risk, and sea bottom conditions. The berth would likely consist of multiple-pile moorings designed to hold vessels in place during all tides, currents, winds, and ice conditions within the design ranges for continuous 24-hour operation. A bathymetric survey would be completed prior to design and construction. Large boulders protruding above the sea floor shown on navigation charts would present navigation hazards and would need to be identified and removed. Because the dock would be extended to the design water depth, it would not be necessary to have traditional dredging at the dock or in shipping channels, either initially or for maintenance. A temporary barge landing would be constructed on the beach adjacent to the dock to support construction of the pipeline and dock extension. It is assumed that tug support for berthing would be provided by vessels already operating out of Nikiski, Kenai or Anchorage.

The total number of ocean barges to Bethel would be 30 during Construction (16 cargo barges plus 14 fuel barges), and 12 during Operations (12 cargo barges plus no fuel barges), compared to 26 during Operations under Alternative 2.

Alternative 3B would reduce peak annual Donlin Gold related river barge traffic on the Kuskokwim River to 64 trips from 122 under Alternative 2, which would be exclusively for cargo transit during Operations. The total number of river barges would remain 89 during Construction (50 cargo barges, plus 19 fuel barges to Angyaruaq [Jungjuk] Port Site, plus 20 pipe and equipment barges during the first two years of Construction to the staging area near Devil's Elbow, above Stony River), and 64 during Operations (64 cargo barges plus no fuel barges).

Transport of diesel by tank truck on the mine access road would be the same as Alternative 2 during Construction but would be reduced by more than 75 percent during Operations.

An increase of four ocean fuel barges from Pacific Northwest (Seattle, WA and Vancouver, BC) ports to Dutch Harbor is estimated to occur during Construction, but there would be no ocean fuel barges estimated during Operations (compared to seven estimated under Alternative 2).



DONLIN GOLD PROJECT EIS

ALTERNATIVE 3B DIESEL PIPELINE TYONEK DOCK

JANUARY 2018

FIGURE 2.3-41

Spill response strategies would be similar to Alternative 2 for the Transportation Corridor but with the reduction in storage volume, the amount of pre-staged response equipment could be reduced. Other transportation facility components to support cargo shipments, such as docks in Bethel and Angyaruaq (Jungjuk), the mine access road, and the airstrip would be the same as Alternative 2. The diesel storage capacity in Dutch Harbor, Bethel and at Angyaruaq (Jungjuk) Port would not be required for Alternative 3B, except that some fuel would be required during Construction before the pipeline is operational. Transportation facilities such as helipads, airstrips, or road segments that would be maintained for spill response are discussed below in the pipeline description. A permanent road would not be provided along the entire pipeline route.

Table 2.3-45: Estimated Annual Ocean and River Barge Traffic Under Alternative 3B

Barge	Transporting	From	To	Number of Round Trips per season	
				During Construction	During Operations
Ocean	Cargo	Seattle WA or Vancouver, B.C. area	Bethel	16	12
Ocean	Fuel	Dutch Harbor	Bethel	14	0
Total cargo and fuel barges to Bethel				**30**	**12**
Ocean	Fuel	Seattle WA or Vancouver, B.C. area	Dutch Harbor	4	0
Total fuel barges to Dutch Harbor				**4**	**0**
River	Cargo	Bethel	Angyaruaq (Jungjuk) Port Site	50[a]	64
River	Fuel	Bethel	Angyaruaq (Jungjuk) Port Site	19[b]	0
River	Pipe and Equipment	Bethel	Staging area near Devil's Elbow, above Stony River	20 during first two years of pipeline construction	0
Total river barges, Transportation Corridor Component				**89**	**64[c]**
Ocean	Fuel	Marine Terminals in Pacific Northwest to include Seattle, WA and/or Vancouver, B.C., or from Tesoro Refinery in Nikiski	Tyonek	0	12
Total ocean barges, Pipeline Component				**0**	**12**

Notes:

a Total would be 200 trips over four years. Exact distribution by year would be determined during final design.

b Average number. Actual number would range from 9 to 29 annually.

c Number represents peak years.

Source: Michael Baker Jr. 2013a, SRK 2013a

2.3.4.3 ALTERNATIVE 3B – DIESEL OR COLLOCATED PIPELINE

Under Alternative 3B, a 334-mile long, 18-inch diameter buried diesel pipeline would be constructed. The pipeline would be capable of delivering 120 Mgal of fuel per year, or about 329,000 gallons of fuel per day. The ROW and construction techniques would be similar to those proposed for the natural gas pipeline and described in detail above for Alternative 2.

The proposed diesel pipeline corridor would begin at the Tyonek dock at the north end of Cook Inlet and extend to MP 0 of the Alternative 2 natural gas pipeline. The remainder of the route follows the same alignment proposed for the natural gas pipeline in Alternative 2. Figure 2.3-42 shows the 18-mile segment between Tyonek and the beginning of the natural gas pipeline route (under Alternative 2) that would be followed for the diesel pipeline. There would be an estimated additional 12 ocean barge trips per year during Operations to transport fuel from refineries to Tyonek (Table 2.3-45).

The diesel pipeline would be operated as an ambient line (i.e., the pipe temperature would generally be within a few degrees of the ground temperature and should not freeze surrounding thawed soils); therefore the line would not likely be impacted by frost heave. Any thaw settlement would most likely be the result of surface disturbance caused by construction activities (i.e., clearing of vegetation and stripping of organics along the pipeline ROW) and not attributed to the pipeline.

The 18-inch diesel pipeline would have a similar diameter and wall thickness to the base case natural gas line described in Alternative 2, and therefore should have similar response to ground deformations caused by various geohazards. Based on preliminary analyses conducted for the base case gas line, the diesel line should be able to accommodate up to approximately 1-foot of movement without any special requirements. The pipeline alignment crosses the Castle Mountain and Denali-Farewell seismic fault lines and, like the base case gas line, would be constructed above grade in these areas. Stream crossing methods would be the same as Alternative 2 with an additional HDD under the Beluga River.

This alternative requires construction of a new Operations Center and Pumping Facility in the uplands near the dock at Tyonek. The facility would contain meters, pumps, and a pig launcher where in-line maintenance and inspection tools would be deployed. The operations center would include living quarters for on-site personnel, a water well, and a sewer septic system. The facility would be connected to the local Chugach Electric grid for power. Overhead distribution lines from the local Chugach Electric grid currently provide power to the area. Installation of 10 miles of additional lines from the Beluga Power plant could be required to supply power required for the pumping facility. While upgrades to existing utility poles could be required for the additional lines, it is unlikely that parallel lines would be required.

A new tank farm consisting of four 2.5-Mgal above-ground storage tanks would be designed to store a one month supply of diesel fuel and would be collocated with these facilities. A spill containment system would be constructed around the fuel tanks.

Manual block valves would be installed on each bank at 27 stream crossing locations where the bank-full width of the stream exceeds 100 feet (see Figure 2.3-41 and 2.3-42; Table 2.3-46). In addition, check valves would be installed on the downstream side of each crossing to provide added protection. Of the 237 total drainage crossings along the entire pipeline route, 210 would not require installation of isolation valves.

The remote manual block valves would require year-round access to allow preventative maintenance and inspection. Some construction site reclamation would occur at each valve site; however helipads (vegetation taller than one foot cleared) would be required for the long-term inspection and operation at all valve locations, including major river crossings. The helipads would allow access to the valves in a shut-down situation and would also be suitable sites locations for containerized response equipment (Polaris Applied Sciences, 2014).

In addition to the six HDD crossings described for Alternative 2, the Beluga River would be crossed by HDD under this alternative. The length of the Beluga River HDD crossing would be 367 ft. From 45,000 to 70,000 gal. of water and from 23,000 to 43,000 gal. of mud would be needed to complete the HDD. The mud and additional 30 to 40 cubic yards of cuttings would require disposal.

For the diesel pipeline, a leak detection and spill response plan would be developed for review and approval by ADEC. Section 3.24, Pipeline Reliability and Safety, of this EIS describes spill risk associated with the project including risks from the diesel pipeline alternative. A software-based leak detection system would be installed with connection to the operations center. Regular over-flights to monitor the pipeline would be required.

For the diesel pipeline some of the construction infrastructure would be required to remain through Operations to provide for a reasonable diesel spill response capability. Spill response techniques are provided in Section 3.24. Spill response requirements and equipment storage locations would necessitate maintaining some of the construction facilities and most of the airstrips in a usable condition throughout the operating life of the pipeline. Modifications may be required to some of the proposed airstrips to make them suitable for multi-season (as opposed to just winter) use and additional Hercules C- 130 capable airstrips and staging areas would be required (see Table 2.3-47). The airstrips required for spill response capacities include the nine new and three existing airstrips proposed as facilities to support construction in Alternative 2 (see Table 2.3-28), plus three additional Donlin Gold proposed airstrips: Puntilla Airstrip, Tatlawiksuk Airstrip, and George River Airstrip.

Portions of gravel roads developed during Construction may be left in place to facilitate movement along the pipeline ROW in select areas for spill response (specific portions would be identified during final design). These roads in combination with the maintained ROW would provide overland access, mainly during summer, but also to small pipeline segments during the winter.

To adequately respond to diesel spills, equipment such as containment boom, skimmers, portable tanks, absorbent materials, four-wheelers, snow machines, boats, rafts, and vacuum equipment would likely be staged at major streams, at the dock facility, tank farms, and other strategic locations along the pipeline corridor. Response materials would be delivered by air from such locations to multiple deployment sites along the affected area or receiving water body.

Conceptually, initial spill response equipment would be staged at the 27 designated large drainages along the pipeline corridor, at the dock facility, and at the tank farms. Donlin Gold would strategically place the spill response equipment at these sites based on location, accessibility, terrain, and stream morphology.

Table 2.3-46: Alternative 3B Block Valve Location Summary

Major Receiving Water Body	Location	MP (Approx.)
Cook Inlet	Beluga River	MP-3
	Theodore Shoofly	MP-5
	Chuitna River	MP-15
Skwentna and Cook Inlet	Skwentna 1	MP-50
	Happy 1	MP-86
	Happy River	MP-108
	3 – mile Tributary	MP-114
	3 – mile Tributary	MP-116
	So Long Creek	MP 123
Kuskokwim	Tatina River	MP-127
	Jones Creek Tributary	MP-133
	Jones Creek Tributary	MP-136
	Jones Creek	MP-137
	Jones Creek Tributary	MP-140
	South Fork Kuskokwim	MP-146
	Tin Creek	MP-150
	Sheep 1	MP-156
	Windy Fork 1	MP-168
	Khuchaynik 1	MP-171
	MF Kusko t5	MP-171
	MF Kusko 1	MP-183
	Big 1	MP-191
	Tatlawiksuk 1	MP-217
	Kuskokwim 1	MP-240
	Kuskokwim 1	MP-241
	EF George 2	MP-283
	EF George 2	MP-291

Source: Michael Baker Project Note May 7, 2014;
Polaris Applied Sciences 2014, Donlin Gold Spill Response Considerations

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ALTERNATIVE 3B DIESEL PIPELINE TYONEK DOCK AND PORT MACKENZIE OPTIONS

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FIGURE 2.3-42

Table 2.3-47: Airstrips for Alternative 3B

Location (MP)[1]	Near Airstrip	Airstrip Class	Airstrip Length (ft)	Hercules Capable	Distance off Alignment (miles)
MP 16	Tyonek	Existing Airstrip (FAA)	5,163	Y	0.4
MP 8	Beluga	Existing Airstrip (FAA)	5,035	Y	0.2
MP 14	Little Susitna	Existing Airstrip (FAA)	2,800	N	21.5
MP 27	Jewell	Existing Airstrip (FAA)	1,900	N	12.8
MP 42	Deep Creek Airstrip	Airstrip (Proposed Donlin)	3,500	N	0.0
MP 50	Skwentna	Existing Airstrip (FAA)	4,022	N	8.0
MP 54	Shell Airstrip	Airstrip (Proposed Donlin)	5,000	Y	0.2
MP 85	Happy River Airstrip	Airstrip (Proposed Donlin)	5,000	Y	0.1
MP 101	Rainy Pass	Existing Airstrip (FAA)	2,359	N	0.3
MP 108	Puntilla Airstrip	Airstrip (Proposed Donlin)	5,577	Y	0.3
MP 111	Threemile Airstrip	Airstrip (Proposed Donlin)	3,500	N	0.2
MP 131	Tatina	Existing Airstrip (FAA)	2,230	N	8.0
MP 133	Bear Paw Airstrip	Airstrip (Proposed Donlin)	4,000	N	0.1
MP 144	Jones Airstrip	Airstrip (Proposed Donlin)	5,000	Y	0.9
MP 149	Tin Creek	Existing Airstrip (FAA)	2,700	N	2.0
MP 158	Farewell Airstrip	Existing Airstrip (FAA)	5,000	Y	2.8
MP 158	Nikolai	Existing Airstrip (FAA)	4,500	N	40.9
MP 170	Medfra	Existing Airstrip (FAA)	2,540	N	50.5
MP 191	Big River Airstrip	Airstrip (Proposed Donlin)	5,000	Y	0.5
MP 200	McGrath	Existing Airstrip (FAA)	6,000	Y	53.1
MP 220	Tatlawiksuk Airstrip	Airstrip (Proposed Donlin)	6,500	Y	0.2
MP 235	Kuskokwim East Airstrip	Airstrip (Proposed Donlin)	5,000	Y	1.4
MP 246	Kuskokwim West Airstrip	Airstrip (Proposed Donlin)	5,000	Y	0.2
MP 258	Stony River	Existing Airstrip (FAA)	3,048	N	19.0
MP 272	Sleetmute	Existing Airstrip (FAA)	3,480	N	21.8
MP 273	Red Devil	Existing Airstrip (FAA)	5,233	Y	17.9
MP 276	George River Airstrip	Airstrip (Proposed Donlin)	5,000	Y	0.8
MP 315	Crooked Creek	Existing Airstrip (FAA)	2,520	N	10.2
MP 315	Aniak	Existing Airstrip (FAA)	6,600	Y	54.7
MP 315	Chuathbaluk	Existing Airstrip (FAA)	3,900	N	46.3

Notes:

1 Mileposts are the same as Alternative 2 Natural Gas Pipeline except that the additional segment to Tyonek is shown as negative mileposts from the Alternative 2 beginning.

FAA = Federal Aviation Administration
ft = feet
MP = milepost

Source: Polaris 2014.

2.3.5 ALTERNATIVE 4 – BIRCH TREE CROSSING (BTC) PORT

Alternative 4 would move the upriver port site from Angyaruaq (Jungjuk) (under Alternative 2) to Birch Tree Crossing (BTC), located about 124 river miles upriver from Bethel. This would reduce the barge distance for freight and diesel out of Bethel bound for the Mine Site from 199 miles to Angyaruaq (Jungjuk) Port versus 124 miles to BTC, a decrease of 75 miles. The same volume of cargo and diesel fuel would be transported by barge as in Alternative 2. The BTC mine access road would be 76 miles long, versus 30 miles for the mine access road from Angyaruaq (Jungjuk) Port, an increase of 46.

There would be no other substantive changes to other project components as described for Alternative 2.

2.3.5.1 ALTERNATIVE 4 – MINE SITE

The Mine Site activities for Alternative 4 would be the same as Alternative 2.

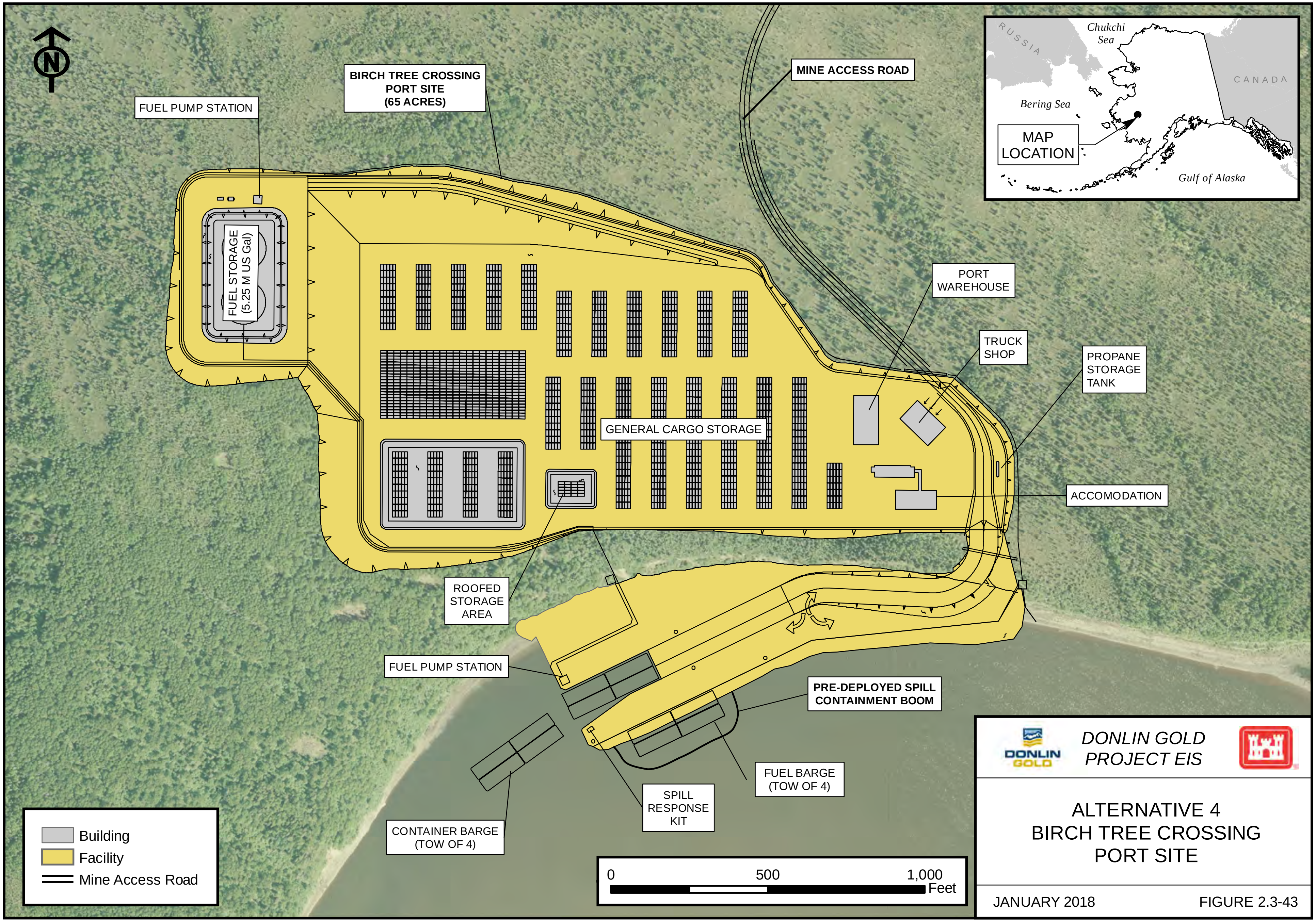
2.3.5.2 ALTERNATIVE 4 – TRANSPORTATION CORRIDOR

Barges procured by Donlin Gold would not travel between BTC and Angyaruaq (Jungjuk). The river depth up to BTC is more favorable, since the limiting river depth is about one foot shallower in the channels between BTC and Angyaruaq (Jungjuk) than downriver of BTC. Three villages, Aniak, Chuathbaluk, and Napaimute, along the Kuskokwim River would experience less barge traffic under this alternative.

The 65-acre port site would be situated on the Kuskokwim River, (Figure 2.3-43). The site consists of an onshore pad area and a filled area in the river to allow container barges to dock. The onshore pad includes areas for general storage, fuels storage, warehouse truck shop and living accommodations. The site is larger than Alternative 2 for two reasons: 1) the nature of the terrain and the high bluff results in a much larger footprint to get the required laydown area, and 2) because of the longer haul road distance, 46 miles longer than the proposed Alternative 2 Angyaruaq [Jungjuk] road). It is considered impractical to haul all the consumables up the road within the barging season; the port and road would have to be operated for a longer period to get all consumables transferred to the Mine Site. As such, more space is needed to store consumables as they build up at the BTC site until they can be moved to the Mine Site.

An approximately 76-mile long, 30-foot wide, all season gravel access road would link the BTC port site to the Donlin Gold Project site (Figure 2.3-44). The road would be used for transporting fuel and cargo for the project, and would be 46 miles longer than the mine access road proposed for Alternative 2. It would cross lands owned by TKC. Public use of the road would not be allowed; however, crossing the road in pursuit of local subsistence activities would be accommodated. The number of cargo trucks and tanker trucks would be the same as Alternative 2, but the time on the road would increase.

Fifty material sites would be used to provide materials to construct the gravel road from BTC to the mine (Table 2.3-48).



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ALTERNATIVE 4
BIRCH TREE CROSSING
PORT SITE

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FIGURE 2.3-43

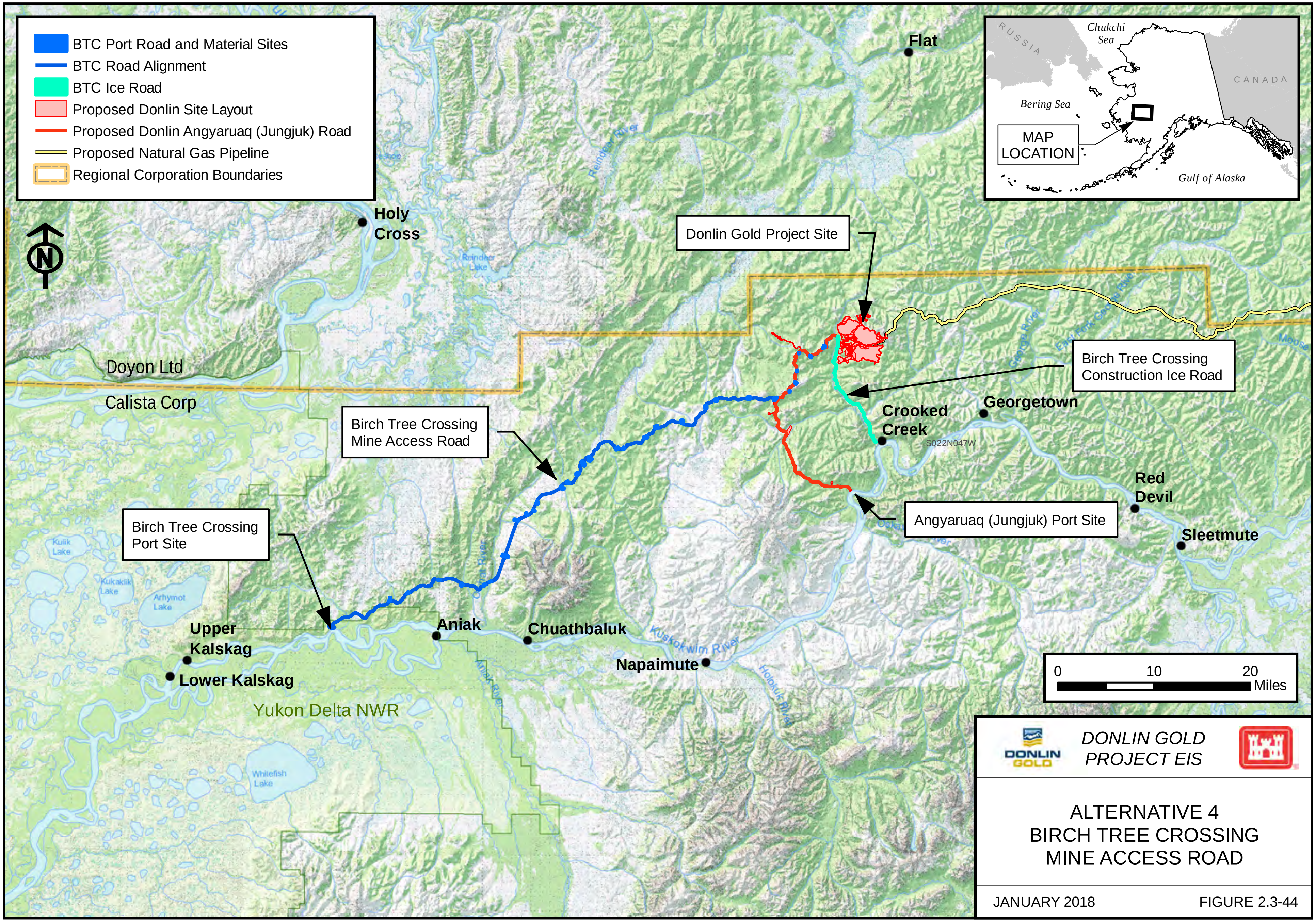
BTC Port Road and Material Sites
BTC Road Alignment
BTC Ice Road
Proposed Donlin Site Layout
Proposed Donlin Angyaruaq (Jungjuk) Road
Proposed Natural Gas Pipeline
Regional Corporation Boundaries
Chukchi Sea
RUSSIA
CANADA
Bering Sea
MAP LOCATION
Gulf of Alaska
Flat
Holy Cross
N
Donlin Gold Project Site
Doyon Ltd
Calista Corp
Birch Tree Crossing Construction Ice Road
Crooked Creek
Georgetown
Birch Tree Crossing Mine Access Road
Red Devil
Angyaruaq (Jungjuk) Port Site
Sleetmute
Birch Tree Crossing Port Site
Upper Kalskag
Lower Kalskag
Aniak
Chuathbaluk
Napaimute
Kuskokwim River
Yukon Delta NWR
0
10
20
Miles
DONLIN GOLD PROJECT EIS
ALTERNATIVE 4
BIRCH TREE CROSSING
MINE ACCESS ROAD
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FIGURE 2.3-44

Table 2.3-48: Material Sites – BTC Road

Material Site	MP nearest BTC Road	Area (acres)	Material Type	Volume (m^3)	Volume (yd^3)
MS 01	2	34.8	Granodiorite	1,000,000	1,307,951
MS 02	3.5	18.8	Sedimentary rock	300,000	392,385
MS 03	5.5	5.9	Sedimentary rock	50,000	65,398
MS 04	7.5	8.4	Sedimentary rock	80,000	104,636
MS 05	8	24.7	Rhyolite	200,000	261,590
MS 06	10	5.2	Rhyolite	50,000	65,398
MS 07	12.5	22.0	Rhyolite	50,000	65,398
MS 08	13.5	42.0	Granodiorite	300,000	392,385
MS 09	14	4.9	Rhyolite	50,000	65,398
MS 10	16	205.3	Gravel	1,500,000	1,961,926
MS 14	31.5	33.6	Basalt	250,000	326,988
MS 15	32	10.4	Sedimentary rock	50,000	65,398
MS 16	12	38.3	Rhyolite fractured	300,000	292,385
MS 17	15	44.7	Rhyolite fractured	400,000	523,180
MS 18	15.5	51.9	Sedimentary & rhyolite	500,000	653,975
MS 19	16.5	47.4	Sedimentary rock	300,000	392,385
MS 20	18.5	29.7	Sedimentary rock	250,000	326,988
MS 21	20	40.5	Sedimentary rock	250,000	236,988
MS 22	20.5	39.5	Sedimentary rock	250,000	326,988
MS 23	21.5	39.5	Sedimentary rock	250,000	326,988
MS 24	23.5	49.4	Sandstone, broken	500,000	653,975
MS 25	26	49.4	Basalt	300,000	292,385
MS 26	28	51.6	Sedimentary rock	250,000	326,988
MS 27	30.5	24.2	Sandstone, broken	200,000	326,988
MS 28	31.6	37.8	Sandstone, slabby	500,000	653,975
MS 29	35.5	73.4	Sandstone, slabby	300,000	292,385
MS 30	36.5	63	Sandstone, slabby	300,000	292,385
MS 31	38	45.2	Sedimentary rock	200,000	261,590
MS 32	39.5	22.5	Sedimentary rock	150,000	196,193
MS 33	40	12.6	Sandstone	150,000	196,193
MS 34	40.5	42.5	Gravel	150,000	196,193
MS 35	43.5	28.9	Sedimentary rock	250,000	326,988
MS 36	44.5	10.9	Sandstone, broken	80,000	104,636
MS 37	45	21.0	Gravel	80,000	104,636

Table 2.3-48: Material Sites – BTC Road

Material Site	MP nearest BTC Road	Area (acres)	Material Type	Volume (m^3)	Volume (yd^3)
MS 38	46.5	27.4	Gravel	150,000	196,193
MS 39	50.5	67.5	Gravel	300,000	292,385
MS 40	53.5	5.4	Gravel	40,000	52,318
MS 41	54.5	17.5	Sedimentary rock	250,000	326,988
MS 42	57	30.6	Sedimentary rock	250,000	326,988
MS 43	58	17.1	Sedimentary rock	100,000	130,795
MS 44	60	14.1	Sedimentary rock	100,000	130,795
MS 45	62	10.6	Sedimentary rock	130,000	170,034
MS 46	64	17.8	Basalt	180,000	235,431
MS 47	64.5	11.6	Basalt	100,000	130,975
MS 48	66.5	30.4	Basalt	300,000	292,385
MS 49	68	5.7	Sedimentary rock	25,000	32,699
MS 50	69.5	25	Sedimentary rock	20,000	26,159
MS 51	71	25	Sedimentary rock	30,000	39,239
MS 52 BTC Port site	73	49.4	Conglomerate	1,500,000	1,961,926
Total	N/A	1,635	N/A	13,265,000	17,349,965

Notes:

BTC = Birch Tree Crossing
m^3 = cubic meters
yd^3 = cubic yards
MP = milepost
MS = material site

Source: RECON 2007a.

The BTC road would cross 40 water bodies or floodways; eight of which would require bridges and 32 would require culverts (see Table 2.3-49).

Table 2.3-49: BTC Road Stream Crossings

Stream Name	MP Nearest BTC Road	Crossing Type	Bridge Span (ft)	Culvert Diameter (in)
Crooked Creek Floodway #1	0	culvert		48
Crooked Creek Floodway #2,	0	culvert		72
Crooked Creek	0	bridge	82	
Crooked Creek Floodway #3	0	culvert		72
Crooked Creek Floodway #4	0	culvert		48

Table 2.3-49: BTC Road Stream Crossings

Stream Name	MP Nearest BTC Road	Crossing Type	Bridge Span (ft)	Culvert Diameter (in)
Skanky Creek	29	culvert		96
Iditarod River	33.5	bridge	49	
Unnamed	36	culvert		60
Unnamed	36.5	culvert		60
Karst Creek	38.5	culvert		96 + 36 for overflow
Cala Poco Creek	39.5	culvert		72
Cobalt Creek	40	bridge	49	
Dunamis Creek	41.5	culvert		96 + 36 for secondary channel
Unnamed	42	culvert		48
Unnamed	42.5	culvert		48
Lithos Creek	44.5	culvert		96
Unnamed	46	culvert		48
Tyrel Creek	46.5	bridge	39	
Unnamed	47	culvert		48
Unnamed	48	culvert		48
Unnamed	49	culvert		48
Unnamed	49.5	culvert		48
Unnamed	50	culvert		48
Jubil Creek	50	bridge	32	
Random Creek	52	culvert		96
Unnamed	53	culvert		48
Unnamed	53	culvert		48
Owhat River	54	bridge	82	
Owhat Floodway #1	54	culvert		84 x 2
Owhat Floodway # 2	54	culvert		84
Unnamed	54.5	culvert		72
Kaina Creek	56.5	bridge	39	
Tor Creek	59.5	culvert		84
Unnamed	62	culvert		48
Unnamed	62.5	culvert		60
Unnamed	66	culvert		60
Aurum Creek	66	culvert		60
Ploutos Creek	71	culvert		84

Table 2.3-49: BTC Road Stream Crossings

Stream Name	MP Nearest BTC Road	Crossing Type	Bridge Span (ft)	Culvert Diameter (in)
Ones Creek	71.5	bridge	49-59	
Unknown	73	culvert		96

Notes:

BTC = Birch Tree Crossing
MP = milepost

Source: Recon 2007a.

Construction of the BTC road would require the installation of a temporary ice road from the vicinity of the Village of Crooked Creek to the Mine Site to allow construction of the BTC road from both ends. The spur roads off of the main access road near the Mine Site would run to the proposed airstrip and permanent camp facilities. The ice road would cross land owned by TKC and the State of Alaska. If this alternative was selected, Donlin Gold would identify water sources and acquire necessary permits for water withdrawal for ice road construction.

Port and road construction techniques would be the same as or very similar to those described for Alternative 2. Maintenance and post-mine decommissioning would be the same.

While there are fewer river miles between Bethel and BTC, the truck haul distance means that additional cargo and fuel tanker trucks would be needed for transporting materials to the Mine Site.

Positioning the upriver port site at BTC rather than Angyaruaq (Jungjuk) would not materially change the total volume of cargo and fuel shipped from the Pacific Northwest to Bethel and on to the Mine Site. The estimated annual ocean and river barge traffic (in terms of number of trips) is the same for both Alternative 2 and Alternative 4.

2.3.5.3 ALTERNATIVE 4 – NATURAL GAS PIPELINE

The natural gas pipeline under Alternative 4 would be identical to Alternative 2.

2.3.6 ALTERNATIVE 5A – DRY STACK TAILINGS

Alternative 5A incorporates an alternate tailings method, using the dry stack tailings (DST) method instead of the subaqueous tailings method that would be used under Alternative 2. This alternative would use filter-presses and vacuum-filters to increase the solid content to more than 80 percent. This alternative was suggested during scoping to avoid the potential for releases from the tailings dam proposed under Alternative 2.

This alternative includes two options:

- Unlined Option: The dry stack TSF would not be lined with an LLDPE liner. The area would be cleared and grubbed and an underdrain system placed in the major tributaries under the dry stack TSF and operating pond to intercept groundwater base flows and infiltration through the dry stack and convey it to an SRS. The underdrain system would be extended upstream as the dry stack footprint increased over time. Flows collected in the dry stack underdrains will be conveyed beneath the upper dam, the operating pond liner and the main dam before discharging to the SRS collection pond. Water collecting in the SRS pond would be pumped to the operating pond, lower CWD, or directly to the process plant for use in process.

- Lined Option: The dry stack TSF would be underlain by a pumped overdrain layer throughout the footprint, with an impermeable LLDPE liner below. The rock underdrain and foundation preparation would be completed in the same manner as the Unlined Option.

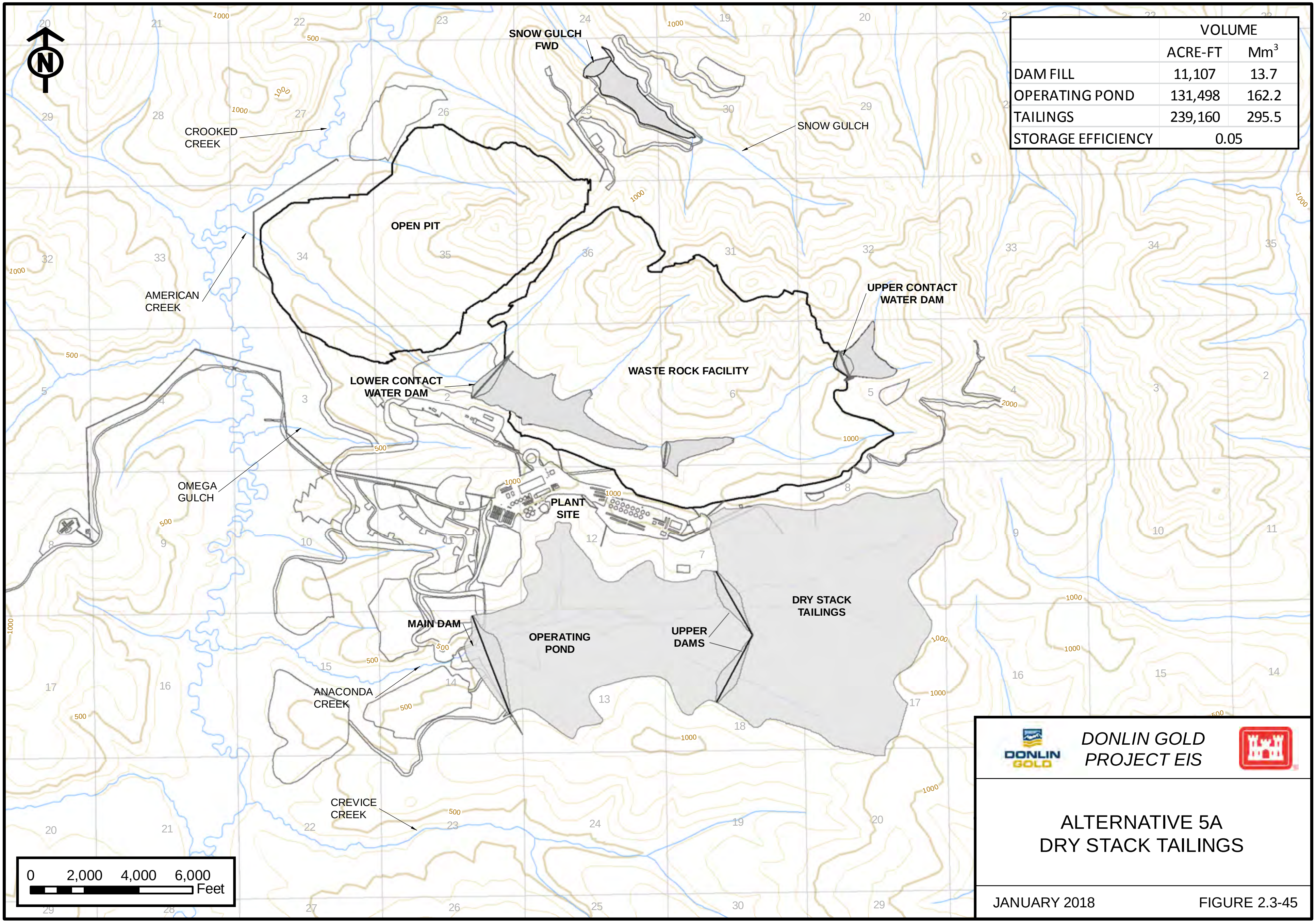
2.3.6.1 ALTERNATIVE 5A – MINE SITE

Under Alternative 5A, tailings would be dewatered in a filter plant using specialized equipment to produce a partially saturated, compactable filter cake, referred to as DST. This material would be delivered to the dry stack TSF by truck and spread and compacted in thin layers using bulldozers. The total volume of filtered tailings that would be produced is approximately 239,500 acre-ft (compared to 334,300 acre-ft of tailings under Alternative 2). Residual process water removed from the tailings would be transported to an operating pond via pipeline. Reclaim water from the operating pond would be pumped back to the process plant for reuse. A small volume of off-specification tailings (assumed five percent) that are not filterable would be directed to the operating pond. (Off-specification tailings could be generated due to unexpected changes in the amount of fines in ore or due to mill upsets.) The operating pond would store the excess water accumulating in the site water balance and water resulting from the filtration of tailings, approximately 125,300 acre-ft, the inflow design flood, freeboard, off specification tailings and one year of contingency water production.

The dry stack TSF and operating pond would be located in the Anaconda Creek Valley in the same general location as under Alternative 2. The dry stack TSF would be located topographically upgradient of the operating pond so that when the operating pond is removed at Closure, the operating pond footprint can drain naturally. Under Alternative 5A, the TSF and operating pond would comprise a main dam and two upper dams that split the valley into two cells (see Figure 2.3-45). The main dam would have a maximum height of 367 feet and would contain the operating pond and would be constructed in lifts similar to the Alternative 2 dam. The upper dams would separate the pond from the DST (to keep water from entering the dry stack), and the taller upper dam would be 218 feet high. The main dam, upper dams, and operating pond would be fully lined with a 60-mil (1.5 mm) LLDPE liner.

The tailings would be spread and compacted in lifts, creating a “dry stack” that would be approximately 412 feet high and extend a maximum length of 1.6 miles from the upper dam crest. The finished surface of the tailings would be sloped towards the operating pond to allow collection of contact water. A collection and diversion system would divert non-contact surface water away from the tailings. DST mobilized from the stack in runoff would be contained behind the upper dams. The footprints of the operating pond impoundment and the dry stack tailings pile would be approximately 1,070 acres and 1,393 acres, respectively, at the conclusion of Operations. The operating pond footprint would be reclaimed during Closure. The ultimate combined operating pond and dry stack footprint would be 2,463 acres. By comparison, the total Alternative 2 TSF footprint would be 2,394 acres.

During Closure, the tailings would be covered with soil, an LLDPE cover, and vegetated. The cover would be graded to the southeast to direct surface runoff to Crevice Creek.



	VOLUME	
	ACRE-FT	Mm^3
DAM FILL	11,107	13.7
OPERATING POND	131,498	162.2
TAILINGS	239,160	295.5
STORAGE EFFICIENCY	0.05	

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ALTERNATIVE 5A
DRY STACK TAILINGS

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FIGURE 2.3-45

At Closure, the operating pond water and any residual solids would be pumped to the open pit. The operating pond and main dam liners would be removed, the dam walls would be breached and graded back into the footprint, and the footprint reclaimed. The SRS would be relocated to be downstream of the upper dams to collect contact water infiltrating through the dry stack cover and water collected in the underdrains. Water from the SRS would be sent to the open pit. After Year 10 of Closure, it is anticipated that surface water from the cover will be of suitable quality for discharge and will be permitted to drain to Crevice Creek.

Operationally, the DST method adds complexity when compared to Alternative 2. There is no precedent in current mining operations for using the dry stack tailings method at this production rate. The production rate would be three times larger than the current largest facility (La Coipa, Chile in an arid climate) and 24 times larger than the current largest facility in a sub-arctic climate (Pogo Mine in Alaska) (BGC 2013g). Specialized filtering equipment would be required and considerable test work would be required to determine the feasibility of filtering fine tailings at the proposed throughput rate of 59,000 tpd. A subarctic climate introduces additional operational complexities in delivery and deposition of the dry stack tailings, because the residual water content in the tailings would freeze in transit unless the haul truck beds are heated. Truck beds, heated with exhaust gas, are proposed as a solution. Nine additional 150-ton capacity haul trucks would be required for the dry stack tailing delivery and deposition, along with additional dozers, graders, and soil compactors to distribute and consolidate the tailings.

The filter plant for Alternative 5A is expected to lead to a 2 percent increase in power consumption. Additionally, for Alternative 5A, the amount of exposed tailings would be increased by 70 acres at the end of Year 1 and 560 acres at Year 23 when compared to Alternative 2. Dust control would include rotating work / deposition fronts, using barriers such as silt fences, and spraying with binders such as Entac or equivalent.

2.3.6.2 ALTERNATIVE 5A – TRANSPORTATION CORRIDOR

The Transportation Corridor under Alternative 5A would be identical to Alternative 2. Alternative 5A would require additional filter plant infrastructure and consumables, along with additional earth moving equipment (to transport and compact the tailings and diesel fuel). Transporting these items to the Mine Site would require an estimated additional seven cargo barge tows per year on average during Operations, for an annual total of 129 round trips compared to 122 under Alternative 2.

2.3.6.3 ALTERNATIVE 5A – NATURAL GAS PIPELINE

The natural gas pipeline under Alternative 5A would be identical to Alternative 2. The volume of natural gas shipped in the pipeline would be increased approximately 2 percent to fuel the filter plant.

2.3.7 ALTERNATIVE 6A – MODIFIED NATURAL GAS PIPELINE ALIGNMENT: DALZELL GORGE ROUTE

Alternative 6A, Dalzell Gorge Route, would realign the natural gas pipeline between MP 106.5 to 152.7, a distance of 46.2 miles. The pipeline ROW under Alternative 6A would be slightly shorter, at 313 miles, compared to 316 for Alternative 2. In the affected segment, the Alternative

6A alignment would be to the west of the proposed action and would traverse Dalzell Gorge. This segment was originally part of the proposed action in the 2012 Plan of Development (POD) but would be bypassed by the alignment presented in the 2013 POD (SRK 2012i and SRK 2013b). This alternative route is carried forward for analysis because it is feasible and would allow comparison of environmental impacts to Alternative 2.

2.3.7.1 ALTERNATIVE 6A – MINE SITE

The Mine Site facilities under Alternative 6A would be identical to Alternative 2.

2.3.7.2 ALTERNATIVE 6A – TRANSPORTATION CORRIDOR

The Transportation Corridor under Alternative 6A would be identical to Alternative 2.

2.3.7.3 ALTERNATIVE 6A – NATURAL GAS PIPELINE

The Alternative 6A Dalzell Gorge Route would depart to the northwest from the Alternative 2 alignment at approximately MP 106.5 (Figure 2.3-46). The route would trend west and parallel Happy River for approximately 5 miles before turning to the northwest at Pass Creek and then through Rainy Pass and Dalzell Gorge, where the terrain is steep. The route through Rainy Pass starts at an elevation of 2,500 feet and gradually climbs to an elevation of 3,327 feet over a distance of about 6 miles. North of Dalzell Gorge, the route drops to 1,500 feet elevation and would cross the Tatina River and traverse the floodplain of the South Fork of the Kuskokwim River for nearly 2 miles before crossing and proceeding parallel to the west bank in hilly terrain with some moderate side slopes at an elevation of about 1,300 feet. It would cross the Denali Fault trace and pass to the south of Egypt Mountain before rejoining the Alternative 2 route at approximately MP 152.7.

The Dalzell Gorge Route would have two mainline valves at approximately MP 119 and 138. Access roads associated with the Dalzell Gorge Route are presented in Table 2.3-50. Potential material sites are shown in Table 2.3-51. New gravel airstrips would be constructed at Pass Creek and Tatina. Table 2.3-52 presents the planned MP section and construction seasons for the Dalzell Gorge Route. Table 2.3-53 shows the potential water sources for construction of the segment of pipeline in this alternative. The Dalzell Gorge Route would cross Happy River and the South Fork of the Kuskokwim River using HDD. HDD might also be used to cross an area of slope instability in Dalzell Gorge, although the required length of the drill does not make this a foregone conclusion.

2.3.8 IMPACT COMPARISON – ALL ALTERNATIVES

Table 2.3-54 illustrates the primary differences between the action alternatives. The table does not summarize all the components of each alternative, but instead lists the parts of the proposed action that would differ in other alternatives.

Table 2.3-55 provides a comparison of the direct and indirect impacts of each alternative. Cumulative impacts are assessed in Chapter 4, Cumulative Effects.

Table 2.3-50: Dalzell Gorge Route Access Road Identification

Milepost (approximate)	Length (miles)	Width (feet)	Description
109	0.53	24	Pass Creek Camp & Strip access
129.8	0.03	24	Tatina Camp access
130.1	0.28	24	Tatina Camp to Tatina River
133.7	0.15	24	Rohn Camp & Strip access
149.2	0.12	24	Shoofly
155.9	2.97	24	Upgrade existing trail to Farewell Strip
156	0.02	24	Farewell Camp access

Source: SRK 2012i.

Table 2.3-51: Potential Material Sites

Material Site	Mile Post	Area (acres)	Material Type	Designation
MS-17	108.5	22.2	Bedrock (ridge)	Airfield quarry
MS-18	114.5	9.4	Gravel (alluvial)	
MS-19	1184.0	2.5	Gravel (alluvial)	Top Pass
MS-20	123.6	28.9	Gravel (alluvial)	Dalzell Creek (camp/laydown airstrip)
MS-21A	128.1	6.5	Gravel (alluvial)	Tatina River
MS-21B	128.4	4.7	Gravel (alluvial)	Tatina River
MS-22	131.7	11.5	Gravel (alluvial)	Tatina River
MS-23	138.9	14.3	Gravel (alluvial)	Post River
MS-24	141.9	11.3	Gravel (alluvial)	South Fork tributary
MS-25	148.5	14.8	Gravel (alluvial)	
MS-26	150.5	3.3	Gravel (alluvial)	(fault zone)

Notes:
MS = material site
Source: SRK 2013b.

Table 2.3-52: Pipeline Construction Execution Sequence

Season	From Milepost	To Milepost	Length (Miles)	End-of-season
Winter Year 1	101.8	114.8	13	April
Summer 1.5	114.8	129.8	15	September
Summer 1.5	129.8	134.8	5	September
Winter Year 2	134.8	189.2	54	April

Source: SRK 2013b

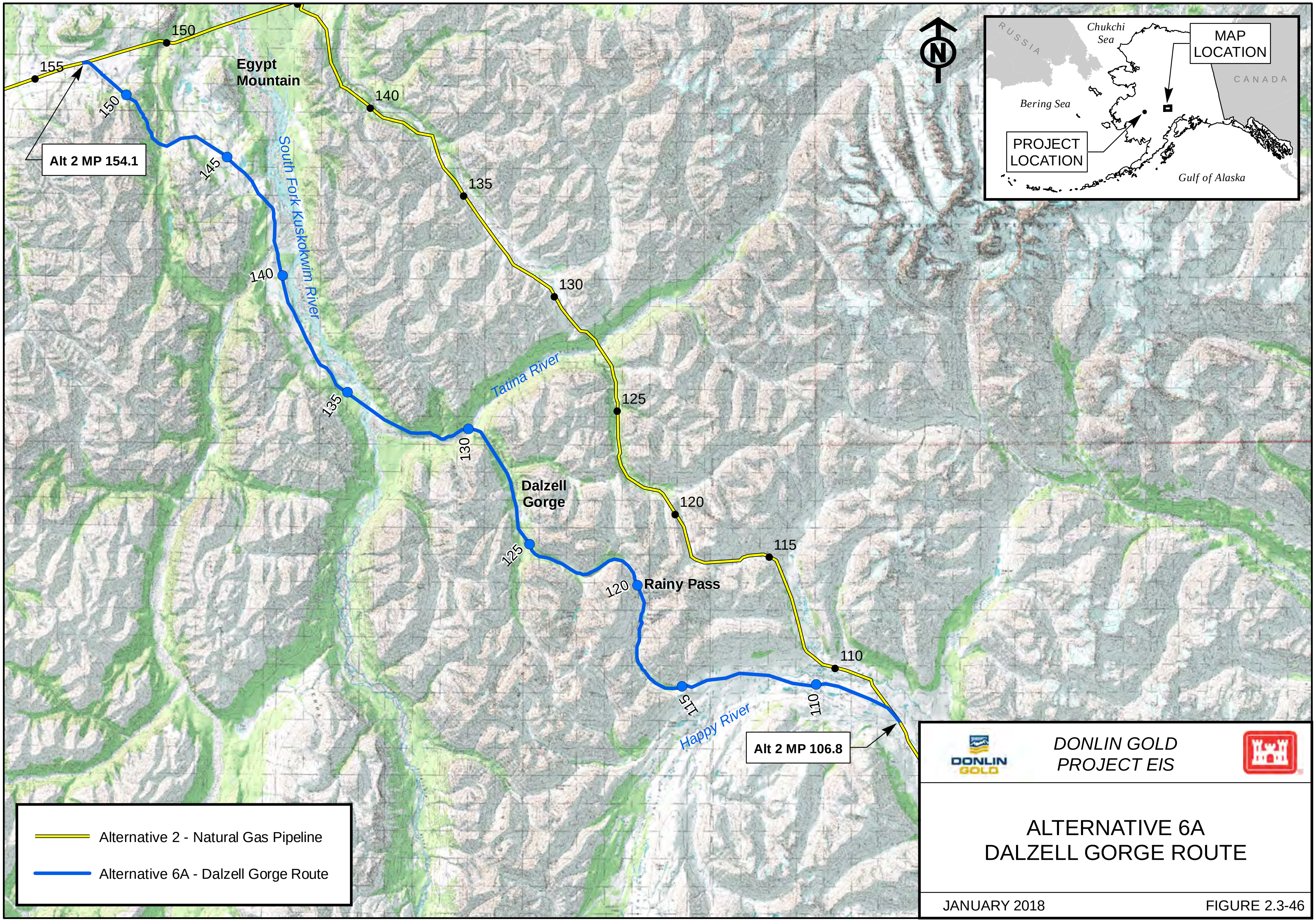
Table 2.3-53: Potential Water Extraction Sites for Pipeline Construction

Water Extraction Site Name	Nearest Milepost (MP)	Water Body Type
WES-039	106.0	Pond
WES-040	108.5	Pond
WES-041	109.6	River
WES-042	114.6	Creek
WES-043	118.6	Creek
WES-044	123.3	Creek
WES-045	126.0	Creek
WES-046	128.2	River
WES-047	129.4	Creek
WES-048	132,1	River
WES-049	139.2	River
WES-050	142.4	Lake
WES-051	145.8	Creek
WES-052	153.7	Creek

Notes:

MP = milepost
WES = water extraction site

Source: SRK 2012i



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ALTERNATIVE 6A
DALZELL GORGE ROUTE

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FIGURE 2.3-46

Table 2.3-54: Primary Differences Between the Action Alternatives

Project Component	Alternative 2 – Proposed Action (includes Alternative 2-North Option)	Alternative 3A – LNG-Powered Haul Trucks	Alternative 3B – Diesel Pipeline (includes Alternative 3B-Port MacKenzie Option and Alternative 3B-Collocated Pipeline Option)	Alternative 4 – BTC Port	Alternative 5A – Dry Stack Tailings (includes Unlined Option and Lined Option)	Alternative 6A – Dalzell Gorge Pipeline Route
Mine Site	Diesel fuel used to power haul trucks.	LNG used to power haul trucks; an LNG plant and storage tanks built at the Mine Site.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
	Diesel Consumption: annual peak of 42.3 Mgal.	Diesel Consumption: annual peak of 13.3 Mgal.	Diesel Consumption: annual peak of 120 Mgal. Collocated Option: Reduced natural gas consumption	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
	Natural gas consumption: 11.2 BSCF/ year (assumed to be the same every year).	Natural gas consumption: annual peak of 15.5 BSCF.	No natural gas consumption. Collocated Option: Power plant would operate primarily on natural gas	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2
	On-site diesel storage: 37.5 Mgal.	Reduced on-site diesel storage Natural gas storage.	On-site diesel storage: 10 Mgal	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
	Tailings stored in combined tailings and pond facility contained by one dam.	Same as Alternative 2.	Same as Alternative 2	Same as Alternative 2.	Tailings stored as a dry stack upstream of an operating pond; operating pond contained by a main dam and two upper dams.	Same as Alternative 2.
	Entire footprint of tailings storage area underlain by impermeable liner.	Same as Alternative 2.	Same as Alternative 2	Same as Alternative 2.	Unlined Option: No impermeable liner under the dry stack tailings facility. Lined Option: Same as Alternative 2; the dry stack tailings facility would be underlain by impermeable liner.	Same as Alternative 2.
	Tailings pumped to storage area.	Same as Alternative 2.	Same as Alternative 2	Same as Alternative 2.	Tailings moved by trucks or conveyer belt to storage area.	Same as Alternative 2.
	Tailings storage footprint (includes tailings pond): 2,351 acres.	Same as Alternative 2.	Same as Alternative 2	Same as Alternative 2.	Tailings storage footprint: 1,393 acres Operating pond footprint: 1,070 acres.	Same as Alternative 2.
	Subaqueous tailings method; no filtering and tailings would be pumped to TSF.	Same as Alternative 2.	Same as Alternative 2	Same as Alternative 2.	More complex operationally to filter and move tailings.	Same as Alternative 2.
Transportation Corridor	7 fuel ocean barge round trips per season (to Dutch Harbor).	2 fuel ocean barge round trips per season (to Dutch Harbor).	12 fuel ocean barge/tanker round trips per season (to Tyonek or Port MacKenzie).	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
	14 fuel barge trips from Dutch Harbor to Bethel.	5 fuel barge trips from Dutch Harbor to Bethel.	No fuel barging on Bering Sea or Kuskokwim River during Operations.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
	Operations - 58 fuel river barge round trips per year (peak usage). Construction – 19 fuel river barge round trips per year, 20 during first two years to staging above Devil's Elbow.	Operations - 19 fuel river barge round trips per year (peak usage). Construction – Same as Alternative 2.	Operations - No fuel river barging. Construction – Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
	64 cargo barge round trips per year.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	71 cargo barge round trips per year	Same as Alternative 2.
	Distance from Bethel to Angyaruaq (Jungjuk) Port: 199 miles.	Same as Alternative 2.	Same as Alternative 2.	Distance from Bethel to BTC: 124 miles.	Same as Alternative 2.	Same as Alternative 2.
	Length of mine access road: 30 miles.	Same as Alternative 2.	Same as Alternative 2.	Length of mine access road: 76 miles.	Same as Alternative 2.	Same as Alternative 2.
	Port size: 21 acres.	Same as Alternative 2.	Same as Alternative 2.	Port size: 65 acres.	Same as Alternative 2.	Same as Alternative 2.

Table 2.3-54: Primary Differences Between the Action Alternatives

Project Component	Alternative 2 – Proposed Action (includes Alternative 2-North Option)	Alternative 3A – LNG-Powered Haul Trucks	Alternative 3B – Diesel Pipeline (includes Alternative 3B-Port MacKenzie Option and Alternative 3B-Collocated Pipeline Option)	Alternative 4 – BTC Port	Alternative 5A – Dry Stack Tailings (includes Unlined Option and Lined Option)	Alternative 6A – Dalzell Gorge Pipeline Route
	Number of material sites along mine access road: 13.	Same as Alternative 2.	Same as Alternative 2.	Number of material sites along mine access road: 50.	Same as Alternative 2.	Same as Alternative 2.
	Water body crossings along mine access road: 55 (6 bridges, 49 culverts).	Same as Alternative 2.	Same as Alternative 2.	Water body crossings along mine access road: 40 (8 bridges, 32 culverts).	Same as Alternative 2.	Same as Alternative 2.
	No ice roads proposed.	Same as Alternative 2.	Same as Alternative 2.	Installation of a temporary ice road from the vicinity of the Village of Crooked Creek to the Mine Site to construct longer mine access road from both ends.	Same as Alternative 2.	Same as Alternative 2.
Pipeline	Pipeline would transport natural gas.	Same as Alternative 2.	Pipeline would transport diesel. Collocated Option: Two pipelines would be constructed in the same ROW; one would transport diesel, the other natural gas.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
	Diameter of pipeline: 14 inches.	Same as Alternative 2.	Diameter of pipeline: 18 inches. Collocated Option: Natural gas pipeline diameter: 14 inches, diesel pipeline diameter: 8 inches.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
	Length of pipeline: 316 miles. North Option: Less than 1 mile shorter than Alternative 2.	Same as Alternative 2.	Length of pipeline: 334 miles Port MacKenzie Option: 335 miles.	Same as Alternative 2.	Same as Alternative 2.	Length of pipeline: 313 miles.
	MP 106.5 to MP 152.7 through Jones River Valley.	Same as Alternative 2.	Same alignment as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	MP 106.5 to MP 152.7 through Dalzell Gorge.
	14 INHT crossings 2.5 Miles of INHT within 100 ft of pipeline 14.3 Miles of INHT 100-1,000 ft of pipeline North Option: 5 INHT crossings 0.2 Miles of INHT within 100 ft of pipeline 5.3 Miles of INHT 100-1,000 ft of pipeline	Same as Alternative 2.	Same as Alternative 2. Port MacKenzie Option: 17 INHT crossings 2.6 Miles of INHT within 100 ft of pipeline 16.9 Miles of INHT 100-1,000 ft of pipeline	Same as Alternative 2.	Same as Alternative 2.	34 INHT crossings 14.5 Miles of INHT collocation 29.4 Miles of INHT within 1,000 ft
	HDD crossings of the Skwentna, Happy, Kuskokwim, East Fork George, George, and North Fork George rivers. North Option: Additional HDD crossings of two Happy River tributaries (McDoel and Distin), but Happy River HDD crossing eliminated.	Same as Alternative 2.	Additional HDD crossing of Beluga River Potential HDD crossing of Susitna River.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
	No need for pre-positioned oil spill response equipment for a natural gas pipeline.	Same as Alternative 2.	Pre-positioned oil spill response infrastructure and equipment located along the diesel pipeline route.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.

Table 2.3-54: Primary Differences Between the Action Alternatives

Project Component	Alternative 2 – Proposed Action (includes Alternative 2-North Option)	Alternative 3A – LNG-Powered Haul Trucks	Alternative 3B – Diesel Pipeline (includes Alternative 3B-Port MacKenzie Option and Alternative 3B-Collocated Pipeline Option)	Alternative 4 – BTC Port	Alternative 5A – Dry Stack Tailings (includes Unlined Option and Lined Option)	Alternative 6A – Dalzell Gorge Pipeline Route
	Compressor station at MP 0.4	Same as Alternative 2.	Extension of the existing Tyonek dock, construction of a new Operations Center, diesel storage tanks (total capacity of 10 Mgal), and Pumping Facility in the uplands near the dock at Tyonek. Port MacKenzie Option: Use of existing dock, new Operations Center, diesel storage tanks, and pumping facilities at existing uplands facility. Collocated Option: Compressor station at MP 0.4	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
	Gravel shoofly roads decommissioned after Construction.	Same as Alternative 2.	Shoofly roads left in place along the pipeline in case needed for oil spill response.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
	Ancillary facilities: 9 new and 3 existing airstrips used during Construction (new airstrips decommissioned after Construction); 70 potential material sites; about 77 miles of shoofly roads. North Option: 10 new airstrips (with addition of Glacier Creek Airstrip); same overall number of material sites; slightly less miles of shoofly roads (less than a mile).	Same as Alternative 2.	Ancillary facilities: 9 new and 3 existing airstrips used during Construction (new airstrips maintained and 3 more added after Construction for spill response); 5-13 material sites less than Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Ancillary facilities: 6 new and 4 existing airstrips used during Construction (new airstrips decommissioned after Construction); 3 fewer material sites than Alternative 2.
	At least one surveillance overflight per year.	Same as Alternative 2.	At least 26 surveillance overflights per year.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.

* These include access roads, laydown areas, airstrips, borrow areas, and campsites.
Source: Krall 2013; SRK 2016a; Donlin Gold 2017k

Table 2.3-55: Impact Comparison by Alternative for Chapter 3 Resources

Impact-Causing Project Component or Resource Area	Alternative 2 – Proposed Action (includes Alternative 2-North Option)	Alternative 3A – LNG-Powered Haul Trucks	Alternative 3B – Diesel Pipeline (includes Alternative 3B-Port MacKenzie Option and Alternative 3B-Collocated Pipeline Option)	Alternative 4 – BTC Port	Alternative 5A – Dry Stack Tailings (includes Unlined Option and Lined Option)	Alternative 6A – Dalzell Gorge Route
Section 3.1: Geology						
Mine Site – Bedrock Geology	Alteration of about 556 million tons of ore and 3,100 million tons of waste rock from the 1,462 acre pit, and final elevation changes up to about 600 feet. Resources would not be anticipated to return to previous.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Final elevation of dry stack 50-150 feet higher than south ridge.	Same as Alternative 2.
Mine Site – Surface Geology	Change to roughly 50 million tons of overburden covering about 9,000 acres. Resources would not be anticipated to return to previous.	Same as Alternative 2.	10 acres < Alternative 2.	Same as Alternative 2.	Aggregate needed for dams about 12 % > Alternative 2.	Same as Alternative 2.
Mine Site - Paleontology	Alteration of potential fossil-bearing rock over 1,462-acre pit. Resources would not be anticipated to return to previous.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Little additional impact.	Same as Alternative 2.
Transportation Corridor – Bedrock Geology	16 miles of road; an additional 400 acres at other facilities (airstrip, camp, material sites); and reduction of about 2.8 Mcy of bedrock aggregate resources.	5 acres < Alternative 2.	5 acres < Alternative 2.	960 acres 11.2 Mcy > Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Transportation Corridor – Surface Geology	Ground disturbance and landform alterations across a total of about 700 acres and reduction of about 1.5 Mcy of gravel resources.	10 to 20 acres < Alternative 2.	5 acres < Alternative 2.	70 acres, 0.2 Mcy < Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Transportation Corridor – Paleontology	Potential localized impacts in areas having fossil potential: road cuts along 7 miles of northern part of mine/airstrip access roads, airstrip, 3 material sites, and 2 low-water relay points.	Reduced impacts along the Kuskokwim River.	Same as Alternative 3A.	Greater impact to bedrock fossils along the BTC Road, and less impact to vertebrate fossils along the Kuskokwim River.	Same as Alternative 2.	Same as Alternative 2.
Pipeline – Bedrock Geology	70 miles of ROW and associated infrastructure bedrock material sites covering a total of 500 acres; and a total reduction of about 2.9 Mcy of bedrock aggregate resources.	Same as Alternative 2.	60 acres > Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	7 acres less.
Pipeline – Surface Geology	262 miles of ROW (out of 316 mile total ROW) and about 80 miles of shoofly roads where cross-slopes may require cut and fill construction; roughly 2,100 acres of associated infrastructure; and would result in a total reduction of about 3.4 Mcy of gravel resources. North Option: – Total length of pipeline and shoofly roads is roughly the same as Alternative 2 (less than one mile shorter for each); roughly __ acres of associated infrastructure; same overall number of material sites but about 30 acres less than Alternative 2with a difference in total reduction of gravel by 195,000 cy compared with Alternative 2.	Same as Alternative 2.	1,365 acres and 5-13 material sites > Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	3 less material sites and 120 acres less than Alternative 2.
Pipeline – Paleontology	Potential impacts within project footprint at locations having fossil potential: pre-Quaternary and Quaternary deposits along roughly 262 miles of ROW (out of 316 mile total ROW), 80	Same as Alternative 2.	Little additional impacts.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.

Table 2.3-55: Impact Comparison by Alternative for Chapter 3 Resources

Impact-Causing Project Component or Resource Area	Alternative 2 – Proposed Action (includes Alternative 2-North Option)	Alternative 3A – LNG-Powered Haul Trucks	Alternative 3B – Diesel Pipeline (includes Alternative 3B-Port MacKenzie Option and Alternative 3B-Collocated Pipeline Option)	Alternative 4 – BTC Port	Alternative 5A – Dry Stack Tailings (includes Unlined Option and Lined Option)	Alternative 6A – Dalzell Gorge Route
	miles of shoofly roads, and material sites covering about 1,000 acres.					
Section 3.2: Soils						
Mine Site – Soil Disturbance/Removal	Irreversible alteration of 9,000 acres of surface soil, with 2,400 acres for TSF.	Same as Alternative 2. (LNG plant within same soil disturbance footprint as Alternative 2.).	Same as Alternative 2 (slightly smaller fuel storage footprint likely disturbed for other uses).	Same as Alternative 2.	85 acres > Alternative 2 for TSF and filter plant.	Same as Alternative 2.
Mine Site - Permafrost	Degradation of 9,000 acres discontinuous permafrost, with 2,400 acres for TSF. About 130 million tons thawed soils could be source of GHG emissions. Impacts would vary in intensity: - Changes in permafrost may not be measurable or noticeable (e.g. ground settlement) and the thermal regime is maintained and rehabilitation can be accomplished through natural recolonization. - Disturbance may require revegetation by active methods but the design is adequate for the expected range of permafrost hazards. - Low probability of disturbance requiring revegetation by active methods or acute/obvious changes with permafrost disturbance resulting in settlement that requires substantial fill for successful rehabilitation. Permafrost hazards may exceed design parameters. Toe instability may occur if deep ice-rich soils are present.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Slightly greater permafrost removal due to larger dam footprints. About 170 million tons thawed soils could be source of GHG emissions under Unlined Option, and 150 million tons under Lined Option.	Same as Alternative 2.
Mine Site – Erosion	Impacts would vary in intensity: - Changes in erosion may not be measurable and standard BMPS would be successful in preventing erosion. - Disturbance may require revegetation by active methods to prevent erosion issues. Special BMPs and more frequent monitoring and/or maintenance may be needed for successful erosion control.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Dry stack surface area 60% > Alternative 2; greater erosion susceptibility and ESC complexity. Slightly larger overburden stockpile (12% > Alternative 2) with BMPs similar to Alternative 2.	Same as Alternative 2.
Mine Site – Soil Quality/Contaminated Sites	Soil quality effects are below regulatory limits or within the range of natural baseline variation outside of the mineralized zone (1 to 5% arsenic increase above naturally high baseline, averaged across large watershed).	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Slightly greater potential for fugitive dust generation/ dispersion (6.6% more than Alternative 2.).	Same as Alternative 2.
Transportation Corridor – Soil Disturbance/Removal	Irreversible alteration of 900 acres (including 30-mile mine access road, and 26-acre Angyaruaq (Jungjuk) Port site).	Reduced disturbance of Kuskokwim River bank soils at relay points. Less soil disturbance at ports by 10 to 20 acres.	Small additional disturbance of already disturbed soils at North Foreland dock.	Soil removal increased by 43 miles of road and 39 acres at BTC Port site. Additional minor compaction along 12-mile ice road. Less riverbank disturbance at	Same as Alternative 2.	Same as Alternative 2.

Table 2.3-55: Impact Comparison by Alternative for Chapter 3 Resources

Impact-Causing Project Component or Resource Area	Alternative 2 – Proposed Action (includes Alternative 2-North Option)	Alternative 3A – LNG-Powered Haul Trucks	Alternative 3B – Diesel Pipeline (includes Alternative 3B-Port MacKenzie Option and Alternative 3B-Collocated Pipeline Option)	Alternative 4 – BTC Port	Alternative 5A – Dry Stack Tailings (includes Unlined Option and Lined Option)	Alternative 6A – Dalzell Gorge Route
				Kuskokwim relay points.		
Transportation Corridor - Permafrost	Intensity of impacts would range from changes in soils and permafrost that may not be measurable or noticeable to disturbances that require revegetation by active methods (degradation and thaw settlement hazards) for short road segments and at 2 ports. About 6.9 million tons thawed soils over the life of the mine could be source of GHG emissions.	Slightly less permafrost effects at Bethel port.	Same as Alternative 2.	Permafrost effects over about 40 more miles of mine access road; greater potential for repeated fill repairs in localized thermokarst areas. Low intensity effects over 12 miles of ice road. Ports similar to Alternative 2. About 30 million tons thawed soils over the life of mine could be source of GHG emissions.	Same as Alternative 2.	Same as Alternative 2.
Transportation Corridor – Erosion	Intensity of impacts would vary: - Could range from changes in soils that may not be measurable or noticeable to disturbances that require revegetation by active methods, but managed through BMPs and ESCs. - Localized disturbances that require revegetation by active methods (such as seeding or sod replacement) to prevent drainage/erosion issues and for successful site rehabilitation. - Occasional acute or obvious indirect effects.	Slightly less erosion effects at relay points and ports.	Same as Alternative 2.	Effects managed through BMPs mostly same as Alternative 2. Less erosion effects at relay points. Slightly less intensity at BTC Port site (reclamation reuse of berth soils).	Same as Alternative 2.	Same as Alternative 2.
Transportation Corridor – Soil Quality/Contaminated Sites	Impacts would vary in intensity: - Small increase in arsenic could occur immediately adjacent to the road above slightly elevated baseline soil concentrations, with final concentrations within the range of natural variation. - Intensity could be elevated on contaminated sites at Dutch Harbor, depending on site-specific presence/extent of existing soil contamination.	Slightly less dust effects along road.	Possible additional contaminated soils near Tyonek dock.	Similar fugitive dust effects. Slightly lower potential effects from contaminated sites along Kuskokwim River.	Same as Alternative 2.	Same as Alternative 2.
Pipeline – Soil Disturbance/Removal	316-mile ROW; up to 8,300 acres of surface disturbance. North Option would have a slightly smaller soil disturbance effect, due to approximately 30 fewer acres of disturbance.	Same as Alternative 2.	334-mile ROW, up to 15,000 acres of surface disturbance (6% > Alternative 2.).	Same as Alternative 2.	Same as Alternative 2.	313-mile ROW, up to 15,400 acres of surface disturbance (9% > Alternative 2.)
Pipeline - Permafrost	31 miles of permafrost soils. Predicted thaw settlement up to 21 feet. Estimated 37 million tons thawed soils.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	41 miles of permafrost soils. Predicted thaw settlement up to 6.8 feet (although Alternative 6A based on less data). Estimate 49 million tons thawed soils.
Pipeline – Erosion	Intensity of impacts would vary: - Impacts	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Effects managed through

Table 2.3-55: Impact Comparison by Alternative for Chapter 3 Resources

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	mostly managed through ESC measures, with isolated occurrences of acute or obvious erosion during ROW construction, or ORV use near discrete segments of ROW. - Erosion during Construction would likely be reduced such that changes in soils due to erosion may or may not be measurable or noticeable within a short period of time due to planned redundancies in ESC measures, reclamation and/or cleanup crew functions, and monitoring/maintenance activities.					BMPs mostly same as Alternative 2. Stream crossings in erodible permafrost 1% < Alternative 2; slightly more wind erosion than Alternative 2; hydraulic erosion similar to Alternative 2.
Pipeline – Soil Quality/Contaminated Sites	Impacts would range in intensity from soil quality below regulatory limits or within the range of natural baseline variation, to small effects compared to baseline resulting from grading of pre-existing contaminated soils at the Farewell airstrip.	Same as Alternative 2.	Trenching could encounter contaminated soils in Beluga-Tyonek area.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Section 3.3: Geohazards and Seismic Conditions						
Mine Site - Earthquakes	Intensity of impacts would vary and mostly range from unmeasurable or unnoticeable, to noticeable changes in the resource character. The TSF dam design is considered robust with seismic parameters incorporated into the design; it is extremely unlikely to fail during a major earthquake. There is a low probability of acute or obvious impacts to the WRF and pit walls in post-Closure.	Slight increase in effects for the LNG plant (designed to withstand ground shaking). However, same overall intensity, duration, extent, and context of impacts as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Slight increase in effects during Operations (ground shaking effects on dry stack above upper dam); slightly less during Closure (shorter duration to stable landform). However, same overall intensity, duration, extent, and context of impacts as Alternative 2.	Same as Alternative 2.
Mine Site – Slope Stability	Intensity of impacts would vary and mostly range from unmeasurable or unnoticeable, to noticeable changes in the resource character. Static stability analysis is incorporated into the TSF and water dam design. There is a low probability of acute or obvious effects at lower CWD (landslide activation) and pit (crest settlement and overtopping).	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Slight increase in effects during Operations for both Unlined and Lined Options (potential dry stack instability); and slightly more in Unlined Option than Lined Option (groundwater wicking and saturation at base of stack). However, same overall intensity, duration, extent, and context of impacts as Alternative 2.	Same as Alternative 2.
Mine Site – Other Geohazards (Dame Seepage and Ice Hazards)	Intensity of impacts would mostly result in noticeable changes to the resource character. Design is adequate for the expected range of geohazard conditions, assuming additional geotechnical investigation in final design and contingencies for ice damage mitigation are effective.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Higher tailings seepage in Closure (both options) and higher ice hazards effects on operating pond liner than Alternative 2., but similar seepage effects on dam stability as Alternative 2. However, same overall intensity, duration, extent,	Same as Alternative 2.

Table 2.3-55: Impact Comparison by Alternative for Chapter 3 Resources

Impact-Causing Project Component or Resource Area	Alternative 2 – Proposed Action (includes Alternative 2-North Option)	Alternative 3A – LNG-Powered Haul Trucks	Alternative 3B – Diesel Pipeline (includes Alternative 3B-Port MacKenzie Option and Alternative 3B-Collocated Pipeline Option)	Alternative 4 – BTC Port	Alternative 5A – Dry Stack Tailings (includes Unlined Option and Lined Option)	Alternative 6A – Dalzell Gorge Route
					and context of impacts as Alternative 2.	
Transportation Corridor - Earthquakes	Intensity of impacts would range from unmeasurable or unnoticeable, to noticeable changes in the character of the resource. The design is expected to be adequate for the range of geohazard conditions.	Slightly lower risk of effects due to reduction in port fuel tanks. Overall intensity, duration, extent, and context of impacts would be the same as Alternative 2.	Slightly more effects for Tyonek dock (seismic, coastal bluff, seafloor concerns). However, overall intensity, duration, extent, and context of impacts would be the same as Alternative 2.	Slightly increased risk of effects due to two additional bridges (seismic design). However, overall intensity, duration, extent, and context of impacts would be the same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Transportation Corridor – Slope Stability	Same as above.	Same as Alternative 2.	Same as Alternative 2.	More effects (3 times road length with steep slopes, and 3 times material sites). However, overall intensity, duration, extent, and context of impacts would be the same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Transportation Corridor – Other Geohazards (Dame Seepage and Ice Hazards)	Same as above.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Pipeline - Earthquakes	Same as above.	Same as Alternative 2.	More effects for tank farm and 19 mi longer pipeline (ground shaking, liquefaction). However, overall intensity, duration, extent, and context of impacts would be the same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	More effects (7 mi longer route with high-hazard unstable slopes). However, overall intensity, duration, extent, and context of impacts would be the same as Alternative 2.
Pipeline – Slope Stability	Same as above.	Same as Alternative 2.	More effects (minor sloughing, debris slides) at 2 steep open-cut river crossings, 3 additional airstrips, and 5 additional material sites. However, overall intensity, duration, extent, and context of impacts would be the same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Pipeline – Other Geohazards (Dame Seepage and Ice Hazards)	Intensity of impacts would mostly range from unmeasurable or unnoticeable, to noticeable changes in the character of the resource. There is a low probability of acute or obvious effects at HDDs (frac-out impacts river water quality).	Same as Alternative 2.	More low probability-acute/obvious effects due to additional Beluga River HDD crossing (frac-out risk unknown). However, overall intensity, duration, extent, and context of impacts would be the same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Section 3.4: Climate and Meteorology						
Mine Site	Any climate or meteorological impacts that would be attributable to the project would be due to air pollutants emitted during project Operations and to the project's small contribution to global greenhouse gas (GHG) emissions. **See Section 3.26, Climate Change, for GHG effects.**	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Transportation Corridor	Same as Mine Site.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Pipeline	Same as Mine Site.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.

Table 2.3-55: Impact Comparison by Alternative for Chapter 3 Resources

Impact-Causing Project Component or Resource Area	Alternative 2 – Proposed Action (includes Alternative 2-North Option)	Alternative 3A – LNG-Powered Haul Trucks	Alternative 3B – Diesel Pipeline (includes Alternative 3B-Port MacKenzie Option and Alternative 3B-Collocated Pipeline Option)	Alternative 4 – BTC Port	Alternative 5A – Dry Stack Tailings (includes Unlined Option and Lined Option)	Alternative 6A – Dalzell Gorge Route
Section 3.5: Surface Water Hydrology						
Mine Site – Streamflow in Operations	Impacts would result in Crooked Creek average annual flow reductions: 12% near American Creek, 5% near Bell Creek, under median (50th percentile) precipitation conditions. Increased effects on dammed Crooked Creek tributaries, and in Crooked Creek adjacent to mine (under below average precipitation and high K conditions).	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Mine Site – Streamflow Post-Closure	Impacts in Crooked Creek would result in monthly flow changes range from -12% to +21% just below mine). Localized increased effects on permanently dammed tributaries.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Overall, same intensity of impacts as Alternative 2 - Slightly reduced discharge to Crevice Creek and Anaconda Creek during post-Closure period; slightly increased treated water discharge to Crooked Creek at Outfall 001.	Same as Alternative 2.
Transportation Corridor – Road and Ports	Impacts from Angyaruaq (Jungjuk) Port site 30-mile mine access road, 51 streams, 6 bridges, and 45 culverts. Most impacts would result in maintained surface water flow systems and changes in water quantity that are likely within the limits of historic seasonal variation.	Same intensity, duration, extent, and context of impacts as Alternative 2 with fewer fuel trucks on mine access road.	Same intensity, duration, extent, and context of impacts as Alternative 2 - addition of Tyonek Port site, reduced fuel trucks on mine access road .	Same intensity, duration, extent, and context of impacts as Alternative 2 - Birch Tree Crossing port site and 76-mile mine access road, 40 streams, 8 bridges, 32 culverts	Same as Alternative 2.	Same as Alternative 2.
Transportation Corridor – River	Impacts from 122 barge trips/year, 110 day barge season, 8 critical sections over 199 miles. Impacts through Operations would not result in changes in the surface water flow systems that are likely to exceed historic seasonal variation. Annual recovery is expected for scour at critical sections. During post-Closure, surface water flow systems would be maintained and changes in water quantity are likely within limits of historic seasonal variation.	Same intensity, duration, extent, and context of impacts as Alternative 2 - 83 barge trips/year, reduced barge-related impacts.	Same intensity, duration, extent, and context of impacts as Alternative 2 – 64 barge trips/year, fewest trips means would result in least barge-related impacts.	Same intensity, duration, extent, and context of impacts as Alternative. 2 - 122 barge trips/year, eliminates barge-related impacts upstream of Birch Tree Port; 3 critical sections over 124 miles.	Same intensity, duration, extent, and context of impacts as Alternative 2 – barge trips/year increase to 129 day barge season .	Same as Alternative 2.
Pipeline	316 mile-long natural gas pipeline and 400 stream/river crossings would mostly result in maintained surface water flow systems and changes in water quantity within historic seasonal variation. North Option: 419 stream crossings; small water use increase for HDD.	Same as Alternative 2.	Same intensity, duration, extent, and context of impacts as Alternative 2 – small water use increase for pressure testing/ice roads/pads/HDDs during Construction. Tyonek Option: 335-mile-long diesel pipeline, 406 stream/river crossings. Port MacKenzie Option: 336-mile-long; about 330 stream crossings.	Same as Alternative 2.	Same as Alternative 2.	Same intensity, duration, extent, and context of impacts as Alternative 2 – 314-mile-long natural gas pipeline, 377 streams crossings.

Table 2.3-55: Impact Comparison by Alternative for Chapter 3 Resources

<table>
<tr><th>Impact-Causing Project Component or Resource Area</th><th>Alternative 2 – Proposed Action (includes Alternative 2-North Option)</th><th>Alternative 3A – LNG-Powered Haul Trucks</th><th>Alternative 3B – Diesel Pipeline (includes Alternative 3B-Port MacKenzie Option and Alternative 3B-Collocated Pipeline Option)</th><th>Alternative 4 – BTC Port</th><th>Alternative 5A – Dry Stack Tailings (includes Unlined Option and Lined Option)</th><th>Alternative 6A – Dalzell Gorge Route</th></tr>
<tr><td colspan="7">Section 3.6: Groundwater Hydrology</td></tr>
<tr><td>Mine Site – Mine pit dewatering</td><td>Groundwater elevation change below original conditions:
• 1,600 feet in Operations;
• 30 feet in post-Closure.
Groundwater flow direction changes:
• Flow towards pit in Construction and Operations.
• Temporary (8 years), localized (within pit rim) flow away from pit, though overall hydraulic containment maintained due to strong topographic gradients beyond pit.
• Flow towards pit in post-Closure (in perpetuity).
Areal extent of cone of depression:
• 9,000 acres in Operations;
• 2,000 acres in post-Closure.</td><td rowspan="3">Mostly the same as Alternative 2, except reduced potential for diesel spill impacts.</td><td rowspan="3">Mostly the same as Alternative 2, except increased potential for diesel spill impacting groundwater.</td><td rowspan="3">Same as Alternative 2.</td><td rowspan="3">Similar to Alternative 2, except capture of up to about 20% more water during early Closure period of Unlined Option, declining to equal amount of capture as Lined Option or Alternative 2, 200 years after Closure.</td><td rowspan="3">Same as Alternative 2.</td></tr>
<tr><td>Mine Site – Reduced or loss of wintertime flow in Crooked Creek</td><td>Range from average K-average flow to high K-low flow conditions:
• 20%-100% flow reduction near pit;
• 10%-40% flow reduction 8 miles downstream.</td></tr>
<tr><td>Mine Site – Capture and diversion of groundwater in Anaconda watershed</td><td>Under TSF and SRS: 450 gpm of groundwater is used for processing water in Operations, and piped to pit lake after Closure.</td></tr>
<tr><td>Transportation Corridor – Groundwater usage at port sites</td><td>Groundwater flow systems are maintained. Changes in water quantity within historic seasonal or minimal variation.</td><td>Mostly the same as Alternative 2. Slight reduced potential for diesel spill impacts from a reduction in fuel barge trips from 58 to 19 per season along the Kuskokwim River.</td><td>Mostly the same as Alternative 2, except decreased potential for diesel spill impacting groundwater.</td><td>Mostly the same as Alternative 2 except translocation of port water well; slight increased potential for trucking-related spill as a result of longer road.</td><td>Same as Alternative 2.</td><td>Same as Alternative 2.</td></tr>
<tr><td>Pipeline – Groundwater usage at camps</td><td>Groundwater flow systems are maintained. Changes in water quantity within historic seasonal or minimal variation.</td><td rowspan="2">Same as Alternative 2.</td><td rowspan="2">Mostly the same as Alternative 2, except increased potential for diesel spill impacting groundwater and shallow groundwater: 10 miles > Alternative 2 for Tyonek/Collocated Options, and 9 miles > Alternative 2 for Port MacKenzie Option.</td><td rowspan="2">Same as Alternative 2.</td><td rowspan="2">Same as Alternative 2.</td><td rowspan="2">Mostly the same as Alternative 2. (shallow groundwater 3 miles < Alternative 2).</td></tr>
<tr><td>Pipeline – Potential diversion of groundwater during Construction or Operations</td><td>Effect on shallow groundwater beneath 112 miles (1/3rd) of ROW (about 3 miles less under Alt 2-North Option). Groundwater flow systems are maintained. Changes in water quantity within historic seasonal or minimal variation.</td></tr>
</table>

Table 2.3-55: Impact Comparison by Alternative for Chapter 3 Resources

Impact-Causing Project Component or Resource Area	Alternative 2 – Proposed Action (includes Alternative 2-North Option)	Alternative 3A – LNG-Powered Haul Trucks	Alternative 3B – Diesel Pipeline (includes Alternative 3B-Port MacKenzie Option and Alternative 3B-Collocated Pipeline Option)	Alternative 4 – BTC Port	Alternative 5A – Dry Stack Tailings (includes Unlined Option and Lined Option)	Alternative 6A – Dalzell Gorge Route
Section 3.7: Water Quality						
Mine Site - Geochemistry	Drainages from the WRF, TSF operating pond, and TSF cover drain layer are predicted to exceed AWQC for several constituents. Lower CWD and drainage from the SOB predicted to exceed AWQC for several constituents during Operations. Surficial pit lake water expected to exceed AWQC for several constituents; about Year 52 post-Closure, the surficial water would be treated to meet AWQC and then discharged.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Impacts associated with the WRF and overburden stockpiles would be the same as Alternative 2. Pit lake stratification would occur at an approximately 40 percent shallower depth, and surface water concentrations of metals would likely be higher than Alternative 2. About Year 42 to 47 post-Closure (depending on the option), the surficial pit lake water would be treated to meet AWQC and then discharged.	Same as Alternative 2.
Mine Site – Surface Water Quality	Surface water in the American and Anaconda Creek watersheds influenced by the creation and perpetual maintenance of the pit lake and TSF impoundment. Pit dewatering discharge to Crooked Creek would be treated to meet AWQC prior to discharge. Atmospheric deposition of mercury could be sufficient to exceed AWQC and baseline ranges in some cases, depending on watershed location and existing baseline concentrations.	Kuskokwim River barge traffic would be reduced and the Bethel and Dutch Harbor ports would not require as much expansion. Changes would not affect overall impact levels from Alternative 2.	The additional use of diesel would result in increased potential of adverse impacts resulting from diesel fuel spills; however, under normal operating conditions (i.e., no spills), impacts would be the same as Alternative 2.	Same as Alternative 2.	Under both options, effects on downgradient water quality in Crooked Creek would be the same as Alternative 2, as SRS water would be contained and conveyed to the open pit. The main difference between the Unlined Option, Lined Option, and Alternative 2 is the time it takes for SRS decommissioning: 200 years under the Unlined Option; and 10-50 years under both the Lined Option and Alternative 2. A small increase in indirect effects could result from dry stack fugitive dust atmospheric deposition and terrestrial runoff from dust deposition; these impacts could exceed AWQC. Impacts that exceed AWQC could occur in the event of a prolonged SRS pumpback failure during post-Closure; risk and contaminant levels would be greater under the Unlined Option than either the Lined Option or Alternative 2.	Same as Alternative 2.

Table 2.3-55: Impact Comparison by Alternative for Chapter 3 Resources

Impact-Causing Project Component or Resource Area	Alternative 2 – Proposed Action (includes Alternative 2-North Option)	Alternative 3A – LNG-Powered Haul Trucks	Alternative 3B – Diesel Pipeline (includes Alternative 3B-Port MacKenzie Option and Alternative 3B-Collocated Pipeline Option)	Alternative 4 – BTC Port	Alternative 5A – Dry Stack Tailings (includes Unlined Option and Lined Option)	Alternative 6A – Dalzell Gorge Route
Mine Site – Groundwater Quality	Seepage from the WRF underdrain to groundwater between the WRF and Lower CWD (during Operations) and the pit lake (during closure) would occur. Net discharge of water from the pit lake to surrounding deep bedrock groundwater would occur during pit lake filling, primarily during the first 8 years following closure. Groundwater impacts would be limited in geographic extent.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Similar to Alternative 2, the Lined Option would provide an advantage over the Unlined Option of minimizing (but not preventing) the potential for impacts to groundwater quality.	Same as Alternative 2.
Mine Site – Sediment Quality	Impacts to sediment quality could result from altered stream flows and water chemistry in Crooked Creek and project-related atmospheric deposition of mercury. Impacts from dust deposition would likely exceed Small Quantity Generators (SQGs), but remain within the naturally occurring range presently found in the study area.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Impacts from fugitive dust would be slightly greater than Alternative 2 and likely exceed SQGs, but would likely remain within the naturally occurring range presently found in the study area. BMPs and mitigation would minimize adverse impacts associated with fugitive dust from the tailings stack.	Same as Alternative 2.
Transportation Corridor - Geochemistry	No impact.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Transportation Corridor – Surface Water Quality	Impacts from occasional barge-induced suspended sediment or erosion effects at construction sites would meet AWQC. Runoff of water from rock used for road construction could include inputs from constituents of concern; potential impacts could be reduced through mitigation.	Potential impacts related to surface water quality in the Kuskokwim River resulting from increases in suspended sediment concentrations and turbidity would decrease by approximately 32 percent from Alternative 2 due to reduced barging activity.	Same as Alternative 2, but with increased risk of spills associated with fuel handling at the Tyonek North Foreland Facility, and a decrease in potential impacts resulting from fuel handing at the ports.	Increased road length, but decreased number of stream crossings from Alternative 2 would result in fewer impacts. Material sites along the road would be used for road construction, which could result in leaching from constituents of concern; impacts could be reduced through mitigation.	Same as Alternative 2.	Same as Alternative 2.
Transportation Corridor – Groundwater Quality	Placement of sheet pile associated with construction of port terminals could infrequently affect groundwater quality within discrete portion of the project area. Use of groundwater for drinking water supplies at the Angyaruaq (Jungjuk) Port would not impact groundwater quality.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.Impacts would be transferred from Angyaruaq (Jungjuk) Port to the BTC Port.	Same as Alternative 2.	Same as Alternative 2.
Transportation Corridor – Sediment Quality	Resettled sediment from barging and construction of the ports would be of similar composition to the existing natural deposit. BMPs and ESC measures would be employed to control erosion and sedimentation effects during Construction.	Reduction in barging would reduce the amount of low water river travel by approximately 32 percent, resulting in fewer situations where sediment quality could be impacted.	Reduction in barging would reduce the amount of low water river travel, resulting in fewer situations where sediment quality could be impacted.	Impacts associated with sediment quality at the ports would be the same as Alternative 2, just located at the BTC Port instead of Angyaruaq (Jungjuk). Impacts from propeller wash would be less than Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Pipeline - Geochemistry	No impact.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.

Table 2.3-55: Impact Comparison by Alternative for Chapter 3 Resources

Impact-Causing Project Component or Resource Area	Alternative 2 – Proposed Action (includes Alternative 2-North Option)	Alternative 3A – LNG-Powered Haul Trucks	Alternative 3B – Diesel Pipeline (includes Alternative 3B-Port MacKenzie Option and Alternative 3B-Collocated Pipeline Option)	Alternative 4 – BTC Port	Alternative 5A – Dry Stack Tailings (includes Unlined Option and Lined Option)	Alternative 6A – Dalzell Gorge Route
Pipeline – Surface Water Quality	Potential erosion impacts and the introduction of fine-grained sediments to surface water associated with the pipeline would be mitigated to meet AWQC.	Same as Alternative 2.	The diesel pipeline would increase risk to surface water resources from spills or pipeline rupture relative to Alternative 2. However, under normal operating conditions, mitigation measures would minimize impacts.	Same as Alternative 2.	Same as Alternative 2.	Impacts associated with installation of the pipeline at stream crossings would be the same as Alternative 2, but repositioned west as a result of the Dalzell Gorge alignment.
Pipeline – Groundwater Quality	Installation of the pipeline could result in alterations to groundwater flow patterns, minor pipeline corrosion, and small changes in groundwater quality. However, these changes would be infrequent and not last longer than the span of Construction.	Same as Alternative 2.	The diesel pipeline would increase risk to groundwater resources from spills or pipeline rupture relative to Alternative 2. However, under normal operating conditions, mitigation measures would minimize impacts.	Same as Alternative 2.	Same as Alternative 2.	Impacts would be the same as Alternative 2. Specific locations would be different as a result of the Dalzell Gorge Route under this alternative.
Pipeline – Sediment Quality	Sediment quality would be impacted during pipeline construction as a result of increased sedimentation at the more than 400 stream crossing sites. However, impacts would not exceed regulatory limits, and would be minimized through mitigation.	Same as Alternative 2.	The diesel pipeline would increase risk to sediment resources from spills or pipeline rupture relative to Alternative 2. However, under normal operating conditions, mitigation measures would minimize impacts.	Same as Alternative 2.	Same as Alternative 2.	Impacts would be the same as Alternative 2. Specific locations would be different as a result of the Dalzell Gorge Route under this alternative.
Section 3.8: Air Quality						
Mine Site - Construction	Direct impacts to air quality during this phase would result from fugitive and mobile sources. Air emissions would not exceed thresholds, and impacts would meet regulatory standards during this phase.	Similar to Alternative 2.	Similar to Alternative 2.	Similar to Alternative 2.	Similar to Alternative 2.	Similar to Alternative 2.
Mine Site - Operations	Direct impacts to air quality during this phase would result from fugitive, stationary, and mobile sources. Mercury emissions would be released from the open pit, ore, and waste rock (volitization of weathered sulfide minerals); ore processing and other mining operations (emitted as fugitive dust); and from the TSF. The gaseous mercury from the point sources would be collected and treated, such that only 0.4 percent of the mercury passing through the mine would be released into the atmosphere. Emissions during Mine Site Operations would be above air quality thresholds; however, impacts comply with Alaska or National Air Quality Standards (AAAQS, NAAQS) and Prevention of Significant Deterioration (PSD) increments for the highest emitting fuel.	Similar to Alternative 2 with the following differences: There would be a reduction in the consumption of diesel, and less diesel storage would be required. Consumption of natural gas would be increased. There would be no vented emissions from the LNG storage tanks, which would reduce Hazardous Air Pollutants (HAPs) emissions by approximately 8 percent. Emissions of carbon monoxide, nitrogen oxides, particulate matter, sulfur dioxide, volatile organic compounds, and CO_2-e at the Mine Site would decrease compared to Alternative 2.	Similar to Alternative 2, with the following differences: Emissions of NO_x, CO, PM, SO_2, VOCs, and GHGs would increase. Mercury emissions would increase compared to Alternative 2 due to use of diesel in the dual fuel-fired boilers, but would still be within permitting and regulatory thresholds.	Similar to Alternative 2.	Similar to Alternative 2, with the following differences: The additional use of mobile machinery for transport and dewatering at the filter plant would increase mobile emissions, exposure of the dry stack surface would increase fugitive emissions, and the increase in power consumption would cause an increase in stationary emissions from the power plant. The increase in fugitive emissions due to the dry stack would be offset by the elimination of fugitive dust emissions from the TSF beach area under Alternative 2. Permitting and regulatory thresholds would still be met.	Similar to Alternative 2.

Table 2.3-55: Impact Comparison by Alternative for Chapter 3 Resources

Impact-Causing Project Component or Resource Area	Alternative 2 – Proposed Action (includes Alternative 2-North Option)	Alternative 3A – LNG-Powered Haul Trucks	Alternative 3B – Diesel Pipeline (includes Alternative 3B-Port MacKenzie Option and Alternative 3B-Collocated Pipeline Option)	Alternative 4 – BTC Port	Alternative 5A – Dry Stack Tailings (includes Unlined Option and Lined Option)	Alternative 6A – Dalzell Gorge Route
Mine Site - Closure	Direct impacts to air quality during this phase would result from fugitive, stationary, and mobile sources. Air emissions would not exceed thresholds, and impacts would meet regulatory standards during this phase.	Similar to Alternative 2.	Similar to Alternative 2.	Similar to Alternative 2.	Similar to Alternative 2.	Similar to Alternative 2.
Transportation Corridor - Construction	Direct impacts to air quality during this phase would result from fugitive and mobile sources associated with land, air, and water transportation. Air emissions would not exceed thresholds, and impacts would meet regulatory standards during this phase.	Similar to Alternative 2.	Similar to Alternative 2.	Similar to Alternative 2, with the following differences: Criteria air pollutants and GHG emissions along the roadway are expected to increase about 3 times compared to Alternative 2. The increase in emissions due to the longer road would be largely offset by the reduced barging emissions. Permitting and regulatory thresholds would still be met.	Similar to Alternative 2.	Similar to Alternative 2.
Transportation Corridor - Operations	Direct impacts to air quality during Operations activities would result from fugitive, stationary, and mobile sources. Air emissions would not exceed thresholds, and impacts would meet regulatory standards during this phase.	Similar to Alternative 2, with the following differences: Using LNG haul trucks would result in lower emissions of all pollutants during this phase.	Similar to Alternative 2, with the following differences: Emissions of all criteria pollutants and GHGs from water transportation would decrease, but could be offset by emissions from increased use of diesel fuel in other transportation facilities-related combustion equipment at the Mine Site. Permitting and regulatory thresholds would still be met.	Similar to Alternative 2, with the following differences: Criteria air pollutants and GHG emissions are expected to increase about 3 times compared to Alternative 2. The increase in emissions due to the longer road would be largely offset by the reduced barging emissions. Permitting and regulatory thresholds would still be met.	Similar to Alternative 2, except there would be a six percent increase in cargo barge traffic compared to Alternative 2. Permitting and regulatory thresholds would still be met.	Similar to Alternative 2.
Transportation Corridor - Closure	Direct impacts to air quality during closure activities would result from fugitive, stationary, and mobile sources. The proposed access roads, Angyaruaq (Jungjuk) Port, and airstrip would be used for long-term monitoring at the Mine Site and would not be reclaimed. Air emissions would not exceed thresholds, and impacts would meet regulatory standards during this phase.	Similar to Alternative 2.	Similar to Alternative 2.	Similar to Alternative 2.	Similar to Alternative 2.	Similar to Alternative 2.
Pipeline - Construction	Direct impacts to air quality during this phase would result from fugitive, stationary, and mobile sources. Air emissions would not exceed thresholds, and impacts would meet regulatory standards during this phase.	Similar to Alternative 2.	Similar to Alternative 2, with the following differences: Temporary emissions of criteria pollutants and GHGs are estimated to increase by about six percent due to construction of the additional 18-mile diesel pipeline. Permitting and regulatory thresholds would still be met.	Similar to Alternative 2.	Similar to Alternative 2.	Similar to Alternative 2.
Pipeline - Operations	Direct impacts to air quality during this phase would result from fugitive and mobile sources.	Similar to Alternative 2.	Same as Alternative 2, with the following differences:	Similar to Alternative 2.	Similar to Alternative 2.	Similar to Alternative 2.

Table 2.3-55: Impact Comparison by Alternative for Chapter 3 Resources

Impact-Causing Project Component or Resource Area	Alternative 2 – Proposed Action (includes Alternative 2-North Option)	Alternative 3A – LNG-Powered Haul Trucks	Alternative 3B – Diesel Pipeline (includes Alternative 3B-Port MacKenzie Option and Alternative 3B-Collocated Pipeline Option)	Alternative 4 – BTC Port	Alternative 5A – Dry Stack Tailings (includes Unlined Option and Lined Option)	Alternative 6A – Dalzell Gorge Route
	Air emissions would not exceed thresholds, and impacts would meet regulatory standards during this phase.		Fugitive GHG emissions from the diesel pipeline would be less compared to that of natural gas pipeline under Alternative 2. Permitting and regulatory thresholds would still be met.			
Pipeline - Closure	Fugitive and mobile emissions during reclamation of the pipeline and associated above-ground facilities would occur. Air emissions would not exceed thresholds, and impacts would meet regulatory standards.	Similar to Alternative 2.	Similar to Alternative 2, but would include reclamation activities for the 18-mile Tyonek diesel pipeline segment and Operations Center and Pumping Facility at Tyonek.	Similar to Alternative 2.	Similar to Alternative 2.	Similar to Alternative 2.
Section 3.9: Noise and Vibration						
Mine Site - Construction	Heavy equipment operations at the Mine Site during initial pioneering and development of mine pits and construction of mining facilities, ore processing facilities, tailings, waste rock, overburden storage facilities, haul roads, and support infrastructure.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Mine Site - Operations	Industrial-type heavy equipment used for extracting material from the ground, transporting ore, overburden, and waste rock; blasting; mining and ore processing; and maintenance of support facilities and infrastructure.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Mine Site - Closure	Industry-standard heavy equipment operations during earthwork activities upon final mine Closure and concurrent reclamation activities.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Transportation Corridor - Construction	Surface Transportation: Heavy equipment operations during construction of a 30-mile long mine access road. Air Transportation: Construction equipment operations during construction of the airstrip and associated facilities; noise from passenger and cargo aircrafts. Water Transportation: Construction equipment operations during ground preparation and development of the Angyaruaq (Jungjuk) Port, construction of cargo terminal and fuel storage at the Bethel Port site, possible construction of fuel storage facilities at the Dutch Harbor Port site, cargo and fuel barge traffic during Construction Phase.	Same as Alternative 2.	Same as Alternative 2.	Surface Transportation: Heavy equipment operations during construction of the 76-mile BTC Road. Air Transportation: Same as Alternative 2. Water Transportation: Same as Alternative 2 except Angyaruaq (Jungjuk) Port is replaced by BTC Port.	Same as Alternative 2.	Same as Alternative 2.
Transportation Corridor - Operations	Surface Transportation: Cargo and fuel trucks, pickup trucks and bus transportation along the mine access road. Air Transportation: Passenger and cargo aircrafts, and two generators.	Same as Alternative 2.	Same as Alternative 2.	Surface Transportation: Same as Alternative 2 except mine access road is replaced by BTC Road. Air Transportation: Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.

Table 2.3-55: Impact Comparison by Alternative for Chapter 3 Resources

Impact-Causing Project Component or Resource Area	Alternative 2 – Proposed Action (includes Alternative 2-North Option)	Alternative 3A – LNG-Powered Haul Trucks	Alternative 3B – Diesel Pipeline (includes Alternative 3B-Port MacKenzie Option and Alternative 3B-Collocated Pipeline Option)	Alternative 4 – BTC Port	Alternative 5A – Dry Stack Tailings (includes Unlined Option and Lined Option)	Alternative 6A – Dalzell Gorge Route
	Water Transportation: Transport equipment, vehicles and power generators used during port operations and maintenance activities at the port sites (Angyaruaq [Jungjuk], Bethel,and Dutch Harbor); barge traffic in Kuskokwim River.			Water Transportation: Same as Alternative 2 except Angyaruaq (Jungjuk) Port is replaced by BTC Port.		
Transportation Corridor - Closure	Surface Transportation: During Closure, impacts would be same as Operations (mine access road would remain as a long-term asset after the end of mining); for subsequent reclamation after Construction, heavy equipment used to perform earthwork to reclaim 11 borrow pits. Air Transportation: Same as Operations (airstrip would remain as a long-term asset after the end of mining). Water Transportation: Same as Operations for the port sites (the ports would be utilized for post-mining reclamation and closure activities and would remain as a long-term asset after the end of mining), reduced barge traffic in Kuskokwim River.	Same as Alternative 2.	Same as Alternative 2.	Surface Transportation: Same as Alternative 2. except mine access road is replaced by BTC Road. Air Transportation: Same as Alternative 2. Water Transportation: Same as Alternative 2. except Angyaruaq (Jungjuk) Port is replaced by BTC Port.	Same as Alternative 2.	Same as Alternative 2.
Pipeline - Construction	Heavy equipment operations during construction of Mainline (includes the 316-mile pipeline, ROWs, and temporary work areas (access roads, construction camps, pipe and equipment storage yards, material sites, and airstrips); and above-ground facilities (compressor station, main line block valve stations, metering stations, and pig launching and receiving facilities) extending from Beluga natural gas pipeline to Donlin Gold Mine Site.	Same as Alternative 2.	Same as Alternative 2, but would include construction of the 19-mile Tyonek diesel pipeline segment, Operations Center, and Pumping Facility; or, the 48-mile Port MacKenzie diesel pipeline segment, Operations Center, and Pumping Facility.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Pipeline - Operations	Mainline: In-line inspection tools (pigs) operated during periodic maintenance and routine inspection activities on the mainline; equipment operated during ROW clearing at approximately 10-year intervals. Above-Ground Facilities: Compressor Station (MP 0.4): two compressor machines and gas-fired power units, fin-fan coolers, blowdown processes, and pipeline pig(s). Metering Stations: Collocated with a pig launcher (MP 0) and receiver (MP 316). Mainline Block Valve Stations: Collocated with pig launcher/ receiver (MP 0, 156, and 316) and the compressor station (MP 0.4).	Same as Alternative 2.	Same as Alternative 2, but would include operations and maintenance of either: the 19-mile Tyonek diesel pipeline segment, Operations Center, and Pumping Facility; or, the 48-mile Port MacKenzie diesel pipeline segment, Operations Center, and Pumping Facility.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Pipeline - Closure	Mainline: Noise from helicopter traffic, purging of natural gas by pigging with a cleaning pig,	Same as Alternative 2.	Same as Alternative 2. but would include reclamation activities for the 19-mile	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.

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	and from small hand tools used to cut aboveground sections of the pipeline. Above-Ground Facilities: Heavy equipment used to perform earthwork and tools to dismantle equipment in the facilities.		Tyonek diesel pipeline segment, Operations Center, and Pumping Facility; or, the 48-mile Port MacKenzie diesel pipeline segment, Operations Center, and Pumping Facility.			
Section 3.10: Vegetation and Nonnative Invasive Species						
Impact-Causing Project Component[2]						
Construction activities, project activities, and infrastructure	17,894.6 total acres of vegetation removal (North Option, 17.832.2 [62 less acres]). Angyaruaq (Jungjuk) port site construction. 30-mile mine access road from port. Mine facilities construction. Road and facilities maintenance may require brushing of above-ground vegetation during Operations. Cone of depression at Mine Site due to water drawdown activities during Operations. 316-mile natural gas pipeline and ancillary facilities construction (North Option – less than 1 mile less in length). Pipeline corridor brushing of above-ground vegetation during Operations in 50' ROW. Summary: Vegetation will be removed, in some locations permanently. One Ecosystem of Conservation Concern may be impacted (spruce floodplain old growth forest). Vegetation damage may occur. Fugitive dust emissions may impact vegetation. There may be changes in vegetation due to changes in water availability. Rare or sensitive plants may be impacted. There is risk of nonnative species invasion from all project activities.	Differences: 17,894.6 total acres of vegetation removal (same as Alternative 2). Fewer diesel trucks and trips. Additional LNG Plant and storage tanks, reduced onsite diesel storage. Summary: Lower risk of invasion along road.	Differences: 18,368.1 total acres of vegetation removal (473.5 more than Alternative 2). Tyonek port site construction; 19-mile pipeline extension construction. 334-mile diesel pipeline and ancillary facilities construction. *Port MacKenzie Option* - Port improvements, alternative diesel pipeline route reconnecting at MP 28. 18,347.4 total acres of vegetation removal (452.5 more than Alternative 2)., *Collocated Pipeline Option* - wider ROW. 18,579.2 total acres of vegetation removal (684.6 more than Alternative 2)., *Collocated Option configured with Port MacKenzie Option* - total vegetation removal would be 18,995.8 acres (1,101.2 acres more than Alternative 2)., Summary: More vegetation removed in Alternative and 2 Options (including configuring Options together). Higher invasion risk due to additional construction and longer routes.	Differences: 18,592.3 total acres of vegetation removal (697.7 more than Alternative 2). BTC port site construction and 76-mile mine access road. Summary: More vegetation removed. Higher risk of invasion along road.	Differences: *Unlined Option* - 17,966.2 total acres of vegetation removal (71.6 more than Alternative 2.). *Lined Option* - 19,256.7 total acres of vegetation removal (362.1 more than Alternative 2). Summary: Similar vegetation removed in Unlined Option. More vegetation removed in Lined Option. Similar invasion risk to Alternative 2.	Differences: 17,882.2 total acres of vegetation removal (12.4 less than Alternative 2). 313-mile natural gas pipeline. Summary: Similar vegetation removed. Similar invasion risk to Alternative 2.
Fugitive dust emissions	Fugitive dust emissions will occur due to project activities. Summary: Risk exists for vegetation impacts such as damage or compositional vegetation type	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Differences: Increased amount of fugitive dust. Summary: Higher risk of vegetation	Same as Alternative 2.

[2] For some resources, where appropriate, impacts are subdivided into impact-causing project components ("Impact-Causing Project Components" and direct and indirect impacts ("Direct or Indirect Impacts"), indicated by a header row within that particular resource's rows.

Table 2.3-55: Impact Comparison by Alternative for Chapter 3 Resources

Impact-Causing Project Component or Resource Area	Alternative 2 – Proposed Action (includes Alternative 2-North Option)	Alternative 3A – LNG-Powered Haul Trucks	Alternative 3B – Diesel Pipeline (includes Alternative 3B-Port MacKenzie Option and Alternative 3B-Collocated Pipeline Option)	Alternative 4 – BTC Port	Alternative 5A – Dry Stack Tailings (includes Unlined Option and Lined Option)	Alternative 6A – Dalzell Gorge Route
	changes due to fugitive dust emissions.				impacts such as damage or compositional vegetation type changes due to fugitive dust emissions.	
River barge trips (Transportation Corridor)	Construction - 89 trips/year (50 cargo, 19 fuel, 20 during first two years to staging above Devil's Elbow) Operations - 122 trips/year (64 cargo and 58 fuel) Summary: Invasion risk exists due to river barge traffic as a vector.	Differences: Operations - 83 trips/year (64 cargo, 19 fuel) Summary: Lower invasion risk along river barge route.	Differences: Operations - 64 trips/year (cargo) Summary: Lower invasion risk along river barge route.	Same number of trips as Alternative 2, but river barges would only go as far as BTC port. Summary: Lower invasion risk along river barge route.	Differences: Operations - 129 trips/year (71 cargo, 58 fuel) Summary: Slightly higher invasion risk along river barge route.	Same as Alternative 2.
Ocean barge trips (Transportation Corridor)	Construction - 30 trips/year to Bethel (16 cargo, 14 fuel) Operations - 26 trips/year to Bethel (12 cargo, 14 fuel) Summary: Invasion risk exists due to ocean barge traffic as a vector.	Differences: Operations - 5 trips/year per year to Bethel (all fuel) during Operations (17 total compared to 26 total in Alternative 2). Summary: Lower risk of invasion along ocean barge route.	Differences: Operations - no fuel barge trips compared to 14 in Alternative 2, for a total of 12 barge trips/year. Summary: Lower risk of invasion along ocean barge route.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Ocean barge trips (Pipeline component)	Construction - 20 ocean barges during the first year from Anchorage to Beluga Landing. Summary: Invasion risk due to ocean barge traffic as a vector.	Same as Alternative 2.	Differences: Operations - 12 trips/year (fuel) compared to none in Alternative 2. (but no barge trips during Construction from Anchorage to Beluga Landing). Summary: Similar invasion risk along ocean barge route.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Direct or Indirect Impacts[3]						
Mine Site – Acres of Vegetation Removed	9,819.8 acres of vegetation removal. Of this, 2391.4 would be in the TSF.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Differences: *Unlined Option* - 9,890.9 acres removed, 2,463.0 in TSF (71.6 more than Alternative 2.). *Lined Option* - 10,181.4 acres removed, 2,753.5 in the TSF (362.5 more than Alternative 2.).	Same as Alternative 2.
Transportation Corridor – Acres of Vegetation Removed	1,093.4 acres of vegetation removal.	Same as Alternative 2.	Same as Alternative 2.	Differences: 1791.1 acres of vegetation removal (697.7 acres more than Alternative	Same as Alternative 2.	Same as Alternative 2.

[3] For some resources, where appropriate, impacts are subdivided into impact-causing project components ("Impact-Causing Project Components" and direct and indirect impacts ("Direct or Indirect Impacts"), indicated by a header row within that particular resource's rows.

Table 2.3-55: Impact Comparison by Alternative for Chapter 3 Resources

Impact-Causing Project Component or Resource Area	Alternative 2 – Proposed Action (includes Alternative 2-North Option)	Alternative 3A – LNG-Powered Haul Trucks	Alternative 3B – Diesel Pipeline (includes Alternative 3B-Port MacKenzie Option and Alternative 3B-Collocated Pipeline Option)	Alternative 4 – BTC Port	Alternative 5A – Dry Stack Tailings (includes Unlined Option and Lined Option)	Alternative 6A – Dalzell Gorge Route
				2.).		
Pipeline – Acres of Vegetation Removed	6,981.9 acres of vegetation removal (6,919.5 acres, North Option [62 less acres]).	Same as Alternative 2.	Differences: 7,455.4 acres of vegetation removal (473.5 more than Alternative 2.). *Port MacKenzie Option*: 7,434.7 acres of vegetation removal (452.8 acres more than Alternative 2). *Collocated Pipeline Option:* 7,666.5 acres of vegetation removal (684.6 acres more than Alternative 2). *Collocated Pipeline Option was configured with Port MacKenzie Option:* 8,083.1 acres of vegetation removal (1,101.2 acres more than Alternative 2).	Same as Alternative 2.	Same as Alternative 2.	Differences: 6,969.5 acres of vegetation removal (12.5 acres less than Alternative 2.).
Rare or sensitive plant impacts	Four rare or sensitive plant species have been confirmed within the Project Area. Two additional species are recorded but unconfirmed. Mine Site - One reported but unconfirmed population of fowl mannagrass would likely be impacted by construction activities within the project footprint. Transportation Corridor - No rare or sensitive plants have been confirmed in the Project Area. Pipeline component - Populations of four confirmed species (little prickly sedge, elephanthead lousewort, fragile rockbrake, and pearfruit smelowskia [BLM sensitive species]) and one unconfirmed species (bristleleaf sedge) occur, but are not likely to be impacted by project activities as they occur outside the project footprint. Loss of any individuals would reduce the population size, which increases the risk of extirpation from the Project Area. Habitat exists for these five species and for other species on rare and sensitive plant lists within the Project Area.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Vegetation damage	Vegetation damage including mechanical damage from construction activities, accidental wildland fire, accidental fuel or chemical spills, or damage from inappropriate forestry practices may occur.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Changes in water availability	There may be changes in vegetation, resulting in vegetation type change or damage to vegetation, from changes in water availability due to water drawdown activities.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.

Table 2.3-55: Impact Comparison by Alternative for Chapter 3 Resources

Impact-Causing Project Component or Resource Area	Alternative 2 – Proposed Action (includes Alternative 2-North Option)	Alternative 3A – LNG-Powered Haul Trucks	Alternative 3B – Diesel Pipeline (includes Alternative 3B-Port MacKenzie Option and Alternative 3B-Collocated Pipeline Option)	Alternative 4 – BTC Port	Alternative 5A – Dry Stack Tailings (includes Unlined Option and Lined Option)	Alternative 6A – Dalzell Gorge Route
NNIS risk	NNIS may be introduced or existing populations may spread due to all project activities if mitigation measures and BMPs are not adequately applied. 27 nonnative invasive terrestrial plant species are known to occur within the Project Area. No other taxa of NNIS are known to have reproducing populations within the Project Area.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Section 3.11: Wetlands						
Mine Site – Direct Wetland Impacts	2,728 acres	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	2,713 acres (Unlined Option) / 2,721 acres (Lined Option)	Same as Alternative 2
Mine Site – Potential Dust Indirect Wetland Impacts	635 acres	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	>635 acres	Same as Alternative 2.
Mine Site – Potential Dewatering Indirect Wetland Impacts	432 acres	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Transportation Corridor – Direct Wetland Impacts	224 acres	Same as Alternative 2.	Same as Alternative 2.	564 acres	Same as Alternative 2.	Same as Alternative 2.
Transportation Corridor - Potential Dust Indirect Wetland Impacts	627 acres	Same as Alternative 2.	Same as Alternative 2.	2,006 acres	Same as Alternative 2.	Same as Alternative 2.
Transportation Corridor – Potential Barge Wake Erosion	Indistinguishable from naturally occurring erosion.	Same as Alternative 2.	Same as Alternative 2.	Route 75 miles shorter than Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Pipeline –Construction Wetland Impacts	1,337 acres / 1,331 acres (North Option)	Same as Alternative 2.	1,490 acres / 1,481 acres (Port MacKenzie Option) / 1,537 acres (Collocated Pipeline Option / 1,574 acres (Collocated Pipeline with Port MacKenzie).	Same as Alternative 2.	Same as Alternative 2.	1,437 acres
Pipeline – Operations Wetland Impacts	525 acres / 519 acres (North Option)	Same as Alternative 2.	637 acres / 623 acres (Port Mackenzie Option) / 652 acres (Collocated Pipeline Option) / 658 acres (Collocated Pipeline with Port MacKenzie).	Same as Alternative 2.	Same as Alternative 2.	558 acres
Total Direct Wetland Impacts (excavation, fill, vegetation clearing)[1]	4,289 acres / 4,283 acres (North Option)	Same as Alternative 2.	4,442 acres / 4,433 acres (Port MacKenzie Option) / 4,489 acres (Collocated Pipeline Option) / 4,526 acres (Collocated Pipeline with Port MacKenzie). Slightly greater impacts than Alternative 2.	4,629 acres Greater impacts than Alternative 2.	4,274 acres (Unlined Option) / 4,282 acres (Lined Option) Similar impacts to Alternative 2.	4,389 acres Slightly greater impacts than Alternative 2.
Potential Indirect Wetland Impacts (dust, dewatering)[2]	1,262 acres	Same as Alternative 2.	Same as Alternative 2.	2,641 acres Greater impacts that Alternative 2.	>1,262 acres Slightly greater impacts than Alternative 2.	Same as Alternative 2.

Table 2.3-55: Impact Comparison by Alternative for Chapter 3 Resources

Impact-Causing Project Component or Resource Area	Alternative 2 – Proposed Action (includes Alternative 2-North Option)	Alternative 3A – LNG-Powered Haul Trucks	Alternative 3B – Diesel Pipeline (includes Alternative 3B-Port MacKenzie Option and Alternative 3B-Collocated Pipeline Option)	Alternative 4 – BTC Port	Alternative 5A – Dry Stack Tailings (includes Unlined Option and Lined Option)	Alternative 6A – Dalzell Gorge Route
Section 3.12: Wildlife – Terrestrial Mammals						
Impact Causing Project Components						
Vegetation removal, construction activities, project activities, and infrastructure	17,894.6 total acres of habitat loss before reclamation, primarily evergreen forest or scrub shrub (17,832.2 acres, North Option [62 less acres]). Angyaruaq (Jungjuk) port site construction. 30-mile mine access road from port. Mine facilities construction. Road and facilities maintenance may require brushing of above-ground vegetation during Operations. 316-mile natural gas pipeline and ancillary facilities construction (North Option - less than one mile shorter). Pipeline corridor brushing of above-ground vegetation during Operations in 50' ROW. Summary: Vegetation will be removed, in some locations permanently, impacting habitat.	Differences: Fewer diesel trucks and trips. Additional LNG Plant and storage tanks, reduced onsite diesel storage. Summary: Same amount of vegetation removal, but with less impacts from diesel transportation and storage.	Differences: 18,368.1 acres of habitat loss before reclamation, similar composition to Alternative 2. Tyonek port site construction; 19-mile pipeline extension construction. 334-mile diesel pipeline and ancillary facilities construction. *Port MacKenzie Option:* Port improvements, alternative diesel pipeline route reconnecting at MP 28. 18,447.4 acres of habitat loss. *Collocated Pipeline Option:* Wider ROW. 18,579.2 acres of habitat loss. Summary: More impacts due to more acres of vegetation removal compared to Alternative 2.	Differences: 18,995.8 acres of habitat loss before reclamation, similar composition to Alternative 2. BTC port site construction. 76-mile mine access road. Summary: More impacts due to more acres of vegetation removal compared to Alternative 2.	Differences: *Unlined Option:* 17,966.2 total acres of habitat removal, similar composition to Alternative 2. *Lined Option:* 19,256.7 total acres of habitat removal, similar composition to Alternative 2. Dry stack methodology reduces open water areas. Summary: More vegetation removal and habitat loss in the Mine Site compared to Alternative 2, but less open water would be present as a potential attractant in the Mine Site because of the DST facility during Operations.	Differences: 17,882.2 acres of habitat loss before reclamation, similar composition to Alternative 2. 313-mile natural gas pipeline. Summary: Similar amount of vegetation removal compared to Alternative 2.
River barge trips (Transportation Corridor)	Construction - 89 trips/year (50 cargo, 19 fuel, 20 during first two years to staging above Devil's Elbow) Operations - 122 trips/year (64 cargo and 58 fuel) Summary: Noise disturbance is possible.	Differences: Operations - 83 trips/year (64 cargo, 19 fuel) Summary: Fewer barge trips lower noise impacts.	Differences: Operations - 64 trips/year (cargo) Summary: Least amount of barge trips lowers noise impacts.	Same number of trips as Alternative 2, but river barges would only go as far as BTC port. Summary: Shorter barge route lowers noise impacts.	Differences: Operations - 129 trips/year (71 cargo, 58 fuel) Summary: Similar impacts as Alternative 2.	Same as Alternative 2.
Ocean barge trips (Transportation Corridor)	Construction - 30 trips/year to Bethel (16 cargo, 14 fuel) Operations - 26 trips/year to Bethel (12 cargo, 14 fuel) Summary: Noise disturbance is possible.	Differences: Operations - 5 trips/year per year to Bethel (all fuel) Summary: Fewer barge trips lower noise impacts.	Differences: Operations - no barge trips (fuel or cargo) Summary: Least amount of barge trips lowers noise impacts.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Ocean barge trips (Pipeline component)	Construction - 20 ocean barges during the first year from Anchorage to Beluga Landing. Summary: Noise disturbance is possible.	Same as Alternative 2.	Differences: Operations - 12 trips/year (fuel) compared to none in Alternative 2. (but no barge trips during Construction from Anchorage to Beluga Landing). Summary: More barge trips during Operations raises potential for noise impacts. No barges during Construction would reduce impacts.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.

Table 2.3-55: Impact Comparison by Alternative for Chapter 3 Resources

Impact-Causing Project Component or Resource Area	Alternative 2 – Proposed Action (includes Alternative 2-North Option)	Alternative 3A – LNG-Powered Haul Trucks	Alternative 3B – Diesel Pipeline (includes Alternative 3B-Port MacKenzie Option and Alternative 3B-Collocated Pipeline Option)	Alternative 4 – BTC Port	Alternative 5A – Dry Stack Tailings (includes Unlined Option and Lined Option)	Alternative 6A – Dalzell Gorge Route
Direct or Indirect Impacts						
Mine Site - Behavioral disturbance (noise, barriers to movement, organic waste attraction)	Noise disturbance and displacement from project activities is possible during Construction and Operations, depending on species sensitivity. During Operations, impacts may be seasonal during the operating season. Organic waste attraction is possible.	Fewer diesel trucks and trips during Operations may reduce noise and displacement impacts.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Mine Site - Risk of injury or mortality (vehicle collisions, environmental contamination)	Risk of injury or mortality is possible due to vehicle collisions during the barging and trucking season during Construction and Operations. Environmental contamination is possible at Mine Site features including the pit lake (Operations and after Closure), and the TSF and CWD ponds (Operations).	Fewer fuel trucks and reduced onsite diesel storage during Operations lowers potential for vehicle collisions, and lowers risk of environmental contamination.	Fewer fuel trucks during Operations lowers potential for vehicle collisions, and lowers risk of environmental contamination.	Same as Alternative 2.	Dry stack methodology reduces open water present in Mine Site and lines ponds reducing habitat during Operations, lowering risk of environmental contamination.	Same as Alternative 2.
Mine Site - Habitat alteration (vegetation removal)	Vegetation will be removed during Construction, in some locations permanently, which may alter or reduce wildlife habitat. Some locations may experience a change in vegetation type during Operations and Closure (through reclamation or natural revegetation).	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	<u>Differences:</u> In the TSF, the Unlined Option would have 2463 acres of vegetation removed (71.6 more than Alternative 2.); the Lined Option would have 2753.5 acres removed (362.5 more compared to Alternative 2.).	Same as Alternative 2.
Mine Site - Increased hunting and trapping pressure	Access will be controlled during the Construction and Operations phases, but there may be impacts to wildlife from increased hunting and trapping pressure.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Transportation Corridor - Behavioral disturbance (noise, barriers to movement, increased barge traffic)	Noise disturbance and displacement from project activities is possible, primarily during Construction and Operations during the barging and trucking season. Disturbance level depends on species sensitivity.	Fewer diesel trucks and trips and fewer river and ocean barge trips during Operations may reduce noise and displacement impacts.	Fewer diesel trucks and trips and fewest river and ocean barge trips during Operations may reduce noise and displacement impacts.	Shorter barge route during Construction and Operations may reduce impacts from barging; longer road may increase impacts.	Similar to Alternative 2.	Same as Alternative 2.
Transportation Corridor - Risk of injury or mortality (vehicle collisions)	Risk of injury or mortality is possible during Construction and Operations during the trucking season.	Fewer fuel trucks during Operations lowers the potential for vehicle collisions.	Fewer fuel trucks during Operations lowers the potential for vehicle collisions.	Longer road increases potential for vehicle collisions.	Same as Alternative 2.	Same as Alternative 2.
Transportation Corridor - Habitat alteration (vegetation removal)	Vegetation will be removed during Construction, in some locations permanently, which may alter or reduce wildlife habitat. Some locations may experience a change in vegetation type during Operations and Closure (through reclamation or natural revegetation).	Same as Alternative 2.	Same as Alternative 2.	<u>Differences:</u> 1791.1 acres of vegetation removal (697.7 acres more than Alternative 2.).	Same as Alternative 2.	Same as Alternative 2.
Transportation Corridor - Increased hunting and trapping pressure	Access will be controlled during the Construction and Operations phases, but there may be impacts to wildlife from increased hunting and trapping pressure.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Pipeline - Behavioral disturbance (noise, barriers to movement,	Noise disturbance and displacement from project activities (mine operations, vehicles,	Same as Alternative 2.	Similar to Alternative 2, although there may be increased impacts due to longer	Same as Alternative 2.	Same as Alternative 2.	Similar to Alternative 2.

Table 2.3-55: Impact Comparison by Alternative for Chapter 3 Resources

Impact-Causing Project Component or Resource Area	Alternative 2 – Proposed Action (includes Alternative 2-North Option)	Alternative 3A – LNG-Powered Haul Trucks	Alternative 3B – Diesel Pipeline (includes Alternative 3B-Port MacKenzie Option and Alternative 3B-Collocated Pipeline Option)	Alternative 4 – BTC Port	Alternative 5A – Dry Stack Tailings (includes Unlined Option and Lined Option)	Alternative 6A – Dalzell Gorge Route
increased barge traffic)	barges, infrastructure, human noise) is possible, primarily during Construction and Operations. Disturbance level depends on species sensitivity.		pipeline route and more complicated construction, and more access roads built to access the pipeline corridor.			
Pipeline - Risk of injury or mortality (vehicle collisions)	Risk of injury is possible due to vehicle collisions mostly during the Construction Phase.	Same as Alternative 2.	Similar to Alternative 2, although there may be increased impacts due to longer pipeline route and more complicated construction, and more access roads built to access the pipeline corridor.	Same as Alternative 2.	Same as Alternative 2.	Similar to Alternative 2, although there is the possibility of more impacts to caribou and bison due to the route.
Pipeline - Habitat alteration (vegetation removal)	Vegetation will be removed during Construction, in some locations permanently, which may alter or reduce wildlife habitat. Some locations may experience a change in vegetation type during Operations and Closure (through reclamation or natural revegetation). Vegetation brushing will occur during Operations in a 50' ROW per PHMSA regulations, resulting in early-successional stage vegetation in the corridor periodically.	Same as Alternative 2.	7455.4 acres of vegetation removal (473.5 more than Alternative 2.). For the Port MacKenzie Option, 7434.7 acres of vegetation removal (452.8 acres more than Alternative 2, 20.7 acres less than Alternative 3B). For the Collocated Pipeline Option, 7666.5 acres of vegetation removal (684.6 acres more than Alternative 2, 211.1 acres more than Alternative 3B).	Same as Alternative 2.	Same as Alternative 2.	<u>Differences:</u> 6969.5 acres of vegetation removal (12.5 acres less than Alternative 2.).
Pipeline - Increased hunting and trapping pressure	Access will be controlled during the Construction and Operations phases, but there may be impacts to wildlife from increased hunting and trapping pressure along the entire pipeline corridor route, given the current use, expected increase in access, and proximity to current recreationally used features and areas such as the Iditarod National Historic Trail.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Section 3.12: Wildlife – Marine Mammals						
Impact Causing Project Component						
River barge trips (Transportation Corridor)	Construction - 89 trips/year (50 cargo, 19 fuel, 20 during first two years to staging above Devil's Elbow). Operations - 122 trips/year (64 cargo and 58 fuel). <u>Summary:</u> Noise disturbance and vessel strike are possible.	<u>Differences:</u> Operations - 83 trips/year (64 cargo, 19 fuel). <u>Summary:</u> Fewer barge trips lowers noise and vessel strike potential.	<u>Differences:</u> Operations - 64 trips/year (cargo). <u>Summary:</u> Least amount of barge trips lowers noise and vessel strike potential.	Same number of trips as Alternative 2, but river barges would only go as far as BTC port. <u>Summary:</u> Shorter barge route lowers noise disturbance and vessel strike potential.	<u>Differences:</u> Operations - 129 trips/year (71 cargo, 58 fuel). <u>Summary:</u> Similar impacts as Alternative 2.	Same as Alternative 2.
Ocean barge trips (Transportation Corridor)	Construction - 30 trips/year to Bethel (16 cargo, 14 fuel). Operations - 26 trips/year to Bethel (12 cargo, 14 fuel). <u>Summary:</u> Noise disturbance and vessel strike are possible.	<u>Differences:</u> Operations - 5 trips/year per year to Bethel (all fuel). <u>Summary:</u> Less barge trips lowers noise and vessel strike potential.	<u>Differences:</u> Operations - no barge trips (fuel or cargo). <u>Summary:</u> Least amount of barge trips lowers noise and vessel strike potential.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Ocean barge trips (Pipeline component)	Construction - 20 ocean barges during the first year from Anchorage to Beluga Landing. <u>Summary:</u>	Same as Alternative 2.	<u>Differences:</u> Operations - 12 trips/year (fuel) compared to none in Alternative 2. (but no barge trips	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.

Table 2.3-55: Impact Comparison by Alternative for Chapter 3 Resources

Impact-Causing Project Component or Resource Area	Alternative 2 – Proposed Action (includes Alternative 2-North Option)	Alternative 3A – LNG-Powered Haul Trucks	Alternative 3B – Diesel Pipeline (includes Alternative 3B-Port MacKenzie Option and Alternative 3B-Collocated Pipeline Option)	Alternative 4 – BTC Port	Alternative 5A – Dry Stack Tailings (includes Unlined Option and Lined Option)	Alternative 6A – Dalzell Gorge Route
	Noise disturbance and vessel strike are possible.		during Construction from Anchorage to Beluga Landing). Summary: More barge trips during Operations raises potential for noise impacts. No barges during Construction reduces impacts.			
Direct or Indirect Impacts						
Transportation Corridor - Behavioral disturbance (noise, increased barge traffic)	Noise disturbance and displacement from barging is possible, primarily during Construction and Operations during the barging season. Disturbance level depends on species sensitivity.	Fewer river and ocean barge trips during Operations may reduce noise and displacement impacts.	Fewest river and ocean barge trips during Operations may reduce noise and displacement impacts.	Shorter barge route during Construction and Operations may reduce impacts from barging.	Similar to Alternative 2.	Same as Alternative 2.
Transportation Corridor - Risk of injury or mortality (vessel strikes)	Risk of injury or mortality from vessel strikes is possible during Construction and Operations during the barging season.	Fewer river and ocean barge trips during Operations may reduce risk of injury or mortality.	Fewest river and ocean barge trips during Operations may reduce risk of injury or mortality.	Shorter barge route during Construction and Operations may reduce risk of injury or mortality.	Similar to Alternative 2.	Same as Alternative 2.
Pipeline - Behavioral disturbance (noise, increased barge traffic)	Noise disturbance and displacement from barging is possible during Construction during the barging season.	Same as Alternative 2.	More barge trips during Operations raises potential for disturbance.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Pipeline - Risk of injury or mortality (vessel strikes)	Risk of injury or mortality from vessel strikes is possible during Construction during the barging season.	Same as Alternative 2.	More barge trips during Operations raises risk of injury or mortality from vessel strike.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Section 3.12: Wildlife – Birds						
Impact Causing Project Component						
Vegetation removal, construction activities, project activities, and infrastructure	17,894.6 total acres of habitat loss before reclamation, primarily evergreen forest or scrub shrub (17,832.2 acres, North Option [62 acres less]). Angyaruaq (Jungjuk) port site construction. 30-mile mine access road from port. Mine facilities construction. Road and facilities maintenance may require brushing of above-ground vegetation during Operations. 316-mile natural gas pipeline and ancillary facilities construction (North Option - 0.5 mile less in length; total acreage difference to be determined after field season 2017). Pipeline corridor brushing of above-ground vegetation during Operations in 50' ROW. Summary: Vegetation will be removed, in some locations permanently, impacting habitat.	Differences: Fewer diesel trucks and trips. Additional LNG Plant and storage tanks, reduced onsite diesel storage. Summary: Same amount of vegetation removal, but less impacts from diesel transportation and storage.	Differences: 18,368.1 acres of habitat loss before reclamation, similar composition to Alternative 2. Tyonek port site construction; 19-mile pipeline extension construction. 334-mile diesel pipeline and ancillary facilities construction. *Port MacKenzie Option:* Port improvements, alternative diesel pipeline route reconnecting at MP 28. 18,447.4 acres of habitat loss. *Collocated Pipeline Option:* Wider ROW. 18,579.2 acres of habitat loss. Summary: More impacts due to more acres of vegetation removal compared to Alternative 2.	Differences: 18,995.8 acres of habitat loss before reclamation, similar composition to Alternative 2. BTC port site construction. 76-mile mine access road. Summary: More impacts due to more acres of vegetation removal compared to Alternative 2.	Differences: *Unlined Option:* 17,966.2 total acres of habitat removal, similar composition to Alternative 2. *Lined Option:* 19,256.7 total acres of habitat removal, similar composition to Alternative 2. Dry stack methodology reduces open water areas. Summary: More vegetation removal and habitat loss in the Mine Site compared to Alternative 2, but less open water would be present as a potential attractant in the Mine Site because of the DST facility during Operations.	Differences: 17,882.2 acres of habitat loss before reclamation, similar composition to Alternative 2. 313-mile natural gas pipeline. Summary: Similar amount of vegetation removal compared to Alternative 2.

Table 2.3-55: Impact Comparison by Alternative for Chapter 3 Resources

Impact-Causing Project Component or Resource Area	Alternative 2 – Proposed Action (includes Alternative 2-North Option)	Alternative 3A – LNG-Powered Haul Trucks	Alternative 3B – Diesel Pipeline (includes Alternative 3B-Port MacKenzie Option and Alternative 3B-Collocated Pipeline Option)	Alternative 4 – BTC Port	Alternative 5A – Dry Stack Tailings (includes Unlined Option and Lined Option)	Alternative 6A – Dalzell Gorge Route
River barge trips (Transportation Corridor)	Construction - 89 trips/year (50 cargo, 19 fuel, 20 during first two years to staging above Devil's Elbow). Operations - 122 trips/year (64 cargo and 58 fuel). Summary: Noise disturbance is possible.	Differences: Operations - 83 trips/year (64 cargo, 19 fuel). Summary: Fewer barge trips lower noise impacts.	Differences: Operations - 64 trips/year (cargo). Summary: Least amount of barge trips lowers noise impacts.	Same number of trips as Alternative 2, but river barges would only go as far as BTC port. Summary: Shorter barge route lowers noise impact potential.	Differences: Operations - 129 trips/year (71 cargo, 58 fuel) Summary: Similar impacts as Alternative 2.	Same as Alternative 2.
Ocean barge trips (Transportation Corridor)	Construction - 30 trips/year to Bethel (16 cargo, 14 fuel) Operations - 26 trips/year to Bethel (12 cargo, 14 fuel). Summary: Noise disturbance is possible.	Differences: Operations - 5 trips/year per year to Bethel (all fuel) during Operations (17 total compared to 26 total in Alternative 2.). Summary: Fewer barge trips lower noise impacts.	Differences: Operations - no fuel barge trips compared to 14 in Alternative 2, for a total of 12 barge trips/year. Summary: Least amount of barge trips lowers noise impacts.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Ocean barge trips (Pipeline component)	Construction - 20 ocean barges during the first year from Anchorage to Beluga Landing. Summary: Noise disturbance is possible.	Differences: Construction – no pipe/equipment barges between Anchorage and Beluga Landing. Summary: No barges during Construction reduces impacts.	Differences: Construction – no pipe/equipment barges between Anchorage and Beluga Landing. Operations - 12 trips/year (fuel) Summary: More barge trips during Operations raises potential for noise impacts. No barges during Construction reduces impacts.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Direct or Indirect Impacts						
Mine Site - Behavioral disturbance (noise, barriers to movement, organic waste attraction)	Noise disturbance and displacement from project activities is possible during Construction and Operations, depending on species sensitivity. During Operations, impacts may be seasonal during the operating season. Organic waste attraction is possible.	Fewer diesel trucks and trips during Operations may reduce noise and displacement impacts.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Mine Site - Risk of injury or mortality (vehicle collisions, environmental contamination)	Risk of injury or mortality is possible due to vehicle collisions during the barging and trucking season during Construction and Operations. Environmental contamination is possible at Mine Site features including the pit lake (Operations and after Closure), and the TSF and CWD ponds (Operations).	Fewer fuel trucks and reduced onsite diesel storage during Operations lowers potential for vehicle collisions, and lowers risk of environmental contamination.	Fewer fuel trucks during Operations lowers potential for vehicle collisions, and lowers risk of environmental contamination.	Same as Alternative 2.	Dry stack methodology reduces open water present in Mine Site and lines ponds reducing habitat during Operations, lowering risk of environmental contamination.	Same as Alternative 2.
Mine Site - Habitat alteration (vegetation removal, nest site loss or disturbance)	Vegetation will be removed during Construction, in some locations permanently, which may alter or reduce or disturb wildlife habitat and nest sites. Some locations may experience a change in vegetation type during Operations and Closure (through reclamation or natural revegetation).	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Differences: In the TSF, the Unlined Option would have 2,463 acres of vegetation removed (71.6 more than Alternative 2.); the Lined Option would have 2753.5 acres removed (362.5 more compared to	Same as Alternative 2.

Table 2.3-55: Impact Comparison by Alternative for Chapter 3 Resources

Impact-Causing Project Component or Resource Area	Alternative 2 – Proposed Action (includes Alternative 2-North Option)	Alternative 3A – LNG-Powered Haul Trucks	Alternative 3B – Diesel Pipeline (includes Alternative 3B-Port MacKenzie Option and Alternative 3B-Collocated Pipeline Option)	Alternative 4 – BTC Port	Alternative 5A – Dry Stack Tailings (includes Unlined Option and Lined Option)	Alternative 6A – Dalzell Gorge Route
					Alternative 2.).	
Transportation Corridor - Behavioral disturbance (noise, barriers to movement, increased barge traffic)	Noise disturbance and displacement from project activities is possible, primarily during Construction and Operations during the barging and trucking season. Disturbance level depends on species sensitivity.	Fewer diesel trucks and trips and fewer river and ocean barge trips during Operations may reduce noise and displacement impacts.	Fewer diesel trucks and trips and fewest river and ocean barge trips during Operations may reduce noise and displacement impacts.	Shorter barge route during Construction and Operations may reduce impacts from barging; longer road may increase impacts.	Similar to Alternative 2.	Same as Alternative 2.
Transportation Corridor - Risk of injury or mortality (vehicle collisions, powerline collisions)	Risk of injury or mortality is possible during Construction and Operations during the trucking season.	Fewer fuel trucks during Operations lowers potential for vehicle collisions.	Fewer fuel trucks during Operations lowers potential for vehicle collisions.	Longer road increases potential for vehicle collisions.	Same as Alternative 2.	Same as Alternative 2.
Transportation Corridor - Habitat alteration (vegetation removal, nest site loss or disturbance)	Vegetation will be removed during Construction, in some locations permanently, which may alter or reduce wildlife habitat. Some locations may experience a change in vegetation type during Operations and Closure (through reclamation or natural revegetation).	Same as Alternative 2.	Same as Alternative 2.	<u>Differences:</u> 1791.1 acres of vegetation removal (697.7 acres more than Alternative 2.).	Same as Alternative 2.	Same as Alternative 2.
Pipeline - Behavioral disturbance (noise, increased barge traffic)	Noise disturbance and displacement from project activities (mine operations, vehicles, barges, infrastructure, human noise) is possible, primarily during Construction and Operations. Disturbance level depends on species sensitivity.	Same as Alternative 2.	Similar to Alternative 2, although there may be increased impacts due to longer pipeline route and more complicated construction, and more access roads built to access the pipeline corridor.	Same as Alternative 2.	Same as Alternative 2.	Similar to Alternative 2.
Pipeline - Behavioral Risk of injury or mortality (vehicle collisions, powerline collisions)	Risk of injury is possible due to vehicle collisions mostly during the Construction Phase.	Same as Alternative 2.	Similar to Alternative 2, although there may be increased impacts due to longer pipeline route and more complicated construction, and more access roads built to access the pipeline corridor.	Same as Alternative 2.	Same as Alternative 2.	Similar to Alternative 2, although there is the possibility of more impacts to caribou and bison due to the route.
Pipeline - Habitat alteration (vegetation removal, nest site loss or disturbance)	Vegetation will be removed during Construction, in some locations permanently, which may alter or reduce wildlife habitat. Some locations may experience a change in vegetation type during Operations and Closure (through reclamation or natural revegetation). Vegetation brushing will occur during Operations in a 50' ROW per PHMSA regulations, resulting in early-successional stage vegetation in the corridor periodically.	Same as Alternative 2.	7455.4 acres of vegetation removal (473.5 more than Alternative 2.). For the Port MacKenzie Option, 7434.7 acres of vegetation removal (452.8 acres more than Alternative 2, 20.7 acres less than Alternative 3B). For the Collocated Pipeline Option, 7666.5 acres of vegetation removal (684.6 acres more than Alternative 2, 211.1 acres more than Alternative 3B). If the Collocated Pipeline Option was configured with Port MacKenzie, 8083.1 acres of vegetation removal (1101.2 acres more than Alternative 2, 627.7 acres more than Alternative 648.4 acres more than the Port MacKenzie Option alone, and 416.6 acres more than the Collocated Pipeline Option alone.	Same as Alternative 2.	Same as Alternative 2.	<u>Differences:</u> 6969.5 acres of vegetation removal (12.5 acres less than Alternative 2.).

Table 2.3-55: Impact Comparison by Alternative for Chapter 3 Resources

<table>
<tr><th>Impact-Causing Project Component or Resource Area</th><th>Alternative 2 – Proposed Action (includes Alternative 2-North Option)</th><th>Alternative 3A – LNG-Powered Haul Trucks</th><th>Alternative 3B – Diesel Pipeline (includes Alternative 3B-Port MacKenzie Option and Alternative 3B-Collocated Pipeline Option)</th><th>Alternative 4 – BTC Port</th><th>Alternative 5A – Dry Stack Tailings (includes Unlined Option and Lined Option)</th><th>Alternative 6A – Dalzell Gorge Route</th></tr>
<tr><td colspan="7">Section 3.13: Fish and Aquatic Resources</td></tr>
<tr><td colspan="7">Impact Causing Project Component</td></tr>
<tr><td>Mine Site – construction of mine infrastructure, access roads, and related facilities</td><td>Construction, Operations, and Closure of open pit, WRF, TSF, and freshwater reservoir:
• Tailings storage and operating pond footprint – 2,394 acres
Tailings stored in combined tailings and operating pond facility contained by one dam.</td><td>Same as Alternative 2.</td><td>Same as Alternative 2.</td><td>Same as Alternative 2.</td><td>Construction, Operations, and Closure of open pit, WRF, TSF, and freshwater reservoir:
• Tailings storage and operating pond footprint – 2,463 acres
Tailings stored as dry stack upstream of an operating pond; operating pond contained by a main dam and two upper dams.</td><td>Same as Alternative 2.</td></tr>
<tr><td>Transportation Corridor – increased barge traffic from baseline levels</td><td>River and ocean barge traffic:
• 50 river cargo trips per year to Angyaruaq (Jungjuk) Port Site (Construction Phase)
• 64 river cargo trips per year to Angyaruaq (Jungjuk) Port Site (Operations Phase)
• 19 river fuel trips per year to Angyaruaq (Jungjuk) Port Site (Construction Phase)
• 64 river fuel trips per year to Angyaruaq (Jungjuk) Port Site (Operations Phase)
• 20 pipe and equipment barges to staging area near Devil's Elbow, above Stony River (during first two years of pipeline construction - Construction Phase)
• 16 ocean cargo trips per year to Bethel (Construction Phase)
• 12 ocean cargo trips per year to Bethel (Operations Phase)
• 14 ocean fuel trips per year to Bethel (both Construction and Operations phases)
Totals:
• 89 river trips per year (Construction Phase)
• 122 river trips per year (Operations Phase)
• 30 ocean trips per year to Bethel (Construction Phase)
• 26 ocean trips per year to Bethel (Operations Phase)</td><td>Differences from Alternative 2:
• 19 river fuel trips per year to Angyaruaq (Jungjuk) Port Site (Operations Phase)
• 5 ocean barge fuel trips per year to Bethel (Operations Phase)
Summary Differences:
• 83 river trips per year (Operations Phase)
• 17 ocean trips per year to Bethel (Operations Phase)</td><td>Differences from Alternative 2:
• No river fuel trips per year to Angyaruaq (Jungjuk) Port Site (Operations Phase)
• No ocean barge fuel trips per year to Bethel (Operations Phase)
Summary Differences:
• 64 river trips per year (Operations Phase)
• 12 ocean trips per year to Bethel (Operations Phase)</td><td>Differences from Alternative 2:
• River trips would only go as far as BTC Port Site, rather than Angyaruaq (Jungjuk) Port Site</td><td>Differences from Alternative 2:
• 71 river cargo trips per year to Angyaruaq (Jungjuk) Port Site (Operations Phase)
Summary Differences:
• 129 river trips per year (Operations Phase)</td><td>Same as Alternative 2.</td></tr>
<tr><td>Pipeline - increased barge traffic from baseline levels</td><td>River and ocean barge traffic:
• 20 ocean barges during the first year of pipeline construction from Anchorage to</td><td>Same as Alternative 2.</td><td>River and ocean barge traffic:
• 12 ocean trips per year to Tyonek (Operations Phase)</td><td>Same as Alternative 2.</td><td>Same as Alternative 2.</td><td>Same as Alternative 2.</td></tr>
</table>

Table 2.3-55: Impact Comparison by Alternative for Chapter 3 Resources

Impact-Causing Project Component or Resource Area	Alternative 2 – Proposed Action (includes Alternative 2-North Option)	Alternative 3A – LNG-Powered Haul Trucks	Alternative 3B – Diesel Pipeline (includes Alternative 3B-Port MacKenzie Option and Alternative 3B-Collocated Pipeline Option)	Alternative 4 – BTC Port	Alternative 5A – Dry Stack Tailings (includes Unlined Option and Lined Option)	Alternative 6A – Dalzell Gorge Route
	Beluga Landing					
Pipeline – stream crossings	Pipeline: • Length of 316 miles (North Option would be 0.5 miles shorter). • 28 stream crossings using HDD and open-cut methods.	Same as Alternative 2.	Pipeline: • Length of 334 miles (additional 19-mile segment between Tyonek and the start of the proposed corridor for Alternative 2. • 29 stream/river crossings using open-cut and HDD methods; additional segment would cross the Beluga River using HDD. • Port MacKenzie Option would add additional HDD crossing at the Susitna River and crossing at Little Susitna River. Collocated Natural Gas and Diesel Pipeline Option would extend ROW by 5 feet.	Same as Alternative 2.	Same as Alternative 2.	Pipeline: • Length of 313 miles • 22 stream crossings using HDD and open-cut methods.
Direct or Indirect Impacts						
Mine Site – construction of mine infrastructure, access roads, and related facilities	Construction, Operations, and Closure of open pit, WRF, TSF, and freshwater reservoir: • Tailings storage and operating pond footprint – 2,394 acres Tailings stored in combined tailings and operating pond facility contained by one dam.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Construction, Operations, and Closure of open pit, WRF, TSF, and freshwater reservoir: • Tailings storage and operating pond footprint – 2,463 acres Tailings stored as dry stack upstream of an operating pond; operating pond contained by a main dam and two upper dams.	Same as Alternative 2.
Mine Site – Habitat alterations, injury, and mortality from in-stream habitat removal and fish loss	Direct loss of 8 miles of instream habitat in five Crooked Creek drainages near the Mine Site. • 5.6 miles of aquatic habitat in American and Anaconda Creeks. • 0.66 mile of EFH. • 2.36 miles of perennial stream habitat.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Mine Site - Habitat alterations from water management and water quality practices	Impacts in five tributaries in the vicinity of the Mine Site and in the middle and lower reaches of Crooked Creek. Reduced surface flows in nearby tributaries and in the middle reaches of Crooked Creek.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Reduced storage requirements within TSF would lessen risk of potential dam failure and downstream release of slurry materials.	Same as Alternative 2.
Mine Site - Habitat alterations from wetland and riparian buffer removal	Impacts involving about 100 acres of riverine wetlands or river channel including about 5 miles of perennial streams and about 1 mile of intermittent streams.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.

Table 2.3-55: Impact Comparison by Alternative for Chapter 3 Resources

Impact-Causing Project Component or Resource Area	Alternative 2 – Proposed Action (includes Alternative 2-North Option)	Alternative 3A – LNG-Powered Haul Trucks	Alternative 3B – Diesel Pipeline (includes Alternative 3B-Port MacKenzie Option and Alternative 3B-Collocated Pipeline Option)	Alternative 4 – BTC Port	Alternative 5A – Dry Stack Tailings (includes Unlined Option and Lined Option)	Alternative 6A – Dalzell Gorge Route
Mine Site - Habitat alterations from streamflows changes to off-channel aquatic habitat along Crooked Creek	Reduction of connected off-channel habitat surface area from 15.3 to 11.3 acres. These impacts would be elevated and may be acute or obvious under a *High K* scenario where flow reductions could reach a maximum of 85 to 100 percent.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Mine Site - Habitat alterations from streamflows changes to aquatic habitat in the mainstem channel of Crooked Creek	Streamflow reductions up to 33 percent in winter between American Creek and Omega Gulch based on a 10-year flow scenario. These impacts would be elevated and may be acute or obvious under a *High K* scenario.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Mine Site - Habitat alterations from streamflows changes and salmon spawning habitat in Crooked Creek	Based on flow depletion model, 21 of 519 salmon redds in Crooked Creek below American Creek would be outside the wetted channel during winter low flow conditions during Mine Site Operations. These impacts would be elevated and may be acute or obvious under a *High K* scenario where flow reductions could reach a maximum of 85 to 100 percent.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Mine Site - Habitat alterations from streamflows changes and salmon spawning substrate freezing in Crooked Creek	Impacts may not be measurable or noticeable relative to dewatering or freezing because the majority of observed spawning habitat has been documented in lower Crooked Creek, where streamflow changes are reduced relative to areas in the vicinity of the Mine Site. These impacts would be elevated and may be acute or obvious under a *High K* scenario where flow reductions could reach a maximum of 85 to 100 percent.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Mine Site - Habitat alterations from streamflows changes and Crooked Creek salmon production	Streamflow reductions would affect an estimated 40 adult salmon near the Mine Site upstream of Crevice Creek. These impacts would be elevated and may be acute or obvious under a *High K* scenario where flow reductions could reach a maximum of 85 to 100 percent.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Mine Site - Injury and mortality from streams temperature changes in Crooked Creek	1.5 miles upstream of the Crooked Creek confluence on the Kuskokwim River, predicted increase in Celsius degree-day TUs is 156.4, 93, and 18.5 for Chinook, chum, and coho salmon, respectively. These values are within the normal range for chum and coho salmon and just slightly above for Chinook salmon. Just downstream of Crevice Creek, predicted increases in Celsius degree-day TUs is 107.4, 63.3, and 12.6 for Chinook, chum, and coho salmon, respectively. These values are well	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.

Table 2.3-55: Impact Comparison by Alternative for Chapter 3 Resources

Impact-Causing Project Component or Resource Area	Alternative 2 – Proposed Action (includes Alternative 2-North Option)	Alternative 3A – LNG-Powered Haul Trucks	Alternative 3B – Diesel Pipeline (includes Alternative 3B-Port MacKenzie Option and Alternative 3B-Collocated Pipeline Option)	Alternative 4 – BTC Port	Alternative 5A – Dry Stack Tailings (includes Unlined Option and Lined Option)	Alternative 6A – Dalzell Gorge Route
	within the documented normal range of TUs for Chinook, chum, and coho salmon.					
Mine Site - Behavioral disturbance and habitat alterations from erosion and sedimentation	Disturbance of approximately 9,000 acres of surface soil. Stream sedimentation would depend on effective implementation of BMPs.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Mine Site - Habitat alterations from metals and mercury emissions	Depending on future bioavailability, concentrations of mercury in fish in Crooked Creek watershed would be up to 3 percent above current levels and within the range of regional background fish tissue concentrations.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Transportation Corridor - Habitat alterations from vessel wave energy impacts on nearshore erosion, turbidity, and water temperature	Impacts along narrow segments of the Kuskokwim River from predicted wave heights up to 0.80 feet in height. Wave heights of this magnitude could temporarily displace small young-of-year salmon or small resident fishes rearing or migrating along the shore zone.	Compared to Alternative 2, this Alternative reduces total trips in the Transportation Corridor from 122 to 83 river trips and from 26 to 17 ocean trips during the Operations Phase. This would result in a proportionate reduction in the probability of tug and barge-generated wakes, prop wash, and riverbed scour that could adversely affect water quality, aquatic habitats, and anadromous and resident fish populations in the mainstem of the Kuskokwim River.	Compared to Alternative 2, this Alternative reduces total trips in the Transportation Corridor from 122 to 64 river trips and from 26 to 12 ocean trips during the Operations Phase. This would result in a proportionate reduction in the probability of tug and barge-generated wakes, prop wash, and riverbed scour that could adversely affect water quality, aquatic habitats, and anadromous and resident fish populations in the mainstem of the Kuskokwim River.	Compared to Alternative 2, this Alternative would reduce barging distance up the Kuskokwim River by 69 miles. This would result in a reduced impact extent.	Same as Alternative 2.	Same as Alternative 2.
Transportation Corridor - Behavioral disturbance and habitat alterations from fish displacement and stranding	Displacement and/or stranding of small young-of-year and possibly some juvenile anadromous fishes from ice breakup to late June during out-migration, particularly in confined channel segments. Potential risks where shallow gradient shorelines are exposed to wave forces from downriver-bound traffic traveling in narrow channel segments.	Compared to Alternative 2, fewer barge trips would result in a proportionate reduction in the probability of tug and barge-generated wakes, prop wash, and riverbed scour that could displace or strand fish.	Compared to Alternative 2, fewer barge trips would result in a proportionate reduction in the probability of tug and barge-generated wakes, prop wash, and riverbed scour that could displace or strand fish.	Compared to Alternative 2, this Alternative would reduce barging distance up the Kuskokwim River by 69 miles. This would result in a reduced impact extent.	Same as Alternative 2.	Same as Alternative 2.
Transportation Corridor - Habitat alterations from prop wash scour of riverbed substrates and spawning gravels	Scouring to gravel-size riverbed substrates at localized areas along the navigation route, particularly in waters with an under keel depth shallower than 8 to 10 feet. Intensity of impacts would depend on depth, speed, location, and other factors associated with tug and barge traffic.	Compared to Alternative 2, this Alternative would result in a reduced impact probability due to fewer fuel barge trips.	Compared to Alternative 2, this Alternative would result in a reduced impact probability due to fewer fuel barge trips.	Compared to Alternative 2, this Alternative would reduce barging distance up the Kuskokwim River by 69 miles. This would result in a reduced impact extent.	Same as Alternative 2.	Same as Alternative 2.
Transportation Corridor - Propeller-induced fish injury and mortality	Intensity of impacts would depend on time of year, time of day, fish life stages (and swimming ability), concentration of fish, and channel character. Fish eggs, larvae, and small young-of-year juvenile fish moving downstream would be at higher risk than upstream migrating adult fish.	Compared to Alternative 2, fewer barge trips would result in a proportionate reduction in the probability of propeller-induced fish injury and mortality.	Compared to Alternative 2, fewer barge trips would result in a proportionate reduction in the probability of propeller-induced fish injury and mortality.	Impacts based on time of year, time of day, fish life stages (and swimming ability), concentration of fish, and channel character; impact is reduced due to shorter distance of barge trips and wider channel traveled. Compared to Alternative 2, this Alternative would reduce barging distance up the Kuskokwim River	Same as Alternative 2.	Same as Alternative 2.

Table 2.3-55: Impact Comparison by Alternative for Chapter 3 Resources

Impact-Causing Project Component or Resource Area	Alternative 2 – Proposed Action (includes Alternative 2-North Option)	Alternative 3A – LNG-Powered Haul Trucks	Alternative 3B – Diesel Pipeline (includes Alternative 3B-Port MacKenzie Option and Alternative 3B-Collocated Pipeline Option)	Alternative 4 – BTC Port	Alternative 5A – Dry Stack Tailings (includes Unlined Option and Lined Option)	Alternative 6A – Dalzell Gorge Route
				by 69 miles. This would result in a reduced extent of propeller-induced fish injury and mortality.		
Transportation Corridor - Behavioral disturbance and habitat alterations from mine access road Construction and Operations	Impacts at approximately 51 stream crossings along the 30-mile long mine access road and associated infrastructure. BMPs would reduce the intensity of runoff, erosion, and sediment loads and minimize potential impacts to fish and their habitat.	Compared to Alternative 2, less maintenance due to reduced fuel deliveries would result in a proportionate reduction in the probability of impacts.	Compared to Alternative 2, less maintenance due to reduced fuel deliveries would result in a proportionate reduction in the probability of impacts.	Compared to Alternative 2, this alternative includes a 73-mile long mine access road (2.5 times longer than Alternative 2.). This would result in a higher probability of behavioral disturbance and habitat alterations.	Same as Alternative 2.	Same as Alternative 2.
Transportation Corridor - Habitat alterations from port site Construction and Operations	Construction at ports would involve 40,000 cy of fill and 1,600 of riprap along the shoreline at the Bethel Port site and 10,000 cy of dredged material along the shoreline at Angyaruaq (Jungjuk) Port site. These would reduce and alter fish habitat in areas at the port sites.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2 though BTC Port site would also involve 10,000 cy of dredged material along the shoreline.	Same as Alternative 2.	Same as Alternative 2.
Pipeline - Behavioral disturbance and habitat alterations from stream crossings	Spring and winter open-cut stream crossings that would occur in areas frequented by burbot, northern pike, Arctic grayling, Dolly Varden, rainbow trout, and salmon species could disturb spawning and/or overwintering areas.	Same as Alternative 2.	Compared to Alternative 2, additional HDD crossing at Beluga River would slightly raise the risk of behavioral disturbance and habitat alteration. Under the Port MacKenzie Option, additional HDD crossing at Susitna River and crossing at Little Susitna River would slightly raise the risk of behavioral disturbance and habitat alteration.	Same as Alternative 2.	Same as Alternative 2.	Compared to Alternative 2, fewer stream crossings would result in a slightly reduced, but similar impacts to spawning and/or overwintering areas.
Pipeline - Behavioral disturbance and habitat alterations from water withdrawals and releases from ice road construction and pipeline testing	Discharge up to 15 Mgal of water and sediment to local drainages from hydrotesting would affect local water levels, streamflows, water quality, fish populations, and fish habitat.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Pipeline - Behavior disturbance and habitat alterations during Construction, Operations, and Closure of pipeline and related infrastructure	Impacts associated with runoff and stream sedimentation until disturbed soils are stabilized and reclamation has been completed.	Same as Alternative 2.	Compared to Alternative 2, there would be similar impacts from erosion and runoff due to additional 19-mile pipeline segment and the additional 12 ocean barge trips per year during Operations. The 289 acre ROW and 674 acre construction footprint under the Port MacKenzie Option and 5% area increase in ROW under the Collocated Natural Gas and Diesel Pipeline Option would result in similar impacts. There would be two additional river crossings under the Port MacKenzie Option. This would result in a proportionate increase in the probability of behavioral disturbance and habitat alterations.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.

Table 2.3-55: Impact Comparison by Alternative for Chapter 3 Resources

Project Component	Alternative 2 – Proposed Action (includes Alternative 2-North Option)	Alternative 3A – LNG-Powered Haul Trucks	Alternative 3B – Diesel Pipeline (includes Alternative 3B-Port MacKenzie Option and Alternative 3B-Collocated Pipeline Option)	Alternative 4 – BTC Port	Alternative 5A – Dry Stack Tailings (includes Unlined Option and Lined Option)	Alternative 6A – Dalzell Gorge Pipeline Route
Section 3.14: Threatened and Endangered Species – ESA-Listed Birds						
Impact Causing Project Components						
Increased ocean barge traffic from baseline volume	16 ocean cargo trips per year to Bethel (Construction Phase) 12 ocean cargo trips per year to Bethel (Operations Phase) 14 ocean fuel trips per year to Bethel (both Construction and Operations phases) Totals: 30 ocean trips per year to Bethel (Construction Phase) 26 ocean trips per year to Bethel (Operations Phase)	Difference from Alternative 2: 5 ocean fuel trips per year to Bethel (Operations Phase) Totals: 17 ocean trips per year to Bethel (Operations Phase)	Difference from Alternative 2: No ocean fuel trips per year to Bethel (Operations Phase) Totals: 12 ocean trips per year to Bethel (Operations Phase)	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Direct or Indirect Impacts						
Behavioral disturbance	-Potential for behavioral disturbance exists from ocean barge trips in the Transportation Corridor. -There would be no impacts in the Mine Site or the Pipeline component as no ESA-listed bird species are known to occur there.	Compared to Alternative 2, this Alternative reduces total ocean trips in the Transportation Corridor: -from 26 trips to 17 trips (Operations Phase) -This alternative would lower the potential for behavioral disturbance in the Transportation Corridor. -There would be no impacts in the Mine Site or the Pipeline component as no ESA-listed bird species are known to occur there.	Compared to Alternative 2, this Alternative reduces total ocean trips in the Transportation Corridor: -from 26 trips to 12 trips (Operations Phase) -This alternative would have the lowest potential for behavioral disturbance in the Transportation Corridor. -There would be no impacts in the Mine Site or the Pipeline component as no ESA-listed bird species are known to occur there.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Risk of injury or mortality	Risk of injury or mortality exists from ocean barge trips in the Transportation Corridor. There would be no impacts in the Mine Site or the Pipeline component as no ESA-listed bird species are known to occur there.	Compared to Alternative 2, this Alternative reduces total ocean trips in the Transportation Corridor: -from 26 trips to 17 trips (Operations Phase) -This alternative would lower the potential for risk of injury or mortality in the Transportation Corridor. -There would be no impacts in the Mine Site or the Pipeline component as no ESA-listed bird species are known to occur there.	Compared to Alternative 2, this Alternative reduces total ocean trips in the Transportation Corridor: -from 26 trips to 12 trips (Operations Phase) -This alternative would have the lowest potential for risk of injury or mortality in the Transportation Corridor. -There would be no impacts in the Mine Site or the Pipeline component as no ESA-listed bird species are known to occur there.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.

Table 2.3-55: Impact Comparison by Alternative for Chapter 3 Resources

Project Component	Alternative 2 – Proposed Action (includes Alternative 2-North Option)	Alternative 3A – LNG-Powered Haul Trucks	Alternative 3B – Diesel Pipeline (includes Alternative 3B-Port MacKenzie Option and Alternative 3B-Collocated Pipeline Option)	Alternative 4 – BTC Port	Alternative 5A – Dry Stack Tailings (includes Unlined Option and Lined Option)	Alternative 6A – Dalzell Gorge Pipeline Route
Section 3.14: Threatened and Endangered Species – ESA-Listed Marine Mammals						
Impact Causing Project Components						
Increased river and ocean barge traffic from baseline volume	Transportation Corridor: 50 river cargo trips per year to Angyaruaq (Jungjuk) Port Site (Construction Phase) 64 river cargo trips per year to Angyaruaq (Jungjuk) Port Site (Operations Phase) 19 river fuel trips per year to Angyaruaq (Jungjuk) Port Site (Construction Phase) 58 river fuel trips per year to Angyaruaq (Jungjuk) Port Site (Operations Phase) 20 pipe and equipment barges to staging area near Devil's Elbow, above Stony River (during first two years of pipeline construction - Construction Phase) 16 ocean cargo trips per year to Bethel (Construction Phase) 12 ocean cargo trips per year to Bethel (Operations Phase) 14 ocean fuel trips per year to Bethel (both Construction and Operations phases) Pipeline: 20 ocean barges during the first year of pipeline construction from Anchorage to Beluga Landing Totals - Transportation Corridor: 89 river trips per year (Construction Phase) 122 river trips per year (Operations Phase) 30 ocean trips per year to Bethel (Construction Phase) 26 ocean trips per year to Bethel (Operations Phase) Totals - Pipeline: 20 ocean trips (first year, Construction Phase)	Difference from Alternative 2- Transportation Corridor: 19 river fuel trips per year to Angyaruaq (Jungjuk) Port Site (Operations Phase) 5 ocean barge fuel trips per year to Bethel (Operations Phase) Totals - Transportation Corridor: 83 river trips per year (Operations Phase) 17 ocean trips per year to Bethel (Operations Phase)	Difference from Alternative 2 - Transportation Corridor: No river fuel trips per year to Angyaruaq (Jungjuk) Port Site (Operations Phase) No ocean barge fuel trips per year to Bethel (Operations Phase) Difference from Alternative 2. - Pipeline: 12 ocean trips per year to Tyonek (Operations Phase) Totals - Transportation Corridor: 64 river trips per year (Operations Phase) 12 ocean trips per year to Bethel (Operations Phase) Totals - Pipeline: 12 ocean trips per year to Tyonek (Operations Phase)	Difference from Alternative 2. - Transportation Corridor: -river trips would only go as far as Birch Tree Crossing Port Site, rather than Angyaruaq (Jungjuk) Port Site, which will not change impacts as ESA-listed marine mammal habitat is located downstream of either port site, closer to Bethel.	Difference from Alternative 2. - Transportation Corridor: 71 river cargo trips per year to Angyaruaq (Jungjuk) Port Site (Operations Phase) Totals - Transportation Corridor: 129 river trips per year (Operations Phase)	Same as Alternative 2.
Direct or Indirect Impacts						
Behavioral disturbance	-Potential for behavioral disturbance exists from river and ocean barge trips in the Transportation Corridor and Pipeline components. -There would be no impacts in the Mine Site component as no ESA-listed marine mammal species are known to occur there.	Compared to Alternative 2, this Alternative reduces total trips in the Transportation Corridor: -from 122 river trips to 83 river trips (Operations Phase) -from 26 ocean trips to 17 ocean trips (Operations Phase) -This Alternative would lower the	Compared to Alternative 2, this Alternative reduces total trips in the Transportation Corridor: -from 122 river trips to 64 river trips (Operations Phase) -from 26 ocean trips to 12 trips (Operations Phase) -This Alternative would have the lowest	Same as Alternative 2.	Compared to Alternative 2, this Alternative increases total trips in the Transportation Corridor: -from 122 river trips to 129 river trips (Operations Phase) -This alternative would slightly raise the potential for	Same as Alternative 2.

Table 2.3-55: Impact Comparison by Alternative for Chapter 3 Resources

Project Component	Alternative 2 – Proposed Action (includes Alternative 2-North Option)	Alternative 3A – LNG-Powered Haul Trucks	Alternative 3B – Diesel Pipeline (includes Alternative 3B-Port MacKenzie Option and Alternative 3B-Collocated Pipeline Option)	Alternative 4 – BTC Port	Alternative 5A – Dry Stack Tailings (includes Unlined Option and Lined Option)	Alternative 6A – Dalzell Gorge Pipeline Route
		potential for behavioral disturbance in the Transportation Corridor. -Pipeline component impacts would be the same as Alternative 2. -There would be no impacts in the Mine Site component as no ESA-listed marine mammal species are known to occur there.	potential for behavioral disturbance in the Transportation Corridor. <u>This Alternative increases total ocean trips in the Pipeline component:</u> -Additional 12 ocean barge trips to Tyonek (Operations Phase) increases the potential for adverse behavioral impacts (depending on the tanker schedule in Cook Inlet relative to distribution of Cook Inlet beluga whales). -There would be no impacts in the Mine Site component as no ESA-listed marine mammal species are known to occur there.		behavioral disturbance in the Transportation Corridor. -Pipeline component impacts would be the same as Alternative 2. -There would be no impacts in the Mine Site component as no ESA-listed marine mammal species are known to occur there.	
Risk of injury or mortality from collisions	-Risk of injury or mortality from collisions exists from river and ocean barge trips in the Transportation Corridor and Pipeline components. -Potential for population -level impacts if a North Pacific right whale is struck due to rare occurrence and scattered distribution in the Transportation Corridor. -Potential for population concern if a Cook Inlet beluga is struck due to Critical Habitat Area designation in Cook Inlet in the Pipeline component. -There would be no impacts in the Mine Site component as no ESA-listed marine mammal species are known to occur there.	<u>Compared to Alternative 2, this Alternative reduces total trips in the Transportation Corridor:</u> -from 122 river trips to 83 river trips (Operations Phase) -from 26 ocean trips to ocean 17 trips (Operations Phase) -This alternative would lower the risk of injury or mortality from collisions in the Transportation Corridor. -Pipeline component impacts would be the same as Alternative 2. -There would be no impacts in the Mine Site component as no ESA-listed marine mammal species are known to occur there.	<u>Compared to Alternative 2, this Alternative reduces total trips in the Transportation Corridor:</u> -from 122 river trips to 64 river trips (Operations Phase) -from 26 ocean trips to 12 trips (Operations Phase) -This alternative would have the lowest risk of injury or mortality from collisions in the Transportation Corridor. <u>This Alternative increases total ocean trips in the Pipeline component:</u> -Additional 12 ocean barge trips to Tyonek (Operations Phase) increases the risk of injury or mortality from collisions for Cook Inlet beluga whales (depending on the tanker schedule in Cook Inlet relative to distribution of this species). -There would be no impacts in the Mine Site component as no ESA-listed marine mammal species are known to occur there.	Same as Alternative 2.	<u>Compared to Alternative 2, this Alternative increases total trips in the Transportation Corridor:</u> -from 122 river trips to 129 river trips (Operations Phase) -This alternative would slightly raise the risk of injury or mortality from collisions in the Transportation Corridor. -Pipeline component impacts would be the same as Alternative 2. -There would be no impacts in the Mine Site component as no ESA-listed marine mammal species are known to occur there.	Same as Alternative 2.
Section 3.15: Land Ownership, Management, and Use						
Impact Causing Project Components						
Mine Site - Acres Affected	TKC/Calista (Surface/Surface): 4,370.6 acres Calista (Additional Surface/Subsurface): 4,575.7 acres Lyman Family (Surface): 13 acres **Total: 8,959.3 acres**	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	TKC/Calista (Surface/ Surface): 4,343.1 acres Calista (Surface/ Subsurface): 4,719.2 acres **Total: 9,067 acres**	Same as Alternative 2.
Transportation Corridor - Acres Affected	TKC/Calista (Surface/Surface): 264 acres Calista (Additional Surface/Subsurface): 11.4 acres	Same as Alternative 2.	TKC/Calista (Surface/Surface): 276.8 acres Calista (Additional Surface/ Subsurface):	TKC/Calista (Surface/Surface): 489.9 acres Calista (Additional Surface/	Same as Alternative 2.	Same as Alternative 2.

Table 2.3-55: Impact Comparison by Alternative for Chapter 3 Resources

Project Component	Alternative 2 – Proposed Action (includes Alternative 2-North Option)	Alternative 3A – LNG-Powered Haul Trucks	Alternative 3B – Diesel Pipeline (includes Alternative 3B-Port MacKenzie Option and Alternative 3B-Collocated Pipeline Option)	Alternative 4 – BTC Port	Alternative 5A – Dry Stack Tailings (includes Unlined Option and Lined Option)	Alternative 6A – Dalzell Gorge Pipeline Route
	State: 544.2 acres **Total: 819.6 acres**		15.3 acres State: 573.7 acres Tyonek Native Corporation/CIRI: 13.5 acres **Total: 879.3 acres**	Subsurface): 15.3 acres State: 315.5 acres Federal (BLM-managed State selections): 913.9 acres **Total: 1,734.6 acres**		
Pipeline - Acres Affected Construction ROW	Total ROW: 316 miles Calista: 73.4 acres CIRI: 79.6 acres Federal (BLM): 1,286.8 acres State: 2,714 or 325.7 acres Other Private Land: 0.9 acres **Total: 4,154.7 acres**	Same as Alternative 2.	Total ROW: 334 mile Calista: 73.4 acres CIRI: 154.4 or 94.3 acres Tyonek Native Corporation Surface/CIRI Subsurface: 48.1 or 0 acres Federal (BLM): 1,287.4 or 1,286.8 acres State: 2, 756.3 or 2,602.5 acres Kenai Peninsula Borough: 61.4 or 231.6acres Native Village of Tyonek: 0.4 or 0 acres Native Allotment: 1.1 or 0 Acres Other Private: 0.9 or 54.5 acres **Total: 4,383.4 or 4,343.1 acres**	Same as Alternative 2.	Same as Alternative 2.	Total ROW: 314.2 miles Calista: 73.4 acres CIRI: 120.2 acres Federal (BLM): 1,286.8 acres State: 2,627.2 acres Other Private: 0.9 acres **Total: 4,108.5 acres**
Pipeline - Acres Affected Operations ROW	Total ROW: 316 miles Calista: 32.8 acres CIRI: 37.9 acres Federal (BLM): 599.9 acres State: 1,252.2 or 160.2 acres Other Private Land: 0.0002 acres **Total: 1,923.7 acres**	Same as Alternative 2.	Total ROW: 334 mile Calista: 32.8 acres CIRI: 75.3 or 45.4 acres Tyonek Native Corporation/CIRI (Surface/Subsurface): 24 or 0 acres Federal (BLM): 599.9 or 573.3 acres State: 1,274.2 or 1,183.3acres Kenai Peninsula Borough: 31.3 or 115.8 acres Native Village of Tyonek: 0.2 or 0 acres Native Allotment: 0.4 or 0 acres Other Private: 0.0002 or 27.2 acres **Total: 2,038.1 or 1,977.8 acres**	Same as Alternative 2.	Same as Alternative 2.	Total ROW: 314.2 miles Calista: 32.8 acres CIRI: 60 acres Federal (BLM): 575.5 acres State: 1,213.1 acres Other Private: 0.0002 acres **Total: 1,880.4 acres**
Direct or Indirect Impacts						
Mine Site	The overall intensity of impacts would result in obvious beneficial changes to lands from the vantage of the landowner. However, direct impacts to 17(b) easements would occur, but may not be measurable or apparent. Routine administrative adjustments may be required to maintain similar use rights; action is consistent with existing management plans and land uses. The duration of impacts would vary. Changes in ownership, management, or land use may	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.

Table 2.3-55: Impact Comparison by Alternative for Chapter 3 Resources

Project Component	Alternative 2 – Proposed Action (includes Alternative 2-North Option)	Alternative 3A – LNG-Powered Haul Trucks	Alternative 3B – Diesel Pipeline (includes Alternative 3B-Port MacKenzie Option and Alternative 3B-Collocated Pipeline Option)	Alternative 4 – BTC Port	Alternative 5A – Dry Stack Tailings (includes Unlined Option and Lined Option)	Alternative 6A – Dalzell Gorge Pipeline Route
	reasonably be expected to convert (or revert) to another use frequently, over the life of the project. In some circumstances, these changes may persist after project Closure even if the actions that caused the change were to cease. The extent or scope of impacts would be limited to the vicinity of the Project Area. The context of impacts would affect a mineral resource that is considered special or rare on Calista/TKC lands.					
Transportation Corridor	In terms of intensity, the predominant impact would be an obvious change from undisturbed and partially disturbed land uses to an industrial use that would be beneficial from the vantage point of the private landowners, which include Calista Corporation, TKC, and the Dutch Harbor and Bethel ports. Changes for state lands would be adverse, but may not be measurable or apparent. Actions would be in line with land management plans. Duration of effects extend beyond the life of the mine. The context of impacts would affect resources throughout the EIS Analysis Area.	Same as Alternative 2.	Same as Alternative 2.	Impacts would be similar to Alternative 2, but would include reduced impacts from barging due to the shorter distance and increased impacts from a longer access road. Alternative 4 may have indirect effects that may not be measurable or apparent to land management if it would accelerate the conveyance of selected lands along the proposed road to the BTC Port site.	Same as Alternative 2.	Same as Alternative 2.
Pipeline	In terms of intensity, impacts to land use would result in obvious changes from mostly undisturbed to industrial use. No direct impacts to land ownership or management would occur, but there would be indirect impacts to land ownership that may not be measurable or apparent. Duration of effects would extend beyond the life of the mine. The extent or scope of effects would extend beyond a local area, affecting resources or populations through the EIS Analysis Area. Impacts would predominantly affect usual or ordinary land resources; however impacts to the INHT would be considered as having special or rare characteristics.	Same as Alternative 2.	Impacts would be similar or the same as Alternative 2, and would encompass impacts from an additional 18-mile pipeline segment to Tyonek or Port MacKenzie and include the Cook Inlet diesel transport facilities.	Same as Alternative 2.	Same as Alternative 2.	Impacts would be similar or the same as those for Alternative 2. The ROW for Alternative 6A would be slightly shorter, but would not change land ownership from Alternative 2. The proposed pipeline alignment for Alternative 6A intersects more state lands crossing or adjacent to the INHT.

Table 2.3-55: Impact Comparison by Alternative for Chapter 3 Resources

Project Component	Alternative 2 – Proposed Action (includes Alternative 2-North Option)	Alternative 3A – LNG-Powered Haul Trucks	Alternative 3B – Diesel Pipeline (includes Alternative 3B-Port MacKenzie Option and Alternative 3B-Collocated Pipeline Option)	Alternative 4 – BTC Port	Alternative 5A – Dry Stack Tailings (includes Unlined Option and Lined Option)	Alternative 6A – Dalzell Gorge Pipeline Route
Section 3.16: Recreation						
Impact Causing Project Components						
Mine Site Area Permitted Recreational Hunting	GMU Unit 19 includes permits for black bear, brown bear, bison, caribou, moose, sheep, wolf, wolverine 0 big game permitted guides and transporters	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Transportation Corridor Area Permitted Recreational Hunting	GMU Unit 19 (see Mine Site) GMU Unit 18 includes permits for black bear, brown bear, caribou, moose, muskox, wolf, wolverine 17 big game permitted guides and transporters	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Transportation Corridor Area	122 of Kuskokwim River annual barge round trips during Operations 199 river miles barge route 30 mile mine access road	83 Kuskokwim River annual barge round trips during Operations	64 Kuskokwim River annual barge round trips during Operations	Same as Alternative 2, 124 river miles barge route 76 mile mine access road	Same as Alternative 2.	Same as Alternative 2.
Pipeline Area Permitted Recreational Hunting	GMU Unit 19 (see Mine Site) GMU Unit 16 includes permits for black bear, brown bear, caribou, moose, sheep, wolf, wolverine 79 big game permitted guides and transporters	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	# of big game permitted guides and transporters: 67
Pipeline Effects to INHT	Proposed Alignment: 14 INHT crossings 2.5 Miles of INHT collocation 14.3 Miles of INHT within 1,000' North Option: 5 INHT crossings 0.2 Miles of INHT collocation 5.3 Miles of INHT within 1,000'	Same as Alternative 2.	Proposed Option (Tyonek): Same as Alternative 2. Port MacKenzie Option: 17 INHT crossings 2.6 Miles of INHT collocation 16.9 Miles of INHT within 1,000'	Same as Alternative 2.	Same as Alternative 2.	34 INHT crossings 14.5 Miles of INHT collocation 29.4 Miles of INHT within 1,000'
Direct or Indirect Impacts						
Mine Site	Activities and infrastructure would affect an immeasurable or unapparent number of existing recreationists, and numbers are expected to remain the same after mine Closure. Impacts would be localized to the Mine Site, and there are many other alternative recreation lands in the area offering similar experiences. Access to the Mine Site would be restricted during Construction and Operations, but open to recreation activities after mine Closure. The road to the Mine Site would be closed to the	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.

Table 2.3-55: Impact Comparison by Alternative for Chapter 3 Resources

Project Component	Alternative 2 – Proposed Action (includes Alternative 2-North Option)	Alternative 3A – LNG-Powered Haul Trucks	Alternative 3B – Diesel Pipeline (includes Alternative 3B-Port MacKenzie Option and Alternative 3B-Collocated Pipeline Option)	Alternative 4 – BTC Port	Alternative 5A – Dry Stack Tailings (includes Unlined Option and Lined Option)	Alternative 6A – Dalzell Gorge Pipeline Route
	general public, and while public access easements (such as 17(b) easements) would remain active, no new recreation access routes would be created. After Closure, limits would be placed on ground disturbing recreation activities. Other recreation activities, such as sport hunting and snowmachining, would be allowed. Indirect impacts could include perceived contamination of the area.					
Transportation Corridor	Activities and infrastructure would affect an immeasurable or unapparent number of existing recreationists, and numbers are expected to remain the same after mine Closure. There are many other alternative recreation lands in the area offering similar experiences. Upgrades to existing ports and airports would remain in place after mine Closure, and could facilitate recreation access. However, this would likely spur imperceptible increases in use due to the remote nature of the EIS Analysis Area that lacks recreation facilities or connections to the road system. Access to the Bethel Port would be restricted during Construction. Section 17(b) easements in the area would necessitate permanent termination or relocation by the BLM for safety reasons.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Pipeline	Activities and infrastructure would affect a noticeable number of existing INHT recreationists, with the majority using the trail during the winter season. Construction would employ design measures to preclude extended soil compaction, interruption of scheduled races and events, or trail improvements that would ease passage. There would be long-term clearing of shrubs from the pipeline ROW at approximately 10-year intervals or as required to preserve pipeline integrity and allow for ongoing surveillance and monitoring activities during mine Operations which could make an attractive route for snowmachine and OHV users in winter. The corridor would not be cleared after Closure, but individuals could maintain clearance on their own initiative. However, use levels would not be likely to increase over current levels as the area would remain remote (disconnected from the road	Same as Alternative 2.	Same as Alternative 2 except that some infrastructure would be left in place after construction, so impacts to setting would last the life of the mine.	Same as Alternative 2.	Same as Alternative 2.	Activities and infrastructure would affect a noticeable number of existing INHT recreationists, but over a greater area than Alternative 2, with the majority using the trail during the winter season. Other impacts would be the same or similar to Alternative 2.

Table 2.3-55: Impact Comparison by Alternative for Chapter 3 Resources

Project Component	Alternative 2 – Proposed Action (includes Alternative 2-North Option)	Alternative 3A – LNG-Powered Haul Trucks	Alternative 3B – Diesel Pipeline (includes Alternative 3B-Port MacKenzie Option and Alternative 3B-Collocated Pipeline Option)	Alternative 4 – BTC Port	Alternative 5A – Dry Stack Tailings (includes Unlined Option and Lined Option)	Alternative 6A – Dalzell Gorge Pipeline Route
	system), lacking recreation facilities, and with low population densities. Impacts to recreation would vary seasonally and geographically along the pipeline corridor due to differing levels and contexts of recreation use. Shoofly road and landing strips would be demobilized and revegetated. Existing airport improvements would remain and could be employed by recreationists.					
Section 3.17: Visual Resources						
Impact Causing Project Components						
Mine Site	Contrast: Strong Scale: Dominant	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Transportation Corridor	Exposure: Transient; Geographic Extent Extending from Bethel to Angyaruaq (Jungjuk) Port.	Same as Alternative 2.	Exposure: Transient; Geographic Extent: Extending from Bethel to Angyaruaq (Jungjuk) Port, and also including the expanded Port facility at Tyonek or Port MacKenzie.	Exposure: Transient; Geographic Extent: Extending from Bethel to the Birch Tree Crossing site.	Same as Alternative 2.	Same as Alternative 2.
Pipeline: Crosses or parallels INHT in SQRU AR-6, AR-2, AR-1, SL-8, SL-7, SL-6, SL-5, and SL-4.	Number of INHT crossings: 14 or 6 Length of INHT Collocation : 2.5 or 0.2 miles Length of Trail Segment within 0- 5 mile Viewshed of Pipeline: 14 miles or 5	Same as Alternative 2.	Same as Alt 2, as vegetation management of the ROW between the Tyonek Dock and the start of the proposed corridor would occur in areas characterized by low stature vegetation.	Same as Alternative 2.	Same as Alternative 2.	Number of INHT crossings: 34 Length of INHT Collocation : 14.5 Length of Trail Segment within 0- 5 mile Viewshed of Pipeline: 9.5 miles
Direct or Indirect Impacts						
Mine Site	Intensity: Strong visual contrast against the existing landscape due to mining equipment, ACMA and Lewis pits, and infrastructure. Duration: Impacts would persist following Closure of the Mine Site. Extent or Scope: The affected area would be largely restricted to the foreground-middleground distance zone (3-5 miles). Context: The affected area is not recognized for its scenic value and does not contain sensitive viewers.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Transportation Corridor	Intensity: Moderate visual contrast against the existing landscape due to increased barge and port traffic. Duration: Changes in landscape character would extend through the life of the project. Extent or Scope: The affected area would be largely restricted to the foreground-	Impacts would be similar to Alternative 2; however, the intensity of impacts resulting from barge traffic would be less as the number of trips would be reduced.	Impacts would be similar to Alternative 2; however, the intensity of impacts resulting from barge traffic would be less as the number of trips would be reduced. Also, additional direct impacts could result from construction (expansion) of the existing dock at Tyonek and operations of the expanded port facility.	Impacts would be similar to Alternative 2; however, impacts resulting from barge traffic would not extend above the BTC Port site, thereby eliminating impacts to villages between Aniak and Crooked Creek.	Same as Alternative 2.	Same as Alternative 2.

Table 2.3-55: Impact Comparison by Alternative for Chapter 3 Resources

Project Component	Alternative 2 – Proposed Action (includes Alternative 2-North Option)	Alternative 3A – LNG-Powered Haul Trucks	Alternative 3B – Diesel Pipeline (includes Alternative 3B-Port MacKenzie Option and Alternative 3B-Collocated Pipeline Option)	Alternative 4 – BTC Port	Alternative 5A – Dry Stack Tailings (includes Unlined Option and Lined Option)	Alternative 6A – Dalzell Gorge Pipeline Route
	middleground distance zone (3-5 miles). Context: Discrete areas along the Kuskokwim River are recognized for their scenic quality.					
Pipeline	Intensity: Intensity of impacts would vary depending on the location, with weak to moderate visual contrast against the existing landscape where the ROW would cross areas characterized by low stature or variable vegetation structure. Visual contrast would be moderate to strong where the ROW crosses areas characterized by open or closed forests. Visual contrast of the ROW would be strongest in these areas when viewed from elevated or aerial vantage points. Duration: Same as above for the Transportation Corridor. Extent or Scope: Same as above for the Transportation Corridor. Context: Same as above for the Transportation Corridor.	Same as Alternative 2.	Impacts would be similar to Alternative 2; however, additional direct impacts could result from additional pipeline segments from either Tyonek or Port MacKenzie.	Same as Alternative 2.	Same as Alternative 2.	Impacts would be similar to Alternative 2; however, the pipeline would cross, be collocated, or be located in close proximity to the INHT for a greater percentage of the corridor.
Section 3.18: Socioeconomics						
All Components - Employment, Income, Sales	Construction Total Direct Jobs: 3,200 • Direct jobs, Alaska: 2,500 • Direct jobs, Y-K region: 1,600 to 1,900 • Indirect Jobs, Alaska: 7,300 Total Direct Payroll: $1.2 billion over project life • Direct Payroll, Alaska: $940 million • Indirect Payroll, Alaska: $390 million over project life Total Direct Expenditures: $5.2 billion over project life • Direct Expenditures, Alaska: $1.7 billion • Indirect Expenditures, Alaska: $1.1 billion over project life Operations Total Direct Jobs: 1,000 • Direct Jobs, Alaska: 600 • Direct Jobs, Y-K region: 500 to 600 • Indirect Jobs, Alaska: 650 Total Direct Payroll: $2.7 billion over project life • Direct Payroll, Alaska: $1.7 billion • Indirect Payroll, Alaska: $40 million over	Construction • Direct and Indirect Jobs: Same as Alternative 2. • Direct and Indirect Expenditures: Same as Alternative 2, except decrease for transportation by tens of millions of dollars Operations • Direct and Indirect Jobs: Same as Alternative 2, except decrease for transportation. • Direct and Indirect Expenditures: Same as Alternative 2, except decrease for transportation by tens of millions of dollars. Closure Same as Alternative 2.	Construction • Direct and Indirect Jobs: Same as Alternative 2, except increase for pipeline. • Direct and Indirect Expenditures: Same as Alternative 2, except - Decrease for Mine Site and transportation by tens of millions of dollars - Increase for pipeline by hundreds of millions of dollars Operations • Direct and Indirect Jobs: Same as Alternative 2, except - Decrease for transportation - Increase for pipeline • Direct and Indirect Expenditures: Same as Alternative 2, except - Increase for Mine Site by hundreds of millions of dollars - Decrease for transportation by tens of millions of dollars - Increase for pipeline by tens of millions of dollars	Construction • Direct and Indirect Jobs: Same as Alternative 2, except increase for transportation • Direct and Indirect Expenditures: Same as Alternative 2, except increase for transportation by tens of millions of dollars Operations • Direct and Indirect Jobs: Same as Alternative 2, except increase for transportation by truck and decrease for transportation by barge • Direct and Indirect Expenditures: Same as Alternative 2, except increase for transportation by less than ten million dollars Closure • Direct and Indirect Jobs: Same as Alternative 2, except increase for transportation • Direct and Indirect	Same as Alternative 2.	Construction • Direct and Indirect Jobs: Same as Alternative 2, except increase for pipeline • Direct and Indirect Expenditures: Same as Alternative 2, except increase for pipeline by tens of millions of dollars Operations Same as Alternative 2. Closure Same as Alternative 2.

Table 2.3-55: Impact Comparison by Alternative for Chapter 3 Resources

Project Component	Alternative 2 – Proposed Action (includes Alternative 2-North Option)	Alternative 3A – LNG-Powered Haul Trucks	Alternative 3B – Diesel Pipeline (includes Alternative 3B-Port MacKenzie Option and Alternative 3B-Collocated Pipeline Option)	Alternative 4 – BTC Port	Alternative 5A – Dry Stack Tailings (includes Unlined Option and Lined Option)	Alternative 6A – Dalzell Gorge Pipeline Route
	project life Total Direct Expenditures: $14 billion over project life • Direct Expenditures, Alaska: $9.8 billion • Indirect Expenditures, Alaska: $150 million over project life <u>Closure</u> Total Direct Jobs: 20 to 100 for deconstruction, 6 for about 50 years after mine Closure, 6 in perpetuity		<u>Closure</u> • Direct and Indirect Jobs: Same as Alternative 2, except increase for pipeline • Direct and Indirect Expenditures: Same as Alternative 2. <u>Collocated Pipeline Option:</u> • 40% increase in construction personnel to build the pipe • 50% increase in barge and truck traffic to move the pipe • 8% increase in footprint of laydown yards, larger mainline work camps • incremental increased capital cost estimated at $320 (32% over Alternative 3B)	Expenditures: Same as Alternative 2, except increase for transportation		
All Components - Lease Fees, ROW Acquisition, Tax Revenue, Royalties	<u>Construction</u> Total ROW Acquisition: $4.4 million • ROW Acquisition to federal: $2.75 million • ROW Acquisition to state: $1.5 million • ROW Acquisition to ANCSA corps: $250,000 <u>Operations</u> • Total Oil and Gas Property Tax from pipeline to Matanuska-Susitna Borough (MSB): $356,000 per year Oil and Gas Property Tax to Kenai Peninsula Borough (KPB): Not estimated Other Property Tax to MSB and Unalaska: Not estimated Royalties to Calista (and shared with other ANCSA regional corporations): $55.4 million per year over project life Royalties to The Kuskokwim Corporation: Not estimated Lease payments to Calista and Cook Inlet Region Inc.: $250,000 per year over project life Corporate Income Tax and Mining License Tax to state: $1.24 billion over project life Misc. Taxes and Fees: Not estimated <u>Closure</u> Not estimated; magnitude of impact generally within normal variation and trends.	<u>Construction and Operations</u> Same as Alternative 2, except no property taxes paid to Unalaska. <u>Closure</u> Same as Alternative 2.	<u>Construction and Operations</u> Same as Alternative 2, except property tax increase for KPB and no additional taxes from diesel storage in Dutch Harbor. <u>Closure</u> Same as Alternative 2. <u>Port MacKenzie Option:</u> • No property tax for KPB <u>Collocated Pipeline Option:</u> Same as Alternative 3B	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
All Components - Local Public Infrastructure and Services	The direct effects in communities in the EIS Analysis Area would be low since the	Same as Alternative 2.	Same as Alternative 2 except there would be no possibility of natural gas in some	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.

Table 2.3-55: Impact Comparison by Alternative for Chapter 3 Resources

Project Component	Alternative 2 – Proposed Action (includes Alternative 2-North Option)	Alternative 3A – LNG-Powered Haul Trucks	Alternative 3B – Diesel Pipeline (includes Alternative 3B-Port MacKenzie Option and Alternative 3B-Collocated Pipeline Option)	Alternative 4 – BTC Port	Alternative 5A – Dry Stack Tailings (includes Unlined Option and Lined Option)	Alternative 6A – Dalzell Gorge Pipeline Route
	temporary and permanent camps housing project workers would be self-contained, and operated and maintained by Donlin Gold throughout project Construction, Operations, and Closure. Indirect effects would include the possibility of natural gas in some communities, and the potential creation of a new borough.		communities, although there could be the possibility of cheaper diesel. For the collocated option, both natural gas and/or diesel could become an option for community energy.			
All Components - Summary	Intensity: Socioeconomic impacts would vary due to increased levels of employment and expenditures in excess of historic limits and trends, with greater increases in employment during the Construction Phase. Employment effects would be particularly elevated within the Y-K region. The intensity of the effects of project payments to state and local governments and ANCSA corporations would be beneficial and range from socioeconomic indicators that are slightly outside normal limits and trends (5-10% increase) to changes well outside normal limits and trends (>10% increase) for the ANCSA landowners. Effects on public infrastructure would be difficult to perceive or measure, and generally within normal limits and trends. Duration: The duration of impacts would extend through Construction and the life of the project during the Operations Phase. Impacts during the Closure Phase would decline relative to the Operations Phase, and would return to pre-project levels, Extent or Scope: The geographic extent of socioeconomic impacts would vary but primarily affect communities throughout the EIS Analysis Area. Context: Direct impacts would affect primarily minority and low-income population given Donlin Gold's commitment to hire qualified Y-K region residents.	The direct and indirect socioeconomic impacts for all phases would be similar to those under Alternative 2. with some exceptions. The decrease in jobs and fuel cost savings that would result from using LNG instead of diesel would be small relative to total project employment and expenditures. Fiscal effects would be similar to those under Alternative 2, except revenues to the City of Unalaska from its property tax would not increase because an increase in tank storage capacity at the Port of Dutch Harbor would probably not be required.	The direct and indirect socioeconomic impacts for all phases would be similar to those under Alternative 2. with some exceptions. The larger workforce and increased expenditures required to construct a diesel pipeline and power mining operations with diesel would more than offset any decreases in employment and expenditures due to reduced diesel shipping, barging, trucking, and storage requirements. Consequently, Alternative 3B would enhance the beneficial direct and indirect employment, income, and sales impacts of the project. Fiscal effects would be similar to those under Alternative 2. except the construction of a new or expanded dock facility and fuel storage in Cook Inlet would enhance the beneficial effects on the KPB. Port Mackenzie Option: Similar to Alternative 3B, except no property tax revenues to KPB. Collocated Pipe Option: Larger labor and materials costs during Construction. Other effects similar to Alternative 3B. Both natural gas and/or diesel could become an option for community energy.	The direct and indirect socioeconomic impacts for all phases would be similar to those under Alternative 2. with some exceptions. The larger workforce required to construct a longer road and truck freight and diesel would more than offset any decreases in employment due to reduced barge crews. Construction of a longer road would increase expenditures. Consequently, Alternative 4 would enhance the beneficial direct and indirect employment, income, and sales impacts during Construction.	The overall direct and indirect socioeconomic impacts would be similar to those under Alternative 2.	The direct and indirect socioeconomic impacts for all phases would be similar to those under Alternative 2. with some exceptions. As a result of the larger workforce and higher expenditures required to construct a pipeline with additional horizontal directional drilling, Alternative 6A would enhance the beneficial direct and indirect employment, income, and sales impacts during Construction.
Section 3.19: Environmental Justice						
Socioeconomics	Construction • Direct jobs, Y-K region: 1,600 to 1,900 (50-59% of total direct jobs) • Direct Payroll, Alaska: $940 million • Direct Expenditures, Alaska: $1.7 billion • ROW Acquisition to state: $1.5 million • ROW Acquisition to ANCSA corps:	Construction • Direct and Indirect Jobs: Similar to Alternative 2 • Direct and Indirect Expenditures: Similar to Alternative 2, except decrease for transportation by tens of millions of dollars	Construction • Direct and Indirect Jobs: Same as Alternative 2, except increase for pipeline. Direct and Indirect Expenditures: Similar to Alternative 2, except • Decrease for Mine Site and transportation by tens of millions of	Construction • Direct and Indirect Jobs: Similar to Alternative 2, except increase for transportation • Direct and Indirect Expenditures: Similar to Alternative 2, except increase for transportation by tens of	Similar to Alternative 2	Construction • Direct and Indirect Jobs: Similar to Alternative 2, except increase for pipeline • Direct and Indirect Expenditures: Similar to Alternative 2, except increase for pipeline

Table 2.3-55: Impact Comparison by Alternative for Chapter 3 Resources

Project Component	Alternative 2 – Proposed Action (includes Alternative 2-North Option)	Alternative 3A – LNG-Powered Haul Trucks	Alternative 3B – Diesel Pipeline (includes Alternative 3B-Port MacKenzie Option and Alternative 3B-Collocated Pipeline Option)	Alternative 4 – BTC Port	Alternative 5A – Dry Stack Tailings (includes Unlined Option and Lined Option)	Alternative 6A – Dalzell Gorge Pipeline Route
	$250,000 Operations • Direct Jobs, Y-K region: 500 to 600 (50-60% of total direct jobs) • Direct Payroll, Alaska: $1.7 billion • Direct Expenditures, Alaska: $9.8 billion • Royalties to Calista (and shared with other ANCSA regional corporations): $55.4 million per year over project life • Royalties to TKC: Not estimated • Lease payments to Calista and Cook Inlet Region Inc.: $250,000 per year over project life • Corporate Income Tax and Mining License Tax to state: $1.24 billion over project life Closure and Reclamation • Total Direct Jobs: 20 to 100 for deconstruction, 6 for about 50 years after mine closure, 6 in perpetuity Potential post-operations employment at other location using skills developed while working at Donlin Gold	Operations • Direct and Indirect Jobs: Similar to Alternative 2, except decrease for transportation. • Direct and Indirect Expenditures: Similar to Alternative 2, except decrease for transportation by tens of millions of dollars. Closure and Reclamation • Similar to Alternative 2.	dollars • Increase for pipeline by hundreds of millions of dollars Operations Direct and Indirect Jobs: Similar to Alternative 2, except. • Decrease for transportation • Increase for pipeline Direct and Indirect Expenditures: Similar to Alternative 2, except • Increase for Mine Site by hundreds of millions of dollars • Decrease for transportation by tens of millions of dollars • Increase for pipeline by tens of millions of dollars Closure and Reclamation • Direct and Indirect Jobs: Similar to Alternative 2, except increase for pipeline Direct and Indirect Expenditures: Similar to Alternative 2	millions of dollars Operations • Direct and Indirect Jobs: Similar to Alternative 2, except increase for transportation by truck and decrease for transportation by barge • Direct and Indirect Expenditures: Similar to Alternative 2, except increase for transportation by less than ten million dollars Closure and Reclamation • Direct and Indirect Jobs: Similar to Alternative 2, except increase for transportation Direct and Indirect Expenditures: Similar to Alternative 2, except increase for transportation		by tens of millions of dollars Operations Similar to Alternative 2 Closure and Reclamation Similar to Alternative 2
Subsistence	Resource abundance : • Mine Site – During Construction and Operations, habitat loss and noise disturbance would affect small portions of available habitat for subsistence resources near the Mine Site and in the Crooked Creek drainage. Disturbance and displacement would largely end in the Closure Phase. • Transportation Facilities – During Construction and Operations, river barge traffic would disrupt subsistence resources along the Kuskokwim River, with greater intensity in narrow and shallow segments. Disturbance would largely cease after Closure. • Pipeline – Disturbance to subsistence resources would occur in a small portion of available habitat during Construction, with limited displacement reduced Operations and Closure. Access: • Mine Site – Crooked Creek and Aniak residents would be displaced during	Similar to Alternative 2, but decreased barging frequency would reduce disturbance to subsistence resources and displacement of subsistence fishing in minority and low-income communities in the narrow reaches of the Kuskokwim River.	Similar to Alternative 2, but decreased barging frequency would reduce disturbance to subsistence resources and displacement of subsistence fishing in minority and low-income communities in the narrow reaches of the Kuskokwim River. Limited impacts would occur to marine mammal subsistence resources from the Tyonek dock expansion. More frequent monitoring flights (26 per year) would add disturbance to wildlife and subsistence uses along the pipeline ROW. Construction-related airstrips would be retained during Operations to support spill response capacity and this would increase the potential for competition where community subsistence use areas overlap with the pipeline ROW. The Port MacKenzie Option would shift impacts for the port away from Tyonek. The Collocated Pipeline Option would increase socioeconomic benefits from greater labor, equipment, and materials required during Construction.	Similar to Alternative 2, but adverse impacts to subsistence fishing in the narrow reaches of the Kuskokwim River above BTC would be eliminated. Displacement of subsistence activities in the vicinity of the mine access road would affect Aniak and Chuathbaluk residents in a small portion of their subsistence use areas.	Similar to Alternative 2. The dry stack tailings could produce more fugitive dust. This may affect subsistence vegetation resources to a greater extent that Alternative 2.	Similar to Alternative 2

Table 2.3-55: Impact Comparison by Alternative for Chapter 3 Resources

Project Component	Alternative 2 – Proposed Action (includes Alternative 2-North Option)	Alternative 3A – LNG-Powered Haul Trucks	Alternative 3B – Diesel Pipeline (includes Alternative 3B-Port MacKenzie Option and Alternative 3B-Collocated Pipeline Option)	Alternative 4 – BTC Port	Alternative 5A – Dry Stack Tailings (includes Unlined Option and Lined Option)	Alternative 6A – Dalzell Gorge Pipeline Route
	Construction and Operations from access to a small portion of their subsistence use areas near the Mine Site and Crooked Creek drainage. With Closure, the disturbance would largely cease, and subsistence uses may be reestablished over time. Bering Sea Coast villages may limit use of migratory waterfowl due to concerns over contamination at mine facilities during all project phases. No impact to other communities. • <u>Transportation Facilities</u> – River barge activity would displace access to subsistence fishing during Construction and Operations, particularly in narrow and shallow segments, such as near Aniak and the Oskawalik River. The displacement would largely cease after Closure. <u>Pipeline</u> – Disturbance during Construction in small portion of available habitat, and reduced disturbance during Operations.					
Human Health	Competition: • <u>Mine Site and Transportation Facilities</u> – Little new competition from non-local mine employees. As an indirect effect of new incomes, renewed in-region competition for moose and salmon, with unpredictable timing and intensity. • <u>Pipeline</u> – Little change for most subregions, however, competition may increase in the vicinity of Farewell Airstrip, affecting subsistence uses of McGrath and Nikolai. Sociocultural impacts: • <u>All components</u> – project related employment and income would have a beneficial effect supporting costs for subsistence equipment and operations. The intensity would be greater during Construction due to the larger workforce. Adverse effects, including out-migration and interruption from shiftwork schedules, would affect about half of project-employed households. At Closure, beneficial effects of income and adverse effects of employment patterns would largely cease. Social Determinants of Health • Beneficial increases in household income, employment, education.	Similar to Alternative 2, except decreased potential for water transport injury, and reduction of hazardous contaminants in the air and surface water, and a reduction of risk from spills.	Similar to Alternative 2, except decreased potential for water transport injury, reduction of hazardous contaminants in the air and water.	Similar to Alternative 2, except increased potential for surface transport injury, increased air contaminants in the vicinity of the roadway, and a reduction in potential subsistence fisheries impacts on the Kuskokwim River.	Similar to Alternative 2. The dry stack tailings could produce more fugitive dust. This may affect subsistence vegetation resources to a greater extent that Alternative 2.	Similar to Alternative 2.

Table 2.3-55: Impact Comparison by Alternative for Chapter 3 Resources

Project Component	Alternative 2 – Proposed Action (includes Alternative 2-North Option)	Alternative 3A – LNG-Powered Haul Trucks	Alternative 3B – Diesel Pipeline (includes Alternative 3B-Port MacKenzie Option and Alternative 3B-Collocated Pipeline Option)	Alternative 4 – BTC Port	Alternative 5A – Dry Stack Tailings (includes Unlined Option and Lined Option)	Alternative 6A – Dalzell Gorge Pipeline Route
	• Adverse psychosocial stressors with possible increased drug and alcohol use and changes in lifestyle and cultural practices. Accidents and Injuries • Potential for water, surface, and air transportation accidents. Exposure to Potentially Hazardous Substances • Potential groundwater contamination (only has a health effect if occurs where used for drinking water). • Fugitive dust could result in elevated concentrations of metal in soils surrounding the Mine Site. • Small changes in mercury concentrations in plants, fish, and wildlife. Food, Nutrition, and Subsistence Activity • Benefits from increases in food security and decreases in regional food costs. • Some potential adverse impacts to subsistence resources, but increased income to facilitate subsistence activities. Infectious Diseases Low magnitude increases in infectious disease possible from employment of workers from outside the region					
Section 3.20: Cultural Resources						
Impact Causing Project Components						
Cultural Resources within the **Mine Site**	Total: 8 • NRHP Eligible: 1 (1 historic cabin) • NRHP Not Eligible: 5 (3 prehistoric sites, 2 historic ditches) • Not Evaluated: 2 (1 prehistoric site, 1 historic cabin)	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Cultural Resources within the **Transportation Corridor**	Total: 1 • NRHP Eligible: 1 (1 prehistoric site)	Same as Alternative 2.	Same as Alternative 2.	Total: 4 • Recommended as NRHP Eligible: 2 (2 prehistoric site) • Not Eligible: 1 (prehistoric lithic scatter) • Not Evaluated: 1 (unable to locate reported	Same as Alternative 2.	Same as Alternative 2.

Table 2.3-55: Impact Comparison by Alternative for Chapter 3 Resources

Project Component	Alternative 2 – Proposed Action (includes Alternative 2-North Option)	Alternative 3A – LNG-Powered Haul Trucks	Alternative 3B – Diesel Pipeline (includes Alternative 3B-Port MacKenzie Option and Alternative 3B-Collocated Pipeline Option)	Alternative 4 – BTC Port	Alternative 5A – Dry Stack Tailings (includes Unlined Option and Lined Option)	Alternative 6A – Dalzell Gorge Pipeline Route
				village location)		
Cultural Resources within the **Pipeline**	Total: 39 • NRHP Eligible: 17 (1 camp, 2 cabins/shelters, 11 prehistoric sites; 3 INHT segments) • NRHP Not Eligible: 21 (18 prehistoric sites, 3 non-cultural,) • Not Evaluated (Treated as eligible): 1 (1 cabin) • Pipeline route had historic and traditional cultural importance. • INHT would cross on 14 occasions, collocated with ROW for 2.5 miles, in proximity (1,000 feet) of the INHT for 14.3 miles, and in the indirect APE for 55.7 miles • North Option: The Pipeline ROW would cross the INHT on 6 occasions; collocated with ROW for 0.2 miles, in proximity to INHT (within 1,000 feet) for approximately 5.3 miles	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Total: 38 (5 sites specific to Alternative 2 and 4 sites specific to Alternative 6A) • NRHP Eligible: 14 (1 camp, 2 cabins/shelters, 8 prehistoric sites; 3 INHT segments) • NRHP Not Eligible: 22 (19 prehistoric sites, 3 non-cultural) • Not Evaluated (Treated as Eligible): 2 (2 cabins) • Pipeline route had historic and traditional cultural importance, same as Alternative 2. • INHT would cross on 37 occasions, collocated with ROW for 9 miles, in proximity for 37.0 miles, and in the indirect APE for 93.7 miles
Direct or Indirect Impacts						
Mine Site	Intensity: Predominantly result in measurable direct impacts to 1 NRHP eligible resource within the Mine Site APE. Impacts to this site would be considered an adverse effect under NHPA; data recovery would be employed to mitigate adverse effect. Duration Resources would be removed from their original locations if the sites cannot be avoided. Resources would not be anticipated to return to previous levels even after actions that caused the impacts were to cease. Extent or Scope: Impacts would affect a single resource in the vicinity of the Mine Site. Context: Affects cultural resources eligible for the NRHP that fill a rare social or cultural role either within the locality or region.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Transportation Corridor	Intensity: Impacts to 1 site recommended as eligible would be considered an adverse effect under NHPA. Consultation performed through the PA and avoidance, minimization or	Same as Alternative 2.	Same as Alternative 2.	Intensity: Result in potential measurable direct impacts to 2 NRHP eligible resources within the transportation facilities. Impacts to	Same as Alternative 2.	Same as Alternative 2.

Table 2.3-55: Impact Comparison by Alternative for Chapter 3 Resources

Project Component	Alternative 2 – Proposed Action (includes Alternative 2-North Option)	Alternative 3A – LNG-Powered Haul Trucks	Alternative 3B – Diesel Pipeline (includes Alternative 3B-Port MacKenzie Option and Alternative 3B-Collocated Pipeline Option)	Alternative 4 – BTC Port	Alternative 5A – Dry Stack Tailings (includes Unlined Option and Lined Option)	Alternative 6A – Dalzell Gorge Pipeline Route
	mitigation measures, as identified in the CRMP could help to mitigate the adverse effect. Through consultation, data recovery could help to mitigate the adverse effect. Duration: Resources would be removed from their original locations if they cannot be avoided. Resources would not be anticipated to return to previous levels even after actions that caused the impacts were to cease. Extent or Scope: Impacts to eligible resources would be limited to discrete portions of the EIS Analysis Area. Impacts to SQRUs associated with the INHT would extend beyond throughout the EIS Analysis Area. Context: Affects cultural resources eligible for the NRHP that fill a rare social or cultural role either within the locality or the region and congressional designation of national historic trail.			these sites would be considered an adverse effect under NHPA. Consultation performed through the PA and avoidance, minimization or mitigation measures, as identified in the CRMP could help to mitigate the adverse effect. Duration: Resources would be removed from their original locations if the sites cannot be avoided. Resources would not be anticipated to return to previous levels even after actions that caused the impacts were to cease. Extent or Scope: Impacts would affect a single resource in the vicinity of the transportation facilities. Context Affects cultural resources eligible for the NRHP that fill a rare social or cultural role either within the locality or region.		
Pipeline	Intensity: Predominantly result in measurable direct and indirect impacts to the INHT (recommended as eligible in NRHP; 3 contributing segments) and 7 NRHP eligible resources within the pipeline APE. Impacts to sites recommended as eligible would be considered an adverse effect under NHPA. Consultation performed through the PA and avoidance, minimization or mitigation measures, as identified in the CRMP could help to mitigate the adverse effect. Duration: Resources would be removed from their original locations if they cannot be avoided. Resources would not be anticipated to return to previous levels even after actions that caused the impacts were to cease. Extent or Scope: Impacts to eligible resources would be limited to discrete portions of the EIS Analysis Area. Impacts to Scenic Quality Rating Units associated with the INHT would extend throughout the EIS Analysis Area. The extent and scope of the effects would be reduced if the North Option were selected. Context: Affects cultural resources eligible for the NRHP that fill a rare social or cultural role either within the locality or the region and congressional designation of national historic trail.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Impacts to INHT would be greater than under Alternative 2.

Table 2.3-55: Impact Comparison by Alternative for Chapter 3 Resources

Project Component	Alternative 2 – Proposed Action (includes Alternative 2-North Option)	Alternative 3A – LNG-Powered Haul Trucks	Alternative 3B – Diesel Pipeline (includes Alternative 3B-Port MacKenzie Option and Alternative 3B-Collocated Pipeline Option)	Alternative 4 – BTC Port	Alternative 5A – Dry Stack Tailings (includes Unlined Option and Lined Option)	Alternative 6A – Dalzell Gorge Pipeline Route
Section 3.21: Subsistence						
Mine Site	During Construction and Operations, disturbance to subsistence resources and displacement of subsistence harvest activities would be limited to small portions of the subsistence use areas of Crooked Creek and Aniak residents for black bear, furbearers, waterfowl, and berries. Bering Sea coast uses of migratory waterfowl would be affected by the perception of contamination at the mine Site (biological analysis indicates this risk is very low). Alternative harvest areas are available at low cost and effort, resulting in little reduction in harvest levels. The project would result in very little direct new competition for subsistence resources, due to policies and the enclave model of development. However, increased employment and incomes may increase subsistence activities and indirectly increase historic forms of competition among regional residents for resources such as Chinook salmon and moose. Sociocultural impacts from project employment and income would include improved support for subsistence equipment and transportation costs, affecting 25-29 percent of EIS Analysis Area households during Construction, and 8-9 percent of households during Operations. Project employment may stabilize employed households, but about half of employed household may migrate out of the EIS Analysis Area. About half of employed households are estimated to see the flexibility of rotating shift work as a benefit, while half would consider this an adverse effect on subsistence activities. After Closure, disturbance to subsistence resources and uses would greatly diminish, as would the sociocultural effects, both beneficial and adverse, from project employment and incomes. The effects would occur primarily during the 31 years of Construction and Operations. The extent of these effects on subsistence resources and uses would focus on Crooked Creek and Aniak, while the effects of competition would extend to the Kuskokwim River, and sociocultural effects would extend to the EIS Analysis Area, with greater concentration among the Central Kuskokwim River villages near the Mine Site.	Same as Alternative 2, because Mine Site footprint and level of activity remain the same.	Same as Alternative 2, because the Mine Site footprint and level of activity would remain the same.	Same as Alternative 2 because the alternative affects the mine access road, addressed under Transportation Corridor, while the Mine Site footprint and level of activity would remain the same.	Generally the same as Alternative 2 because the alternative affects the tailings management at the Mine Site. In the TSF, the Unlined Option would have 2463 acres of vegetation removed (71.6 more than Alternative 2); the Lined Option would have 2753.5 acres removed (362.5 more compared to Alternative 2). (2391.4 would be removed in the TSF in Alternative 2). The risk of potential dam failure and downstream release of slurry materials to Anaconda and Crooked creeks would be reduced from Alternative 2 while the general level of activity would remain the same.	Same as Alternative 2 because the alternative affects the Pipeline component, while the Mine Site footprint and level of activity would remain the same.

Table 2.3-55: Impact Comparison by Alternative for Chapter 3 Resources

Project Component	Alternative 2 – Proposed Action (includes Alternative 2-North Option)	Alternative 3A – LNG-Powered Haul Trucks	Alternative 3B – Diesel Pipeline (includes Alternative 3B-Port MacKenzie Option and Alternative 3B-Collocated Pipeline Option)	Alternative 4 – BTC Port	Alternative 5A – Dry Stack Tailings (includes Unlined Option and Lined Option)	Alternative 6A – Dalzell Gorge Pipeline Route
	The context of these affects would generally include resources that are common and widely available, with Chinook salmon and moose the focus of urgent conservation measures in recent years. Migratory waterfowl are protected by the Migratory Bird Treaty Act, and subsistence practices are recognized in the rural subsistence priority of Title VIII of ANILCA. Operation of the mine could result in exposure to mercury, arsenic, and antimony through stack emissions and fugitive dust through the consumption of subsistence foods harvested in the vicinity of the mine. A Human Health Risk Assessment (HHRA) concluded that within a 20-mile radius of the mine, consumption of subsistence resources with the potential to accumulate methyl mercury (northern pike, beaver, mallard, and berries), there could be increased exposure of Crooked Creek residents to mercury. The results of the analysis concluded that within a 20-mile radius of the mine site, exposure to mercury at baseline and estimated project levels would be below the advisory levels of both the Environmental Protection Agency (EPA) and State of Alaska Environmental Public Health Program. For arsenic, exposure at baseline and estimated project levels are within EPA's acceptable risk management range. The findings of the quantitative HHRA indicated that the small increases in constituent concentrations estimated to occur outside of the Mine Site due to Project-related activities are unlikely to result in unacceptable risks to human populations who would have the highest exposure (i.e., subsistence populations). Based on these findings, other human populations, such as residents in the region, would not be expected to be exposed to unacceptable risk due to exposure to Project-related concentrations of mercury, arsenic, or antimony.					

Table 2.3-55: Impact Comparison by Alternative for Chapter 3 Resources

Project Component	Alternative 2 – Proposed Action (includes Alternative 2-North Option)	Alternative 3A – LNG-Powered Haul Trucks	Alternative 3B – Diesel Pipeline (includes Alternative 3B-Port MacKenzie Option and Alternative 3B-Collocated Pipeline Option)	Alternative 4 – BTC Port	Alternative 5A – Dry Stack Tailings (includes Unlined Option and Lined Option)	Alternative 6A – Dalzell Gorge Pipeline Route
Transportation Corridor	During Construction and Operations, subsistence resources would be affected by habitat loss in small acreages associated with the port sites, airstrip and mine access road. Limited disturbance from river and ocean barge traffic would affect fish, birds, marine mammals, and terrestrial mammals, with greater effects in the narrow and shallow segments of the river, such as near Aniak and the Oskawalik River. Fugitive dust from vehicle traffic would affect berry resources along the mine access road. Subsistence activities near the mine access road and Angyaruaq/Jungjuk port site would be displaced, affecting residents of Crooked Creek and other Kuskokwim River villages. River barge traffic would intermittently disturb subsistence fishing and moose hunting along the bank, with greater displacement in narrow and shallow segments of the Kuskokwim River near Birch Tree Crossing, Aniak, and Oskawalik River. Redirection to alternative times and place at low expense and effort would result in little change in harvest levels. Effects on competition and sociocultural features of subsistence would be the same as at the Mine Site. Duration, extent, and context would be the same as at the Mine Site.	River barge frequency would be reduced from 122 barge tow round trips under Alternative 2 to 83 under Alternative 3A, due to reduced diesel fuel barging. This would reduce the intensity of impacts to subsistence fish resources and fishing activity, particularly in the narrow and shallow segment of the Kuskokwim River. The estimated average interval between barges would be 12-24 hours, compared to 8 hours under Alternative 2. Redirection to alternative times and place at low expense and effort would result in little change in harvest levels. Effects on other impact assessment factors would be the same as Alternative 2.	River barge frequency would be reduced from 122 barge tow round trips under Alternative 2 to 64 under Alternative 3B, due to elimination of fuel barging. This would reduce the intensity of impacts to subsistence fish resources and fishing activity, particularly in the narrow and shallow segments of the Kuskokwim River. The estimated interval between barges would be 16-24 hours, compared to 8 hours under Alternative 2. Redirection to alternative times and place at low expense and effort would result in little change in harvest levels. The expanded dock near Tyonek to receive diesel tankers would result in small intensity impacts to marine mammals, including beluga whales, because the occurrence of marine mammals in that area is low. Effects on other impact assessment factors would be the same as Alternative 2.	Barging distance would be reduced from 199 river miles to 124 under Alternative 4, avoiding the narrow and shallow segments upstream of Birch Tree Crossing, and reducing potential conflicts with subsistence fishing. The mine access road would increase from 30 miles to 76 miles under this alternative, affecting moose, black bear, waterfowl, and berry picking areas for Aniak and Chuathbaluk residents. Impacts to subsistence fishing would be reduced while habitat loss and disturbance from the mine access road would increase. Redirection to alternative times and place at low expense and effort would result in little change in harvest levels. Effects on other impact assessment factors would be the same as Alternative 2.	Same as Alternative 2, as this alternative would not change the Transportation Corridor component.	Same as Alternative 2, as this alternative would not change the Transportation Corridor component.
Pipeline	During the 2.5 years of Construction, 14,100 acres of habitat would be affected along the 316-mile pipeline corridor. Construction activities and noise would affect subsistence resources beyond the pipeline corridor, but would be unlikely to result in reduced abundance. During Operations, the pipeline would be buried, with limited above ground facilities, and temporary construction facilities would be stabilized, recontoured and reclaimed. The ROW would not be fenced, but vegetation in the ROW would be cleared every 10 years to allow for maintenance and visual monitoring. Little effect on resource abundance is expected. After Closure, the brushing of the corridor would cease. The Pipeline corridor overlaps with portions of the subsistence use areas of Crooked Creek, Stony River, McGrath, Nikolai, Skwentna, and Tyonek. Displacement would be greater during Construction and very limited during Operations and Closure. The ROW affects small portions of these subsistence use areas, and alternative areas would be available at low cost and effect,	Same as Alternative 2, as this alternative would not affect the pipeline component.	Same as Alternative 2, except that retention of airstrips and gravel access roads during operations for spill response capacity would result in greater intensity of competition impacts to Beluga, McGrath, Nikolai, Takotna, Central Kuskokwim villages and Crooked Creek compared to Alternative 2. In addition, operation of the diesel pipeline would require twice monthly helicopter surveillance of the entire pipeline for the operational life. Helicopter overflights could disturb wildlife and interfere with subsistence hunting activity along the pipeline.	Same as Alternative 2, as this alternative would not change the Pipeline component.	Same as Alternative 2, as this alternative would not affect the Pipeline component.	The alternative route segment alternatives would affect other resources, but not subsistence practices.

Table 2.3-55: Impact Comparison by Alternative for Chapter 3 Resources

Project Component	Alternative 2 – Proposed Action (includes Alternative 2-North Option)	Alternative 3A – LNG-Powered Haul Trucks	Alternative 3B – Diesel Pipeline (includes Alternative 3B-Port MacKenzie Option and Alternative 3B-Collocated Pipeline Option)	Alternative 4 – BTC Port	Alternative 5A – Dry Stack Tailings (includes Unlined Option and Lined Option)	Alternative 6A – Dalzell Gorge Pipeline Route
	resulting in little change to harvest levels. Increased access for fly-in hunters and trappers at Farewell Airstrip and the ROW to the north and west may lead to a small increase in competition for McGrath and Nikolai subsistence users. For all other impact assessment factors, the effects would be the same at the Mine Site.					
Section 3.22: Human Health						
HEC 1: Social Determinants of Health:	Increases in household incomes, employment rates, and education attainment could result in an improvement to the overall health and well-being of residents. The potential impacts of psychosocial stressors, such as high unemployment, low income, low education attainment, outward population migration, and rural isolation could be lessened by the potential for increased economic opportunities. There is also the potential for increases in psychosocial stress, related to fear of changes in lifestyle and cultural practices, impact to natural resources (e.g., soil, air, groundwater, and surface water), and food security and quality. Increases or decreases in substance abuse (drug and alcohol consumption) rates could occur. The overall impact for HEC 1: Social Determinants of Health is rated Category 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
HEC 2: Accidents and Injuries:	The summary impact of accidents and injuries is rated Category 2. The accidents and injuries discussed in this section are generally considered to be events with low probability of occurrence, but high consequence if they did occur. The summary impact level (considering the combined ratings for the three phases) is rated Category 2, acknowledging a lower level of estimated impact associated with surface transportation.	Decreased potential for water transport accidents.	Decreased potential for water transport accidents.	Potential for accidents and injuries decreased for water transport, but same as Alternative 2 for surface transport.	Same as Alternative 2.	Same as Alternative 2.
HEC 3: Exposure to Potentially Hazardous Materials:	Effects to human health related to groundwater quality would occur only if project-related contamination were to migrate out to where groundwater usage may be occurring. The principal mechanisms responsible for effects to groundwater quality at the Mine Site would be inputs of seepage from the WRF and TSF to shallow groundwater resources underneath and immediately adjacent to the WRF, and the discharge of water from the pit to the	Decreased emission loads, reducing the overall quantity of hazardous contaminants in the air, and surface water.	Decreased impacts on air quality, water quality and biota in the Kuskokwim River, due to the reduction in barge traffic.	Impacts to air quality may increase in the vicinity of the additional section of surface roadway, but would remain low.	Same as Alternative 2.	Same as Alternative 2.

Table 2.3-55: Impact Comparison by Alternative for Chapter 3 Resources

Project Component	Alternative 2 – Proposed Action (includes Alternative 2-North Option)	Alternative 3A – LNG-Powered Haul Trucks	Alternative 3B – Diesel Pipeline (includes Alternative 3B-Port MacKenzie Option and Alternative 3B-Collocated Pipeline Option)	Alternative 4 – BTC Port	Alternative 5A – Dry Stack Tailings (includes Unlined Option and Lined Option)	Alternative 6A – Dalzell Gorge Pipeline Route
	surrounding deep bedrock groundwater. Groundwater that could potentially be contaminated by inputs of WRF seepage would flow towards the pit, and the spatial extent of the impacts would be limited because the contaminated groundwater would be intercepted by the pit and the pit dewatering system. Similarly, seepage and leakage from the TSF would be captured, contained, and treated, and impacts to groundwater would be minimized. Fugitive dust generated during Mine Site Construction (pre-production) and Operations could potentially result in elevated concentrations of metals in soils surrounding the Mine Site over time through dust deposition. Given the low predicted overall increase in mercury content in soil and sediment and lack of large change anticipated for methylmercury production rates, potential changes in mercury concentrations in plants, fish, and wildlife as result of the Donlin Gold Project were predicted to be small. The summary impact level for exposure to potentially hazardous materials is rated Category 1 for all project components and all project phases.					
HEC 4: Food, Nutrition, and Subsistence Activity:	Impacts would result from increases in economic opportunities, increase in the median household incomes, decreases in regional food costs, and an increase in food security. Low levels of adverse impacts could result from changes in access to and/or quantity of subsistence resources in the region could occur as a result of changes in employment (population outward migration), the fly-in, fly-out work rotations of the workforce, and overlap of subsistence resources and uses in the vicinity of project components. Alternative 2 is rated Category 2 for potential health benefits due to decreased regional food costs, and Category 3 for increased food security (resulting from potential increases in median household incomes). This alternative is rated Category 1 for impacts (adverse) due to a potential for decreased access to and/or quantity of subsistence resources.	Reduced impacts to fish and subsistence fishing due to reduced barging.	Reduced impacts to fish and subsistence fishing due to reduced barging.	Impacts to subsistence fisheries reduced, increased potential for displacement of terrestrial wildlife.	Same as Alternative 2.	Same as Alternative 2.
HEC 5: Infectious Diseases:	Increases in infectious disease rates could occur due to employment of workers from outside the region and/or the rotation of the	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.

Table 2.3-55: Impact Comparison by Alternative for Chapter 3 Resources

Project Component	Alternative 2 – Proposed Action (includes Alternative 2-North Option)	Alternative 3A – LNG-Powered Haul Trucks	Alternative 3B – Diesel Pipeline (includes Alternative 3B-Port MacKenzie Option and Alternative 3B-Collocated Pipeline Option)	Alternative 4 – BTC Port	Alternative 5A – Dry Stack Tailings (includes Unlined Option and Lined Option)	Alternative 6A – Dalzell Gorge Pipeline Route
	workforce. The summary impact for increases in rates of infectious (communicable) diseases (e.g., STIs, influenza, pneumonia, and foodborne illnesses) is rated Category 1 for Alternative 2, acknowledging a potential Category 2 rating for the Construction Phase for the transportation and pipeline components.					
HEC 6: Water and Sanitation:	Impacts to the availability and quality of water and sanitation services of the potentially affected communities are considered unlikely. The summary impact level for increases in morbidity and mortality rates due to changes in the availability and quality of water and sanitation services is rated Category 1 for Alternative 2. It is very unlikely that water and sanitation services of communities located near the Donlin Gold Project would be affected.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
HEC 7: Non-communicable and chronic diseases:	Increased cancer, respiratory, and cardiovascular morbidity and mortality rates due to increased exposure to hazardous air pollutants is considered unlikely. The summary impact level for increased morbidity and mortality rates for cancer, respiratory, and cardiovascular diseases is rated Category 1 for Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
HEC 8: Health Services Infrastructure and Capacity:	Under routine conditions, decreased access to healthcare services is rated Category 1. Under emergency situations, the summary impact is rated Category 2 with potential to overwhelm health care capacities. Alternative 2 is rated Category 2for overwhelming regional healthcare capacities under emergency situations. The emergency situations are generally considered to be events with low probability of occurrence.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Section 3.23: Transportation						
Impact Causing Project Components						
Mine Site	Primitive trails affected – 9 miles	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Transportation Corridor	**Surface Transportation** Road constructed – 30 miles **Water Transportation** Marine barges (cargo) to Bethel per season • 16 barges (Construction) • 12 barges (Operations)	**Surface Transportation** Same as Alternative 2. **Water Transportation** Marine barges (cargo) to Bethel per season • Same as Alternative 2.	**Surface Transportation** Same as Alternative 2. **Water Transportation** Marine barges (cargo) to Bethel per season • Same as Alternative 2.	**Surface Transportation** Road constructed – 76 miles **Water Transportation** Marine barges (cargo) to Bethel per season • Same as Alternative 2.	Same as Alternative 2 except for seven additional cargo barge round trips per year.	Same as Alternative 2.

Table 2.3-55: Impact Comparison by Alternative for Chapter 3 Resources

Project Component	Alternative 2 – Proposed Action (includes Alternative 2-North Option)	Alternative 3A – LNG-Powered Haul Trucks	Alternative 3B – Diesel Pipeline (includes Alternative 3B-Port MacKenzie Option and Alternative 3B-Collocated Pipeline Option)	Alternative 4 – BTC Port	Alternative 5A – Dry Stack Tailings (includes Unlined Option and Lined Option)	Alternative 6A – Dalzell Gorge Pipeline Route
	Marine barges (fuel) to Bethel per season • 14 barges (Construction) • 14 barges (Operations) Marine barges (fuel) to Dutch Harbor per season • 4 barges (Construction) • 7 barges (Operations) Kuskokwim River barging distance – 199 miles River barges (cargo) from Bethel to Angyaruaq (Jungjuk) Port site per season • 50 barges (Construction) • 64 barges (Operations) River barges (fuel) from Bethel to Angyaruaq (Jungjuk) Port site per season • 19 barges (Construction) • 58 barges (Operations) **Air Transportation** *Construction:* Annual Operations at Mine Airstrip of Fixed Wing Aircraft: 5,148 *Operations:* Annual Operations at Mine Airstrip of Fixed Wing Aircraft: 1,716	Marine barges (fuel) to Bethel per season • 14 barges (Construction) • 5 barges (Operations) Marine barges (fuel) to Dutch Harbor per season • 4 barges (Construction) • 2 barges (Operations) River barges (cargo) from Bethel to Angyaruaq (Jungjuk) Port site per season • Same as Alternative 2. River barges (fuel) from Bethel to Angyaruaq (Jungjuk) Port site per season • 19 barges (Construction) • 19 barges (Operations) **Air Transportation** Same as Alternative 2.	Marine barges (fuel) to Bethel per season • 14 barges (Construction) • 0 barges (Operations) Marine barges (fuel) to Dutch Harbor per season • 4 barges (Construction) • 0 barges (Operations) River barges (cargo) from Bethel to Angyaruaq (Jungjuk) Port site per season • Same as Alternative 2. River barges (fuel) from Bethel to Angyaruaq (Jungjuk) Port site per season • 19 barges (Construction) • 0 barges (Operations) **Air Transportation** Same as Alternative 2.	Marine barges • Same as Alternative 2. River barges • Same as Alternative 2. Kuskokwim River barging distance – 124 miles **Air Transportation** Same as Alternative 2.		
Pipeline	**Surface Transportation** Winter access routes – 58 miles **Water Transportation** • River barges (pipe and equipment) from Bethel to Angyaruaq (Jungjuk) Port site per season: 20 (Construction, first year) **Air Transportation** Existing airports to be upgraded: 3 airports Temporary airstrips to be constructed: 9 Helicopter overflights per year: 24 flights (Operations)	Same as Alternative 2.	**Water Transportation** Marine barge (fuel) trips per year in the Cook Inlet: 24 **Air Transportation** Same as Alternative 2, except for the addition of three new proposed airstrips; Rainy Pass Lodge, Tatlawiksuk, and George River airstrips.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Direct or Indirect Impacts						
Mine Site	Few intermittent users (e.g., snowmachines and dog teams) would be affected by the removal of trails at the Mine Site.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Transportation Corridor	Increase in barge traffic between the Bethel and Angyaruaq (Jungjuk) ports would impair existing travel patterns by delaying or displacing small boat traffic from preferred routing	Reduction in barge trips and less on-site diesel storage due to a large increase in barge traffic relative the existing baseline conditions.	Smaller increase in barge traffic. Less on-site diesel storage would be needed.	The mine access road would be 46 miles longer than Alternative 2 and would impact surface transportation, For barge transportation, reduced	Same as Alternative 2.	Same as Alternative 2.

Table 2.3-55: Impact Comparison by Alternative for Chapter 3 Resources

Project Component	Alternative 2 – Proposed Action (includes Alternative 2-North Option)	Alternative 3A – LNG-Powered Haul Trucks	Alternative 3B – Diesel Pipeline (includes Alternative 3B-Port MacKenzie Option and Alternative 3B-Collocated Pipeline Option)	Alternative 4 – BTC Port	Alternative 5A – Dry Stack Tailings (includes Unlined Option and Lined Option)	Alternative 6A – Dalzell Gorge Pipeline Route
	Increase in barge receipts at the Port of Bethel would displace other uses, but would be offset by the additional barge, cargo and fuel capacity constructed at the port.			disturbance and displacement of other uses, relative to Alternative 2.		
Pipeline	Disturbance or displacement of existing transportation uses from the increase in trips for surface, air, and water transportation.	Same as Alternative 2.	Impacts to water transportation in Cook Inlet would occur since the new marine transport would not change or exceed capacity.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Section 3.24: Spill Risk						
All Components	*Diesel:* High probability of a less than 10 gallon spill and a very low probability of a spill over 100,000 gallons. *LNG*: No risk *Cyanide*: The likelihood of a spill is very low. *Mercury*: A release would have a low or very low probability. *Dam Tailings*: A partial unplanned release of tailings and water from the TSF would have a very low probability of a very high volume of material release.	*Diesel:* Same as Alternative 2. *LNG*: High probability of a release less than 10 gallons, and a release over 50,000 gallons would be very low or would not occur. *Cyanide*: Same as Alternative 2. *Mercury*: Same as Alternative 2. *Dam Tailings*: Same as Alternative 2.	*Diesel:* Same as Alternative 2 except pill risk along the Transportation Corridor would be eliminated during Operations. *LNG*: Same as Alternative 2. *Cyanide*: Same as Alternative 2. *Mercury*: Same as Alternative 2. *Dam Tailings*: Same as Alternative 2.	*Diesel:* Same as Alternative 2, with slightly increased risk of land spills, and slightly decreased risk of transportation corridor spills. *LNG*: Same as Alternative 2. *Cyanide*: Same as Alternative 2. *Mercury*: Same as Alternative 2. *Dam Tailings*: Same as Alternative 2.	*Diesel:* Same as Alternative 2. *LNG*: Same as Alternative 2. *Cyanide*: Same as Alternative 2. *Mercury*: Same as Alternative 2. *Dam Tailings*: The risk of a release of a combined tailings and process affected water release would be eliminated and the risk of release of process affected water would remain.	*Diesel:* Same as Alternative 2. *LNG*: Same as Alternative 2. *Cyanide*: Same as Alternative 2. *Mercury*: Same as Alternative 2. *Dam Tailings*: Same as Alternative 2.
Section 3.25: Pipeline Reliability						
Pipeline	Risk to the public is evaluated in Section 3.25 rather than impact effects for the pipeline component. With natural gas pipeline construction, there would be a slight increase in risk to the nearby public. Pipeline location is remote, away from high consequence areas (HCAs), further minimizing risk to the public. No risk factors identified that would support public safety risks higher than current industry experience in terms of anticipated number of severity of incidents.	Same as Alternative 2.	Risks from a diesel pipeline could be similar but different from natural gas pipelines, and would be subject to alternative oversight and regulation'	Same as Alternative 2.	Same as Alternative 2.	The alternative pipeline route would not change public safety risk. Same as Alternative 2.
Section 3.26: Climate Change						
Impacts to Atmosphere	GHG emissions would represent at most 4% of state of Alaska emissions in 2010. Impacts would last the life of the project, with GHG emissions occurring throughout the duration of the project	Approximately 28% reduction in GHG emissions from haul trucks, based on the number of fewer haul truck trips required compared to Alternative 2.	Anticipated to have higher GHG emissions; however, impacts would be similar to Alternative 2.	GHG emissions not substantially different than Alternative 2.	Anticipated to have approximately 3% GHG emissions as compared to Alternative 2,	GHG emissions not substantially different than Alternative 2.
Impacts to Water Resources	Climate effects may or may not be discernable beyond predicted extremes. Hydrologic designs would meet state guidelines and would be	Less potential for low water barge impacts (fewer trips needed). Other impacts would be the same as	Slightly less effects along Transportation Corridor (fewer barge trips); slightly more effects along Pipeline component (more	Less potential for low water barge effects. Other impacts would be the same as Alternative 2.	Flexible mine water management and design of operating pond would be able	Potential for slightly higher climate-caused precipitation and aufeis

Table 2.3-55: Impact Comparison by Alternative for Chapter 3 Resources

Project Component	Alternative 2 – Proposed Action (includes Alternative 2-North Option)	Alternative 3A – LNG-Powered Haul Trucks	Alternative 3B – Diesel Pipeline (includes Alternative 3B-Port MacKenzie Option and Alternative 3B-Collocated Pipeline Option)	Alternative 4 – BTC Port	Alternative 5A – Dry Stack Tailings (includes Unlined Option and Lined Option)	Alternative 6A – Dalzell Gorge Pipeline Route
	adequate to accommodate climate change effects. Water management and treatment strategies would accommodate potential long-term precipitation trends.	Alternative 2.	stream crossings subject to climate effects). Other impacts would be the same as Alternative 2.		to accommodate climate-caused precipitation changes. Other impacts would be the same as Alternative 2.	effects. Other impacts would be the same as Alternative 2.
Impacts to Permafrost	Slightly more climate change effects on Transportation Corridor (Bethel Dock, a connected action) and Pipeline ROW than from project-induced thaw. Climate change would not add to project-induced effects at the Mine Site, but could affect intermittent areas of permafrost not impacted by project activities. Small beneficial effects (preservation of remaining permafrost) could occur in some areas following reclamation.	Same as Alternative 2. While there could be a slight increase in the effects of climate change on permafrost thaw at the Bethel Dock, the increase would be relatively small compared to the project as a whole.	Same as Alternative 2.	Slightly more climate-caused effects along Crooked Creek winter road and Bethel Dock (a connected action). Other impacts would be the same as Alternative 2.	Slight increases in permafrost impacts, but overall impacts would be the same as Alternative 2.	Same as Alternative 2.
Impacts to Biological Resources	Effects on biological resources (primarily vegetation and wetlands) would be incremental and include changes in vegetation community types or shifts in use patterns by wildlife, with changes tied to broad regional landscape shifts in vegetation type at the biome level, or large-scale fire regime changes.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.
Impacts to Subsistence	Subsistence losses to coastal and riverine communities may occur as traditional harvest species change relative location and abundance. Effects would be incremental.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.	Same as Alternative 2.

Notes:

1 Total includes only pipeline direct construction impacts; all pipeline operation wetland impacts areas are also included within construction impact areas.

2 Total includes only potential Mine Site and Transportation Corridor indirect impacts from dust; many of the Mine Site drawdown indirect impact areas would also be affected by dust generated at the Mine Site.

2.4 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED ANALYSIS

The alternative options eliminated from further analysis are presented in tables organized by the major elements of the proposed project:

2.4.1 Eliminated Mine Site Options (Table 2.4-1);

2.4.2 Eliminated Transportation Options (Table 2.4-2);

2.4.3 Eliminated Power Generation Options (Table 2.4-3); and

2.4.4 Eliminated Pipeline Options (Table 2.4-4).

The tables provide a short description of each option that was considered and dismissed. Appendix C includes tables that explain why options were considered and provides the rationale for the elimination of each option. All options carried forward are described in Sections 2.3.2 through 2.3.7 above.

Overall, few options were eliminated because they did not meet the screening test for Purpose and Need. The technical and economic feasibility (including logistics in some cases) were evaluated carefully, and these factors were more often the basis for eliminating options. Environmental impacts were assessed at a screening level; some options were eliminated because they would not reduce environmental impacts when compared with the corresponding components of the proposed project. Others were not carried forward as options because they were more properly characterized as potential mitigating measures. Mitigation measures are addressed in Chapter 5, Impact Avoidance, Minimization, and Mitigation.

2.4.1 ELIMINATED MINE SITE OPTIONS

Mine Site options eliminated from further analysis are presented in Table 2.4-1.

Table 2.4-1: Mine Site Options Eliminated from Detailed Consideration

Option No.	Option Description
MS-2	Extracting ore by underground mining techniques only (including block caving)
MS-3	Extracting ore by a combination of surface and underground mining techniques
MS-4	Option for altered pit design: flatten pit walls in order to improve stability
MS-5	Grouting the pit-walls and floor to control pit wall/floor infiltration of groundwater
MS-7	Allowing surface-water runoff to enter the pit
MS-9	Using only diesel shovels as loading equipment at the Mine Site
MS-11	Using a trolley-assist system as hauling equipment at the Mine Site
MS-12	Using a conveyor system as hauling equipment at the Mine Site
MS-15	Processing ore by heap leaching. In the heap leaching process, gold is extracted by direct cyanidation of crushed ore placed on a lined pad where the gold-containing solution is percolated through the heap by gravity flow and is collected and further processed to create a final doré product.
MS-17	Off-site concentration - transporting flotation concentrate offsite and further processed to recover gold.

Table 2.4-1: Mine Site Options Eliminated from Detailed Consideration

Option No.	Option Description
MS-20	On-site processing by roasting - oxidizing ground ore in the roasting process, to convert sulfide mineralization to oxides, which are more suitable for carbon-in-leach (CIL) extraction.
MS-21	On-site biological oxidation - using microorganisms to oxidize sulfides in the concentrated ore, allowing gold to be more efficiently removed during the CIL process.
MS-22	Using whole ore instead of concentrate in the pressure oxidation (POX) process
MS-25	Using thiosulfate for chemical extraction - This technology uses calcium thiosulfate (with the addition of ammonia and cupric ion) to extract gold.
MS-26	Using thiourea for chemical extraction
MS-27	Using bromine for chemical extraction
MS-28	Using a combination of cyanide and other extracting chemicals
MS-29	Locating processing plant on Lower American Ridge
MS-31	Extracting 20,000 tons of ore per day
MS-32	Extracting 30,000 tons of ore per day
MS-34	Extracting 75,000 tons of ore per day
MS-35	Extracting 100,000 tons of ore per day
MS-37	Reducing length, number and vulnerability of process pipelines (design mitigation)
MS-39	Water Treatment: Increasing tank capacity by 50%
MS-40	Water Treatment: Increasing pumping capacity by 50%
MS-41	Water Treatment: Adding backup power supply
MS-42	Zero discharge – Keeping all waste water on site.
MS-43	Treatment and Discharge of Pit Dewatering and Storage/Use/Reuse of Process and Contact Water
MS-44	Treatment and Discharge of all Water
MS-45a	Using alternatives to the Octolig columns for treatment for selenium
MS-50	On-site mercury disposal – building and permitting a small hazardous waste landfill on site for mercury-containing wastes
MS-51	On-site mercury recycling – building a mercury recovery/refining/ recycling facility on-site to recover mercury from mercury-loaded carbon
MS-53	Transporting mercury by air to federally regulated storage facility
MS-54	Using an off-site mercury recycling facility
MS-56	Using Cyanochlor for cyanide neutralization
MS-57	Having on-site segregation and disposal of cyanide-containing waste
MS-58	Tailings Storage: Segregated
MS-60	Neutralizing potentially acid-generating (PAG) waste rock by placing in the TSF.
MS-60a	Neutralizing PAG waste rock by placing in the completed pit.
MS-61	Chemical management at the TSF to segregate arsenic-containing tailings for separate handling - In this option the tailings stream would be chemically segregated and the arsenic containing portion would be disposed of separately.

Table 2.4-1: Mine Site Options Eliminated from Detailed Consideration

Option No.	Option Description
MS-62	Chemical management at the TSF, treating tailings stream with a buffering agent (lime) and/or stabilizing agents (fly-ash, cement)
MS-63a	Use the dry stack method in the summer and subaqueous in the winter.
MS-64	Paste (thickened) tailings
MS-66	Unlined TSF - In this option, only the dam wall of the TSF would be lined.
MS-68	Double-lined TSF
MS-69	High-performance liner
MS-69a	TSF liner design of a prepared surface topped with a layer of clay, overlain by a permeable layer to provide leak detection, topped with a synthetic liner
MS-71	Secondary dam downstream from TSF
MS-72	Designing the TSF with multiple cells in an upstream to downstream sequence
MS-73	Flattening TSF side slopes
MS-74	Improvement of TSF foundation soils
MS-75	Comingling WRF and TSF
MS-75a	Blending PAG 6 into the WRF instead of placing in isolated PAG 6 cells.
MS-75b	Installing a liner under the WRF
MS-75c	Using a high permeability layer underneath the soil layer could also help minimize the amount of water infiltrating the waste rock
MS-78	TSF: Anaconda Creek Valley (single TSF) WRF: American Creek Valley (in WRF), Anaconda Creek Valley (in TSF)
MS-79	TSF: Anaconda Creek Valley (single TSF) WRF: American Creek Valley (2 WRF), Anaconda Creek Valley (in TSF)
MS-80	TSF: Lower American Creek Valley (single TSF) WRF: American Creek Valley (in WRF), ACMA Pit
MS-81	TSF: Upper American Creek Valley (single TSF) WRF: American Creek Valley (in WRF) ACMA Pit
MS-82	TSF: American Creek Valley (CIL/POX tailings), Anaconda Creek Valley (flotation tailings) WRF: American Creek Valley (in WRF) ACMA Pit
MS-83	TSF: Anaconda Creek Valley (CIL/POX tailings cell, and flotation tailings in cell in single TSF) WRF: American Creek Valley (in WRF) ACMA Pit
MS-84	TSF: American Creek Valley (CIL/POX tailings cell, and flotation tailings in cell in single TSF) WRF: American Creek Valley (in WRF)
MS-85	TSF: American Creek Valley (CIL/POX tailings), Anaconda Creek Valley (flotation tailings) WRF: American Creek Valley (in WRF), Anaconda Creek Valley (in TSF)
MS-86	TSF: American Creek Valley (years 1-5 production) WRF: American Creek Valley (in WRF), Snow Creek Valley (in TSF)
MS-87	TSF: Snow Creek Valley (single TSF) WRF: American Creek Valley

Table 2.4-1: Mine Site Options Eliminated from Detailed Consideration

Option No.	Option Description
MS-88	Decommission and remove all mine infrastructure at Closure
MS-90	Decommissioning pit with full pit backfill - The pit would be completely backfilled with waste rock, and no pit-lake would form.
MS-92	Decommissioning pit without any backfill - The pit would not be filled with waste rock at all, causing it to fill with water and create a larger pit-lake than Alternative 2.
MS-92a	Decommissioning pit without backfill of PAG waste rock, TSF water, or drainage/seepage from the WRF.
MS-94	Using wet closure for the TSF
MS-96	Closing TSF by moving all tailings to the pit
MS-97	Self-buffering tailings closure, involving a lime-rich cover layer over the TSF
MS-98	Lined cover cap
MS-100	Using a cover allowing run-on of surface water
MS-102	Using a hard cover with no revegetation for the Mine Site - create a final cover that includes crushed rock to provide erosion protection, with minimal or no revegetation
MS-105	Creating a hard closure cover for TSF which does not encourage human or wildlife access
MS-107	Remote-sensing monitoring

Notes:

CIL = carbon-in-leach
MS = Mine Site
PAG = potentially acid-generating
POX = pressure oxidation
TSF = tailings storage facility
WRF = waste rock facility

2.4.2 ELIMINATED TRANSPORTATION OPTIONS

Transportation options eliminated from further analysis are presented in Table 2.4-2.

Table 2.4-2: Transportation Options Eliminated from Detailed Consideration

Option No.	Option Description
TI-2	Alternative design of the Dutch Harbor cargo & fuel terminals.
TI-4	Bethel Location #2
TI-5	Bethel Location #3
TI-6	Provide a floating port located in Bethel or in the Bering Sea at mouth of the Kuskokwim River.
TI-8	Place the down river port on Fowler Island.
TI-9	Place the down river port at Johnson Crossing.
TI-10	Place the down river port in Goodnews Bay.
TI-11	Place the down river port at Eek Island.
TI-12	Place the down river port in Security Cove.

Table 2.4-2: Transportation Options Eliminated from Detailed Consideration

Option No.	Option Description
TI-13	Place the down river port in Akiachak.
TI-14	Place the down river port in Napakiak.
TI-17	Use air transport for mining equipment and consumables.
TI-19	Air transport of diesel fuel with the Bulk Aviation Transport Tank.
TI-20	Air transport of diesel fuel by a commercial aircraft equipped with fuel storage capabilities.
TI-22	Build a railroad from Bethel to the Mine Site for cargo and fuel transportation.
TI-23	Build a road from Bethel to the Mine Site
TI-24	Build a road from Dillingham (Nushagak) to the Mine Site for cargo and fuel transportation.
TI-25	Build a road from Nenana to the Mine Site for cargo and fuel transportation.
TI-26	Build a road from Cook Inlet to the Mine Site for cargo and fuel transportation.
TI-27	Roadless year round transport from Dillingham to the Mine Site for cargo and fuel transportation using Rolligons, an all-purpose, all-terrain, tractor-trailer combination.
TI-28	Roadless year round transport from Nenana to the Mine Site for cargo and fuel transportation using Rolligons.
TI-29	Roadless year round transport from Cook Inlet to the Mine Site for cargo and fuel transportation using Rolligons.
TI-30	Build an ice/snow road to the Mine Site for transportation of cargo and fuel.
TI-31	Establish a winter snow cat route for transportation of cargo and fuel.
TI-32	Use hovercrafts rather than barges for transportation of cargo and fuel to the Mine Site.
TI-32a	Use airships rather than barges.
TI-33	Limit barging during key commercial or subsistence fishing periods
TI-34	Build a road to the Yukon River.
TI-35	Build a port on the Yukon River.
TI-36	Tie into the state's planned road to the Yukon River.
TI-37	Build a port at the end of the State planned road to the Yukon River.
TI-38	Upriver barging on the Yukon River.
TI-39	Downriver barging from Nenana (Tanana/ Yukon River).
TI-39a	Establish and maintain a deeper and wider navigation channel between the river mouth and the upriver port
TI-40	Place the upriver port in Aniak. (Aniak Port option)
TI-41	Build a road from the proposed upriver port in Aniak (TI-40) to the Mine Site.
TI-47	Use riprap for the Angyaruaq (Jungjuk) Port design.
TI-48	Use a removable floating barge & ramp for the Angyaruaq (Jungjuk) port.
TI-49	Dredge a deeper floating basin at the Angyaruaq (Jungjuk) Port.
TI-51	Use a seasonal/temporary port at Angyaruaq (Jungjuk).
TI-52	Move the pilings landward of the bank at Angyaruaq (Jungjuk) Port.

Table 2.4-2: Transportation Options Eliminated from Detailed Consideration

Option No.	Option Description
TI-53	Add a second slip to the Angyaruaq (Jungjuk) Port
TI-55	Use “Hi-Float” or “Chip Seal” on the road to the Mine Site from Angyaruaq (Jungjuk) Port.
TI-56	Pave the road to the Mine Site from Angyaruaq (Jungjuk) Port.
TI-56a	Reduce the Angyaruaq (Jungjuk) Port Access road to one lane in wetlands
TI-57b	Reclaim and decommission the road from Angyaruaq (Jungjuk) Port to the Mine Site at Closure
TI-59	Improve the Crooked Creek village airstrip.
TI-60	Build a road between Crooked Creek and the Mine Site.
TI-62	Reclaim the Mine Site airstrip after operation was complete.
TI-65	Improve “Kiska Metals” strip for use during pipeline construction
TI-65a	Use existing strip at Whiskey Bravo.
TI-66	Substitute fixed wing planes with helicopters for the construction of the pipeline.
TI-68	Return the gravel used for temporary pipeline construction airstrips to the material sites for full restoration of both airstrip and material sites.

Notes:

TI = transportation infrastructure

2.4.3 ELIMINATED POWER GENERATION OPTIONS

Power generation options eliminated from further consideration are presented in Table 2.4-3.

Table 2.4-3: Power Options Eliminated from Detailed Consideration

Option No.	Option Description
TI-71	Using wind power as the main source of power
TI-71a	Using solar power as the main source of power
TI-72	Using nuclear power as the main source of power
TI-73	Using run-of-the-river hydropower as the main source of power
TI-74	Using conventional hydropower as the main source of power
TI-75	Using biomass as the main power source
TI-76	Using waste-to-fuel as the main power source
TI-77	Using coal as the main power source
TI-78	Using peat power as the main source of power
TI-79	Combining two or more of options TI-69 through TI-78 (energy alternatives)
TI-80	Using natural gas-fired electricity generated off-site
TI-81	Purchasing electricity from the existing grid to power the Mine Site.
TI-82	Purchasing power from Susitna-Watana Hydroelectric.

Table 2.4-3: Power Options Eliminated from Detailed Consideration

Option No.	Option Description
TI-83	Purchasing power generated from the off-site Williamsport Coal Plant
TI-84	Purchasing power generated off-site from a coal plant to be located in Bethel
TI-85	Purchasing power generated off-site from the Beluga Coal Plant
TI-86	Purchasing power generated off-site at the Healy Power Plant (Coal)
TI-87	Building a Bethel LNG Plant with an associated pipeline to the Mine Site
TI-88	Building a Bethel LNG fuel power facility with a transmission line to the Mine Site

Notes:

TI = transportation infrastructure

2.4.4 ELIMINATED PIPELINE OPTIONS

Pipeline options eliminated from further analysis are presented in Table 2.4-4.

Table 2.4-4: Pipeline Options Eliminated from Detailed Consideration

Option No.	Option Description
PL-2	Routing an overland natural gas pipeline from Dillingham (Nushagak) to the Mine Site.
PL-3	Routing an overland natural gas pipeline from Nenana to the Mine Site.
PL-4	Using alternative routes that do not require substantial grading of hillsides for the pipeline ROW.
PL-6	There was an option to consider pipeline route options near established guide camps to reduce viewshed impacts, e.g, near Windy River.
PL-7a	Route that avoids federal lands
PL-9	Local route option at Lower Theodore River, MP 0 - MP 5
PL-11	Local route option, Little Mount Susitna East, MP 9 - MP 29
PL-13	Local route option, Theodore River Alternate East, MP 32 - MP 49
PL-15	Local route options along Skwentna River - south, MP 58 – MP 70
PL-16	Regional route option through Alaska Range over Merrill Pass
PL-18	Local route option on south side Alaska Range via North Round Mountain, MP 95 – MP 98
PL-19	Route option through Alaska Range via Goodman Pass west
PL-20	Route option through Alaska Range via Goodman Pass east
PL-21	Route option through Alaska Range via Rainy Pass and Dalzell Gorge, Egypt Mountain, south, MP 141 – MP 150
PL-23	Route option through Alaska Range via Rainy Pass and Dalzell Gorge, local route option to avoid salt lick 2-3 miles west of Egypt Mountain, ~MP 146 – MP 147 on Egypt Mountain, north route
PL-25	Route option through Alaska Range via Jones Pass, MPs J 105 – J 150, local route option further to north away from salt lick near Egypt Mountain
PL-26	Regional route option through Alaska Range via Kichatna River Valley; route northwest at Skwentna to Kichatna River then west, bypassing 58 miles collocation with INHT

Table 2.4-4: Pipeline Options Eliminated from Detailed Consideration

Option No.	Option Description
PL-28	Local route option, St. Johns Hill/Windy Fork north, MP 155 – MP 167
PL-29	Local route option, Big River north, MP 187 – MP 192
PL-30	Moving regional route north along face of Alaska Range, MP 150 – MP 194, to avoid important transitional habitat for wildlife and reduce hunting pressure (from improved access).
PL-32	Local route option, Tatlawiksuk River south, MP 212 – MP 214
PL-34	Local route option, Kuskokwim River south, MP 239 – MP 241
PL-36	Three local route options near Moose Creek
PL-38	Local route option - Kuskokwim Hills south, MP 279 – MP 308 east side E. George River - north, MP 284 – MP 287
PL-39	Local route option - Kuskokwim Hills south, MP 279 – MP 308 east side E. George River - south, MP 284 – MP 287
PL-41	An option that reduces the initial clearing requirements for the majority of the ROW, preferably to less than 50 Feet.
PL-42	Avoiding construction alternatives that require substantial grading of hillsides for the pipeline ROW.
PL-44	An option that does not require clearing of vegetation every 10 years, to preserve early reclamation.
PL-46	Coordinating with PHMSA to refine clearing requirements in consideration with PHMSA's regulations and the ecological values.
PL-47	Installing slope breakers and trench breakers at wetland boundaries to prevent trenches from draining wetlands.
PL-50	Constructing a permanent dirt road or work pad alongside the entire length of pipeline ROW for operations and maintenance.
PL-51	Further restricting public access to the ROW.
PL-52	Facilitating local communities in acquiring a natural gas supply from the pipeline.
PL-54	Reducing the size of the pipeline or possibly even eliminating it.
PL-56	Constructing an above-ground natural gas pipeline.
PL-57a	For Alternative 3B – Diesel Pipeline, construct aboveground.
PL-58	Using the minimum tool concept that is used in wilderness areas (i.e., hand tools or much smaller equipment than usual) for trenching on hillsides.
PL-60	Requiring a dewatering filter bag or geotextile bag when dewatering a trench.
PL-64	Impressed current cathodic protection at large river crossings.
PL-66	Options in event HDD frac-out or scour risk is high (e.g, bridges, aerial, other).
PL-67	Option for HDD at all fish-bearing streams.
PL-70	Moving visible pipeline components further from the Kuskokwim shore.
PL-72	Alternative crossing that further avoids Devil's Elbow cemetery.
PL-74	Using freeze depressants for hydro-testing if testing is done in winter or shoulder seasons.
PL-75	Use air testing for pipeline integrity testing.
PL-77	Option for trucking water if water sources inadequate.

Table 2.4-4: Pipeline Options Eliminated from Detailed Consideration

Option No.	Option Description
PL-79	Alternative placement of valve stations to avoid visual impacts to local businesses, the INHT, hunting/guiding camps and cabins.
PL-80	Placing a valve station close to Rainy Pass Lodge and Kiska Metals.
PL-81	Placing additional valves before/after stream crossings.
PL-83	Increasing the number of remote closure valves.
PL-87	Using a gas-powered compressor station with emissions controls.
PL-88	Providing storage areas to divert pipeline contents in the event of a breakage.
PL-91	Improving pipeline security by burying the pipeline even at fault crossings.
PL-93	Option to time pipe staging to avoid seasonal presence of Beluga whales in critical habitat.
PL-94	An option for housing construction workers in existing lodges.
PL-96	Avoiding wetlands in the positioning of temporary construction camps.
PL-99	Minimizing the use of culverts and associated fill in flowing waterways.
PL-102	Constructing temporary access roads using geotextile, “Chip Seal,” “High Float,” or paving.
PL-103a	Route winter access trail for pipeline construction on the Susitna, Yentna, and Skwentna rivers
PL-105	Enacting seasonal timing restrictions on blasting.
PL-106	Reduce the total number of material sites by maximizing the distance between them.
PL-109	Constructing a gas pipeline laid on the ground and not buried.

Notes:

HDD = horizontal directional drilling

MP = milepost

PL = pipeline

ROW = right-of-way