Executive Summary

US Army Corps of Engineers

Pebble Project EIS

Environmental Impact Statement

July 2020

www.PebbleProjectEIS.com

DEPARTMENT OF THE ARMY
ALASKA DISTRICT, US ARMY CORPS OF ENGINEERS
REGULATORY DIVISION
PO BOX 6898
JBER, AK 99506-0898

Regulatory Division
POA-2017-271

Re: Release of the Pebble Project Final Environmental Impact Statement

Dear Reader:

Enclosed is the Pebble Project Final Environmental Impact Statement (FEIS). The United States Army Corps of Engineers (USACE) received a permit application (POA-2017-271) from Pebble Limited Partnership (the Applicant), on December 22, 2017, for the placement of fill in waters of the US and work in navigable waters of the US for developing the Pebble deposit, pursuant to Section 10 of the Rivers and Harbors Act of 1899 and Section 404 of the Clean Water Act.

The Applicant proposes to develop the Pebble copper-gold-molybdenum porphyry deposit (Pebble deposit) as a surface mine in Southwest Alaska near Iliamna Lake, approximately 200 miles southwest of Anchorage and 60 miles west of Cook Inlet. The closest communities are the villages of Iliamna, Newhalen, and Nondalton, each approximately 17 miles from the Pebble deposit. The project would include development of the open pit mine, with associated infrastructure to include a 270-megawatt power generating plant. A natural gas pipeline from the Kenai Peninsula across Cook Inlet to the mine site is proposed as the energy source for the mine. The transportation corridor includes mine and port access roads and a port facility on the western shore of Cook Inlet.

The FEIS describes the proposed Pebble Project, as detailed in the permit application and subsequent Applicant-provided information. It also describes the regulatory processes that guide the project review by USACE and cooperating agencies. The FEIS describes the project scoping process and the key issues that were raised by interested parties, as well as the project's purpose and need. A range of reasonable alternatives was developed based on the purpose and need and input from the scoping process; the alternatives development process is discussed in the FEIS. The document provides information on environmental resources in the EIS analysis area, and an evaluation of the potential environmental effects of all project alternatives. The FEIS also presents the Applicant's proposed mitigative measures, which have been incorporated into the project design.

On July 24, 2020 a Notice of Availability for the FEIS was published in the Federal Register. The FEIS provides agency decision makers with the scientific basis for their permitting decisions.

Where and How to Access the Document

You may access the document on the internet at: **https://pebbleprojecteis.com**.

Requests for an electronic copy of the FEIS can be made to:

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USACE, Alaska District
P.O. Box 6898
JBER, AK, 99506-0898
907-753-2715

An electronic version of the FEIS document may also be viewed at the following public libraries:

- **Alaska Resources Library and Information Services**, *Anchorage*
- **Bristol Bay Borough Libraries** *(serving King Salmon, Naknek, and South Naknek)*
- **Dillingham Public Library**, *Dillingham*
- **Georgetown University**, *Washington, DC*
- **Homer Public Library**, *Homer*
- **Kenai Community Library**, *Kenai*
- **Soldotna Public Library**, *Soldotna*
- **University of Alaska/ Alaska Pacific University Consortium Library**, *Anchorage*
- **Z.J. Loussac Public Library**, *Anchorage*

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CONTENTS

List of Figures

List of Tables

ACRONYMS

ACHP	Advisory Council on Historic Preservation
ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish and Game
ADNR	Alaska Department of Natural Resources
AHRS	Alaska Heritage Resources Survey
APDES	Alaska Pollutant Discharge Elimination System
APE	area of potential effects
ARD	acid rock drainage
AS	Alaska Statute
BBEDC	Bristol Bay Economic Development Corporation
BMP	best management practice
BSEE	Bureau of Safety and Environmental Enforcement
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	cubic feet per second
CMP	Compensatory Mitigation Plan
CWA	Clean Water Act
DA	Department of the Army
DEIS	Draft Environmental Impact Statement
EIS	Environmental Impact Statement
EPA	US Environmental Protection Agency
ES	Executive Summary
FEIS	Final Environmental Impact Statement
FR	Federal Register
GHG	greenhouse gas
HDD	horizontal directional drilling
HGM	hydrogeomorphic
HUC	hydrologic unit code
H:V	Horizontal:Vertical
LPB	Lake and Peninsula Borough
MAD	mean annual discharge
ML	metal leaching
MLLW	mean lower low water
MM	Maximum Management (level)
MMP	Management and Monitoring Plan
MOVES	Motor Vehicle Emission Simulator
NEPA	National Environmental Policy Act
NFK	North Fork Koktuli River
NHPA	National Historic Preservation Act
NWUS	navigable waters of the US
PA	Programmatic Agreement
PAG	potentially acid generating
PLP	Pebble Limited Partnership
RFFA	reasonably foreseeable future action
RFI	Request for Information
ROD	Record of Decision
ROW(s)	right(s)-of-way
SCP	seepage collection pond
SFK	South Fork Koktuli River
SWHS	Statewide Harvest Survey
TES	Threatened and Endangered Species
TSF	tailings storage facility
TSS	total suspended solids
US	United States
USACE	US Army Corps of Engineers
USCG	US Coast Guard
USFWS	US Fish and Wildlife Service
USGS	US Geological Survey
UTC	Upper Talarik Creek
WMP	water management pond
WOUS	waters of the US
WQC	Water Quality Criteria
WTP	water treatment plant

SUMMARY OF CHANGES FROM THE DRAFT EIS

The Pebble Project Draft Environmental Impact Statement (DEIS) was posted for public comment from March 1 to July 1, 2019. The Final Environmental Impact Statement (FEIS) includes updates from the Applicant to optimize project design to avoid and minimize impacts; edits to address public comments; and additional data to fill gaps. Specifically, the FEIS identifies the Applicant's Preferred Alternative and includes changes to environmental topic areas, as summarized below.

Applicant's Preferred Alternative

Pebble Limited Partnership (PLP) has identified Alternative 3 as the Applicant's Preferred Alternative, and updated their Project Description (PLP 2020d) in May 2020 to reflect this decision. PLP's updated Project Description is included as Appendix N of the EIS.

Alternative 3 includes the following additional Applicant-proposed avoidance and minimization:

- The dock facility, dredged channel, and turning basin were moved approximately 0.75 mile north in Iliamna Bay, the onshore facility was moved approximately 2.5 miles north, and the gas pipeline and fiber-optic cable right-of-way (ROW) location was updated to reflect the change in port location.
- The port causeway and dock construction methodology changed from an earthen fill with sheet pilings to a concrete-supported caisson design.
- The alternate lightering location west of Augustine Island was eliminated.
- An approximately 0.5 mile access road from the transportation corridor to the Pedro Bay airport was added.

Alternative 1a

As a result of public input on the DEIS, Alternative 1a was identified and evaluated in the Environmental Impact Statement (EIS). Alternative 1a is a combination of portions of DEIS Alternative 1 and Alternative 2. It includes:

- The DEIS Alternative 1 natural gas pipeline between Anchor Point and Iliamna Lake, the Amakdedori port (with a caisson dock), the port access road, and the south ferry terminal
- An ice-breaking ferry route from the south ferry terminal to the DEIS Alternative 2 Eagle Bay ferry terminal and the mine access road
- The DEIS Alternative 1 Mine Site
- A natural gas pipeline crossing of Iliamna Lake from the south ferry terminal to Newhalen, where it would continue north to the mine access road, and follow the road to the mine site

Alternative 1a avoids constructing the mine access road in Upper Talarik Creek (UTC), as proposed under Alternative 1. Concern was expressed during scoping and in comments on the DEIS about the fish, wildlife, and subsistence values in UTC, and commenters expressed support for combining Alternative 1 and Alternative 2 to avoid the area.

Alternative 1a also includes the following additional Applicant-proposed avoidance and minimization:

- The caisson dock design at Amakdedori, which would minimize in-water impacts when compared to the previously proposed earthen fill dock
- The natural gas pipeline alignment in Cook Inlet has been realigned for approximately 12 miles to avoid a shipwreck
- A different crossing of the Newhalen River than originally considered under DEIS Alternative 2; the new preferred southern crossing avoids cultural resources discovered at the original crossing during field studies in 2019
- Several optimizations of the project design have been proposed to avoid and minimize impacts to wetlands and waters of the US

Since the DEIS was published, numerous changes have been made to respond to comments received on the DEIS.

Tailings Dam Failure Scenarios

Modeling of a catastrophic, very low-probability tailings release was requested by commenters, but deemed inappropriate based on the Applicant's permeable, flow-through design for the bulk tailings storage facility (TSF) main embankment, compared with historical water-inundated TSFs that have been subject to large-scale failures. The comments and concern have been addressed in the FEIS by providing supplemental information in a new Appendix K4.27, Spill Risk, to provide a detailed rationale on the probability of catastrophic tailings release from the bulk TSF. The discussion addresses several recent significant tailings dam failures (e.g., Brazil, Mount Polley), noting the higher probability of failure of water-inundated tailings slurries behind upstream dams compared to drained, thickened tailings behind downstream/centerline dams. Appendix K4.27, Spill Risk, also provides a technical review of full dam breach models put forth by the US Environmental Protection Agency (EPA) and Lynker, which assume water-inundated TSFs, and describes the relevance of these models in the context of the proposed facility design.

Cultural Resources and Historic Properties

The Cultural Resources and Historic Properties sections have been combined in Chapter 3, Affected Environment; and Chapter 4, Environmental Consequences. Cultural resources data collected during the 2019 field season and National Register of Historic Places Determinations of Eligibility have been incorporated. This information provides more specific information about the cultural resources that are near project components, and helps fill gaps that were identified in the DEIS. A draft Programmatic Agreement (PA) is included as Appendix L of the FEIS.

Groundwater Hydrology

The Piteau groundwater model in the DEIS has been replaced with a model from BGC Engineering. The BGC model is based on US Geological Survey (USGS) source code and includes a full-calibration report. Although the groundwater predictions are similar for the two models, the new model allowed addressing other concerns expressed in comments on the DEIS, such as model uncertainty.

Air Quality Modeling

The on-road and off-road emissions for all project phases and components were updated for the EIS using the current EPA Motor Vehicle Emission Simulator (MOVES) model to estimate emissions for mobile sources. The MOVES model contains a database of equipment, and age and location-specific emission factors, and shows reduced emissions compared to the DEIS.

Fugitive Dust (Particulate) Modeling

Copper has been included in fugitive dust constituents of concern for the mine site dust dispersion model, and presented in the EIS. Additionally, the potential impact on surface water quality from mine site dust deposition was analyzed by modeling using a sediment partitioning approach. The model results indicate that exceedance of the most stringent water quality discharge criteria would not be expected.

Wetlands and Vegetation

All wetlands and vegetation DEIS data gaps have been filled, and greater resolution has been given to streams and polygons originally mapped as wetland/upland mosaics (the DEIS assumed these polygons were all wetlands; therefore, remapping allowed more accurate quantification of impacts). Additionally, the wetlands that would be affected by pit dewatering have been mapped by incorporating information from the new groundwater model.

Management Plans Including Reclamation Plan

The Applicant has provided several additional management plans since the DEIS was published. These include a Reclamation and Closure Plan (Request for Information [RFI] 115), a Restoration Plan for Temporary Impacts (construction-related impacts to wetlands) (RFI 123), an Invasive Species Management Plan (RFI 133), a Conceptual Fugitive Dust Control Plan (RFI 134), and a Monitoring Summary Report (RFI 135). These plans fill gaps identified in the DEIS, and were used to refine the impact analysis in the FEIS. Additionally, the Applicant has submitted a revised Compensatory Mitigation Plan (RFI 056a).

1.0 PURPOSE AND NEED

1.1 Lead and Cooperating Agencies and Authorities

The US Army Corps of Engineers (USACE), Alaska District (District), Regulatory Division is examining the potential environmental impacts associated with PLP's proposed project, as described in PLP's Department of the Army (DA) Permit Application (POA-2017 271) (PLP 2020f). In its application, PLP has asked for authorization to discharge fill material into waters of the US (WOUS), and for work in and the placement of structures in navigable waters of the US (NWUS) for the purpose of developing a copper-gold-molybdenum porphyry deposit (Pebble deposit). PLP's proposed mine location is in southwest Alaska, near Iliamna Lake, approximately 200 miles southwest of Anchorage and 60 miles west of Cook Inlet (Figure ES-1). The mine site and a majority of the proposed supporting infrastructure would be in the Lake and Peninsula Borough (LPB), with the remainder of supporting infrastructure in the Kenai Peninsula Borough.

Through review of the application, USACE identified two additional federal decision-makers that would use the EIS to inform their decisions: the US Coast Guard (USCG), and the Department of the Interior's Bureau of Safety and Environmental Enforcement (BSEE). The USCG has authority under the General Bridge Act of 1946, as amended, 33 United States Code (USC) 525 to review and approve locations and navigational clearances of bridges and causeways in or over NWUS; USCG authorization is required for proposed bridges over the Newhalen River and the Iliamna River.

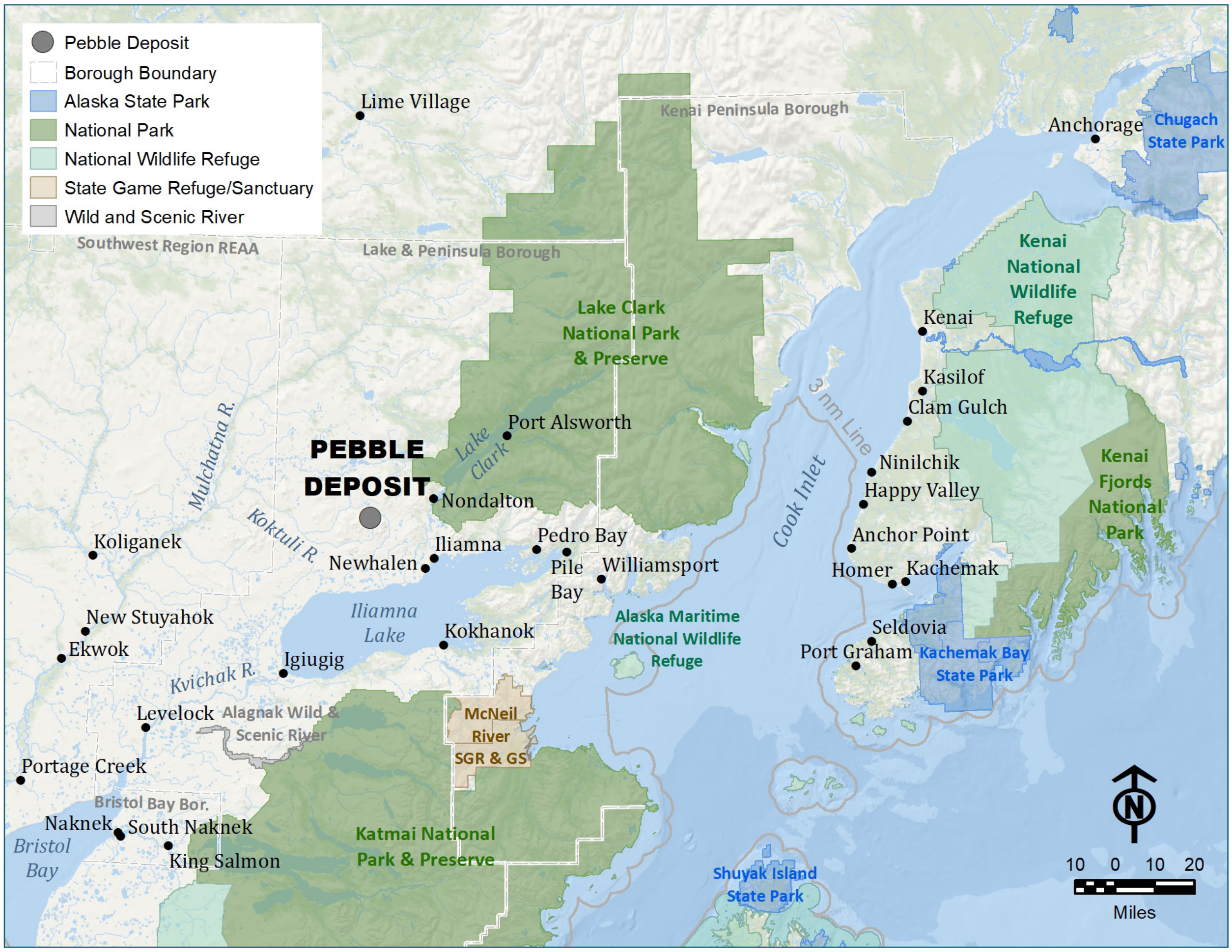


Figure ES-1: Regional Map

The USCG has set forth implementing regulations in 33 Code of Federal Regulations (CFR) Parts 114 118. The BSEE oversees safety, environmental protection, and conservation of resources related to the exploration for and development of offshore resources on the Outer Continental Shelf; BSEE authorization is required for the ROW)encompassing the natural gas pipeline between the Kenai Peninsula and the proposed port facility, but only that portion of the ROW that would lie on the Outer Continental Shelf of Cook Inlet. This authority derives from the Outer Continental Shelf Lands Act, as implemented by BSEE regulations at 30 CFR Part 250, Subpart J.

An EIS is used to inform the public and agency decision-makers, but it is not a decision document. A joint Record of Decision (ROD) by the USACE and USCG, issued at the conclusion of the National Environmental Policy Act (NEPA) process, will record each appropriate federal agency's decision(s), identify the Alternatives considered in reaching those decision(s), and identify practicable means to avoid or minimize environmental harm (if required). As the lead federal agency under NEPA, the USACE issued a Notice of Intent to prepare an EIS, and a Notice of Scoping for the Pebble Project was published in the Federal Register (FR) on March 29, 2018 (83 FR 13483; pages 13483 13484).

The USACE is coordinating this EIS with multiple cooperating agencies, which are defined as those agencies with jurisdiction by law or special expertise with respect to any environmental impact involved in a proposed project or its reasonable alternatives. Cooperating agencies may include state or local agencies and Tribal governments. The USACE invited USCG, BSEE, and other federal and state agencies, local governments, and federally recognized tribes to become cooperating agencies based on their special expertise and/or jurisdiction by law. The USCG, BSEE, the Advisory Council on Historic Preservation (ACHP), the US Fish and Wildlife Service (USFWS), the EPA, the US Department of Interior National Park Service, the US Department of Transportation Pipeline and Hazardous Materials Safety Administration, the State of Alaska, the LPB, the Curyung Tribal Council, and the Nondalton Tribal Council accepted invitations to become cooperating agencies.

1.2 Background

The Pebble deposit is on land acquired by the State of Alaska in 1974 via a three-way land swap with the federal government and Cook Inlet Region, Inc. The initial discovery of the Pebble deposit was made in 1988 by Cominco Alaska, a division of Cominco Ltd. (Cominco). Cominco (later acquired by Teck Resources Limited) discontinued work on potential development of the Pebble deposit in 1997; and in 2001, the Pebble claims were optioned by a subsidiary of Northern Dynasty Minerals Ltd. (Northern Dynasty). In 2005, Northern Dynasty exercised its option to acquire the Pebble deposit, and in the same year discovered a significant, higher-grade eastern extension to the deposit. Over the next 7 years, knowledge of the size of the Pebble deposit was expanded through exploratory drilling. In 2007, Northern Dynasty formed PLP with another company and placed the deposit into the partnership. Over the next 6 years, PLP continued to advance exploratory drilling of the deposit through additional drilling, environmental data collection, and engineering studies. In 2013, PLP reverted to a wholly owned subsidiary of Northern Dynasty.

1.3 Project Overview

PLP is proposing to develop the Pebble deposit as an open pit mine, with associated infrastructure. The project has four major components: the mine site, the transportation corridor, the Amakdedori port, and the natural gas pipeline corridor.

The project would progress through four distinct phases: construction, operations (also referred to as the production phase), closure, and post-closure. Construction would last for approximately 4 years, during which the facilities would be built, and pre-production mining would occur. The workforce during construction is expected to peak at 2,000 personnel. During operations, the project would have an operating schedule of two 12 hour shifts per day, 365 days per year, and employ an average of approximately 850 personnel annually. Commissioning to transition the facilities into full operational status would commence near the end of the construction phase, and continue into the operations phase (approximately 4 to 6 months). The operations phase would last for 20 years. This phase would consist of mining in the open pit, processing the mineralized material, expansion of the tailings facilities, and water management. Closure would commence once mining and processing are complete. During closure, the production-related facilities would be removed, the material would be removed from the pyritic TSF, and other facilities reclaimed. Water management would continue through the closure phase. The post-closure phase is the period of time after the closure phase when water quality would be closely monitored, and changes and adjustments to the treatment process would be made over the long term, as needed.

1.4 Issues Selected for Analysis

Social, physical, or biological resources or other concerns were selected for analysis based on scoping comments. These include:

Social Resources:

- Socioeconomics
- Subsistence
- Traditional way of life
- Archeological and cultural resources, historic properties
- Land ownership, management, and use
- Transportation and navigation
- Recreation
- Environmental justice
- Public health and safety
- Visual resources and aesthetics
- Wilderness characteristics
- Food and fiber production

Physical Resources:

- Air quality
- Geology
- Geohazards and seismic activity
- Surface and groundwater hydrology
- Noise
- Water and sediment quality and quantity

Biological Resources:

- Vegetation and ecosystems
- Fish and aquatic resources
- Wetlands, other waters, and special aquatic sites
- Wildlife, birds, and mammals
- Endangered Species Act-listed threatened and endangered species
- Invasive species

Other Concerns:

- Tailings dams
- Hazardous materials stored and transported to and from the mine site
- Fugitive dust
- Climate change
- Fuel spill risks or releases
- Natural gas supply
- Pipeline safety

1.5 Project Purpose and Need

A permit applicant's stated purpose and need is used as part of the NEPA process to inform the reasonable Alternatives to a proposed action that are evaluated in an EIS. PLP's stated purpose is to produce commodities, including copper, gold, and molybdenum, from the Pebble deposit in a manner that is commercially viable, using proven technologies that are suitable for the project's remote location. This purpose addresses PLP's stated need "to meet the increasing global demand for commodities such as copper, gold, and molybdenum."

According to the PLP, because the area PLP has leased for mineral development is not served by existing infrastructure, achieving the project purpose requires the construction of facilities for the mining and processing of mineral-bearing rock, as well as construction of support and access infrastructure. The stated purpose of the natural gas pipeline from the Kenai Peninsula is to provide a long-term stable supply of natural gas to meet the energy needs of the project by connecting to the existing regional gas supply network.

After evaluating an applicant's stated purpose and need from both the applicant's and the public's perspective, the USACE determines a proposed project's basic and overall purposes solely for evaluation of the project under the Clean Water Act (CWA) 404(b)(1) Guidelines. A basic project purpose (typically general in scope) is used to determine if a project is water-dependent. An overall project purpose is used to help identify practicable Alternatives (i.e., those that are available and capable of being done after taking into consideration cost, existing technology, and logistics) for evaluation under the CWA 404(b)(1) Guidelines. The USACE has determined that the overall project purpose is to develop and operate a copper, gold, and molybdenum mine in Alaska to meet current and future demand.

2.0 ALTERNATIVES

NEPA requires consideration of a reasonable range of Alternatives that can accomplish the purpose and need of the proposed action, and evaluation of a no action alternative. Consideration of Alternatives is also pertinent to CWA 40 CFR Part 230 Section 404(b)(1) Guidelines for Specification of Disposal Sites for Dredged or Fill Material (hereafter identified as 404(b)(1) guidelines), which require the analysis of practicable Alternatives to the proposed discharge.

The EIS team developed and screened options for potential action Alternatives suggested during public scoping around three criteria: 1) Purpose and need; 2) Reasonable under Council on Environmental Quality (CEQ) guidance and practicable under 404(b)(1) guidelines; and 3) Environmental impacts. Options that failed to meet one of the three criteria, which were followed sequentially, were eliminated from detailed consideration as part of an action Alternative in the EIS.

Options that met screening criteria were packaged into action Alternatives (i.e., a functioning project, including power, a port, transportation, and mine facilities). Variations to components of the project that do not comprise a complete Alternative are analyzed as variants under action alternatives. Although a variant may be analyzed under a specific action alternative, the USACE's determination of the least environmentally damaging practicable Alternative in its final permit decision may include a combination of components from the various Alternatives and variants analyzed in the EIS. Additionally, even though an Alternative may be carried forward for detailed analysis in the EIS, it may be determined not practicable during USACE 404(b)(1) analysis.

During the public comment period on the DEIS, alternatives-related comments included, but were not limited to:

- Support for the Alternative 2 mine access road versus the Alternative 1 mine access road
- Assertions that some Alternatives were not practicable and should not be analyzed in the EIS because portions crossed lands owned by entities who have declared their lands not available to PLP
- Suggestions for new alternatives

The FEIS addresses these comments as follows:

- A new Alternative (Alternative 1a) composed of components from Alternative 1 and Alternative 2 from the DEIS was developed. The transportation corridor consists of the mine access road from Alternative 2 (from the mine site to a ferry terminal at Eagle Bay), a ferry crossing from Eagle Bay to the south ferry terminal, and the Alternative 1 port access road (from Kokhanok to Amakdedori port). This Alternative also evaluates a different natural gas pipeline alignment across Iliamna Lake.
- USACE has determined that even though some Alternatives may not be available to the Applicant at this time, the Alternatives remain reasonable under NEPA guidelines and are retained in the FEIS.
- New Alternatives that were suggested were screened and documented.

The USACE regulatory process is iterative; therefore, the USACE works with applicants to identify additional avoidance and minimization measures that are often incorporated into the proposed project. These changes to the applicant's proposed project frequently result in updated project descriptions. Primary updates and project optimizations to the proposed project since publication of the DEIS are described in the preceding section. PLP's updated project description is included as Appendix N of the EIS.

Four action Alternatives (i.e., Alternative 1a, Alternative 1, Alternative 2, and Alternative 3) and the No Action Alternative are evaluated in the EIS, and are summarized in the subsequent sections. Appendix K2, Alternatives, provides a summary of the permanent and temporary construction footprints for each action Alternative by project component (mine site, transportation corridor, port, and natural gas pipeline).

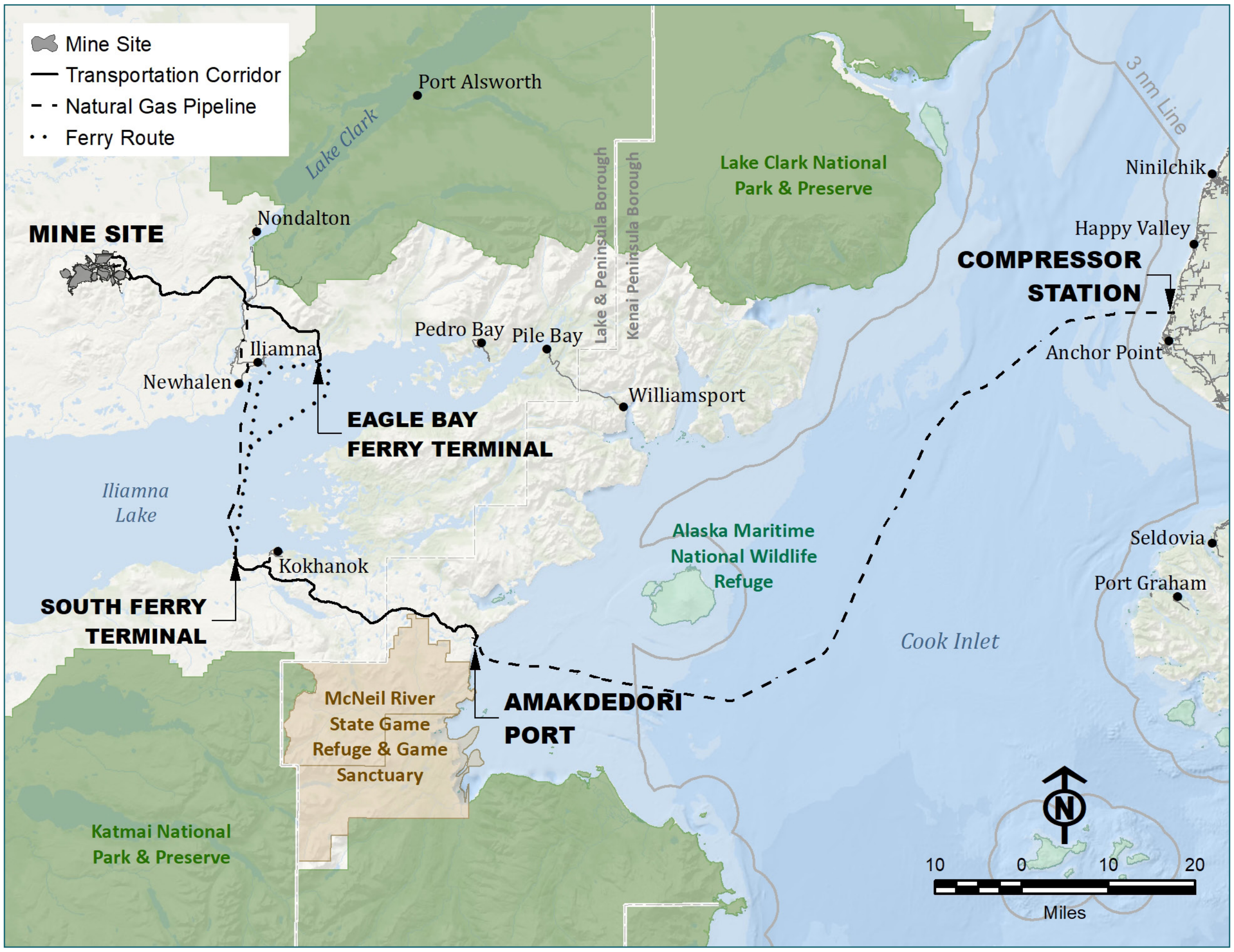


Figure ES-2: Alternative 1a—General Project Layout

NA 2.1 No Action Alternative

The No Action Alternative would result in federal agencies with decision-making authorities on the project not issuing permits under their respective authorities. The Applicant's Preferred Alternative would not be undertaken, and no construction, operations, or closure activities specific to the Alternative would occur. Although no resource development would occur under the Applicant's Preferred Alternative, PLP would retain the ability to apply for continued mineral exploration activities under the State's authorization process, as well as any activity that would not require federal authorization. In addition, there are many valid mining claims in the area, and these lands would remain open to mineral entry and exploration by other individuals or companies.

Current State-authorized activities associated with mineral exploration and reclamation and scientific studies would be expected to continue at levels similar to recent post-exploration activity. The State requires reclaiming sites at the conclusion of their State-authorized exploration program. If reclamation approval is not granted immediately after the cessation of activities, the State may require continued authorization for ongoing monitoring and reclamation work as it deems necessary.

A1a 2.2 Alternative 1a

Alternative 1a is composed of four primary components: the mine site at the Pebble deposit location, the Amakdedori port on the western shore of Cook Inlet, a transportation corridor connecting these two sites, and a natural gas pipeline corridor connecting to existing infrastructure on the Kenai Peninsula (Figure ES-2). The project would progress through four distinct phases: construction, operations

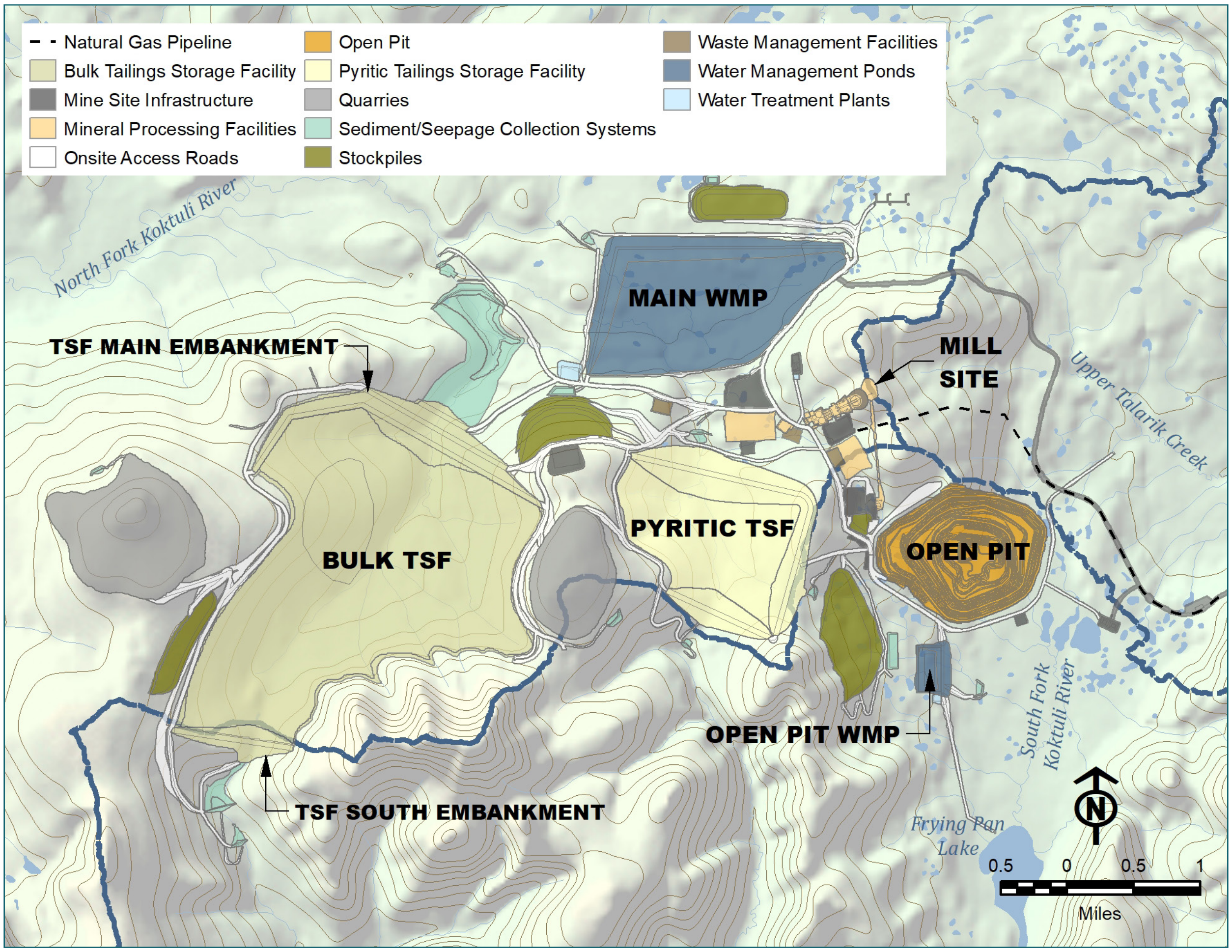


Figure ES-3: Alternative 1a—Mine Site Layout

(also referred to as the production phase), closure, and post-closure. However, the four phases would be integrated under the concept of designing, constructing, and operating—with closure and post-closure in mind. Appendix K2, Alternatives, provides the proposed construction schedule. A technical glossary of mining-related and physical science scientific terms applied throughout project documents can be accessed online at: https://pebbleprojecteis.com/overview/glossary.

Mine Site

The mine site (approximately 8,390 acres) would include the open pit, bulk TSF, pyritic TSF, overburden stockpiles, material sites (quarries), water management ponds (WMPs), seepage collection ponds (SCPs), sediment ponds, milling and processing facilities, and supporting infrastructure such as the 270 megawatt power plant, water treatment plants (WTPs), camp facilities, and storage facilities (Figure ES-3 and Figure ES-4). A proposed mine site safety boundary, shown on Figure ES-3, has been identified by PLP as the minimum area needed to safely conduct mine construction, operations, and reclamation.

The open pit mine would be a conventional drill, blast, truck, and shovel operation with an average mining rate of 70 million tons per year, and an overall stripping ratio of 0.12 ton of waste per ton of mineralized material. Mining would commence during the construction phase (mine pre-production), and extend 20 years during the operations phase. Appendix K2, Alternatives, summarizes the types and volumes of material proposed to be mined.

Mine pre-production would commence with dewatering of the open pit before the start of pre-production mining. This water would be primarily collected from perimeter wells, and discharged to the environment if it meets water quality criteria; otherwise, it would be treated in a WTP prior to discharge. The purpose of the pre-production mining is to prepare the open pit for production. Approximately 33 million tons of material, primarily overburden and waste rock with a small amount of accompanying mineralized material, would be mined during this period.

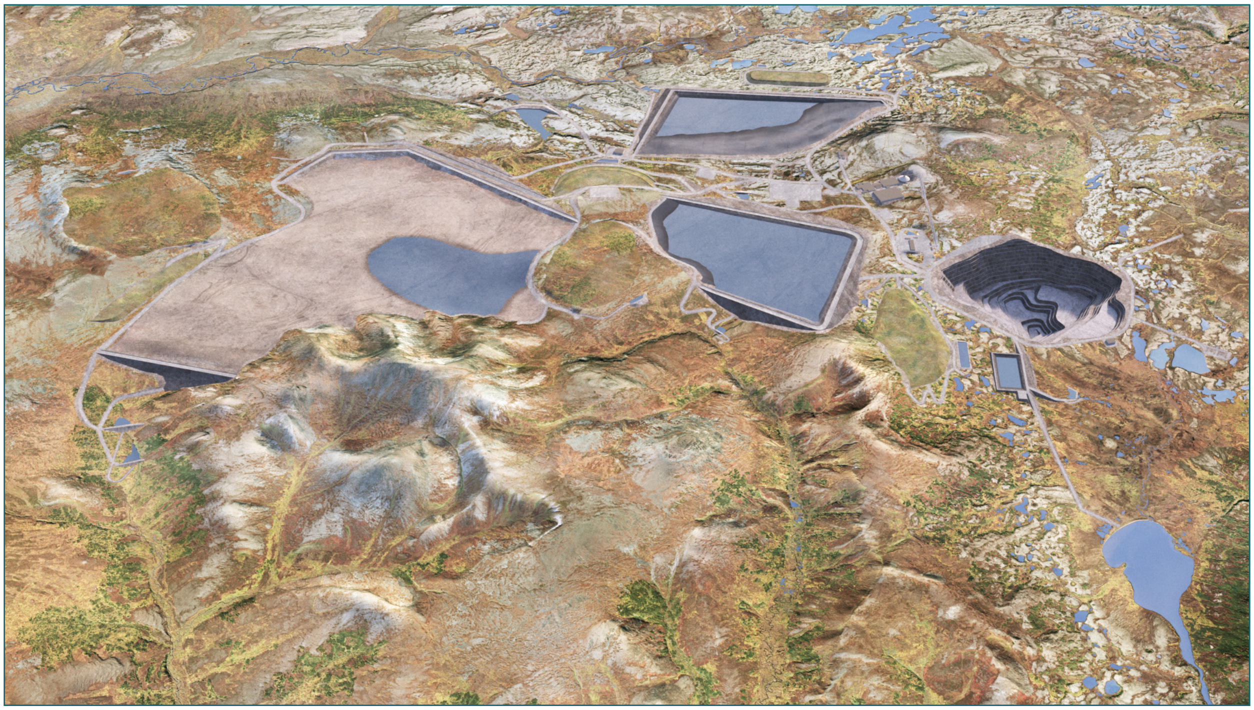


Figure ES-4: Digital Simulation of the Mine Site

Mine production during the operations phase encompasses the period during which economic-grade mineralized material would be fed to the mill. Mineralized material would be fed through the process plant at a rate of 180,000 tons per day. The open pit would be mined in a sequence of increasingly larger and deeper stages. Approximately 1.4 billion tons of material are planned to be mined during the operations phase. The final footprint of the open pit at the end of the operations phase would be 609 acres.

Mineral processing facilities such as the mill site process plant, crusher and conveyor, and container yard would be at the mine site near the open pit. Blasted mineralized material from the open pit would be fed to a crushing plant, and then conveyed to a coarse ore stockpile, which in turn would feed a grinding plant in the process plant. At various points throughout the mill, water and reagents would be added to the process. In the grinding plant, mineralized materials would be reduced to the consistency of very fine sand. The next step in the process would be froth flotation, in which the copper and molybdenum minerals are separated from the remaining material to produce concentrates. Multiple flotation steps would be used to produce the copper-gold and molybdenum concentrates. The concentrates would then be filtered for shipment for off-site refining.

Gravity concentrators would be placed at various locations throughout the grinding and flotation circuits in the process plant, with the intent of recovering a portion of the free gold and silver in the plant feed. The concentrates from these facilities would consist primarily of higher-density particles with accompanying gold and silver.

The copper-gold concentrate would be loaded into covered bulk shipping containers, and the molybdenum concentrate would be packaged in bulk bags and loaded into shipping containers for off-site transport. Other economically valuable minerals (e.g., palladium and rhenium) would be present in the concentrates and may be recovered at the refineries. The gravity concentrate would be packaged in bulk bags, trucked to the Iliamna Airport, and shipped by air.

Processing mineralized material to recover concentrates would result in two types of tailings: bulk tailings and pyritic tailings. Separate TSFs for the bulk tailings (approximately 2,797 acres) and pyritic tailings (approximately 1,000 acres) would be in the North Fork Koktuli (NFK) and SFK watersheds (Figure ES-3). The main WMP (approximately 1,002 acres) would be in the NFK. Both TSFs and the main WMP would have associated SCP facilities. The total TSF capacity would be sufficient to store the 20 year mine life tailings volume. Approximately 88 percent of the tailings would be bulk tailings,[1] and approximately 12 percent would be pyritic tailings.[2]

The bulk TSF would have two embankments: the main embankment, constructed using the centerline construction method; and the south embankment, constructed using the downstream construction method.[3] The main embankment of the bulk TSF would be built with earthfill and rockfill material. The embankment would not be lined. It would function as a permeable flow-through structure to continually enhance the seepage of water out of the tailings mass so that the tailings mass can drain, consolidate, and increase in strength over time. The main embankment of the bulk TSF would be designed to promote seepage to the SCP, thereby minimizing the volume of water contained in the impoundment and enhancing consolidation of the tailings solids. The upstream slope of the south embankment would be covered with a liner system to minimize water seepage through the south embankment. This would force the seepage out of the TSF to flow in a northerly direction, and ultimately flow through and under the main embankment and its underdrains, instead of through and under the south embankment.

The pyritic TSF would be a fully lined facility with an underdrain system below the liner. It would have three embankments: north, south, and east. The pyritic TSF embankments would be constructed using the downstream method of construction, with overall downstream slopes of 2.6 Horizontal:1 Vertical (H:V) and upstream slopes of 3H:1V. The pyritic TSF would contain the pyritic tailings and would be kept submerged during operations to prevent the oxidation and potential acid generation. The pyritic TSF would also be used to store PAG waste rock during operations.

WMPs at the mine site (1,066 acres) include the open pit WMP, bulk TSF main SCP, pyritic TSF SCP, seepage collection and recycle ponds, sediment ponds, main WMP, and main WMP SCP. The main WMP is the primary water retention facility at the mine site used to store surplus water for milling, or for managing surplus water from other impoundment and seepage structures. It would be a fully lined facility, and the enclosing embankment would be constructed using quarried earthfill and rockfill materials founded on competent bedrock (PLP 2018 RFI 101).

Supporting infrastructure and facilities that would be constructed in the mine site footprint include the mill site power plant, shops, on-site access roads, temporary and permanent personnel camps, potable water supply, communications, laboratories, and fire and emergency response.

A landfill and incinerator would be constructed and operated at the mine site for domestic waste handling. Separate sewage treatment plants would be at the camp and the process plant. The camp sewage treatment plant would be designed to remove biological oxygen demand, total suspended solids (TSS), total phosphate, total nitrogen, and ammonia to meet Alaska Department of Environmental Conservation (ADEC) domestic waste-discharge criteria. The process plant sewage treatment plant would receive effluent that may have metallic residues from the workers' change house and associated laundry, and therefore would also be designed for metals removal. Sludge from both plants would be stabilized and disposed of in the proposed on-site landfill.

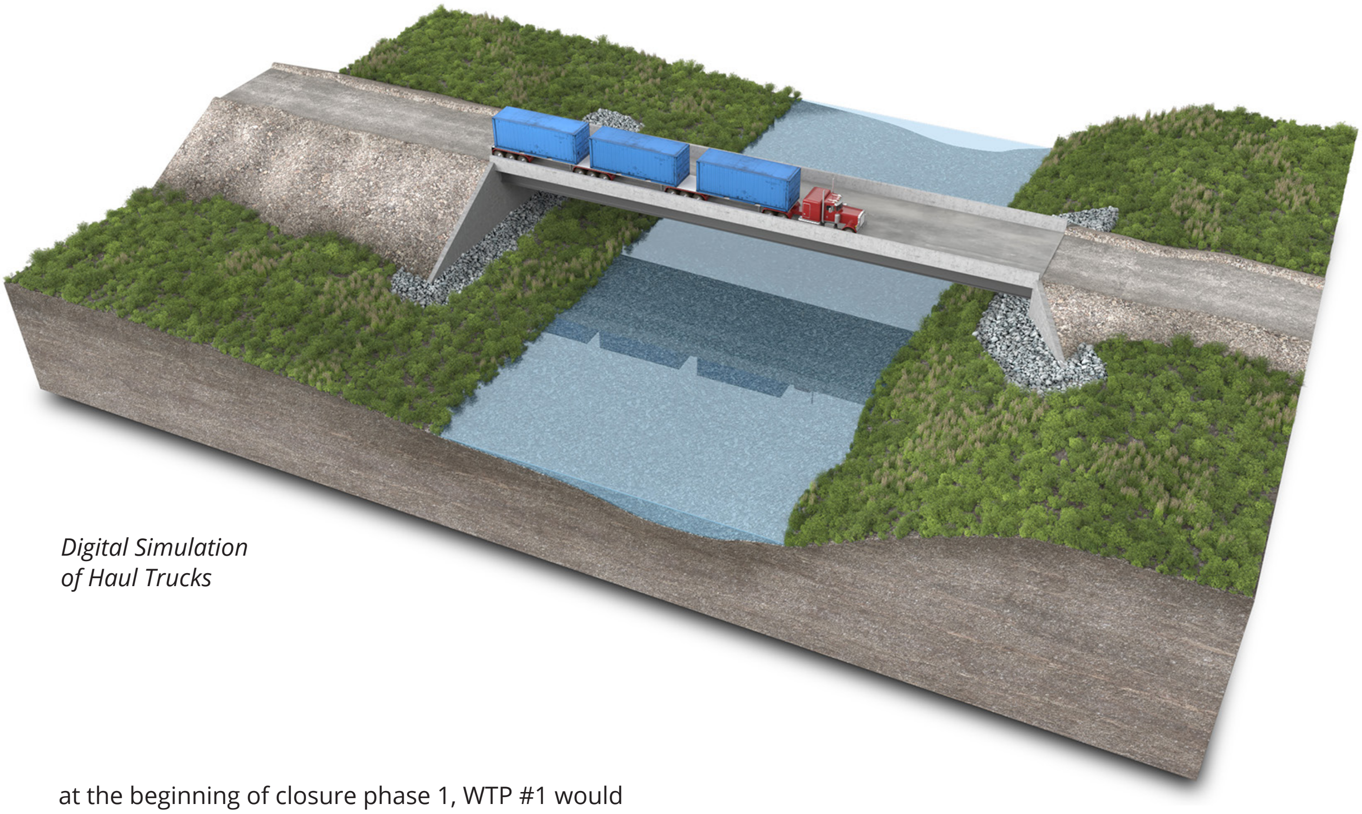
The mine area would have two WTPs during operations: WTP #1 (used during operations to treat surplus water from the open pit WMP), and WTP #2 (used during operations to treat surplus water from the main WMP). WTP #1 would have two treatment trains to meet the influent flow of 14 cubic feet per second (cfs). WTP #2 would have six treatment trains to meet the influent flow of 46 cfs.

WTP #2 would be repurposed for closure phase 1 to treat surplus water from the main WMP. WTP #2 would continue to treat the predicted maximum inflow of 46 cfs with six treatment trains, and a seventh train to allow for maintenance rotation. WTP #3 would be newly constructed for closure phase 1 to treat water from the open pit, and would be south of the open pit adjacent to the site of operations phase WTP #1. Once WTP #3 is operational

[1] Bulk tailings are primarily composed of non-acid-generating finely ground rock material that remains after economic minerals, and most pyritic materials have been extracted through mineral processing at the mine site.

[2] Pyritic tailings are composed of potentially acid-generating finely ground rock material containing the naturally occurring mineral pyrite that remains after economic minerals have been extracted through mineral processing at the mine site.

[3] Downstream and centerline construction are methods of dam (embankment) construction in which a rockfill dam is raised. With the downstream construction, the dam is raised completely in the downstream direction using the placement of fill on top of the rest, and downstream slope of the previous raise. Therefore, the upstream slope would remain as a uniform slope. With the centerline construction method, the rockfill embankment is raised with the objective of continually raising the crest vertically upward. This requires the concurrent placement of fill on top of the tailings beach, the remaining upstream slope, the crest, and the downstream slope of the previous raise during the raise process. The result is a zigzag-shaped upstream face, with the upstream part of the raise founded on the part of the tailings beach closest to the embankment.



Digital Simulation of Haul Trucks

at the beginning of closure phase 1, WTP #1 would be decommissioned. Predicted maximum inflow to WTP #3 during closure phase 1 is 25 cfs, with three treatment trains, and a fourth train to allow for maintenance rotation. During closure phase 2 (approximately 5 years), WTP #3 would be maintained in standby status, but not operated, to allow the water level in the pit to rise. In closure phase 3 and post closure, WTP #3 would treat two influent streams separately: surplus water from the bulk TSF main SCP; and surplus water from the open pit.

At the end of operations, mine facilities would be closed and reclaimed. Project closure has been broken down into three closure phases, Phases 1 through 3, and one post-closure phase (Phase 4, Closure Year 50 and beyond[4]). Physical reclamation is scheduled for a period of 20 years. Closure would include the following major actions:

- All production-related facilities would be decommissioned.
- Waste rock and tailings material would be removed from the pyritic TSF and placed in the pit; the facility would be reclaimed by removing the liner, breaching and regrading the embankments, and covering the disturbed area with growth medium.
- The bulk TSF would be covered with a low-permeability cover and would be capped with a layer of non-PAG waste rock sourced from the embankments of pyritic TSF and a layer of growth medium.
- The water management pond would be reclaimed by removing the liner, breaching and regrading the embankment, and covering the disturbed area with growth medium.
- The quarries would be reclaimed by sloping, covering with growth medium, and revegetating the disturbed area.

Post-closure activities would include:

- Operation of WTP(s)
- Care and maintenance of WTP(s)
- Care and maintenance of water management facilities
- Monitoring of revegetation, surface water, and groundwater

[4] The long-term post-closure phase is expected to last for centuries.

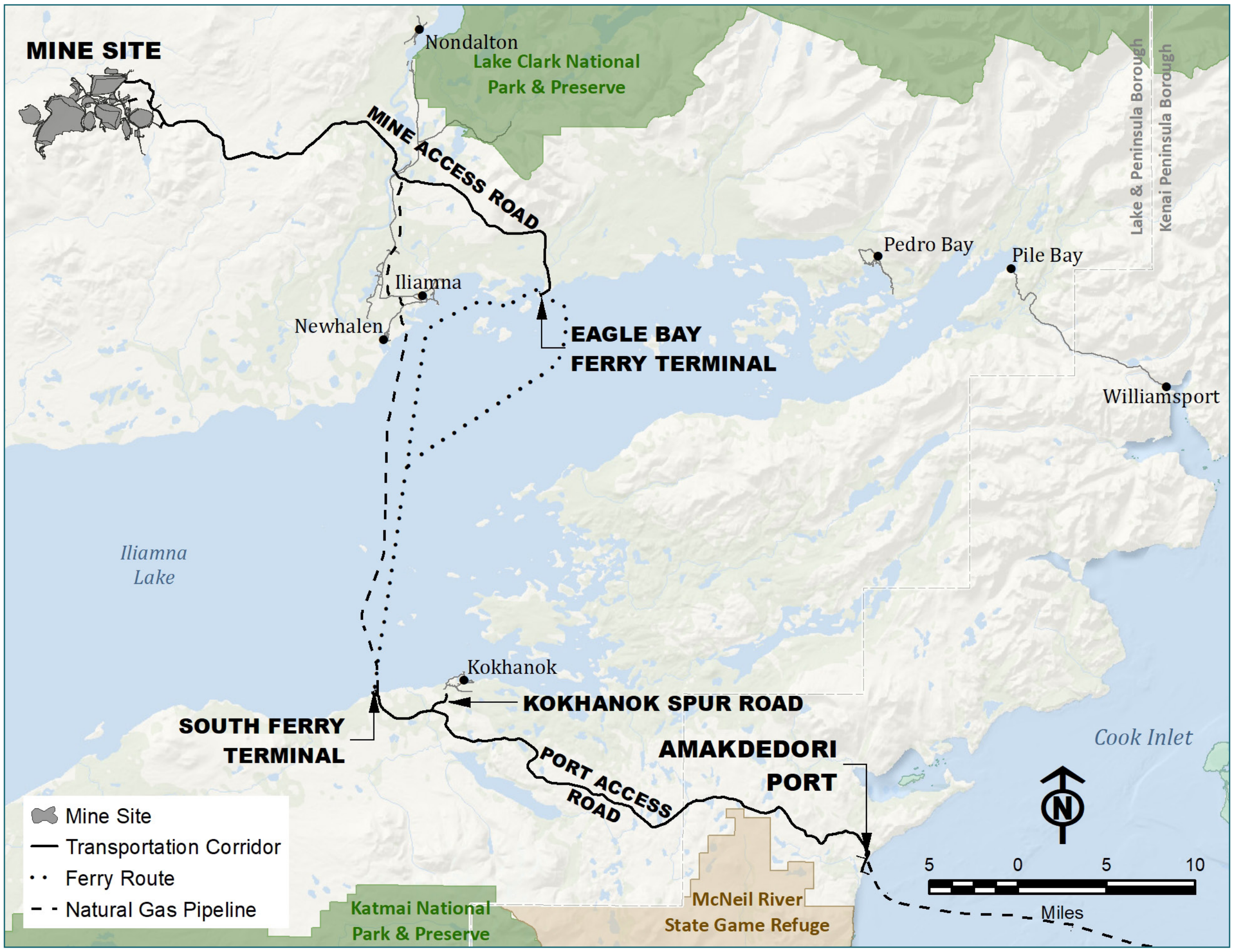


Figure ES-5: Alternative 1a—Transportation Facilities Overview

Transportation Corridor

The transportation corridor would connect the mine site to Amakdedori port on Cook Inlet (Figure ES-5), and consist of a mine access road (approximately 35 miles long with a footprint of 353 acres), ferry crossing (28 miles), and port access road (approximately 37 miles long with a footprint of 411 acres). Separate short spur roads, approximately 1 mile or less in length, would connect with the main access road of the transportation corridor. Alternative 1a includes an unpaved spur road (15 acres) from the port access road to the community of Kokhanok, and an unpaved spur road (4 acres) from the mine access road to a storage pad near the mine site.

The main mine and port access roads would be designed as private gravel roads with a 30 foot-wide driving surface to enable two-way traffic, and capable of supporting anticipated development and operational activities during construction and truck haulage of concentrate from the mine to the port. The road system would include ten bridges, eight of which would be single-span, two-lane bridges that range in length from approximately 60 to 90 feet. There would be one large (510 feet) multi-span, two-lane bridge across the Newhalen River, which would have a minimum of 32 feet of vertical clearance in the navigation channel, with 96 feet between each piling. There would be one large (300 feet) multi-span, two-lane bridge across the Gibraltar River that would have a minimum of 43 feet of vertical clearance in the navigation channel, with 100 feet between each piling. The Newhalen River crossing is proposed at a southern crossing location instead of the north crossing evaluated in the DEIS. Culverts at streams without fish would be designed and sized for drainage only. Culverts at streams with fish would be designed to meet the USFWS's culvert design guidelines for ecological function (USFWS 2020).

During project operations, daily transportation of materials (concentrate, fuel, reagents, and consumables) would require up to 35 truck round trips per day for each leg of the road, including three loads of fuel per day. There would also be additional low-volume light vehicle traffic.

Figure ES-6: Digital Simulation of Eagle Bay Ferry Terminal

An all-season ice-breaking ferry would transit Iliamna Lake, carrying inbound supplies from Amakdedori port to the mine site, and returning with copper-gold and molybdenum concentrates, backhauled waste material, and empty shipping containers. The one-way ferry trip would be about 28 miles, and would take approximately 2.5 hours to complete in open water, or 4.5 hours in ice conditions. On average, one round-trip per day across the lake would be required. Two ferry terminals are proposed: one on the northern shore (Eagle Bay ferry terminal [7 acres], Figure ES-6); and one on the southern shore (south ferry terminal [23 acres], Figure ES-7). The south ferry terminal would include a ferry assembly site. The ferry would be assembled from pre-fabricated components barged to Amakdedori port, and then transported across the road. The assembly site would remain intact to enable regular vessel surveys and maintenance as required.

A temporary camp would be established at each of the ferry landings to support road construction. At the south ferry landing, the camp would also support ferry assembly. These camps would be constructed in the area proposed for the permanent footprint, and would remain in place until the permanent facilities are established. Until the access road crossing the Newhalen River is complete, the crews would be shuttled to their workplaces by boat or by helicopter.

All temporary construction facilities would be removed after construction; and the sites would be reclaimed, unless being used for permanent facilities. Temporary impacts areas would be restored as outlined in PLP's Restoration Plan for Temporary Impacts (PLP 2019 RFI 123). The road system would be retained as long as required for the transport of bulk supplies needed for long-term post-closure water treatment and monitoring. Once the roads are no longer needed, the alignments would be recontoured if required, stabilized, and overburden would be placed as appropriate. The Iliamna Lake ferry facilities would be reclaimed after closure activities are completed (PLP 2018 RFI 024). At that time, the Iliamna Lake ferry facilities would be removed, and all supplies would be transported across the lake using a summer barging operation.

State requirements pertaining to permitting and ROW easement processes prior to construction include a detailed reclamation plan. Reclamation of lands privately owned by Alaska Native corporations would be established in lease and surface use agreements that PLP would negotiate with the land owner.

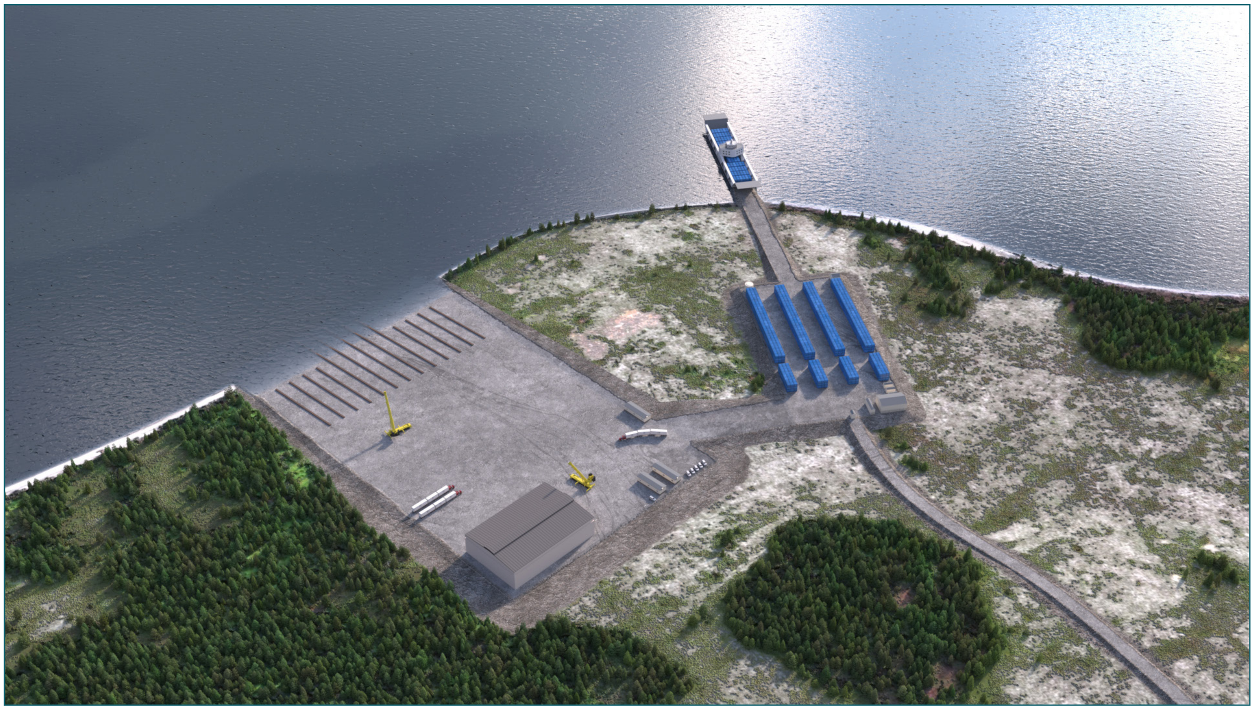


Figure ES-7: Digital Simulation of South Ferry Terminal

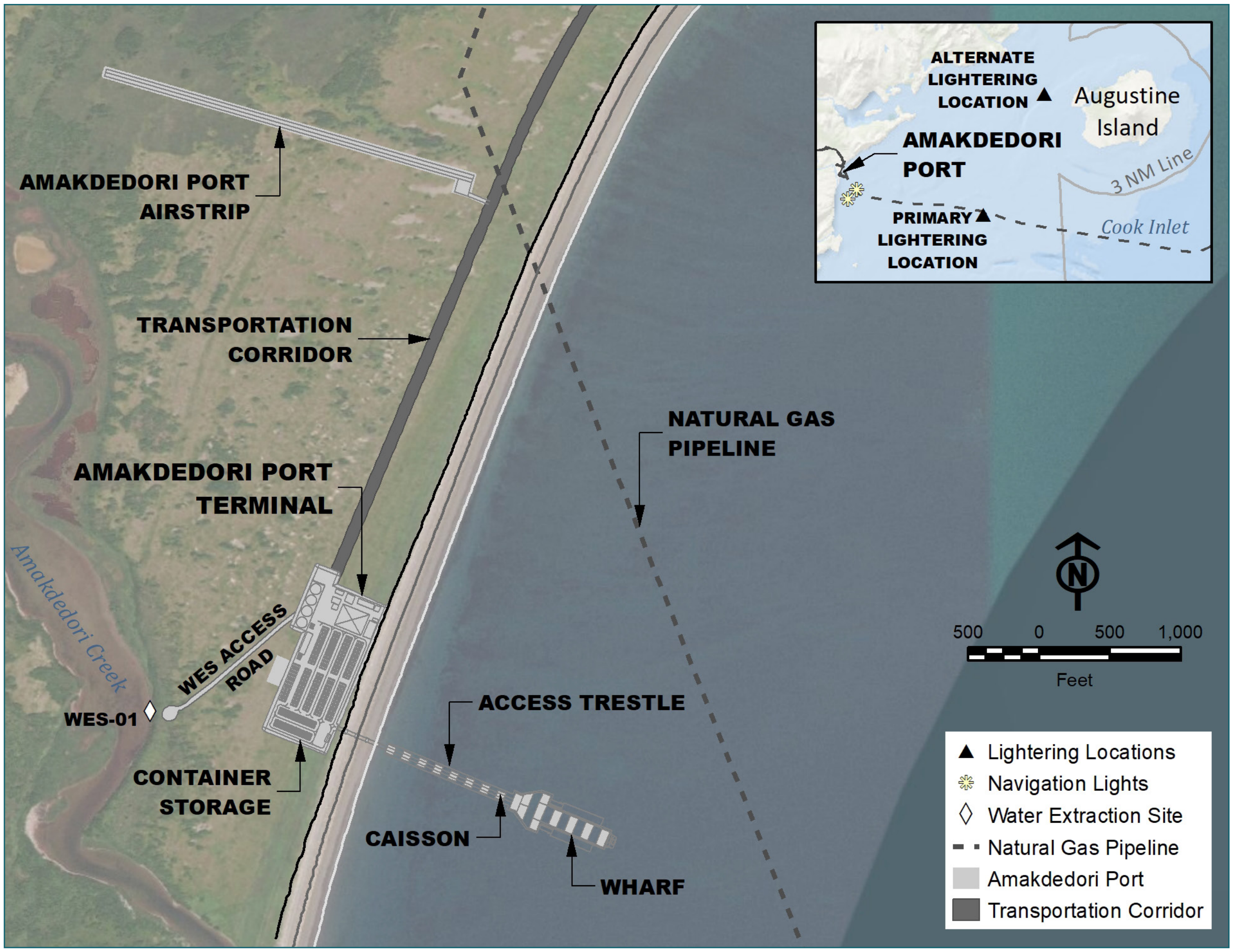


Figure ES-8: Alternative 1a—Amakdedori Port and Lightering Locations

Amakdedori Port and Lightering Locations

Alternative 1a includes construction of Amakdedori port (Figure ES-8 and Figure ES-9), a year-round port east of Amakdedori Creek on the western shore of Cook Inlet. The port site is undeveloped, and not served by any transportation or utility infrastructure.

The port site (17 acres) would include shore-based and marine facilities for the shipment of concentrate, freight, and fuel for the project. The shore-based facilities (15 acres) would include a container storage area for receipt and storage of containers for concentrate and freight. The port would be supported by a permanent airstrip (6 acres) that would be used primarily for construction, but retained for emergency access.

Marine facilities (2 acres) would include a causeway/access trestle extending out to a marine jetty/wharf at 15 feet below mean lower low water (MLLW). The causeway/access trestle would be constructed using 60 foot by 60 foot concrete caissons. The caisson footprints would be leveled, and the caissons placed 60 feet apart to allow for the free flow of sediment and water parallel to the shoreline. The concrete deck of the causeway would rest on the top of the caissons, and would be 24 feet wide by 1,340 feet long, extending out to the marine jetty/main wharf. The marine jetty/wharf would be constructed using 60 foot by 120 foot concrete caissons, separated by 60 feet to allow for the free flow of sediment and

Figure ES-9: Digital Simulation of Barges at Amakdedori Port

water parallel to the shoreline. The jetty/main wharf would be 120 feet wide and 720 feet long, except for a section where floating dock ramps would be attached on both sides of the jetty; that section would be up to 240 feet wide (additional caissons would be used to support the wider jetty section). A floating dock, on the jetty but separate from the cargo handling berths, would be provided for ice-breaking tug moorage.

Copper-gold concentrate would be transported from the mine site to Amakdedori port by truck and ferry in covered bulk cargo containers that are commonly used in the mining industry. The containers would be stored between vessel sailings on a dedicated laydown pad adjacent to the jetty. During port operations, the containers would be loaded onto lightering barges, then transported to one of two lightering locations for transfer to bulk carriers. The primary lightering location is approximately 12 miles offshore east of the Amakdedori port; an alternate lightering location is approximately 18 miles east-northeast of the port between Augustine Island and the mainland.

Up to 27 Handysize ships (i.e., bulk cargo ships) would be required annually to transport concentrate. Up to 33 marine linehaul barge loads of supplies and consumables would be required annually. Two ice-breaking tugboats would be used to assist the Handysize ships and barges with mooring and approach/departing the barge berths.

During the initial construction effort at Amakdedori port, temporary facilities (i.e., camp and service facilities) would be sited in the area that would be used for port operations, and would not require a separate footprint. Temporary diesel generators would be used for power supply. While the initial site access work is under way, crews would be housed on vessels moored near the site.

Physical site closure work would commence as operations end. At that time, the Amakdedori port facilities would be removed, except for those required to support shallow draft tug and barge access to the dock for the transfer of bulk supplies. The marine port facilities would be removed and reclaimed after closure activities are completed.

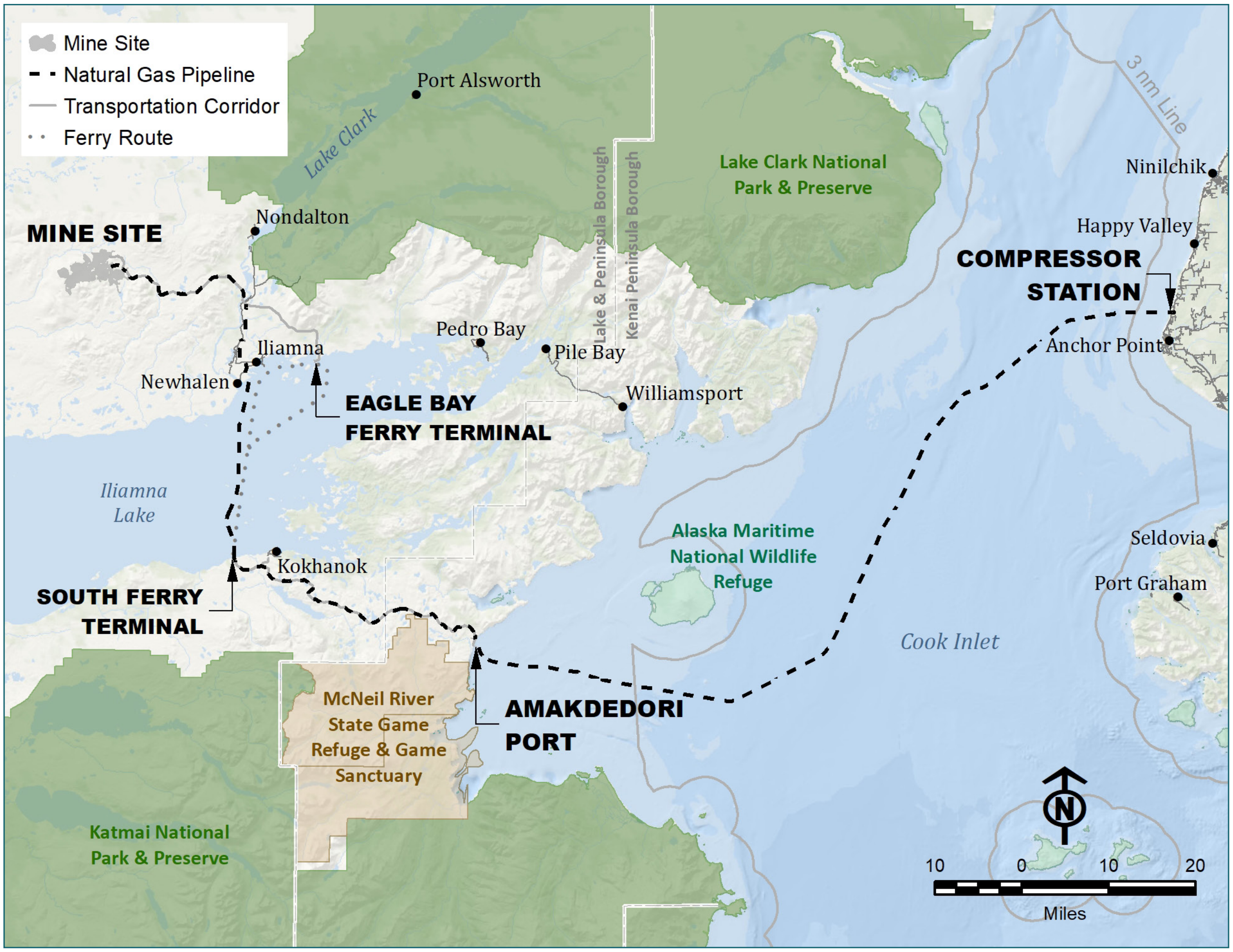


Figure ES-10: Alternative 1a—Natural Gas Pipeline Alignment

Natural Gas Pipeline

Natural gas, sourced through the existing natural gas supply infrastructure for the Cook Inlet area, would be the primary energy source for the project. The proposed natural gas pipeline would be open access; more specifically, a contract carrier. PLP has committed to providing community access to the gas line during project operations.

The natural gas would be supplied to Amakdedori port and the mine site by pipeline (Figure ES-10). The 12 inch-diameter steel pipeline would connect to the existing gas pipeline infrastructure near Anchor Point on the Kenai Peninsula, and would be designed to provide a gross flow rate of approximately 50 million standard cubic feet per day. A fiber-optic cable would be buried in the pipeline trench or ploughed in adjacent to the pipeline. A metering station, compressor station, and pig launching/receiving facility would be on a gravel pad (2 acres) at the offtake point, sited on a land parcel on the eastern side of the Sterling Highway.

The 192 mile natural gas pipeline from the Kenai Peninsula has five main segments: 1) Cook Inlet crossing to the Amakdedori port (104 miles); 2) along the port access road to Iliamna Lake; 3) across Iliamna Lake to Newhalen; 4) overland to connect with the mine access road east of the Newhalen River crossing; and 5) along the mine access road to the mine site.

Horizontal directional drilling (HDD) would be used to install pipe segments from the compressor station out into Cook Inlet water that is deep enough to avoid navigation hazards. From this point, the heavy-wall pipe would be trenched into the sea floor for approximately 61 miles, laid on the surface for the next approximately 11 miles, and then trenched into the sea floor for the final approximately 32 miles of the Cook Inlet crossing (PLP 2019h). Trenching and burial would occur with use of traditional cut-and-fill excavation using extended-reach backhoes for non-HDD shore crossings. Clamshell dredging/conventional excavation would be used for shallow water areas, and mechanical dredging and/or jet trenching for deepwater areas.

The segments of the natural gas pipeline and fiber-optic cable constructed along the access roads would be buried adjacent to the road bed shoulder. At bridged river crossings, the gas pipeline would either be placed beneath the rivers using HDD or trenching, or would be attached to the bridge structures. Surface roughness along a 0.6 mile section of the Iliamna Lake pipeline segment would require building a permanent berm to place the pipeline on. For the remainder of the lake crossing, the pipe would either be trenched into and buried, as needed, or laid onto the lake bed. A 150 foot temporary construction ROW is proposed for pipeline-only segments to allow for adjustment of the final route to suit terrain. The ROW would be reduced to a 50 foot permanent operations ROW following completion of pipeline construction. Pipeline stream crossings along the pipeline-only segments would use trenching or HDD to cross streams. Temporary impact areas associated with construction of the natural gas pipeline would be restored as outlined in PLP's Restoration Plan for Temporary Impacts (PLP 2019 RFI 123).

On completion of construction, the natural gas pipeline would be pressure-tested, and all mechanical, civil, structural, and electrical installations would be checked to ensure that they are installed according to design, and can operate safely. The natural gas pipeline would be equipped with a leak detection system. In the event of a gas release, shut-off valves would be closed to limit the extent of the release. An automatic shut-off system would be installed on the eastern side of Cook Inlet, near the compressor station. At the port site on the western side of the inlet, either an automatic or manual shut-off system would be installed.

The natural gas pipeline would be maintained through operations to provide energy to the project site. Industry best practices would be used for inspection and maintenance activities during operations. If no longer required at closure, the pipeline would be pigged and cleaned; and either abandoned in place or removed, subject to State and federal regulatory review and approval at the decommissioning stage of the project. Surface utilities associated with the pipeline would be removed and reclaimed.

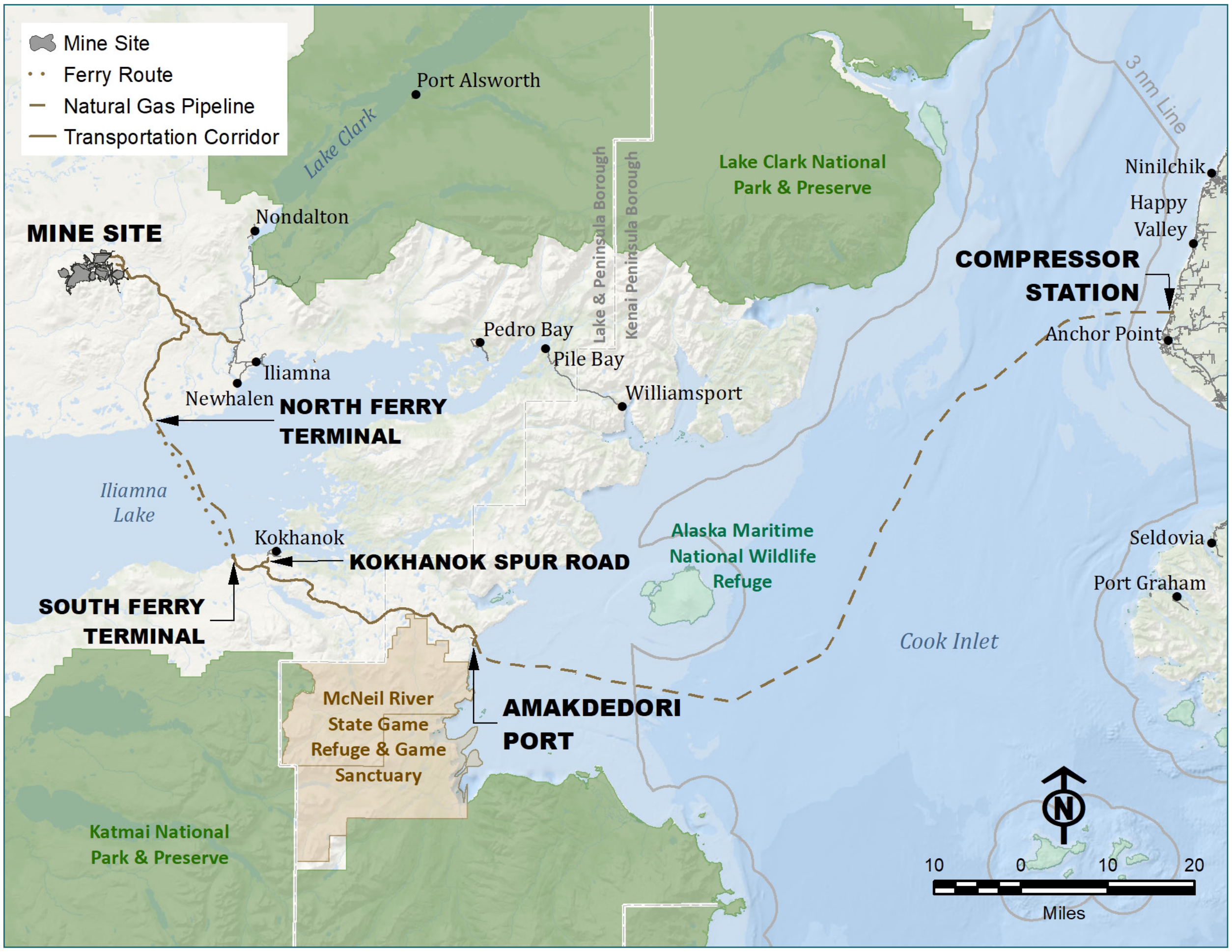


Figure ES-11: Alternative 1—General Project Layout

A1 2.3 Alternative 1

The base case for Alternative 1 is PLP's original proposed Pebble Project, described in detail in PLP's December 2018 Project Description.

Alternative 1 considers:

1. the same mine site layout and processes as Alternative 1a;
2. a different transportation corridor and natural gas pipeline route from the north ferry terminal to the mine site that traverses the UTC watershed;
3. a different north ferry terminal; and
4. the same port access road and the same port site and facilities as Alternative 1a (Amakdedori port), but with a solid fill/sheet pile dock (Figure ES-11).

Mine Site

The mine site layout, footprint (approximately 8,390 acres), and processes under Alternative 1 would be the same as described for Alternative 1a.

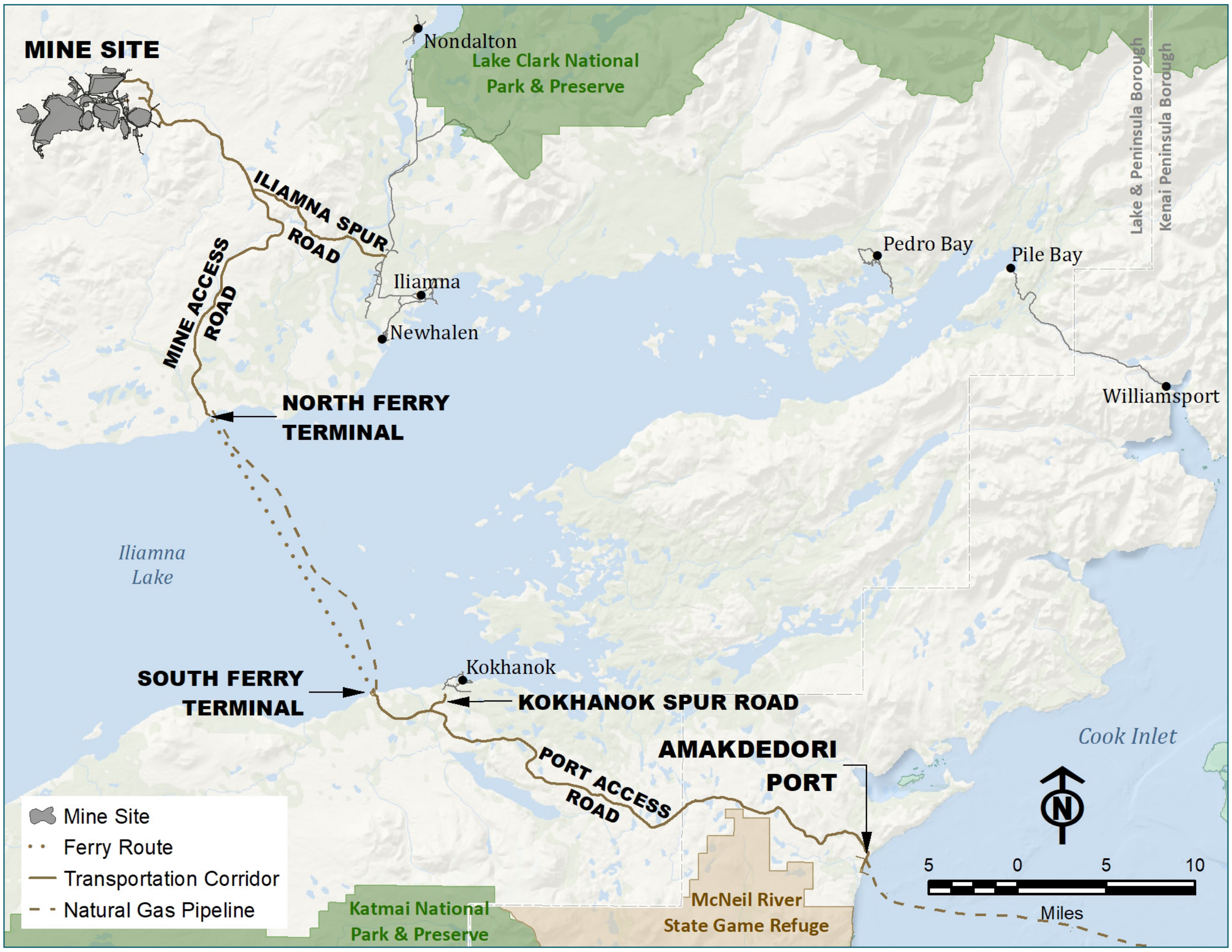


Figure ES-12: Alternative 1—Transportation Facilities Overview

Transportation Corridor

The transportation corridor, which would connect the mine site to Amakdedori port on Cook Inlet, has three main components (Figure ES-12):

- Mine access road (341 acres): A private, unpaved, two-lane road extending approximately 28 miles south from the mine site to a ferry terminal on the northern shore of Iliamna Lake
- Ferry crossing: An ice-breaking ferry to transport materials, equipment, and concentrate 18 miles across Iliamna Lake to a ferry terminal on the southern shore near the village of Kokhanok
- Port access road (411 acres): Same as Alternative 1a

Separate spur roads would extend from the main access roads of the transportation corridor. Spur roads under Alternative 1 include:

- Iliamna spur road (119 acres): An unpaved spur road, approximately 9 miles long, from the mine access road to the existing road system supporting the communities of Iliamna and Newhalen
- Kokhanok spur road (15 acres): Same as Alternative 1a
- Explosives storage spur road (4 acres): Same as Alternative 1a

Design of the access roads would be the same as Alternative 1a. The Alternative 1 road system would include 10 bridges, eight of which would be single-span, two-lane bridges that range in length from approximately 40 to 90 feet. There would be two multi-span, two-lane bridges at Newhalen River (575 feet) and Gibraltar River (300 feet). Typical bridge and culvert designs would be the same as described for Alternative 1a.

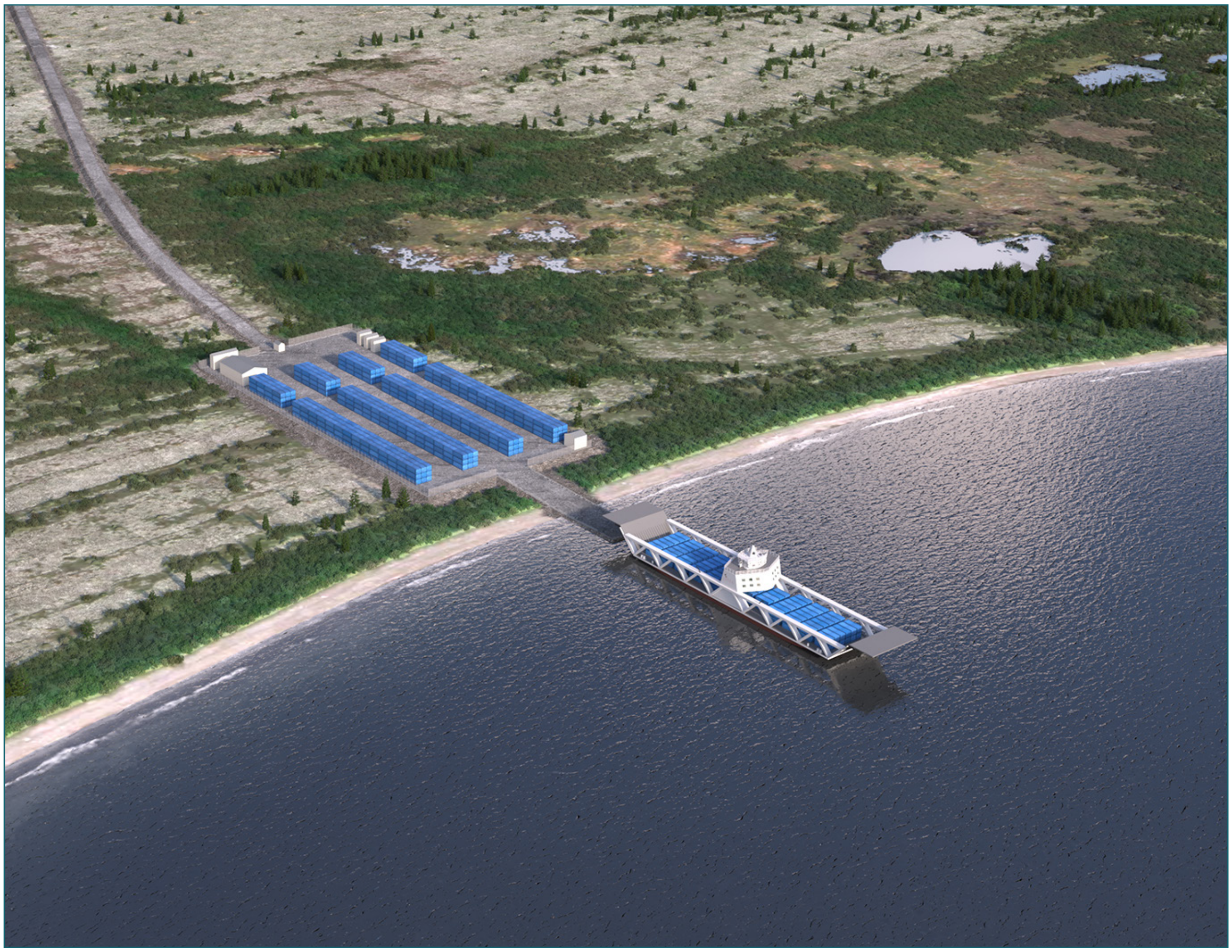


Figure ES-13: Digital Simulation of North Ferry Terminal

The ferry vessel design and operations would be year-round, the same as Alternative 1a, but would have a different ferry terminal location on the north shore of Iliamna Lake, and a different ferry crossing route. The north ferry terminal (4 acres) would have a similar layout, facilities, and operations as Alternative 1a (Figure ES-13). The one-way ferry trip is about 18 miles, and would take approximately 1.5 hours in open water, or 3 hours in ice conditions. On average, one round trip per day across the lake would be required, the same as Alternative 1a.

Temporary facilities associated with Alternative 1 would be the same as described for Alternative 1a for access roads. Trucks, containers, and personnel traffic would also be the same as described for Alternative 1a.

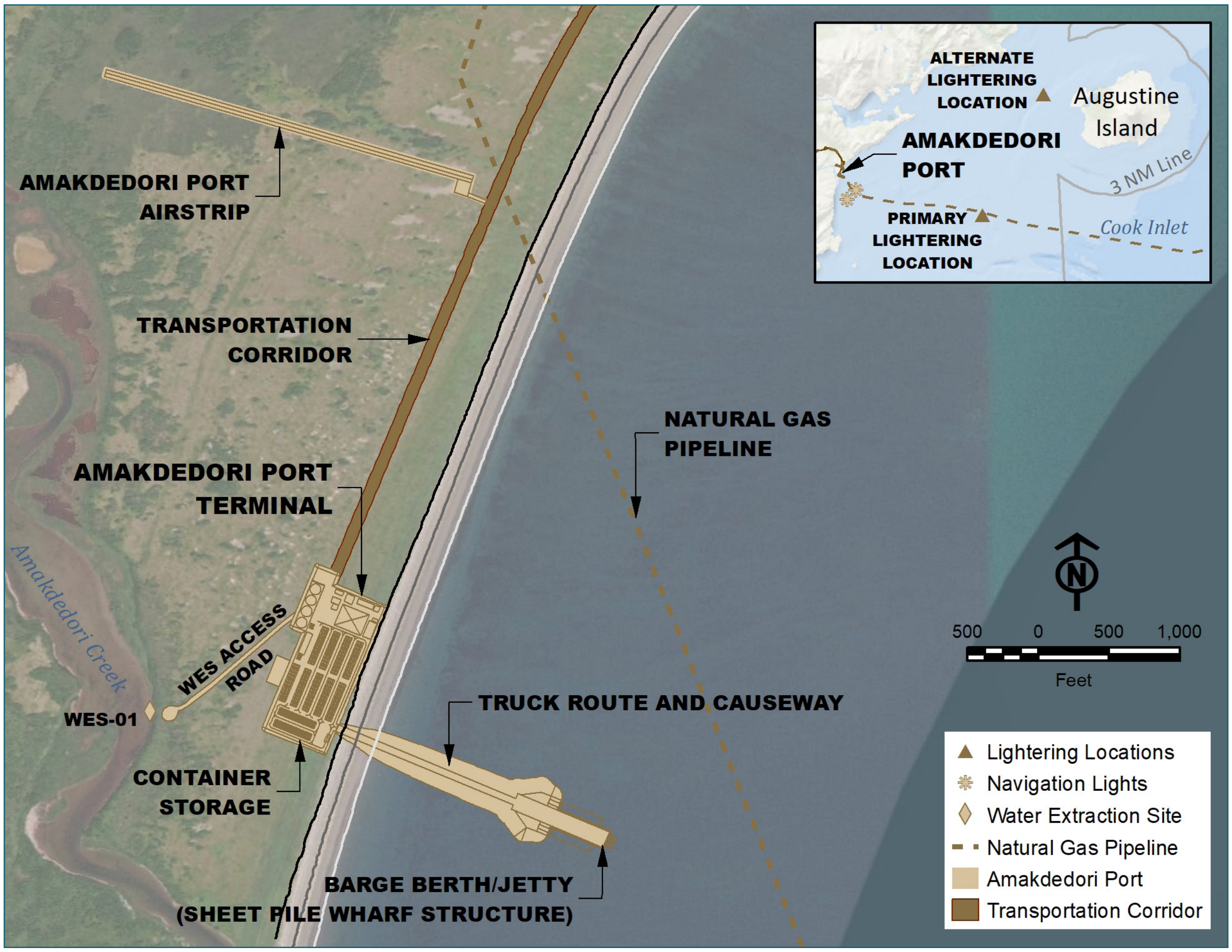


Figure ES-14: Alternative 1—Amakdedori Port and Lightering Locations

Amakdedori Port and Lightering Locations

Alternative 1 includes construction of the Amakdedori port and lightering locations, as described for Alternative 1a, but the marine facilities would include an earthen access causeway and sheet pile jetty instead of a caisson dock (Figure ES-14). All other aspects of the port facilities, operation, water management, and physical reclamation and closure would be the same as described for Alternative 1a.

The shore-based facilities (15 acres) at Amakdedori would be similar to those described for Alternative 1a. The port would be supported by a permanent airstrip (6 acres) that would be used primarily for construction, but retained for emergency access.

The marine facility (11 acres) would include an earthen access causeway extending out to a marine jetty at 15 feet below MLLW. The jetty is expected to be constructed as a sheet pile cell structure filled with granular material. Permanent structures mounted on the causeway and or dock would include a fuel pipeline for unloading barges, a powerline for vessel shore power, a water supply line for firefighting, and illumination and navigation lights. No permanent cranes or fuel storage would be on the dock. Mobile cranes would be used on the dock for some operations.

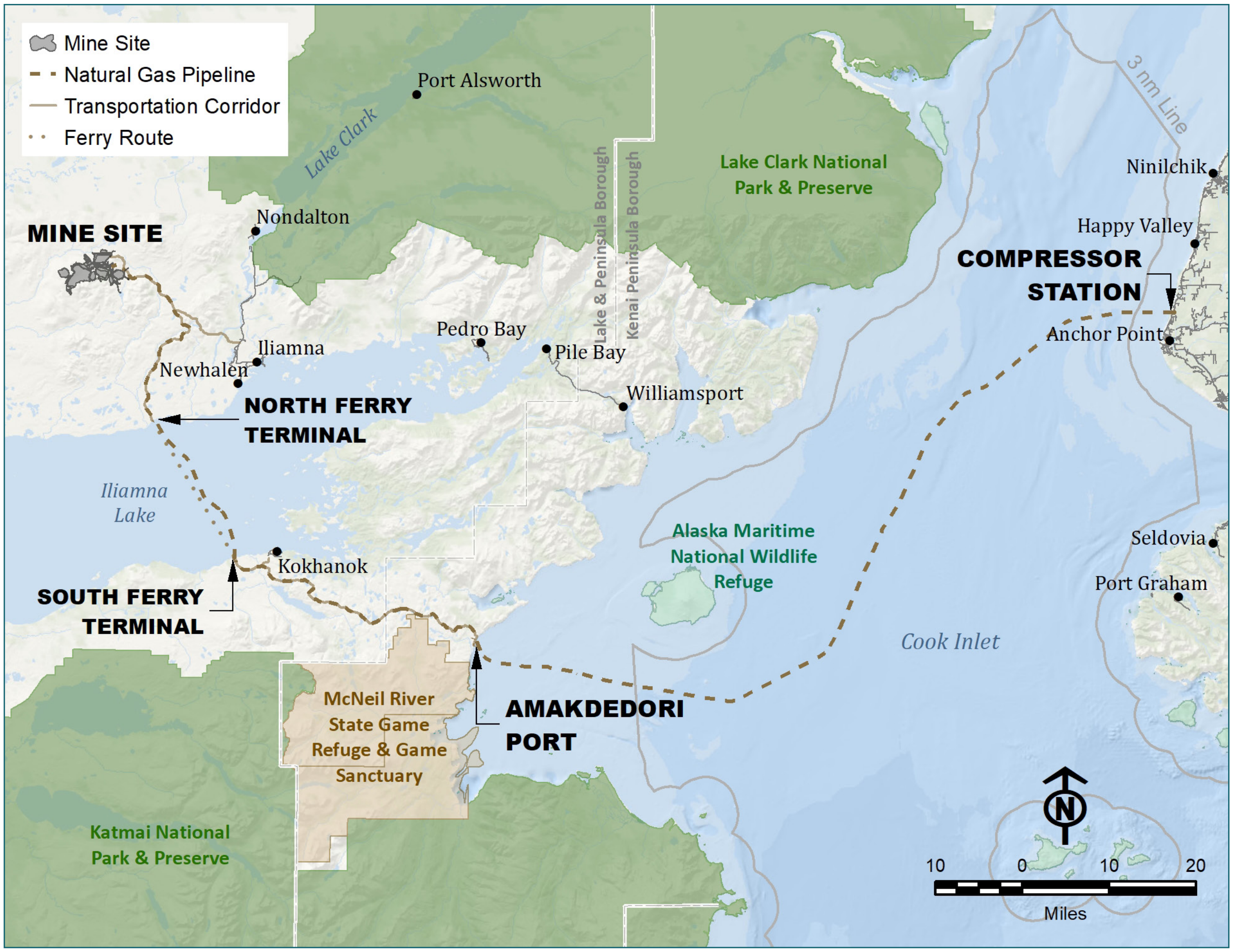


Figure ES-15: Alternative 1—Natural Gas Pipeline Alignment

Natural Gas Pipeline

Natural gas would be supplied to Amakdedori port and the mine site by pipeline (187 miles) (Figure ES-15). The natural gas pipeline across Cook Inlet (104 miles) would be constructed as described for the Alternative 1a, coming ashore at Amakdedori port.

The natural gas corridor from Amakdedori port to the mine site would consist of three sections. The first section would follow the port access road to the south ferry terminal. At the south ferry terminal, gas would be fed from the pipeline to the facilities for power supply and facility heat. At this point, the pipeline would enter Iliamna Lake for the next section, an approximately 19 mile lake crossing. The pipeline would come ashore at the north ferry terminal. Natural gas would be used to provide power and heat at ferry terminal facilities. From this point, the pipeline would follow the mine site access road to the mine site.

Surface roughness along two sections of the Iliamna Lake pipeline segment (approximately 2 miles combined) would require building permanent berms on the lakebed to place the pipeline on. The berms would be 13 feet wide, resulting in a permanent footprint of 4 acres. The berms would be constructed as describe for Alternative 1a.

Pipeline construction and all other aspects of the pipeline would be the same as described for Alternative 1a.

Alternative 1 Summer-Only Ferry Operations Variant

An option to restrict ferry operations to the open water season was suggested during scoping due to concerns with use of an ice-breaking ferry. With this variant, concentrate shipping at the Amakdedori port using lightering and bulk freighters would continue per the year-round schedule even though the ferry operations would be restricted to the open water season. Therefore, additional storage of containers would be needed at the mine site, to facilitate year-round processing operations; and at the port site, to accommodate the additional containers trucked when the ferry is operating. This variant would not involve changes to the natural gas pipeline component.

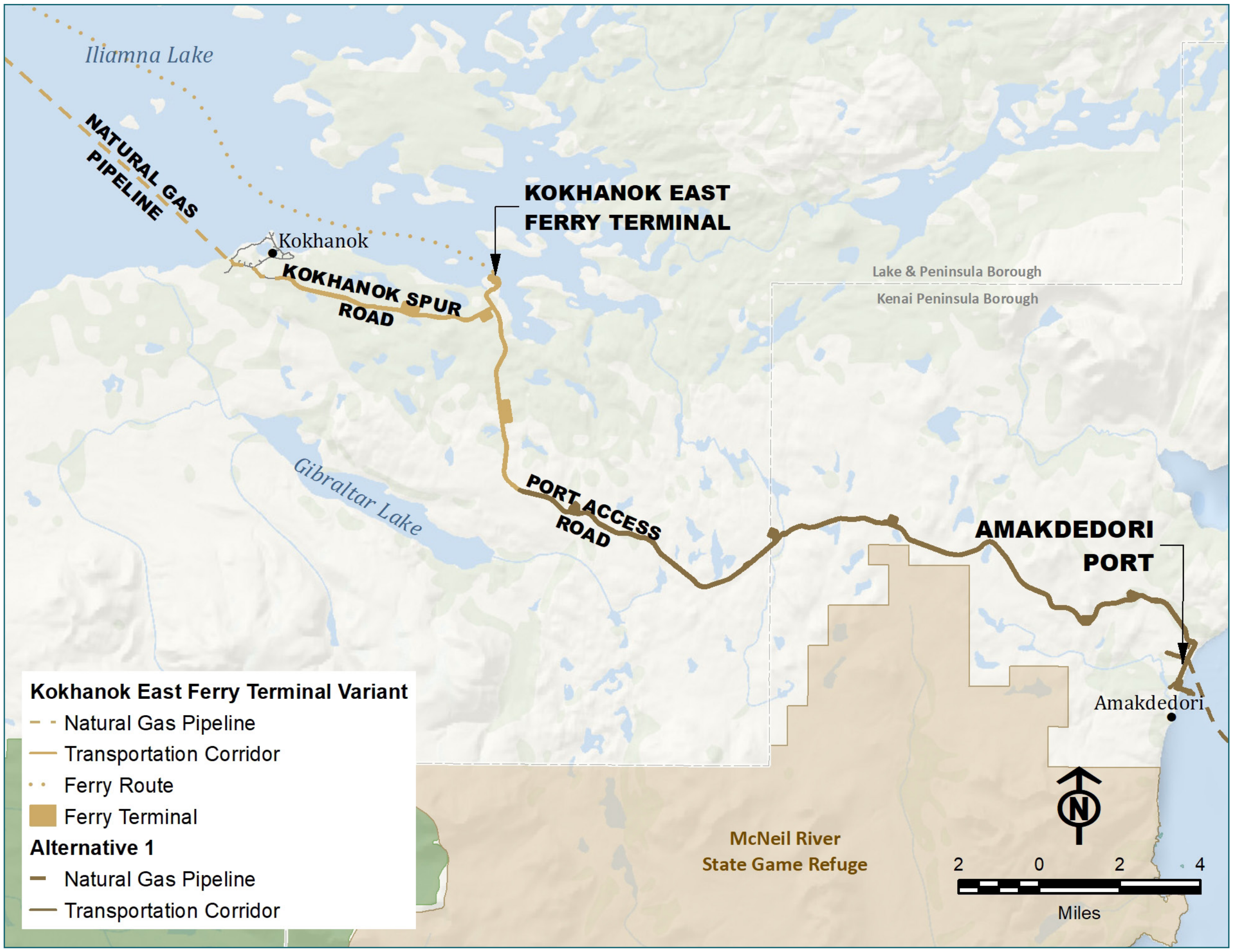


Figure ES-16: Alternative 1—Kokhanok East Ferry Terminal Variant

Storage of concentrate at the mine site would be needed during the non-operating months, until Iliamna Lake is free of ice and can resume the movement of cargo. Storage would be through a container-based system with an additional laydown area at the mine site. The container yard would be relocated and expanded, the sewage tank pad would be relocated to provide additional laydown space in proximity to the mill, and on-site access roads would be reconfigured slightly; resulting in an increase of the mine site footprint by about 33 acres.

To transport annual quantities of concentrate, fuel, and consumables during the open water months, a larger non–ice-breaking vessel, or possibly two vessels, would be necessary (PLP 2018 RFI 065).

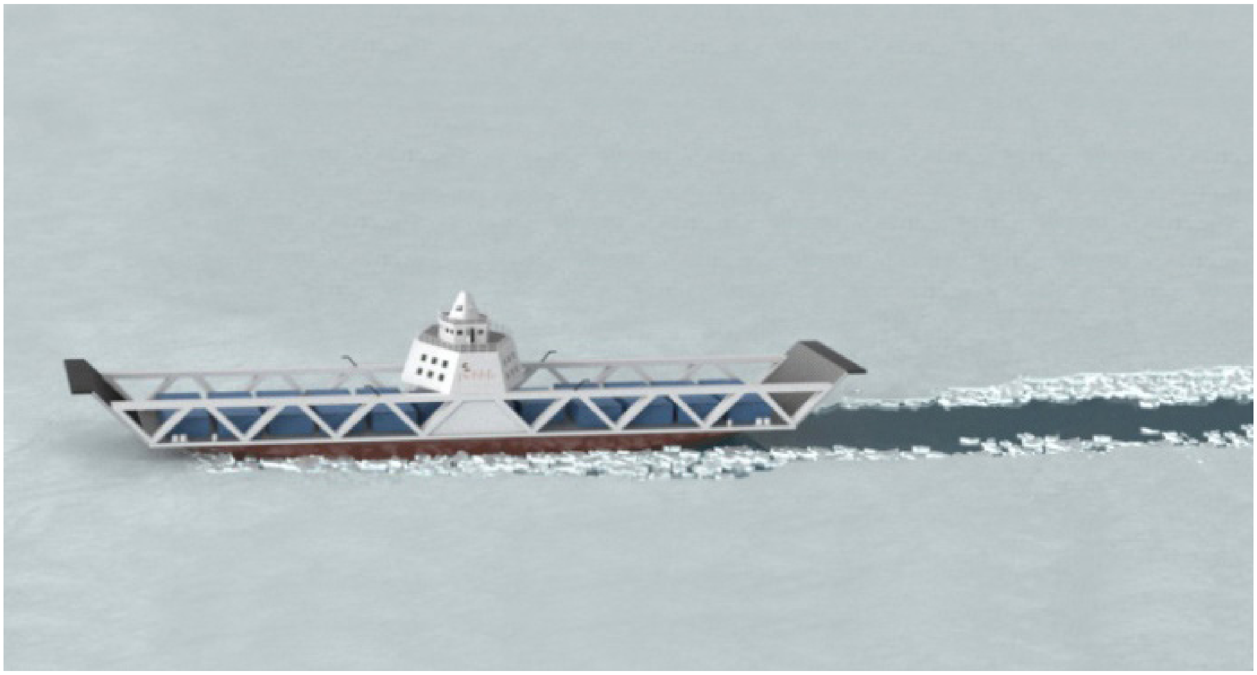
With this variant, the vessel(s) would be pulled out of the water at freeze-up and launched at break-up. The ferry crew jobs would be seasonal only. During the non-operating months, the ferry or ferries would be over-wintered in cradles onshore in the ferry terminal construction area. The ferry or ferries would be winterized, and any required maintenance would be completed while the ferry or ferries were out of the water.

Trucks would also only operate when the ferry or ferries are running, which would double the number of round-trip truck moves to 70 per day each side of the ferry terminals. The fleet size of truck and trailer units would also double.

Concentrate would be transported to the port site during the operating months and stored on site, where it would be lightered out to the bulk carriers and shipped to market on a year-round basis. Storage would be through a container-based system with an expanded container storage yard (27 acres) at the port site (PLP 2018 RFI 065).

Alternative 1
Kokhanok East Ferry Terminal Variant

This variant considers a south ferry terminal site: the Kokhanok east ferry terminal site (Figure ES-16). The transportation corridor and natural gas pipeline components would change with incorporation of this variant. This variant does not involve changes to the mine site or port components.



An ice-breaking ferry could be used to transport materials, equipment, and concentrate 27 miles across Iliamna Lake to a ferry terminal on the southern shore east of the village of Kokhanok (Kokhanok east ferry terminal)

The transportation corridor with incorporation of this variant is as follows:

- Mine access road (341 acres): Same as Alternative 1 base case
- Ferry crossing: An ice-breaking ferry to transport materials, equipment, and concentrate 27 miles across Iliamna Lake to a ferry terminal on the southern shore east of the village of Kokhanok (Kokhanok east ferry terminal)
- Port access road (297 acres): A private, unpaved, two-lane road extending approximately 27 miles southeast from the Kokhanok east ferry terminal to Amakdedori port on Cook Inlet

Separate spur roads would extend from the main access roads of the transportation corridor. Spur roads under this variant include:

- Iliamna spur road (119 acres): Same as Alternative 1 base case
- Kokhanok spur road (65 acres): An unpaved spur road, approximately 5 miles long, from the port access road to the community of Kokhanok
- Explosives storage spur road (4 acres): Same as Alternative 1 base case

The port access road to the Kokhanok east ferry terminal site would not require a crossing of the Gibraltar River, and would also have fewer overall stream crossings.

The Kokhanok east ferry terminal site (15 acres) would have a similar layout to the south ferry terminal. The one-way ferry trip under this variant would be longer than the Alternative 1 base case, which would add to the trip duration. The crossing would take approximately 2.25 hours to complete in open water, or 4.5 hours in ice conditions.

The natural gas pipeline alignment from the Amakdedori port would follow the port access road towards the Kokhanok east ferry terminal and the spur road into Kokhanok. From Kokhanok, it would follow an existing road alignment to the point, where it would depart the shoreline to tie into the proposed route from the south ferry terminal site. The total pipeline length with this variant would be 185 miles. The pipeline design and all other segments of the pipeline would be the same as described for Alternative 1.

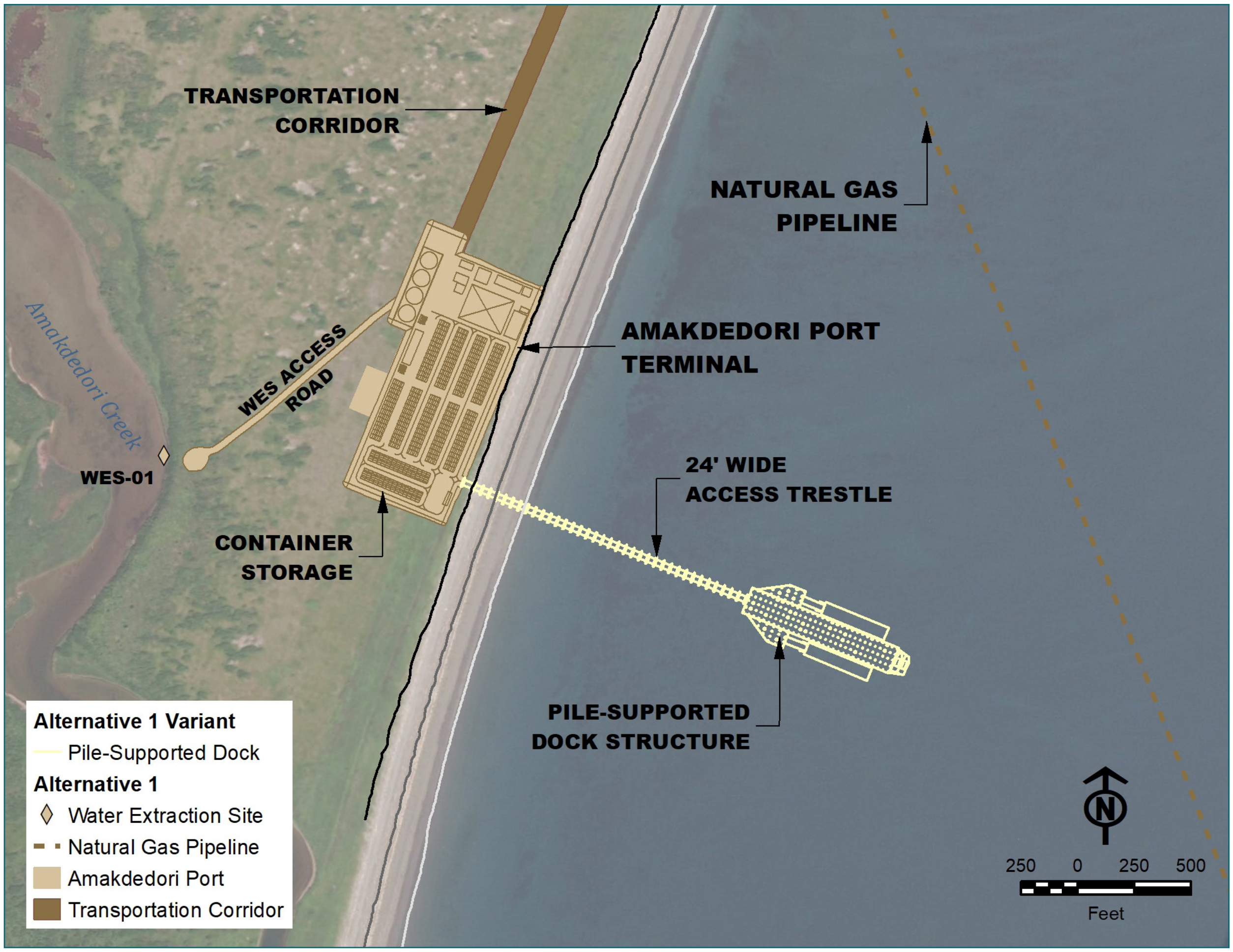


Figure ES-17: Alternative 1—Amakdedori Port Pile-Supported Dock Variant

Alternative 1 Pile-Support Dock Variant

This variant considers construction of an access trestle and pile-supported dock at Amakdedori port, instead of an earthen access causeway and jetty, to minimize in-water impacts (Figure ES-17). The conceptual structure would consist of 76 trestle piles and 177 dock piles, for a total of 253 piles. All piles would be 48 inches in diameter, with a 1.5 inch wall thickness. The steel piles would be vibrated into place and then driven to refusal with an impact hammer. The footprint of the marine facility with this variant would be less than 0.1 acre (3,200 square feet). Other than pilings, no in-water fill would be placed below mean high water of Cook Inlet with this variant. All other facilities and operations at the port would be the same as described for Alternative 1. This variant would not involve changes to the mine site, transportation corridor, or natural gas pipeline components.

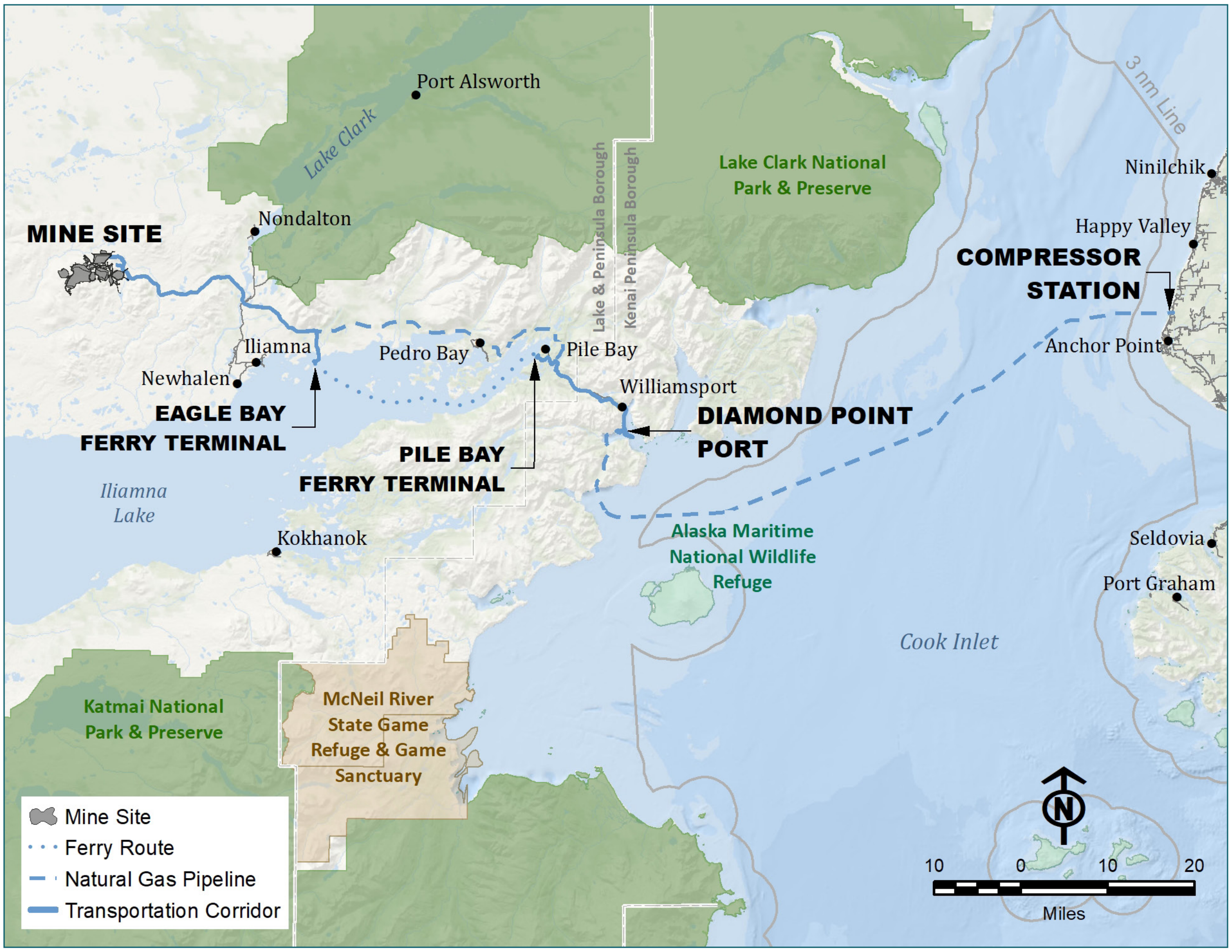


Figure ES-18: Alternative 2—General Project Layout

A2 2.4 Alternative 2 - North Road and Ferry with Downstream Dams

Alternative 2—North Road and Ferry with Downstream Dams, was developed primarily to address scoping comments suggesting that the EIS analyze Alternative road corridors, ferry terminal, and port locations; and due to concerns expressed about the stability of tailings facilities.

Alternative 2 considers: 1) downstream construction methods for the north bulk TSF embankment; 2) a different transportation corridor route (access roads and ferry) on the northern end of Iliamna Lake; 3) a port site at Diamond Point; and 4) a natural gas pipeline alignment on the northern end of Iliamna Lake (Figure ES-18).

Mine Site

The mine site layout and processes under Alternative 2 would be the same as described for Alternative 1a, except for the construction methods for the north embankment of the bulk TSF. Under Alternative 2, the north bulk TSF embankment would be constructed using the downstream method with buttresses, instead of the centerline method described under Alternative 1a.

The Alternative 2 bulk TSF footprint would be 2,907 acres; an increase of 110 acres compared to Alternative 1a. There would also be minor adjustment to the sediment/seepage collection systems (1 acre increase), mine site infrastructure (1 acre decrease), and on-site access roads (4 acre decrease), compared to Alternative 1a, to accommodate the bulk TSF design. The overall mine site footprint for Alternative 2 would be 8,497 acres.

Transportation Corridor

The transportation corridor under Alternative 2 would connect the mine site to the Diamond Point port in Iliamna Bay for the transportation of materials, equipment, and concentrate. It has three main components: mine access road (353 acres, same as Alternative 1a), ferry crossing (29 miles), and port access road (18 miles with a footprint of 209 acres). The explosives storage spur road (4 acres), previously described for Alternative 1a, is the only spur road proposed under Alternative 2. The ferry, truck transportation, and the Diamond Point port would operate year round. Under Alternative 2, an airstrip would not be constructed at the port site; however, improvements to the existing airstrip near Pile Bay may be necessary for limited use during construction.

The mine access road alignment and design would be the same as Alternative 1a. The Alternative 2 road system would include seven bridges, four of which would be single-span, two lane bridges that range in length from approximately 50 to 90 feet. There would be one large (510 feet) multi-span, two-lane bridge at the Newhalen River (575 feet), and two other multi-span bridges at Iliamna River (200 feet) and Chinkelyes Creek (140 feet). The Newhalen River crossing would be at the southern crossing location. Typical bridge and culvert designs would be the same as described for Alternative 1a.

The ferry vessel design and operations would be year-round, the same as Alternative 1a, but would have a different ferry terminal location on the southern shore of Iliamna Lake and a different ferry crossing route. The south shore ferry terminal (18 acres) would be south of the start of the Williamsport-Pile Bay Road on the eastern shore of Iliamna Lake (Pile Bay ferry terminal). The one-way ferry trip is about 29 miles, and would take approximately 2.5 hours to complete in open water, or 5 hours in ice conditions. On average, one round trip per day across the lake would be required, the same as Alternative 1a.

The general descriptions for temporary facilities, transportation corridor traffic, material transport, and physical reclamation and closure would be the same as Alternative 1a, but would occur at the locations described under this alternative, with the exception of the Diamond Point port, discussed below.

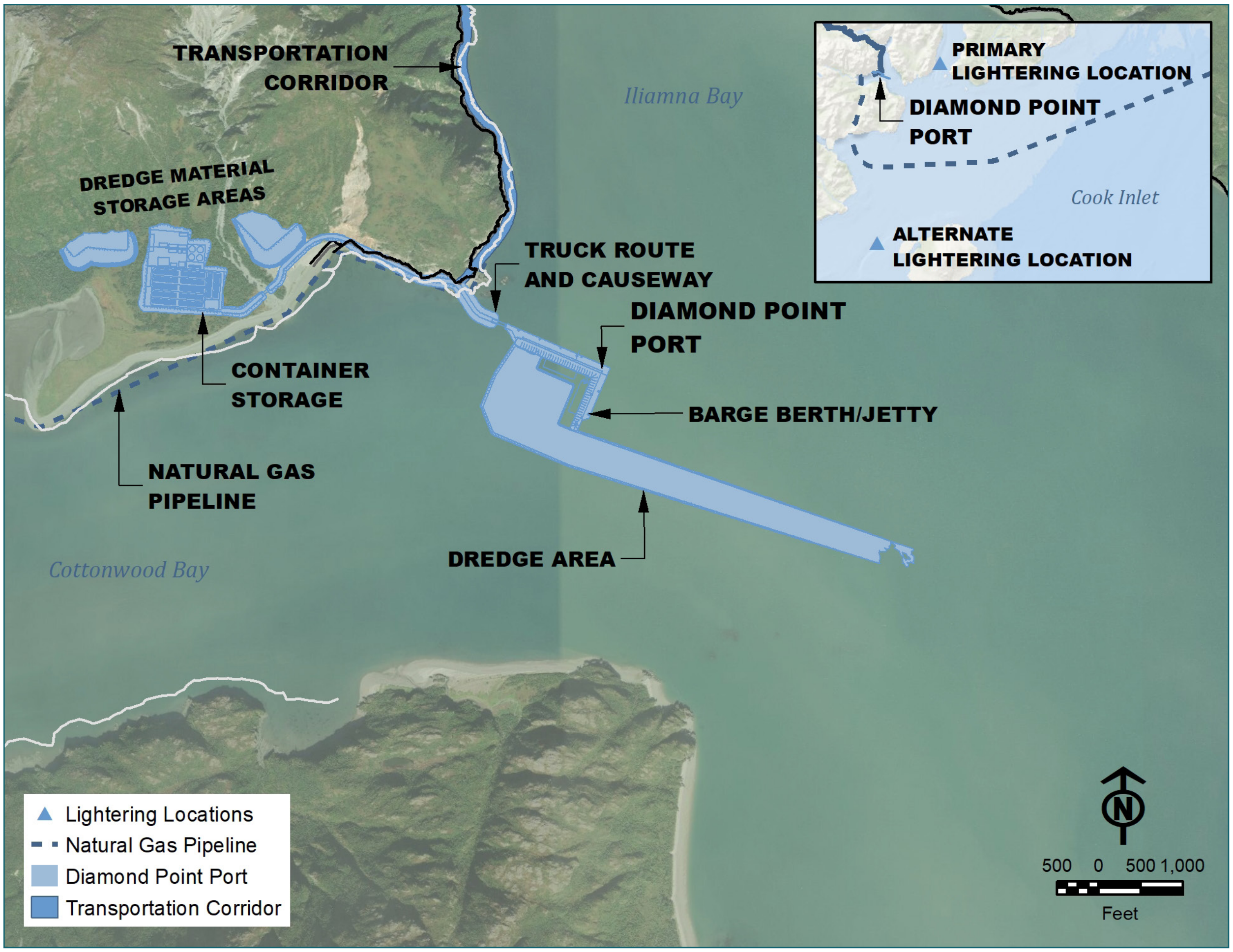


Figure ES-19: Alternative 2—Diamond Point Port and Lightering Locations

Diamond Point Port and Lightering Locations

Alternative 2 includes construction of Diamond Point port (55 acres), a year-round port at Iliamna Bay (Figure ES-19 and Figure ES-20). The Amakdedori port would not be constructed under this alternative. The port site would include shore-based and marine facilities for the shipment of concentrate, freight, and fuel for the project. The shore-based facilities (41 acres) would include the port site (25 acres) with separate facilities for the receipt and storage of containers for concentrate and freight, as well as two bermed facilities (16 acres) for storage of maintenance dredging material. The marine facility (14 acres) would be similar to the Amakdedori port design under Alternative 1, consisting of an earthen access causeway extending out to a marine jetty. The jetty is expected to be constructed as a sheet-pile cell structure filled with granular material. The shallow approach at this port site would require dredging to 20 feet MLLW to ensure year round access by vessels requiring 15 foot water depth. Dredged material would either be used in construction of the causeway and dock, or disposed of onshore. The dredge area would be approximately 58 acres. The total volume of dredged material for the 20 foot-deep channel would be 650,000 cubic yards, of which a minimum of 50 percent is estimated to be used in the barge dock construction, and the remainder would be placed in an onshore fill.

Two offshore lightering stations would be used to lighter the ore concentrate to moored bulk carriers. The primary location in Iniskin Bay would be used unless weather, waves, ice, or other factors preclude its use. If the primary location is not suitable under given conditions, the alternate location, approximately 18 miles east-northeast of the proposed Amakdedori port between Augustine Island and the mainland, would be used if conditions there are more favorable. The proposed mooring system would be the same as described for Alternative 1a.

Port operations and material transport would be the same as described for Alternative 1a; however, the shipping routes would be to/from Diamond

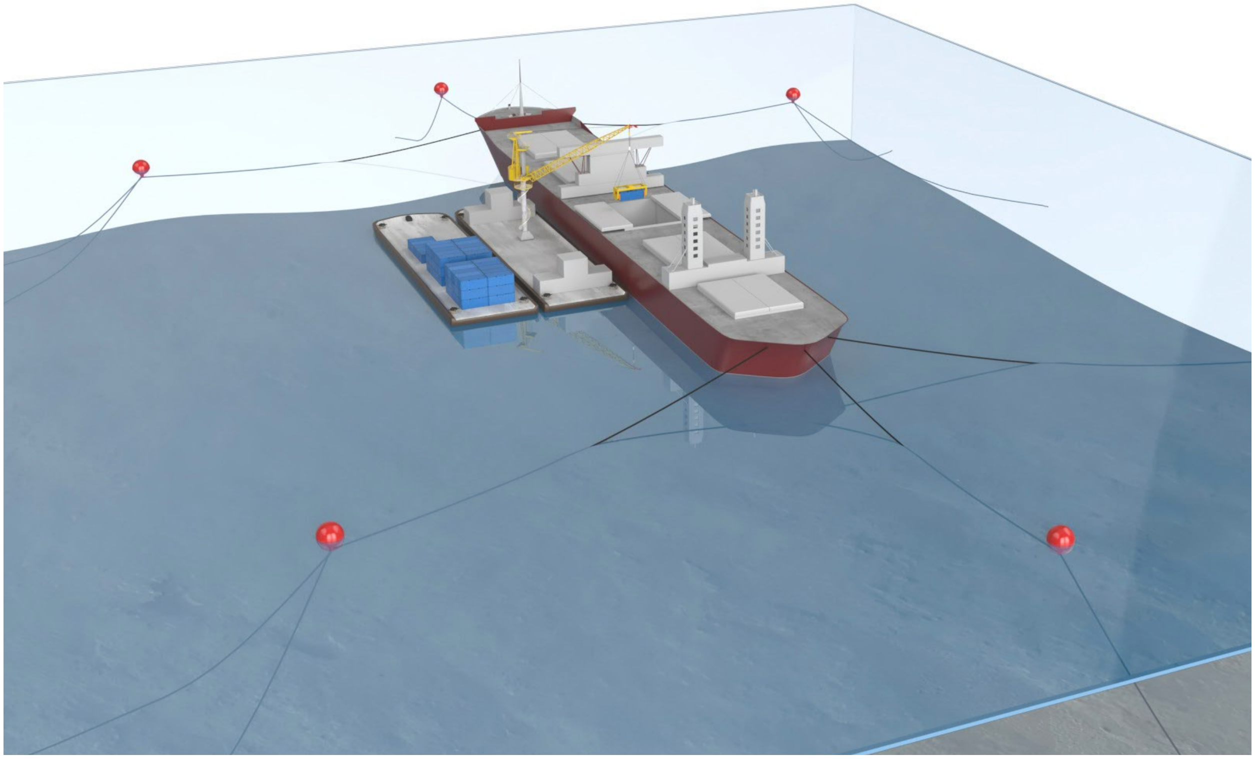
Figure ES-20: Digital Simulation of Diamond Point Port

Point rather than Amakdedori. The likely bulk carrier shipping route for transport of concentrate to Asia, the primary supply and construction barge route from the West Coast to Diamond Point, as well as an Alternative inland barge route that could be used under adverse conditions are illustrated in Appendix K3.12, Transportation and Navigation.

Natural Gas Pipeline

Natural gas would be supplied to the Diamond Point port and mine site via pipeline. The pipeline across Cook Inlet (75 miles) would be constructed as described for Alternative 1a, but the alignment would come ashore at Ursus Cove. As with Alternative 1a, HDD would be used to install pipe segments from the compressor station out into waters that are deep enough to avoid navigation hazards. From this point, the heavy-wall pipe would be trenched into the sea floor for the remaining Cook Inlet crossing. The temporary construction footprint for seabed installation would vary; ranging from 57 to 101 feet across Cook Inlet (PLP 2020 RFI BSEE 1a), and a maximum 183 feet in nearshore areas. Trenching and burial would occur using the same technology described for Alternative 1a. Additional potential seabed disturbance may occur from anchor placement to hold pipe-lay barges in place. Anchor placement may extend approximately 650 feet to 4,101 feet on either side of the pipeline centerline depending on depth. The pipeline would come ashore in Ursus Cove using trenching, follow an overland alignment across Ursus Head (west of Brown's Peak Creek for approximately 2.6 miles until the creek crossing), then continue across Cottonwood Bay to the Diamond Point port. This overland pipeline-only segment (i.e., not adjacent to an access road) would be constructed as described for Alternative 1a; with a temporary construction footprint encompassing the proposed 150 foot ROW to conservatively account for pipeline trenching, side-casting, and equipment operation/travel. Access for construction of the pipeline across Cottonwood Bay would be by barge landings from each end of the ROW.

From Diamond Point port, the pipeline would be buried in a trench that follows the general Alternative 3 north access road alignment (described below) with minor deviations. For segments that follow the Alternative 2 access road alignment to the mine site, the pipeline and fiber-optic cable would be buried in a trench adjacent to the access roads. At bridged river crossings, the gas pipeline would either be placed beneath the rivers using HDD or trenching, or would be attached to the bridge structures. For overland segments that do not follow the road alignment, PLP would secure ROW easements from landowners. A 150 foot temporary construction ROW would be requested, as described above. Three construction access points would be required for construction of the pipeline-only segments, and would be reclaimed after construction.



Copper-gold concentrate containers would be lightered to bulk carriers moored offshore

Alternative 2 Summer-Only Ferry Operations Variant

An option to restrict ferry operations to the open water season was suggested during scoping due to concerns with use of an ice-breaking ferry. With this variant, concentrate shipping at the Diamond Point port using lightering and bulk freighters would continue per the year-round schedule even though the ferry operations would be restricted to the open water season. Therefore, additional storage of concentrate containers would be needed at the mine site to facilitate year-round processing operations, and along the Williamsport-Pile Bay Road due to limited available space at Diamond Point port to accommodate the additional containers trucked when the ferry is operating. This variant would not involve changes to the port or natural gas pipeline components.

Changes at the mine site with incorporation of this variant would be the same as described for the Alternative 1—Summer-Only Ferry Operations Variant. Additional storage during the non-operating months of the ferry would be needed for concentrate, consumables, reagents, and diesel. The Alternative 2 mine site footprint would increase by about 33 acres as a result of the expanded and relocated container yard, relocated sewage tank pad, and reconfigured on-site access roads. Changes associated with the transportation corridor with incorporation of this variant would be similar to those described for the Alternative 1—Summer-Only Ferry Operations Variant. The only difference is that the Alternative 2—Summer-Only Ferry Operations Variant would require an additional laydown area (container yard: 22 acres) along the Williamsport-Pile Bay Road, instead of at the port, due to limited available space at the Diamond Point port site. Concentrate would be transported to the container yard during the ferry operating months, where it would be accessible for year-round shipment through the Diamond Point port.

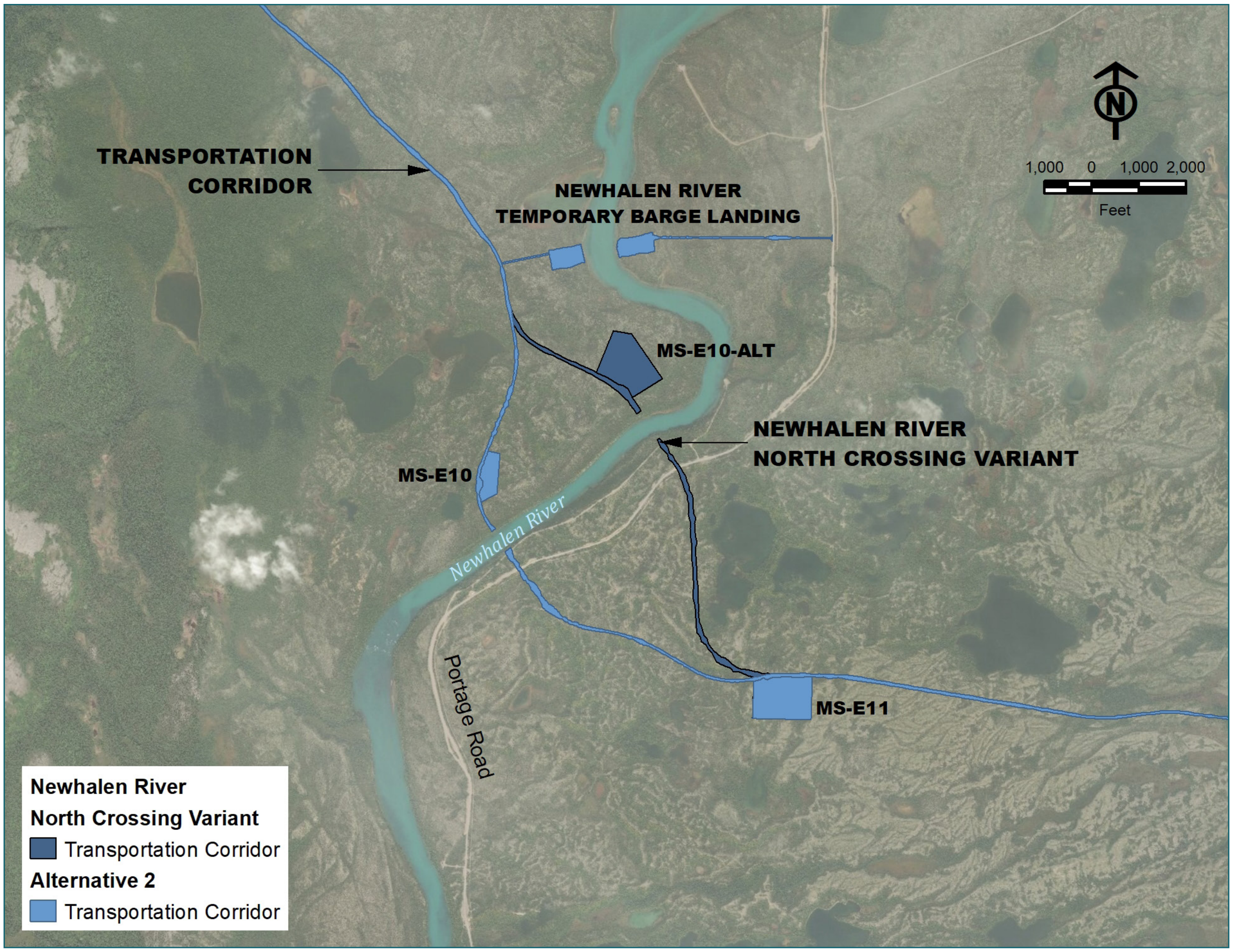


Figure ES-21: Alternative 2—Newhalen River North Crossing Variant

Alternative 2 Pile-Supported Dock Variant

This variant would construct an access trestle and pile-supported dock at Diamond Point, instead of an earthen access causeway and jetty, to minimize in-water impacts. The conceptual structure would consist of 44 trestle piles and 474 dock piles, for a total of 518 piles. All piles would be 48 inches in diameter, with a 1.5 inch wall thickness. The steel piles would be vibrated into place and then driven to refusal with an impact hammer. The footprint of the marine facility with this variant would be less than 4 acres, which includes the footprint of the pilings (6,500 square feet) and fill placed below the mean high-water mark of Cook Inlet for the port site. All other facilities and operations at the port, including the dredge area and onshore dredge material storage areas, would be the same as described for the Alternative 2 base case. This variant does not involve changes to the mine site, transportation corridor, or natural gas pipeline components.

Alternative 2 Newhalen River North Crossing Variant

This variant considers a north crossing location of the Newhalen River, approximately 0.8 mile north of the south crossing location that is described for Alternative 1a, and carried forward as the base case for Alternative 2 and Alternative 3 (Figure ES-21). The north crossing was PLP's original proposed crossing in the DEIS that was evaluated for all action alternatives. The bridge design under this variant is similar to the base case Alternative 2, both requiring five spans. This variant would not involve changes to the mine site, port, or natural gas pipeline components.

The mine access road follows the same general alignment as Alternative 2, extending about 35 miles from the mine site to a ferry terminal at Eagle Bay, but follows a north crossing location of the Newhalen River. The mine access road with this variant is slightly shorter (about 0.3 mile), and the footprint is about 3 acres larger (356 acres total). The bridge design under this variant is similar to the Alternative 2 base case, but the length of the bridge would increase from 510 feet to 625 feet.

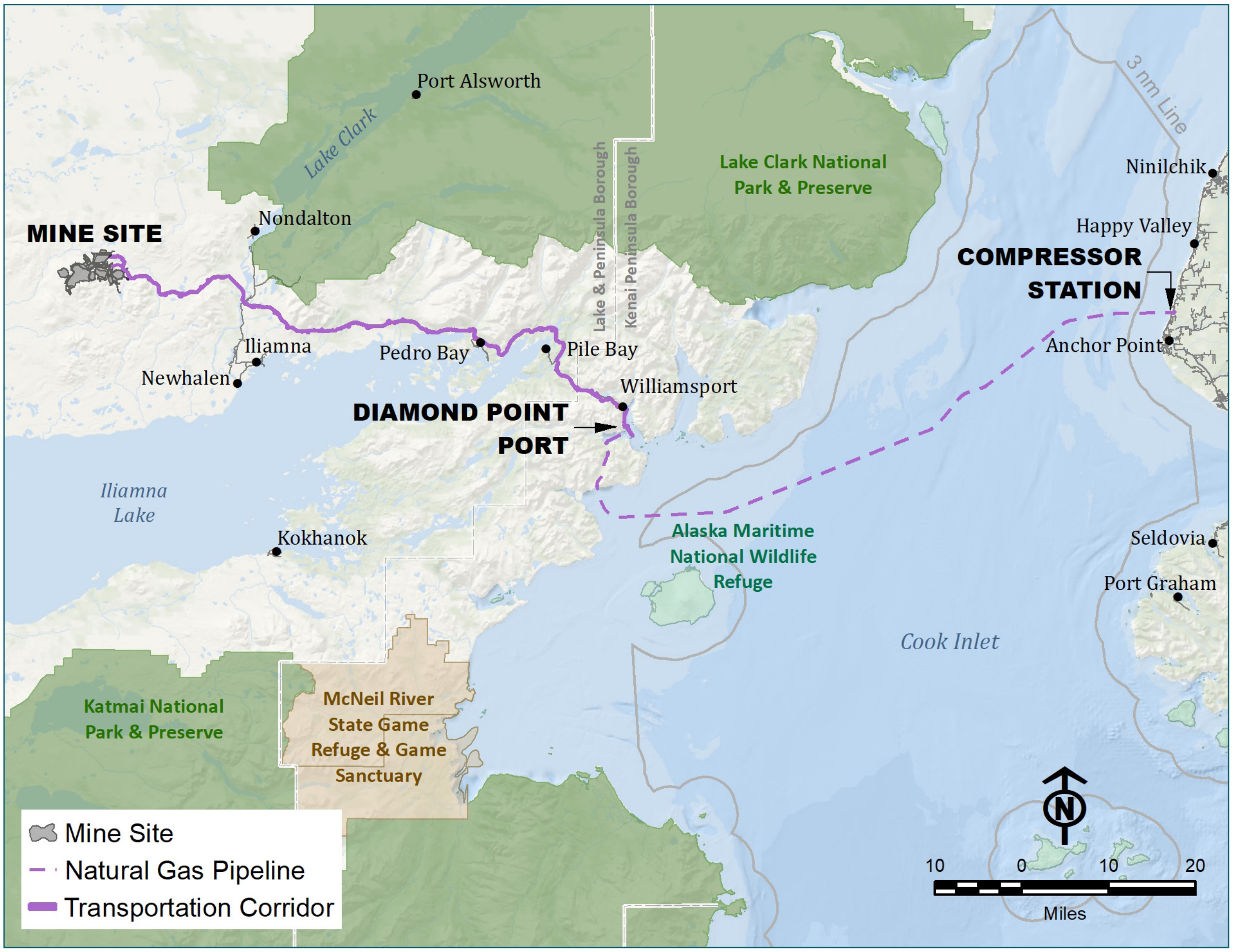


Figure ES-22: Alternative 3—General Project Layout

A3 2.5 Alternative 3—North Road Only

Alternative 3—North Road Only was developed to address scoping comments suggesting that the EIS evaluate an access road alignment north of Iliamna Lake to eliminate the need for a lake (ferry) crossing (Figure ES-22). Alternative 3 considers: 1) the same mine site layout and processes as Alternative 1a; 2) a transportation corridor route on the northern end of Iliamna Lake that does not require a ferry crossing of the lake; 3) a port site north of Diamond Point, with a caisson-supported dock design; and 4) a natural gas pipeline alignment on the northern end of Iliamna Lake that follows the north access road corridor. PLP has identified Alternative 3 as the Applicant's Preferred Alternative, and updated their Project Description in May 2020 to reflect this decision. PLP's updated Project Description is included as Appendix N of the EIS.

Mine Site

The mine site layout, footprint (approximately 8,390 acres), and processes under Alternative 3 would be the same as described for Alternative 1a.

Transportation Corridor

The transportation corridor under Alternative 3 would connect the mine site to the port site north of Diamond Point port in Iliamna Bay (Figure ES-23). The project transportation corridor would consist of a double-lane road north of Iliamna Lake—the north access road (approximately 82 miles and 1,077 acres), which would act as the main access route to and from the mine for the transportation of materials, equipment, and concentrate.

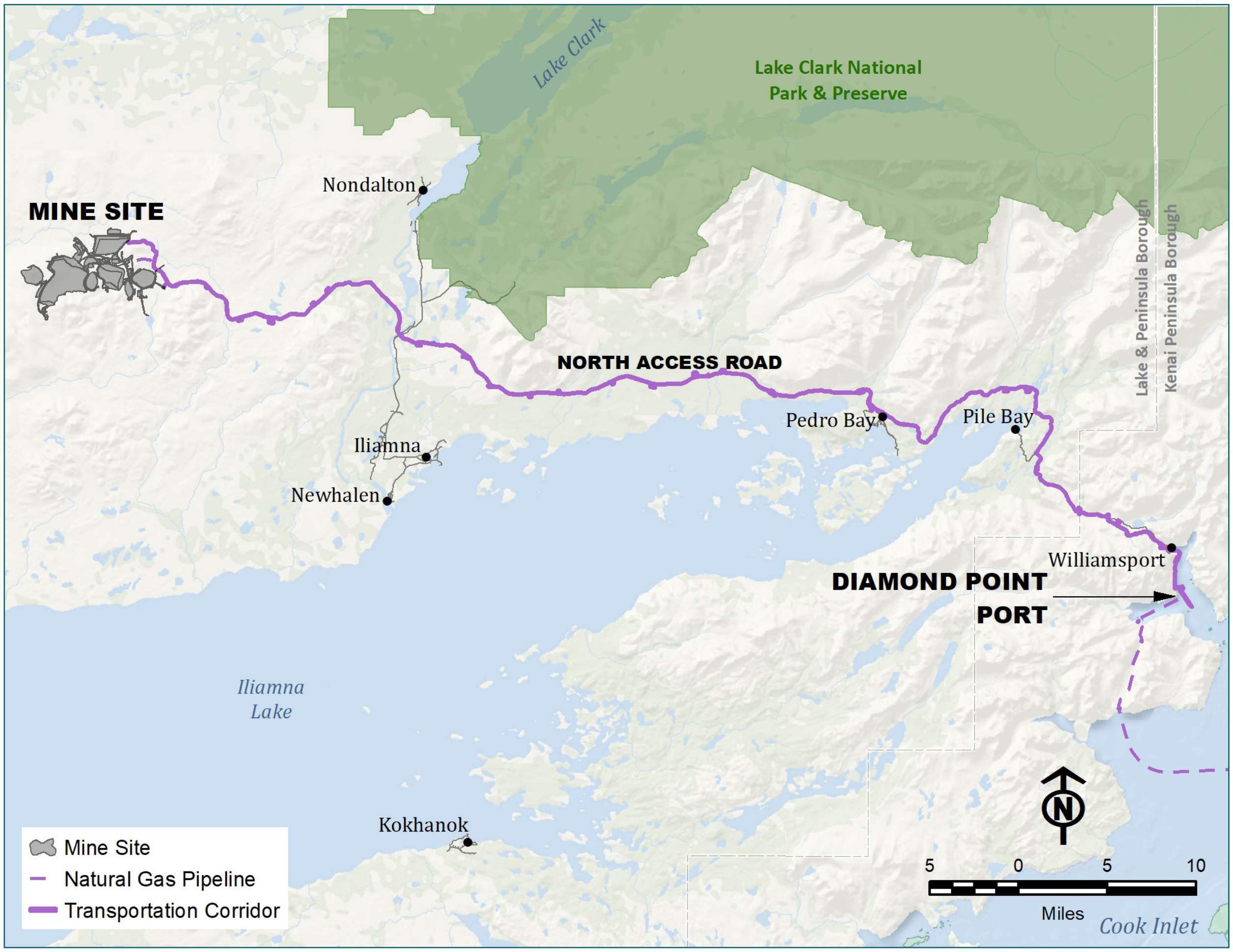


Figure ES-23: Alternative 3—Transportation Facilities Overview

The proposed north access road would parallel the existing Williamsport-Pile Bay Road for approximately 5 miles from Williamsport, and would then replace the existing road for approximately 7 miles from that point until the existing road turns toward Pile Bay. Once constructed, it is assumed that project-related haul trucks would share the road with the existing road users, which are primarily privately operated trucks transporting freight and vessels being portaged. The proposed road to the mine site also intersects the existing road network for the villages of Iliamna and Newhalen.

There would be no ferry transportation across Iliamna Lake. The truck transportation and Diamond Point port would operate year-round. Alternative 3 includes two spur roads: the explosives storage spur road (4 acres), previously described for Alternative 1a; and a short spur road (less than 1 mile) to the Pedro Bay Airport (6 acres).

Physical reclamation and closure would be the same as described for Alternative 2.

The north access road design would be the same as Alternative 1a. The Alternative 3 road system would include 17 bridges, nine of which would be single-span bridges that range in length from approximately 50 to 90 feet. There would be one large (510 feet) multi-span two-lane bridge across the Newhalen River, and seven other multi-span, two-lane bridges that range in length from approximately 140 to 240 feet. The Newhalen River crossing would be at the southern crossing location.

Typical bridge and culvert designs would be similar to those described for Alternative 1a. The natural gas pipeline and fiber-optic cable would be buried in a corridor adjacent to the access road (described below).

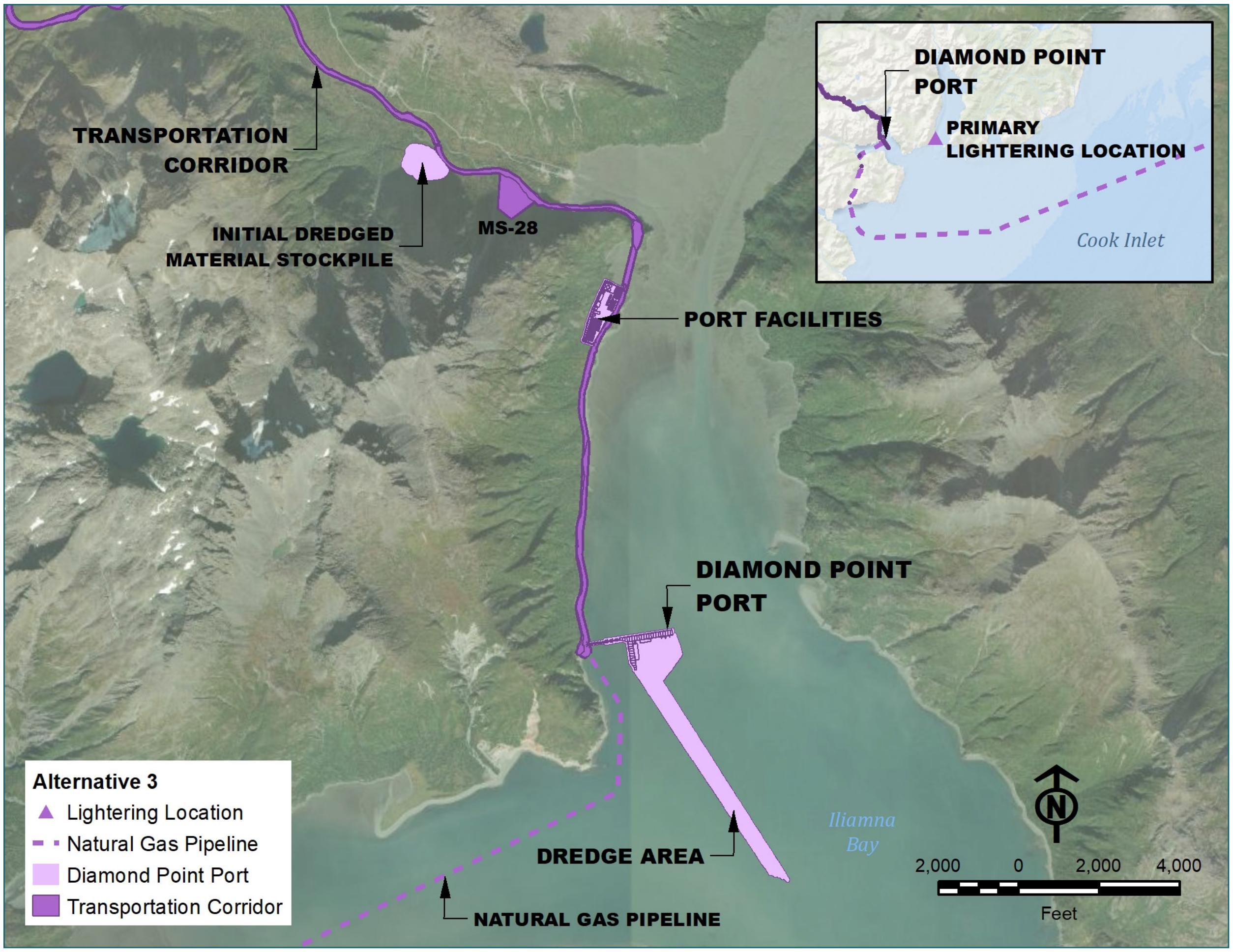


Figure ES-24: Alternative 3—Diamond Point Port and Lightering Locations

Temporary facilities and initial site access would be similar to those described for Alternative 1a, but would occur at the construction locations associated with Alternative 3. For example, the initial construction effort would be at the Diamond Point port instead of Amakdedori port. Temporary facilities associated with ferry terminals would not apply to Alternative 3.

The existing Williamsport-Pile Bay Road would be used to transport equipment and supplies for initial construction of the road alignment along the north shore of Iliamna Lake while the port facilities and road along Iliamna Bay's western side are being constructed. Additional equipment would be shipped by barge from Pile Bay to Iliamna/Newhalen so that work can commence on the western portions of the access road at the same time. The existing Pedro Bay runway would be used to support initial construction of the access road. No modifications of the runway would be required. Initial access to the mine site should be complete within 1 year.

Physical reclamation and closure would be the same as described for Alternative 2.

Diamond Point Port and Lightering Location

Alternative 3 includes construction of a port site north of Diamond Point in Iliamna Bay (Figure ES-24 and Figure ES-25). The Amakdedori port would not be constructed under this alternative. The general descriptions for temporary facilities, water management, port operations, and material transport would be the same as described for Alternative 2; physical reclamation and closure would be the same as Alternative 1a, but would occur at the locations described under this alternative. An airstrip would not be constructed at the port site under Alternative 3.

The port site (35 acres) would include shore-based and marine facilities for the shipment of concentrate, freight, and fuel for the project. The shore-based facilities (16 acres) and dredge material stockpiles (16 acres) would be the similar to those described for Alternative 2, but at the location shown in Figure ES-24.

Figure ES-25: Digital Simulation of Diamond Point Port with Caisson-Supported Dock

Marine facilities (3 acres) would include a causeway extending out to a marine jetty/main wharf situated in an 18 foot-deep dredge basin. A dredge access channel would lead to deep water. The jetty would be constructed along the northern and western limits, and consist of 160 foot by 120 foot concrete caissons up to 58 feet high that would be separated by 60 feet to allow for the free flow of sediment and water, and free passage of fish. The causeway would also be constructed using concrete caissons (60 feet by 60 feet) to support a concrete deck. Fuel and freight barges would be moored to the jetty for loading and unloading. Fuel would be pumped to the storage tanks at the shore-based facility through an 8 inch pipeline. Two ice-breaking tugboats would be used to support marine facility operations.

The dredge area for the access channel and turning basin would be 76 acres at a depth of 18 feet below MLLW to provide access to the jetty under all tidal conditions. The total volume of dredged material for the initial dredging is estimated at 1,100,000 cubic yards. Maintenance dredging (estimated at 20 inches every 5 years) is expected to total 700,000 cubic yards over 20 years (four times).

Bulk concentrate would be lightered by barges out to Handysize bulk carriers at a mooring point in Iniskin Bay. There would not be an alternate lighting location under Alternative 3. The proposed mooring system would be the same as described for Alternative 1a.

Natural Gas Pipeline

The pipeline would connect to the existing gas pipeline infrastructure near Anchor Point on the Kenai Peninsula; the pipeline design, fiber-optic cable, and laydown area for the metering station, compressor station, and pig launching/receiving facility would be as described for Alternative 1a. Leak detection systems, inspections, and maintenance would also be the same as described for Alternative 1a.

The Alternative 3 natural gas pipeline corridor would be similar to Alternative 2, but would follow the entire north road access route from Diamond Point to the mine site, and be buried in a trench adjacent to the roadbed shoulder. Additionally, the three construction access points described for Alternative 2 would not apply to Alternative 3, because there would not be pipeline-only segments on the north side of Iliamna Lake requiring construction access.

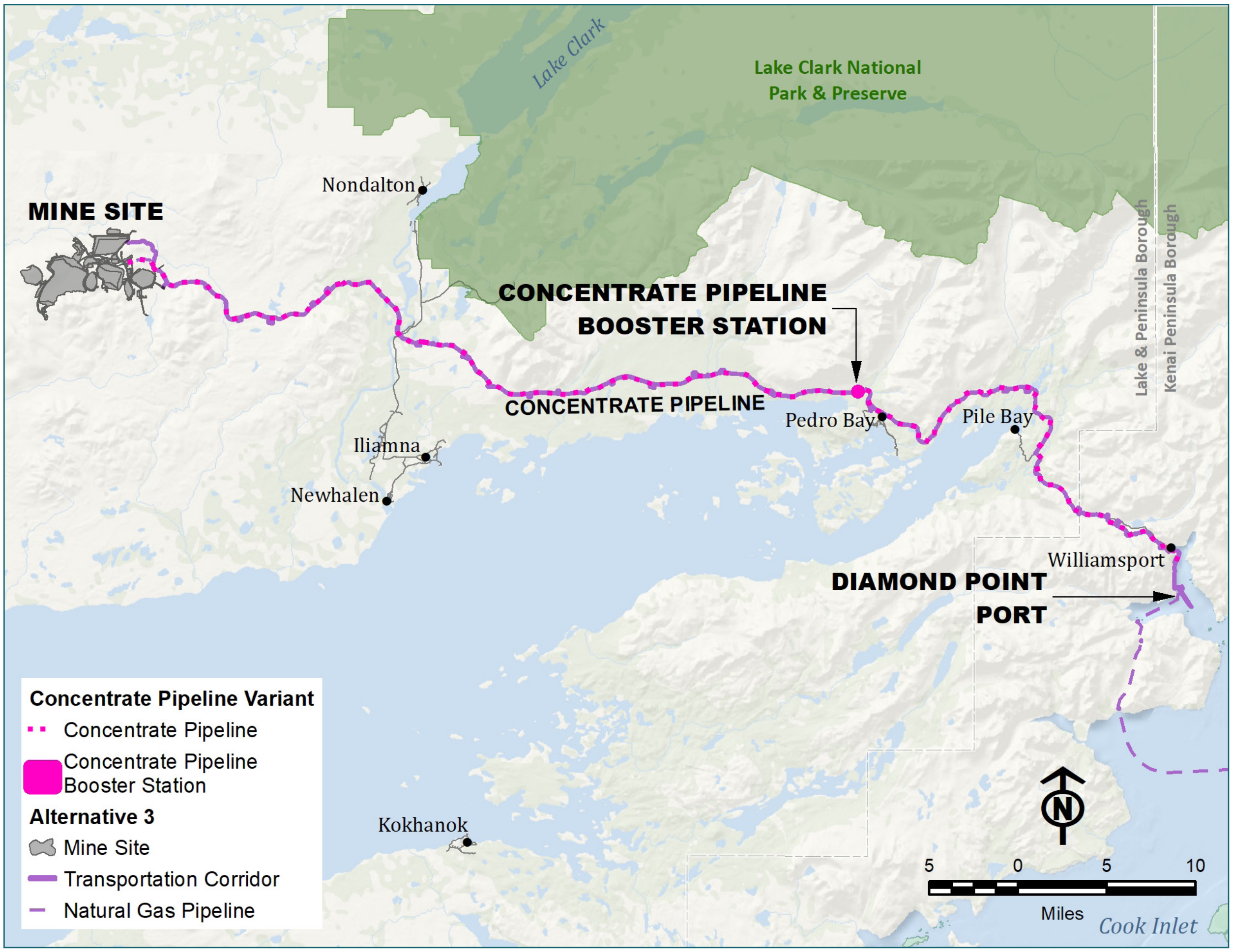


Figure ES-26: Alternative 3—Concentrate Pipeline Variant

Alternative 3 Concentrate Pipeline Variant

This variant evaluates the concept of delivering copper-gold concentrate from the mine site to Diamond Point port as a slurry, using a pipeline instead of trucking along the north access road (Figure ES-26). Two options are addressed under this variant: concentrate slurry pipeline with water removal, treatment, and discharge at Diamond Point; and an option to return the water to the mine site using a second pipeline to allow reuse of water from the slurry instead of discharging at Diamond Point. This variant does not involve changes to the natural gas pipeline component or the trucking of molybdenum concentrate. This variant is being considered under Alternative 3 only because the concentrate pipeline would need to be co-located with a road to allow inspections and response actions in the event of a pipeline leak/rupture.

With this variant, mineral processing would be the same as described for Alternative 1a, except the copper-gold concentrate slurry (a mixture of 55 percent concentrate and 45 percent water by mass) would be transported to the port by pipeline, where it would be filtered. The molybdenum concentrate would be filtered at the mine site. Two electric pump stations would be required: one at the mine site, and one at an intermediate point (described below). Both pump stations would use positive displacement pumps in the 1,000 horsepower range.

This variant would increase the mine site footprint by 1 acre. With incorporation of a concentrate pipeline only (no return water pipeline) and the corresponding treatment and discharge of the filtrate at the port site (discussed below), the amount of water available for release to surrounding drainages at the mine site would be reduced by approximately 1 to 2 percent, on average (PLP 2018 RFI 066). With the option of the return water pipeline, water extracted from the concentrate slurry and flushing water would be piped back to the mine site at a rate of approximately 1 cubic foot per second (PLP 2020 RFI 066b).

The concentrate pipeline would follow the Alternative 3 north access road route and would be co located in the same trench with the natural gas pipeline and fiber-optic cable at the toe of the road embankment. Construction of the concentrate pipeline adjacent to the north access road corridor would increase the road corridor width, compared to base case Alternative 3, by less than 10 percent under most construction conditions.

Truck transport of copper-gold concentrate would be eliminated with this variant, and daily truck traffic would be reduced to 18 round trips per day for transportation of molybdenum concentrate, fuel, reagents, and consumables. Transportation of personnel would be the same as described for Alternative 3, except the Pedro Bay Airport would also be used by inspection crews, approximately once per month. No modifications to the airport are expected.

Copper-gold concentrate would be transferred from the mine site to the Diamond Point port by concentrate pipeline, then dewatered at the port site and stored in a dedicated concentrate storage building between vessel sailings. Use of a concentrate pipeline would require concentrate handling, dewatering, and depending on the option, treatment facilities at Diamond Point port. Port operations would change due to the requirements of dewatering the concentrate, storing water and concentrate, and treating and discharging the filtrate water; however, the overall footprint of the port terminal would not increase.

In addition to the jetty described for Alternative 3, the marine facility would include a series of three caissons (60 feet by 60 feet) placed in the dredge basin to provide mooring and loading for concentrate lightering barges; expanding the marine facility footprint by less than 1 acre (approximately 0.2 acre). A gantry would support an enclosed conveyor from the jetty to a barge loader mounted on the caissons.

Copper-gold concentrate would be loaded onto lightering barges using the enclosed conveyor system and then transported to the lightering location in Iniskin Bay for bulk transfer. The lightering barges would have dust covers to control dust emissions. Once loaded, the barges would be transported to and secured against Handysize vessels at the mooring location in Iniskin Bay. Wheel loaders would reclaim the concentrate from the barge deck and transfer it to a ship loader, which would load the ships.

Changes from the Concentrate Pipeline Variant described above, with incorporation of a return water pipeline, are as follows:

- The return water pipeline would be placed in the same trench as the slurry and natural gas lines, adjacent to the road, which would increase the average width of the road corridor by approximately 3 feet. This pipeline would need to be sized to accommodate water from flushing operations, resulting in a return water pipeline size of approximately 8 inches. This would also be a high-density polyethylene–lined steel pipeline with corrosion protection and safety controls similar to the concentrate pipeline. No intermediate pump station would be required for the water return pipeline.
- The Diamond Point port footprint would not change. The WTP would be removed, but other process and storage infrastructure would remain, and a return water pump station and associated generation capacity would be required at the port site.

3.0 ENVIRONMENTAL ANALYSIS

An area of analysis (i.e., the EIS analysis area) was established based on the potential direct and indirect impacts that would result from construction, operations, and closure of the Pebble Project for each of the resource topics addressed in Chapter 3, Affected Environment; and Chapter 4, Environmental Consequences. The EIS analysis area considers the scope of analysis in the USACE review of all standard public interest review factors in context to determine significance. For those resources that would be potentially affected by a release described in the evaluation of spill events, an additional area of potential effects was identified. The resources are also described in terms of the project area, or the exact project footprint for each of the action Alternatives and associated variants.

The environmental impacts of the project Alternatives on resources were analyzed by first describing existing conditions, also called the affected environment, and then analyzing potential effects that could occur because of proposed activities. Hypothetical spill scenarios were also analyzed. Three types of effects were considered: direct effects, indirect effects, and cumulative effects. The direct and indirect effects for each resource or resource use were analyzed based on the factors of intensity (magnitude), duration, extent, and potential (likelihood) of the impact to occur. For this analysis, in terms of potential or likelihood, impacts would be expected to occur as described if the project (with the defined Alternative and/or variant as applicable) is permitted and constructed. Cumulative effects are interactive, synergistic, or additive effects that would result from the incremental impact of the proposed activities when added to other past, present, and reasonably foreseeable future actions (RFFAs) regardless of what agency (federal or non-federal) or person were to undertake such other actions.

A summary of existing environment and potential consequences of development is presented below for key resources. These include: Social Environment, Water, Fisheries (Fish Values), Wetlands and Other Waters/Special Aquatic Sites, and Spill Risk. There is also a summary of Climate Change.

Potential Impacts to Bears and Recreational Viewing and Hunting

- Impacts to bears are assessed in Section 3.23 and Section 4.23, Wildlife Values; impacts to commercial and recreational viewing are described in Section 3.5 and Section 4.5, Recreation.
- Recreational wildlife viewing opportunities at existing bear-viewing facilities at McNeil River State Game Refuge and Katmai National Park and Preserve may be affected, but the nature and extent of changes cannot be predicted.
- Recreational hunting may be displaced by project activities at Amakdedori port and traffic along the transportation corridor.
- Bears may become habituated to humans at project facilities, affecting migration patterns and behavior around humans.
- Incidental wildlife viewing and hunting may be affected or displaced in areas near project facilities.

3.1 Social Environment

The analysis of socioeconomic characteristics includes the monetized and non-monetized economies of the state, regions, and communities most likely affected by the proposed project. The monetized economy includes economic sectors, such as tourism, and jobs involving labor for wages; and the non-monetized or rarely monetized economy includes subsistence hunting and fishing, which is an important component of the socioeconomic and sociocultural system of rural Alaska communities. Cultural resources include archaeological and historical resources, and locations of traditional cultural or religious importance to specific social and/or cultural groups. The subsistence way of life is a significant contributor to household and community welfare, social relationships, and cultural importance of the people who use subsistence resources near the project area (the 417 square-mile claim block held by subsidiaries of PLP and by a subsidiary of PLP's parent company, Northern Dynasty). Environmental justice addresses disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States. The associated topics addressed in the EIS related to socioeconomics, cultural resources, subsistence, and environmental justice (all relevant to the analysis of needs and welfare of the people) are summarized below.

Society has demands and uses for copper, gold, and molybdenum, and for the mining of these resources. PLP presented information related to the role that these minerals play worldwide for electronics, jewelry, currency/bullion, and medical purposes. The proposed project would ultimately result in annual production of an average copper-gold concentrate (dry concentrate) of 613,000 tons, and molybdenum concentrate production (dry concentrate) of 15,000 tons, to help meet global demand. The proposed project would result in an increase in the availability of these metals to the market and for use in manufacturing goods. The proposed project would result in a 20 year beneficial effect on the public's mineral needs.

3.1.1 Existing Conditions (Affected Environment) Summary

Socioeconomics

The EIS analysis area for this resource (Section 3.3, Needs and Welfare of the People—Socioeconomics) includes regions and communities where aspects of the monetized economy could be impacted by the construction, operations, and closure of all components of each alternative.

Employment in the region and throughout Alaska can vary greatly through the year, because many jobs are seasonal, leading to a large fluctuation in employment between the summertime peaks and the wintertime lows. Much of the seasonal employment is related to the commercial fishing and tourism industries, and varies geographically in the region.

In many of the potentially affected communities, employment relies heavily on the local government and education and health services industry sectors. The local government industry sector accounted for the greatest percentage of employees for all communities in the LPB. State and local government jobs are particularly important to these small communities because they are often year-round and relatively high-paying. The top five performing industries by total employment in the Iliamna Lake region are health care and social services, local government, retail trade, accommodations and food services, and commercial fishing. The lower area of the Dillingham Census Area and coastal portions of the LPB are dominated by the commercial salmon fishery and the economic activity it generates. Communities around Iliamna Lake and upriver in the Dillingham Census Area have less participation in commercial salmon fishing, and are more typical of small roadless rural Alaskan communities, with economic activities limited to local government, Native Alaskan organizations, and some support of commercial recreation and tourism.

Although the cost of living can be high in rural communities, subsistence hunting and fishing helps provide for the needs of families and communities. Iliamna had the highest median household income of the communities reviewed, at $93,750, while the community of Levelock had the lowest, at less than $25,000 (although the data available may contain errors).

Cultural Resources

- Addressed in Section 3.7 and Section 4.7, Cultural Resources
- Combines DEIS cultural and historic sections
- Describes cultural, archaeological, historical, and architectural resources and impacts
- Recognizes the importance of salmon and water resources to the people of the region
- Section 3.9, Subsistence, discusses subsistence resources, areas used for the gathering of subsistence resources, and their importance to passing on cultural practices.

Cultural Resources

The EIS analysis area for this resource (Section 3.7, Cultural Resources) consists of the following:

- At the mine site, the EIS analysis area is the project footprint for direct effects, and the area within 3 miles of the outer extent of the footprint for indirect effects.
- For other features outside the mine site, excluding the natural gas pipeline in Cook Inlet and Iliamna Lake, the EIS analysis area is the construction footprint for direct effects, and the area within 1 mile of the footprint for indirect effects. These features include the transportation corridors, ferry terminals, port facilities, mooring spreads, navigation aids, onshore portions of the natural gas pipeline, and the natural gas compressor station.
- For the natural gas pipeline in Cook Inlet and Iliamna Lake, the EIS analysis area is the construction footprint of the natural gas pipeline for direct effects, and the width of the anchor spread (the area where anchoring of the pipelaying barges may occur) for indirect effects. The width of the anchor spread would be variable; the maximum anchor spread width would be 4,101 feet on each side of the pipeline. The maximum total width of the anchor spread would be 8,202 feet.

The area of potential effects (APE) is defined in 36 CFR Part 800.16(d) as the “geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist. The APE is influenced by the scale and nature of an undertaking, and may be different for different kinds of effects caused by the undertaking.” Modeled information on the potential extent of viewshed, noise, and dust effects was used to determine the size of the APE for portions of the undertaking that would not be submerged in navigable WOUS. The portions of the APE that are outside of navigable waters include the direct footprint of the project (i.e., the surface area that would be directly disturbed by construction activities); the area that is in the foreground and of strongest visual contrast; the distance where more than 10 weighed decibels above ambient noise would be expected; and areas that would be impacted by fugitive dust. For this project, the APE is the same as the EIS analysis area for both indirect and direct effects.

The mine site and transportation corridor areas contain interview-identified routes and trails, subsistence use areas, place names, and other cultural resources features that are included in the EIS analysis area and detailed in Appendix K3.7, Cultural Resources.

For the purposes of this EIS, the analysis for historic properties (including the tables and information presented in Appendix K3.7, Cultural Resources), is based on known cultural resources listed in the Alaska Heritage Resources Survey (AHRS) database that are identified as being in the EIS analysis area. This reliance on AHRS data for defining potential historic properties will be addressed through ongoing research and consultation as part of the Section 106 process. Methods and approaches to completing determinations of eligibility will be provided in the PA.

Currently, there would be no known National Register–eligible sites in the Alternative 1a or the Alternative 1 project footprints, and one known historic property in the footprint of Alternative 2 and Alternative 3. There are numerous cultural resource features spread across the landscape that represent a wide range of site types. Many of these may warrant additional analysis as potential historic properties. Further identification efforts under Section 106 may also involve the analysis of cultural landscapes, traditional cultural properties, and/or archaeological or historic districts in the permit area.

Identification efforts will continue following the FEIS. If the project is permitted, the Section 106 process would be concluded by the finalization of a PA signed by the USACE, ACHP, and the Alaska State Historic Preservation Office. Among other provisions, it is anticipated that the PA will require that additional identification efforts be completed by PLP to meet the Reasonable and Good Faith Standard (36 CFR Part 800.4[b][1]). The identification methods, areas to be subject to field investigations, and associated consultation procedures for evaluating resources, assessing effects, and resolving adverse effects are outlined in the PA, included as Appendix L of the FEIS.

Subsistence

The EIS analysis area for this resource (Section 3.9, Subsistence) includes habitat and migration routes for subsistence resources, community subsistence search and harvest areas, and areas used by harvesters to access resources that could be affected by facilities and activities at the mine site, port, and transportation and natural gas pipeline corridors.

Subsistence is the way of life for cultural groups in Alaska, including the Dena'ina Athabascan of Southcentral Alaska, the Central Yup'ik of Southwest Alaska, and the Sugpiaq-Alutiiq of lower Cook Inlet and Alaska Peninsula. Subsistence encompasses hunting, fishing, trapping, gathering, camping, and ceremonial activities, as well as the processing, sharing, use, consumption, trade, and barter of wild resources. Subsistence resources include fish, mammals, birds, marine invertebrates, edible and medicinal plants, mushrooms, and firewood. These renewable resources provide food, fuel, and materials to make clothing, shelter, tools, and art.

In addition to its inextricable roots in traditional Alaska Native culture, subsistence is integral to the contemporary mixed economic system in rural Alaska. Cash incomes typically supplement and support subsistence activities, which have provided considerable nutritional and economic value for rural households for generations. Subsistence foods are culturally and nutritionally preferred to store-bought foods that are available in most communities, which can also be difficult to afford. Sharing of subsistence foods in and between communities reinforces social bonds and helps recipients meet economic, material, and nutritional needs.

In general, communities in southwest Alaska share a similar seasonal round of harvest activities, with some variations depending on the area, available resources, and applicable hunting and fishing regulations. In this region, salmon is the most important subsistence food. In the most recent comprehensive community subsistence harvest surveys, salmon accounted for most of the edible subsistence harvest (by weight) for the majority of the communities in the region. Large land mammals (e.g., moose and caribou) and non-salmon fish (e.g., northern pike, Dolly Varden/char, whitefish, trout) composing the second and third most important category of subsistence resources in these communities in terms of edible weight. Within the region, subsistence-harvested food is widely shared, and is integral to the culture and way of life.

Lakes, rivers and streams, and marine coastal areas are used for resource harvests of freshwater seals, salmon, and other aquatic resources. Terrestrial habitats are used for hunting grouse and ptarmigan, waterfowl, caribou, moose, and small land mammals; and for harvesting berries, wood, and other plant resources.

Environmental Justice

Executive Order 12898 (1994) requires that "each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States and its territories." Under Executive Order 12898, demographic information is used to determine whether minority populations or low-income populations are present in the areas potentially affected by a project. If so, a determination must be made as to whether implementation of the project may cause disproportionately high and adverse human health or environmental effects on those populations. The EIS analysis area for this resource (Section 3.4, Environmental Justice) impacts includes the EIS analysis areas described above for socioeconomics and subsistence, and for the Health and Safety resource (Section 3.10, Health and Safety) in the EIS, corresponding to an area that could be affected by the mine site, transportation corridor, and natural gas pipeline for each Alternative through changes in economic, subsistence, and health resources and activities.

For the purposes of this analysis, a minority community is defined as a community with a majority (i.e., 50 percent or greater) minority population, and a low-income community is defined as having a greater percentage of the population living in households below the poverty threshold as defined by the US Census Bureau than the percentage of the population in the state living below that level. This is consistent with guidance from the CEQ. The following communities meet the CEQ definition of minority and/or low-income: Igiugig, Iliamna, Kokhanok, Levelock, Newhalen, Nondalton, and Pedro Bay in the LPB; and Dillingham, Ekwok, Koliganek, and New Stuyahok, and the Dillingham Census Area as a whole.

3.1.2 Expected Effects (Environmental Consequences) of Alternatives

Socioeconomics

Scoping comments related to socioeconomics focused on beneficial impacts of additional employment opportunities, economic benefits to the state of Alaska, and how risks to the environment could outweigh short-term benefits. Environmental consequences are discussed in Section 4.3, Needs and Welfare of the People—Socioeconomics.

NA No Action Alternative

The No Action Alternative would result in federal agencies with decision-making authorities on the project not issuing permits under their respective authorities. The Applicant's Preferred Alternative would not be undertaken; and no construction, operations, or closure activities specific to the Alternative would occur. Under the No Action Alternative, it is anticipated that State-authorized activities associated with mineral exploration and reclamation, as well as scientific studies, would continue at levels similar to recent exploration activity. The current number of direct and indirect jobs created during exploration and permitting would remain roughly the same, and there would be no impact to the regional economy, the cost of living in the potentially affected communities, or regional infrastructure.

AV Alternatives and Variants

The Alternatives and variants would have very similar socioeconomic effects. The primary differences would be that under Alternative 1a and Alternative 1, Kokhanok would realize more potential benefits than Pedro Bay, and under Alternative 2 and Alternative 3, Pedro Bay would realize more potential benefits than Kokhanok. PLP has stated that its objective is to maximize opportunities for local hire: first, directly to residents of the project area, or those with close ties to the area; second to Alaska residents in general. In terms of magnitude, non-Alaskan labor would likely be required to fill the anticipated 2,000 construction jobs, potentially as high as 50 percent of hires. It is estimated that during operations, 250 employees would come from surrounding communities, and approximately 600 from Anchorage or Kenai, for a total of 850 anticipated jobs. Employment would decline after mine closure. Communities near the mine site and ferry/port terminals would likely see a beneficial impact of higher employment rates. Although the proposed project would provide a more stable employment base in the region, it should be noted that the actual number of direct and indirect jobs in any given year could fluctuate based on economic conditions and/or business decisions.

This beneficial impact would be greater for the nearby communities as compared to communities farther away, such as those in the lower Bristol Bay watershed.

Under the summer-only ferry operations variants for Alternative 1 and Alternative 2, employment for truck drivers would be seasonal only, which creates less stable annual income in the region.

Under Alternative 3—Concentrate Pipeline Variant, there would be decreased employment of truck operators and increased employment at the dewatering facility. Overall, the total number of employees needed during operations would likely decrease, which would decrease overall income and employment in the potentially impacted communities.

All Alternatives would generate revenue for the State of Alaska and for municipal governments where project facilities and activities are located in their boundaries. The project would generate $25 million

annually in state taxes through construction, and $84 million annually in state taxes and royalty payments during the operations phase. The project would generate $27 million annually in severances taxes for the LPB during operations, and annual property tax revenue to the Kenai Peninsula Borough based on assessed value of project-related real property.

School closures are a serious challenge faced by rural Alaska communities around the state. Alaska State law (Alaska Statute [AS] 14.17.450) cuts off state funds for schools with nine or fewer students. Falling population can create a challenging cycle, in which declines in the number of residents lead to school closures, declining services, and fewer economic opportunities; these trends can lead to further population declines. Although the project would not be expected to result in an increased number of schools in the region, it may benefit educational opportunities for some communities through an increased revenue stream to the LPB and access to PLP supported education programs. The project could reduce or eliminate this decline, allowing local schools to remain open and continue to serve local communities. It may also allow the school district to offer expanded services such as the expansion of vocational education.

Workers would be transported from multiple locations (including from local communities) to the mine site via aircraft or other approved transport such as local roads, and would stay in work camps during their shifts. As a result, the local communities would not be anticipated to see a large increase in population from the project from in-migration. The largest impacts could occur in Iliamna, Kokhanok, Newhalen, and potentially Nondalton, which may see an increase in population related to any businesses that are developed to support the project.

The project could reduce or eliminate the current local population decline because of the increase in employment opportunities and indirect effects on education and infrastructure; it could also lead some prior residents to return to communities. Conversely, steady employment and income may provide some families the ability to move to other areas, which may decrease the population of some communities. Therefore, the impacts on population for individual communities are difficult to anticipate.

The project is likely to reduce transportation costs (thereby reducing the cost of living) to communities near the transportation corridor, should arrangements be made to allow controlled public use of the mine and port access roads and spur roads. This beneficial long-term impact would last the life of the project, or until roads are decommissioned.

CE Cumulative Effects

The cumulative effects analysis area includes the region around the potentially affected communities; and to a lesser extent, the state of Alaska. The categories of past and present actions that have contributed to the existing socioeconomic conditions of potentially affected communities include commercial and subsistence harvest of fish and wildlife, commercial recreation and tourism, community development and infrastructure, mining exploration activities, the Williamsport-Pile Bay Road, and the Diamond Point Quarry. RFFAs include the Pebble Project expansion scenario, continued exploration at other mineral deposits, oil and gas activities that would increase exploration activities and vessel traffic in Cook Inlet, commercial and residential development in regional communities, and continued commercial and subsistence harvest of fish and wildlife.

The Pebble Project expansion scenario would extend the life of the project, along with beneficial effects from employment, generation of State and LPB revenue, and potential reduction in cost of living due to lower transportation costs. Continued local employment could help stabilize populations and maintain school enrollment. Oil and gas activities would have a minimal contribution to cumulative effects, potentially providing some employment opportunities. Local transportation and community development projects would result in improvements in local services and facilities, potentially reduce cost of living, and benefit from extended revenue generation associated with Pebble Project expansion.

Cultural Resources

Scoping comments expressed concerns regarding impacts to cultural resources and historic properties such as historical and pre-contact sites; traditional use areas and practices; salmon, clean water, and the confidentiality of information shared on culturally and religiously significant properties. Some additional places of cultural importance were provided during the comment period on the DEIS, and through Section 106 consultation completed after publication of the DEIS. Environmental consequences are discussed in Section 4.7, Cultural Resources.

The USACE has assessed the potential for impacts to cultural resources across all of the Alternatives based on known AHRS locations, interview-identified cultural resources, and place name data; it is assumed that a wide range of cultural resources exist across the landscape, and some are in the project footprint.

The execution of the PA will continue to systematically address data and augment site identification in the EIS analysis area. Whether through additional background and site file research, archaeological investigations, consultation with tribes, and/or ethnographic analysis, the PA will ensure that cultural resource identification efforts in the EIS analysis area are completed, consistent with the requirements of 36 CFR Part 800. Should the PA be implemented by the USACE, these investigations would only be completed by the Applicant under the agency-selected alternative. Likewise, when project-related adverse effects to historic properties are identified, the PA and the Cultural Resource Management Plan would lay out the process for consultation, assessment of effects, and measures to avoid, minimize, and/or mitigate adverse effects.

NA

No Action Alternative

The No Action Alternative would result in federal agencies with decision-making authorities on the project not issuing permits under their respective authorities. The Applicant's Preferred Alternative would not be undertaken; and no construction, operations, or closure activities specific to the project would occur. Although no resource development would occur under the Applicant's Preferred Alternative, PLP would retain the ability to apply for continued mineral exploration activities under the State's authorization process, as well as any activity that would not require federal authorization. In addition, there are many valid mining claims in the area; these lands would remain open to mineral entry and exploration by other individuals or companies. There would be no new impacts to known AHRS sites or historic properties in the region, and existing activities that impact place names or other types of cultural resources would continue at the current intensity.

A1a

Alternative 1a

All Alternatives have the potential for direct impacts to cultural resources from the construction, operations, reclamation, and closure of the project. Necessary ground-disturbing actions involved with constructing and operating the mine and its facilities (i.e., transportation corridor, natural gas pipeline, and port facilities) can destroy, remove, or otherwise damage cultural resources. Direct impacts can include the physical destruction of a cultural resource, removal of a cultural resource from its original location, or result from project activities that increase a site's susceptibility to erosion. These types of direct effects are irreversible and permanent. Indirect impacts may include visual, atmospheric, olfactory, and audible intrusions as a result of construction and operations activities, or disruptions to cultural use of lands and increased presence of people in culturally sensitive areas. Traditional use areas for cultural purposes are in the geographic extent of the mine site EIS analysis area; there are camps, cabins, and trails/routes surrounding the mine site.

Twelve known AHRS locations would be in the EIS analysis area for the mine site, and two of them would be in the mine site footprint for Alternative 1a. The impacts on these sites would be certain to occur, irreversible, and not diminished through reclamation activities. No historic properties have been currently identified as part of National Historic Preservation Act (NHPA) Section 106 efforts in the EIS analysis area for the mine site; therefore, there would be no direct or indirect impacts to identified historic properties in or near the mine site. There are 19 interview-identified sites present in the mine site EIS analysis area; six of these features are in the project footprint. There is one place name in the project footprint (for Frying Pan Lake); four place names in the analysis area; one that is categorized as a spiritually important place in the interview-identified cultural resources information.

Nine interview-identified sites were recorded in the port analysis area, and one would be in the project footprint. One known place name in the port footprint would be subject to direct and indirect impacts.

There are 17 known AHRS locations in the transportation corridor EIS analysis area, 101 interview-identified cultural resources, and six place names.

A1

Alternative 1

Alternative 1 would have the same impacts to AHRS locations, place names, interview-identified cultural resources, and historic properties as described for the mine site, south ferry terminal, port access road, and Amakdedori port under Alternative 1a.

Along the mine access road, there would be four known AHRS sites; none in the project footprint. There would be 37 interview-identified cultural resources; 14 in the project footprint. The impacts to the AHRS locations and the interview-identified cultural resources would be similar to the impacts for these types of resources discussed for Alternative 1a.

The natural gas pipeline would be co-located with the transportation corridor from Amakdedori port to the mine site, and therefore would have the same impacts to cultural resources. Alternative 1 would also share the cultural resources discussed for the compressor station on the Kenai Peninsula that were discussed for Alternative 1a.

The area of the Alternative 1—Kokhanok East Ferry Terminal Variant includes known AHRS locations at Kokhanok, a contemporary village that contains historic-era buildings identified in the AHRS. This variant would also impact 56 interview-identified cultural resources along the port access road, 10 of which would be in the project footprint. No historic properties have been identified as part of NHPA Section 106 cultural resource identification and evaluation efforts in the EIS analysis area for the Kokhanok East Ferry Terminal Variant.

A2

Alternative 2

Alternative 2 would have the same potential for direct and indirect impacts on cultural resources at the mine site as discussed above for Alternative 1a.

The transportation corridor, Diamond Point port, and the natural gas pipeline would have the same types of potential effects as Alternative 1a, but in different locations.

In terms of potential modification to the setting, the transportation corridor under this Alternative would cross through areas where there are 23 known AHRS sites, 41 known locations with indigenous place names (16 are in the footprint), and 54 interview-identified cultural resources (26 in the footprint). There is one interview-identified feature recorded in the EIS analysis area, 7 place names, and no known AHRS sites at the Diamond Point port site. There would be direct and indirect impacts to the Williamsport-Pile Bay Road, a historic property, under Alternative 2.

Under this alternative, the ferry would have a different route than discussed under Alternative 1a, and winter operations would be less disruptive to traditional winter over-ice transportation associated with cultural practices, such as inter-community visits. The primary difference is that only travel between Pedro Bay and other communities would be affected by this alternative. The nature, magnitude, duration, and extent of direct and indirect impacts to these cultural features would be similar to those described above for sites potentially impacted by Alternative 1a. The mine access road under the Newhalen River North Crossing Variant would affect the same AHRS locations as in the mine access road of the Alternative 2 analysis area, plus one site in the footprint.

A3

Alternative 3

Alternative 3 would have the same potential for direct and indirect impacts on cultural resources at the mine site as discussed above for Alternative 1a. The transportation corridor, Diamond Point port, and natural gas pipeline would have the same types of potential effects as Alternative 1a, but in different locations, some of which are discussed under Alternative 2. These include 32 known AHRS sites in the transportation corridor and an additional three in the natural gas pipeline corridor. The transportation corridor would overlap with the one historic property, which would have both direct and indirect impacts as discussed under Alternative 2. There are no known AHRS sites at the Diamond Point port site.

In terms of potential modification and setting, the transportation corridor would cross through areas where there are 43 known locations with indigenous place names (15 are in the footprint), and 90 interview-identified cultural features are present across the landscape, including 37 that would be in the project footprint. The magnitude, duration, and extent of direct and indirect impacts to these cultural features would be similar to those described above for sites potentially impacted by Alternative 1a.

CE

Cumulative Effects

The cumulative effects analysis area for cultural resources encompasses the EIS analysis area, which has been defined as the project footprint, and lands within 3 miles of the mine site (including material sites) and within 1 mile of the other project components (e.g., port sites, transportation corridors, and ferry terminals) for indirect impacts (e.g., dust, visual, auditory, and olfactory). Past and present actions that have, or are currently, affecting cultural resources, including historic properties, in the EIS analysis area are minimal; there is no operational industry and limited infrastructure in the area. Such activities that have likely resulted in a loss of or adverse effects to some cultural resources and activities, include development projects involving transportation infrastructure and community development actions, mining exploration and non-mining-related projects, and commercial recreation and tourism.

The direct impact of these past and present actions on cultural resources from mining exploration activities are minimal due to limited ground disturbance. It is likely that the presence of helicopters affected the context and experience of other cultural activities in the vicinity of exploration activities.

Construction of roads affect cultural resources through direct removal and destruction of an archaeological site. Indirect effects may be associated with the visual changes of introducing a new road, and the potential for increased access and traffic noise that would result from constructing a new road. However, these development projects have a relatively small construction footprint, and consequently have likely resulted in limited past and present cumulative effects on a regional basis. They may also improve access to the location of cultural sites and activities.

The Pebble Project expansion scenario in a relatively undeveloped area would increase the geographic area affected and duration of effects of the project by combining project elements of Alternative 1a and Alternative 3. Other RFFAs would have geographical and contextual impacts to cultural resources. Once a cultural resource feature, archaeological site, or historic site is destroyed, its value is gone and cannot be restored. Cumulative impacts to cultural resources from Alternatives 2 and 3, combined with the Pebble Project expansion scenario, would be of lesser magnitude and geographic extent than Alternative 1a or Alternative 1.

Subsistence

Scoping comments requested that all subsistence hunting practices be considered in the analysis of effects and the heavy reliance on fish for all users in the area. Specific impacts due to disturbance from mine transportation needs and potential effects of contaminants from the project on subsistence resources were also mentioned by commenters. Environmental consequences are discussed in Section 4.9, Subsistence.

NA No Action Alternative

The No Action Alternative would result in federal agencies with decision-making authorities on the project not issuing permits under their respective authorities. The Applicant's Preferred Alternative would not be undertaken; and no construction, operations, or closure activities specific to the project would occur. Although no resource development would occur under the Applicant's Preferred Alternative, PLP would retain the ability to apply for continued mineral exploration activities under the State's authorization process, as well as any activity that would not require federal authorization. In addition, there are many valid mining claims in the area; these lands would remain open to mineral entry and exploration by other individuals or companies.

No additional future direct or indirect effects to subsistence resources or access to subsistence resources would be expected, and existing habitat and resource trends would continue. It should be noted that exploration activities associated with the project provided some local employment and income; the latter could contribute to pursuit of subsistence activities. Any displacement of current subsistence activities from exploration activities may continue.

AV Alternatives and Variants

In terms of magnitude and extent, construction and operations would primarily affect the subsistence areas of the six communities (Iliamna, Newhalen, Pedro Bay, Nondalton, Igiugig, and Kokhanok) closest to project infrastructure and transportation activities, including the mine site, transportation corridor, the ferry and terminals, port, and airports. The communities would be affected by changes in resource availability, access to resources, competition for resources, and sociocultural dimensions. Many project features would be removed, reclaimed, or both, during closure. Once reclamation activities have been completed, impacts on the availability of subsistence resources would be reduced as these areas revegetate, and recreate habitat.

Project construction (and to a lesser extent, operations) would impact the availability and abundance of traditional and subsistence resources through habitat loss; behavioral disturbance to resources from increased noise and human activity; fugitive dust deposits on vegetation; concerns about contamination of resources; avoidance of subsistence harvest areas; wildlife injury and mortality; and increased costs and times for traveling to more distant areas. In terms of magnitude and duration, impacts would occur with more intensity along the transportation corridor during construction because activities would be more disruptive. At the mine site, effects could occur with more intensity during operations, due to mining activity, noise, and expansion of the open pit and waste rock and tailings storage.

Overall, impacts to fish and wildlife would not be expected to impact harvest levels. Resources would continue to be available because no population-level decrease in resources would be anticipated. There would be some site-specific habitat fragmentation from project facilities, causing behavioral disturbance to terrestrial wildlife and birds, and localized changes in distribution. This may result in having to travel further to harvest species, such as caribou, that are anticipated to avoid project facilities. Subsistence search and harvest areas directly in the footprint of the project components (mine site, ferry terminals, port, and transportation corridor) would no longer be available, and some wildlife may shift away from areas disturbed by the project. Although no population-level impacts to terrestrial species are anticipated, species range and use areas may shift to areas further away from disturbed areas.

In terms of extent of impacts, project facilities and transportation corridors may open or remove areas from subsistence activities, or facilitate or restrict access to subsistence resources. In addition to physical access, project activity may change the character of the subsistence activities due to noise and visual effects. The magnitude, duration, and extent of impacts would be to impair or restrict access to resources during construction in the immediate vicinity of project components. Such restrictions would affect communities near project infrastructure that use this land for or to access subsistence fishing, hunting, gathering, education of youth on subsistence traditions, and other customary practices. Construction of linear features, such as the roads and pipeline, could interrupt or impede travel to resources or communities on the other side of the ROW, especially during pipeline construction. During the operations phase, the magnitude and extent of impacts would be the restriction of access to subsistence resources at the project footprint of the mine site and in the mine site safety boundary, Iliamna Lake ferry terminals and winter ferry routes, mine and port access roads, and port. The duration of the impact would be long-term, lasting throughout the life of the project and closure.

Impacts to the availability of subsistence resources would be similar across all action alternatives, affecting resources nearest the project area. Access to subsistence resources would be similar across all action alternatives, except that Alternative 1 would occur farther away from the communities of Iliamna, Newhalen, and Nondalton, and the magnitude of impacts to subsistence users' access to freshwater seal harvest locations would be less. Alternative 2 and Alternative 3 would impact routes around Pedro Bay and the northern and eastern ends of the lake. The Summer-Only Ferry Operations Variants would not have the impacts to winter access, harvest activities, or safety concerns for travel across Iliamna Lake that are associated with the ice-breaking ferry discussed in Alternative 1 and Alternative 2. Impacts to sociocultural dimensions of subsistence would be the same across all alternatives, although with greater effects on specific communities depending on the transportation corridor location.

CE Cumulative Effects

The cumulative effects analysis area for subsistence is the same as the EIS analysis area for subsistence, which includes habitat and migration routes for subsistence resources, community subsistence search and harvest areas, and areas used by harvesters to access resources. Past and present actions have caused noticeable effects to subsistence resources, access, competition, and social and cultural values. Such activities include subsistence activities, commercial fishing, sport fishing and hunting, mining exploration, and non-mining-related projects, such as transportation, oil and gas development, or community development actions.

The subsistence harvest of sockeye salmon in the Kvichak River drainage has decreased over the past 20 years. Several communities observed that habitat change in southwest Alaska is affecting the Mulchatna caribou herd, causing the herd to move farther away from communities in the EIS analysis area, which impacts subsistence harvest. Additionally, Nondalton residents have noted declines in caribou numbers due to disturbance from helicopters and declines in caribou and moose numbers due to overharvest by sport hunting. These habitat changes have benefitted moose, resulting in increased moose harvest by local residents in the EIS analysis area over the last 10 years. Residents of Pedro Bay also observed a decline in Dolly Varden in the Iliamna River due to overharvest by sport fishing and habitat disturbance from motorized boats. Subsistence harvest of Cook Inlet beluga whales prior to 2000 led to population decline and severe limitation on the subsequent subsistence harvest. Mining and oil/gas exploration have caused some site-specific disturbance to subsistence resources, area-specific limitations to subsistence access, and sociocultural dimension of subsistence, but such effects have been seasonal and short-term in nature, with no population-level effects on subsistence resource populations. The same is generally true of community and transportation infrastructure. Construction and operation of the Williamsport-Pile Bay Road disturbed subsistence activities and resources in the vicinity of the road during summer months, and has potentially created some non-resident competition for fish and wildlife resources, particularly in the vicinity of Pedro Bay.

The Pebble Project expansion scenario would affect more fish habitat in the upper reaches of the NFK and SFK, as well as UTC. It would also generate more noise over a slightly larger area for a longer period of time, potentially affecting caribou that might transit the area, and affect subsistence access and user experience, although the mine site area is not heavily used for subsistence. These effects would be the same across the action alternatives. The expanded mine would contribute to cumulative effects with additional infrastructure (mine site, two access roads, and two ports), habitat loss, subsistence resource disturbance, and positive/negative changes in subsistence access over a longer period of time, up to an additional 58 years, depending on the period of post-mining milling and closure. Additional habitat loss associated with the mine site would not be expected to have population-levels effects on fish and wildlife.

Construction of other facilities can affect the quality and cultural experience of subsistence activities, leading to adverse impacts on subsistence resources that are central to cultural belief systems and the way of life of local people. For Alternative 1a and Alternative 1, the contribution to cumulative effects would be slightly more than the other alternatives. However, for Alternative 2, the cumulative effect would be of lesser magnitude and extent than the other Alternatives because the south transportation corridor would not be in place. Because the Pebble Project expansion scenario would use the north access road system that would already be built under Alternative 3 and not include any ferry operations, cumulative impacts from Alternative 3, combined with the expansion scenario to resource availability and access to resources, would be less than the other alternatives.

Cumulative effects from continuing mineral and oil and gas exploration, depending on the location, would contribute to landscape-level effects where there is recurring introduction of additional impediments to the movement of people and animals; increased noise, vibration, and emissions; and increased numbers of people to the area. This would lead to similar effects to resource availability, access to resources, competition for resources, and sociocultural conditions described for the Pebble Project expansion scenario.

Environmental Justice

Scoping comments requested that low-income, minority, and Alaska Native communities that may be impacted by the project be identified. Concerns regarding food security and subsistence resources, impacts on cultural practices, health impacts from pollution and exposure to increased industrial activities and noises, increased risk of injury and exposure to hazardous materials, increased exposure to outsiders, and the associated social and psychological effects should be addressed. Environmental consequences are discussed in Section 4.4, Environmental Justice.

NA No Action Alternative

The No Action Alternative would result in federal agencies with decision-making authorities on the project not issuing permits under their respective authorities. The Applicant's Preferred Alternative would not be undertaken; and no construction, operations, or closure activities specific to the Applicant's Preferred Alternative would occur. Although no resource development would occur under the Applicant's Preferred Alternative, PLP would retain the ability to apply for continued mineral exploration activities under the State's authorization process (ADNR 2018 RFI 073), or for any activity not requiring federal authorization. In addition, there are many valid mining claims in the area, and these lands would remain open to mineral entry and exploration by other individuals or companies.

Current State-authorized activities associated with mineral exploration and reclamation, as well as scientific studies, would be expected to continue at levels similar to recent post exploration activity. The State requires reclamation of sites at the conclusion of their State-authorized exploration program. If reclamation approval is not granted immediately after the cessation of activities, the State may require continued authorization for ongoing monitoring and reclamation work as it deems necessary.

PLP has employed local community members at the site during the exploratory phase of the project. The communities closest to the exploration area in the LPB, likely including Iliamna, Newhalen, and Nondalton, provide the greatest proportion of the local workforce. These communities are identified as minority and/or low-income communities. Similarly, these communities and others harvest caribou, large land mammals, and other subsistence resources near project components. Scoping comments suggested that exploration activities have affected wildlife populations (caribou) used for subsistence. Although there may be some decrease in the current level of economic activity generated by exploration of the project, exploration could continue. No changes in additional future direct or indirect effects to existing socioeconomics, subsistence resources, or access to subsistence resources would be expected. Therefore, existing socioeconomic and habitat and resource trends would continue.

AV Alternatives and Variants

The magnitude, duration, extent, and likelihood of impacts to minority and/or low-income communities would be similar for all four action Alternatives and variants, with slight differences to impacts, such as by location of transportation corridors and port sites, or subsistence resource. The communities closest to the mine site and/or transportation corridors include Nondalton, Iliamna, Newhalen, Kokhanok, and Pedro Bay. These communities are minority and low-income communities, and have a lower median household income and a higher unemployment rate than Anchorage, as well as Alaska as a whole. Although PLP has generated exploration-related employment for residents of villages throughout the LPB and broader Bristol Bay region over the past decade, the communities surrounding Iliamna Lake and connected by road have provided the greatest proportion of the local workforce. It would be anticipated that residents of the communities surrounding Iliamna Lake would continue to provide most of the local workforce for construction and operations of the project. Therefore, employment through the project would have beneficial economic effects on minority and low-income communities lasting for the life of the project. The primary differences between Alternatives would be that under Alternative 1a and Alternative 1, Kokhanok would experience more beneficial impacts than Pedro Bay; and under Alternative 2 and Alternative 3, Pedro Bay would experience more beneficial impacts than Kokhanok. Although the project would provide a more stable employment base, it should be noted that the actual number of direct and indirect jobs in any given year could fluctuate based on economic conditions and/or business decisions. Employment would decrease at mine closure.

The higher cost of living in rural areas is primarily associated with high transportation cost of food, fuel, and other supplies. All action Alternatives are likely to slightly reduce transportation costs of materials and goods to the transportation corridor area's potentially affected communities (Kokhanok, Iliamna, Newhalen, Pedro Bay, and potentially Nondalton, depending on the specific alternative). Reduced transportation costs would lower the cost of living for these communities, all of which are minority and low income.

Communities adjacent to the natural gas pipeline (Kokhanok, Newhalen, Iliamna, and Pedro Bay, depending on the specific alternative) would have the

opportunity to connect to the pipeline. For heating buildings, natural gas would likely be less expensive than diesel heating oil, which could lower the cost of living once equipment (e.g., furnace, water heater) is converted to natural gas; however, communities would be responsible for funding the connections and conversions. After mine closure, the pipeline would be decommissioned, and there would no longer be natural gas available for community use, unless otherwise negotiated between the communities and utility providers. These benefits may cease and communities may incur additional costs to reconvert to diesel heating oil if the pipelines are reclaimed at the end of the project. The Summer-Only Ferry Operations Variant under Alternative 1 and Alternative 2 would likely shift some of the project-related jobs held by community members from year-round to seasonal, which would also lower the overall income earned by community members that stay in the region compared to year-round ferry operations.

The increase in job opportunities, year-round or seasonal employment, steady income, and lower cost of living described above would have beneficial impacts on the EIS analysis area, especially for communities in the LPB, during construction and operations of the project. Therefore, the effects of all Alternatives on the needs and welfare of the people would not be "high and adverse." The duration of impacts would last thorough the life of the project.

The loss of high-harvesting households and a reduction in sharing could result in less availability of traditional foods, thereby having adverse impacts on minority and low-income communities. If high-harvesting members of "super households" find project-related employment and have less time for subsistence activities, the rest of the community and households in other communities could end up receiving less wild food through sharing and trading relationships. Therefore, the impacts would be long-term, lasting through mine closure. However, the effects could be reduced with planned periods of leave options during subsistence harvest periods.

Impacts on access to and quantity of subsistence resources could be both adverse and positive to health and safety, and in terms of magnitude and extent, many of these effects would be disproportional to minority and low-income communities in close proximity to the mine site and transportation corridor. Potential negative impacts could be from actual or perceived decreases in access to, availability, and/or quality of subsistence recourses, which could also adversely impact community health/well-being and cultural identity. Subsistence users would likely adjust resource use areas and species composition of harvest resources to target resources that would be less affected by project activities. However, positive benefits may also occur, because increased incomes and employment can positively affect subsistence harvest levels and participation, including making procurement of hunting and fishing equipment more affordable. The project could also provide additional access to subsistence resources and harvest areas, depending on access arrangements. The duration of impacts would be long-term.

Impacts on psychosocial health, family stress, and unintentional and intentional injuries would be both beneficial and adverse. The magnitude of beneficial effects could include increased funding from the borough to maintain or improve community health services, and additional disposable income for project employees. Adverse health consequences may be related to fear of changes in lifestyle and cultural practices, land encroachment, impacts to the environment, and real or perceived impacts on food security and quality associated with both commercial and recreational fishing, and with subsistence activities. Other adverse key health outcomes considered are the potential for increased risk of exposure to hazardous chemicals in air, soil, groundwater, surface water, and sediment. These impacts could last through the life of the mine and beyond closure.

CE Cumulative Effects

Impacts to environmental justice are those high and adverse human health or environmental effects that affect a minority or low-income population at a greater rate than the general population. The cumulative effects analysis area consists of the geographic area of those who live, work, subsist, or recreate in the EIS analysis area, and the broader region that would be affected by the RFFAs. These areas include the communities primarily in the LPB, and those in the Dillingham Census Area concerned with potential project impacts, and are considered minority and low-income communities. There could be some cumulative effects on minority and low-income residents in the Kenai Peninsula Borough, Bristol Bay Borough, and Municipality of Anchorage, which are not considered minority or low income communities as a whole. Past, present, and RFFAs in the cumulative impact analysis area have the potential to cumulatively contribute to disproportionately high and adverse effects on minority and low-income communities.

The Pebble Project expansion scenario would continue, and likely increase, the beneficial and adverse impacts to socioeconomic conditions and psychosocial health for minority and low-income communities from the project. The effects of the expansion scenario on socioeconomic characteristics and subsistence are described above and would have an effect on environmental justice. Potential human health impacts include adverse effects associated with stress over the presence of mining activities and potential for contamination, but also include beneficial effects from employment opportunities, potentially maintaining school-age populations, increased local revenue to continue and expand health and social services, and potential reduction in the cost of living. These effects would be extended over the 78 years of operational life, and would vary by alternative, with Alternative 1 having the largest geographic footprint for adverse and beneficial impacts, followed by Alternative 1a. Potential effects from continued mining and oil/gas exploration have also been discussed above for socioeconomic characteristics and subsistence. Opportunities for local employment would be offset by concerns over future development of mineral resources in the region, and potential effects on social fabric and subsistence resources. Future community and infrastructure development may provide beneficial effects associated with employment opportunities and improved services and quality of life.

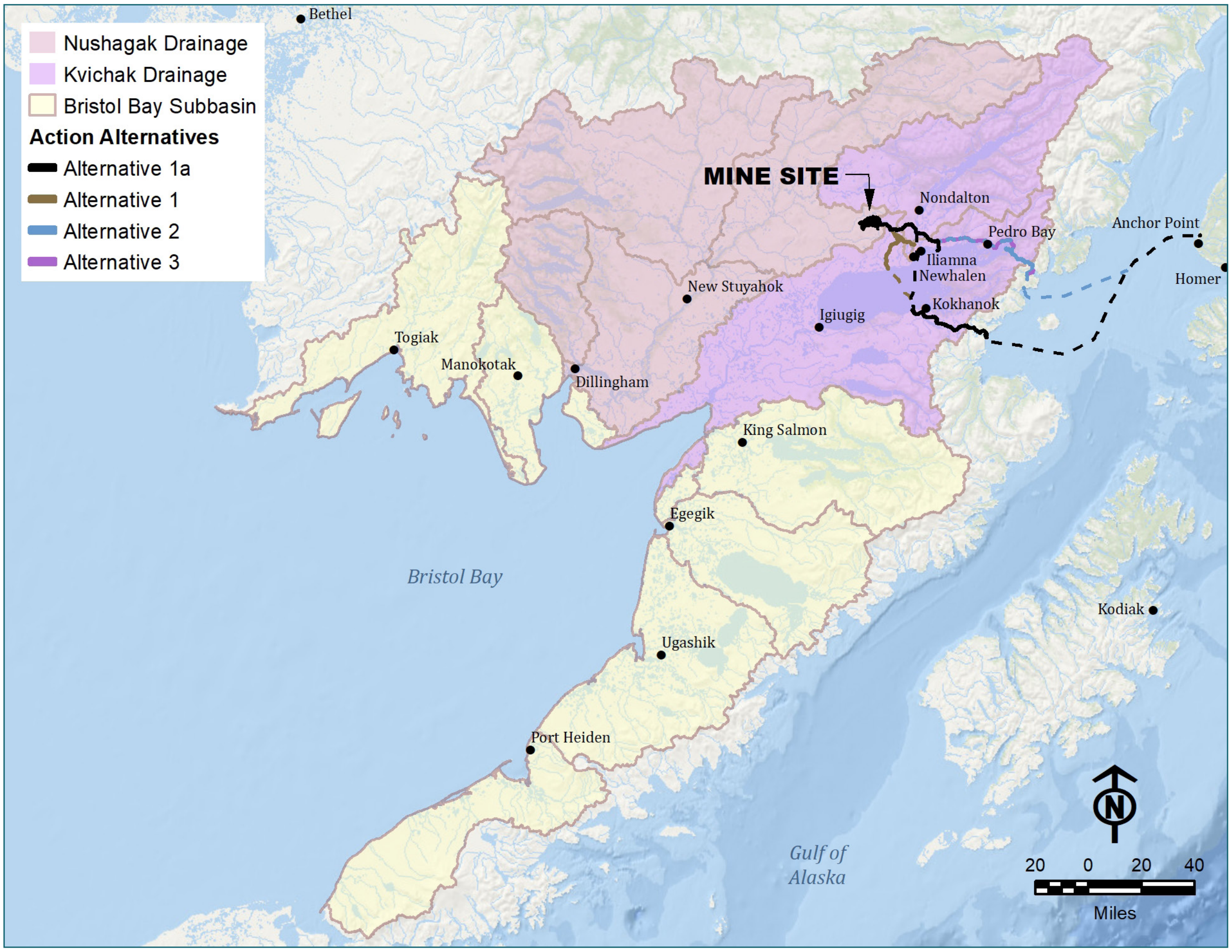


Figure ES-27: Bristol Bay Watershed

3.2 Water

The proposed project and the nature of open-pit mining would lead to a complex interaction between groundwater, surface water, and a number of water-related resources. The proposed project would also lead to a complex interaction between the water-related resources and fish and aquatic resources. Impacts to water, fish, and wildlife resources could in turn have impacts on subsistence or commercial fishing; for example, water quality may affect fish populations, which in turn may influence subsistence or commercial fishing harvests, which can have implications for other human outcomes such as health and socioeconomics. Impacts described in one section may depend on the analysis from another section. During the writing process, preparers collaborated by sharing data and discussing interrelated aspects of the analyses to better capture the interrelated nature of environmental resources.

3.2.1 Existing Conditions (Affected Environment) Summary

Scoping comments related to water and water quality were extensive. Specific concerns included pit water and tailings management, changes in streamflow, downstream nutrients and other water quality parameters, risks associated with acid rock drainage (ARD), and treated water discharge locations. Commenters also requested that an evaluation of surface water and groundwater use be provided.

Surface Water Hydrology

The EIS analysis area for surface water (Section 3.16, Surface Water Hydrology) includes watersheds with numerous streams, ponds, and lakes (including Iliamna Lake), marine water (Cook Inlet), and wetlands that have the potential to be impacted by the project.

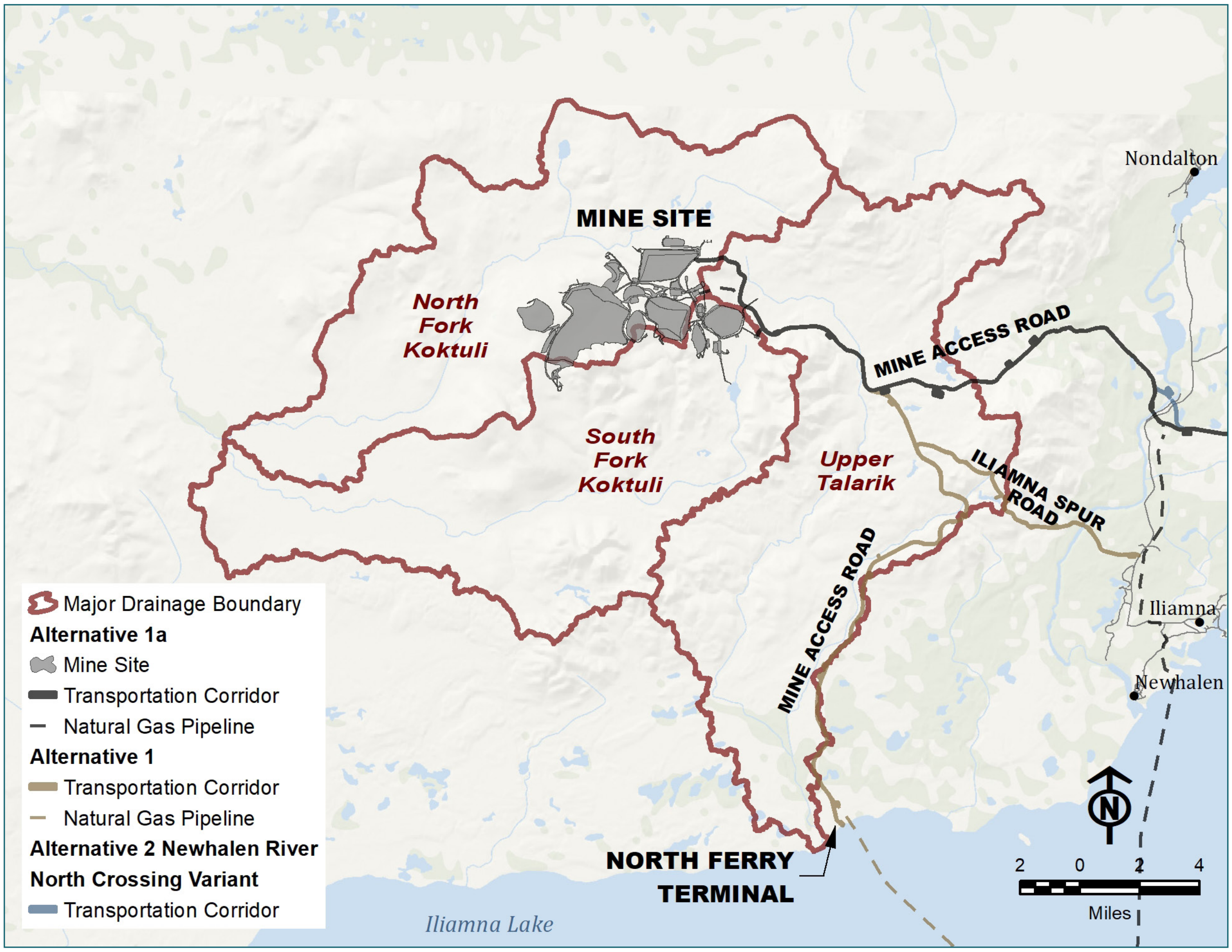


Figure ES-28: Watersheds in the Mine Study Area

Much of the mine site is hydrologically connected to Bristol Bay (Figure ES-27) via the NFK and SFK rivers, which join the Mulchatna River west of the mine site. The majority of the mine site facilities would be in the NFK watershed (Figure ES-3). The open pit, as well as the overburden stockpile, open pit WMP, WTP #1, and the SFK treated water discharge location would be in the SFK watershed. Only the UTC treated water discharge location and a short portion of the mine access road would be in the UTC watershed (Figure ES-3).

General characteristics common to the drainage basins (Figure ES-28) include:

- Main streams occupy valley bottoms 0.5 mile to 2 miles wide.
- Tributaries to the main streams are incised into the hilly terrain and typically occupy narrow valleys with bottom widths of only 0.1 to 0.2 mile.
- The three main stream channels are highly sinuous and flow in floodplains containing wetlands and oxbow lakes.
- The upper parts of the three main basins are represented by flat, poorly drained terrain.
- Areas of glacial drift (sediment of glacial origin) deposits occur along lower hillslopes and near the headwaters of the main stream valleys, characterized by undulating terrain and numerous kettle lakes.

Streamflow in the Bristol Bay region is generated primarily from spring snowmelt runoff and runoff from fall rain events. The mine site watersheds are undisturbed; therefore, baseline streamflow presented in the EIS is representative of existing natural conditions. The annual pattern of streamflow in the mine site watersheds is characterized by high flows in spring due to snowmelt; lower flows during early to mid-summer; and a high-flow period during late summer to fall derived from rain events. During winter and early spring, some streams have very low or no measurable flow except where recharged by groundwater (described in more detail below under Groundwater Hydrology).

Most of the transportation and pipeline corridors from the mine site toward the east are in the Kvichak River watershed to the Cook Inlet watershed boundary defined by the Alaska Range. The remaining onshore transportation and pipeline corridors and port sites are in the Cook Inlet watershed.

Iliamna Lake is the largest lake in Alaska, approximately 75 miles long by 22 miles wide, with surface area of about 1,000 square miles. The ice-covered season at Iliamna Lake is highly variable. Complete freeze-over occurs between late October and mid-March and can last for 2 to 5 months before break-up. The average length of the ice-covered season is expected to be about 115 days, based on 15 years of data collected in several southwestern Alaska lakes.

Groundwater Hydrology

The EIS analysis area for groundwater hydrology is the geographic area in the near vicinity of all project components (i.e., within 0.5 mile to several miles), where project activities could be expected to affect groundwater flow and patterns.

The mine site is generally characterized by surficial sedimentary materials (e.g., silts, sands, and gravels) occurring in valleys and low slopes, and permeable weathered and fractured bedrock exposed in the upland areas and hilltops. Most of the groundwater storage and flow occurs in the sedimentary materials (overburden). Streams in the deposit area exhibit complex interactions with groundwater, with both gaining and losing reaches, depending on local soil types, land surface gradients, and water-table gradients. Studies in the mine site suggest that groundwater discharge to streams or rivers prevails; and that where it is occurring, groundwater base flow is highest in the winter, and lowest (on a percent volume basis) during the spring and summer runoff events.

The weathered and fractured bedrock, which is up to approximately 50 feet thick, provides a pathway for elevated rates of groundwater recharge beneath the bedrock ridges. Below the weathered bedrock, bedrock permeability generally decreases with depth. This decrease is likely responsible for the numerous seeps observed on hillsides, where downward-percolating groundwater recharge is blocked by relatively low-permeability rocks at depth, and is forced to emerge at the land surface and flow as surface water. Some fractured and faulted rocks produce areas of enhanced permeability through open fractures. In some faults, reduced permeability may occur where clay-rich fault gouge plugs the fractures. Therefore, where faults are mapped, it is not immediately known whether the faults contribute to enhanced permeability, reduced permeability, or have practically no effect at all. Some faults are laterally extensive and have the potential to function as barriers to groundwater flow that would result in the compartmentalization of groundwater flow. Deep aquifer testing (up to 4,000 feet deep) has shown that faults can be interpreted to be at least a localized barrier to groundwater flow. However, regionally there are no anomalously elevated or lowered water-level data from the bedrock aquifer to suggest that either enhanced or reduced permeabilities associated with faults or localized compartmentalized flow affect regional flow.

Regional groundwater flow in the deep bedrock is a very small portion of the overall groundwater budget of the area. Local and intermediate groundwater flow systems dominate the overall groundwater regime, with most flow occurring in shallow levels in overburden and shallow bedrock.

The Comprehensive Water Modeling System is composed of three models:

1. **Watershed model**—estimates long-term baseline surface and groundwater flows under a range of climatic conditions and is used to assess potential effects of the mine on streamflow (described in Appendix K3.16, Surface Water Hydrology).
2. **Groundwater model**—simulates groundwater flow and groundwater-surface water interactions. Used to assess potential impacts of the mine on the groundwater system, including the evaluation of pit inflows and groundwater drawdown and mounding, and hydraulic containment of groundwater near the pit/pit lake, TSFs, and WMPs (described in Section 3.17 and Section 4.17, Groundwater Hydrology).

- **Mine site water balance model**—a model developed for water management and engineering design purposes. Provides flow estimates for all major components of the mining process for operations and closure, and includes the Water Quality Model (described in Appendix K3.16, Surface Water Hydrology; and Appendix K4.18, Water and Sediment Quality).

These three models are interconnected, and collectively provide the means of quantifying the numerous water flows in the streams, ground, pipes, ponds, and mine structures associated with the mine development and project water quality modeling.

Three mostly continuous groundwater divides are indicated in the project footprint area as follows:

- Between the UTC drainage and the NFK drainage (except for a segment where the divide is probably absent)
- Near the Pebble deposit between the SFK River drainage and the UTC drainage (except for a segment where the divide is absent)
- Between the SFK River drainage and the NFK River drainage

Groundwater divides are generally considered to be approximately coincident with surface water divides. An exception to this is in the area of the surface water drainage divide between the SFK and tributary UT1.190 basins, where the groundwater divide is interpreted to be absent, reflecting interbasin groundwater flow from the SFK to the UTC drainage. Western portions of the mine access road are in the well-studied UTC drainage. Limited data are available for the port access road under Alternative 1a and Alternative 1, or the access roads under Alternative 2 and Alternative 3. No known hydrogeological investigations have been conducted along the port access roads or port sites. The mine access road from the mine to Eagle Bay under Alternative 1a and Alternative 2, and the western part of the north access road under Alternative 3, cross mostly glacial and alluvial deposits in the UTC, Newhalen River, Eagle Bay Creek, Chekok Creek, and Canyon Creek drainages. Based on the similar geologic setting and topography across the mine access road and port access road, aquifers and confining units in the transportation corridor are likely similar. Permeable sands and gravels, which make up the abundant glacial till and outwash across the mine access road and port access road, as well as lake terrace and beach deposits 1 to 2 miles from the north ferry terminal (under Alternative 1), likely host surficial and/or intermediate aquifers. It is possible that weathered and/or fractured bedrock stores additional groundwater at depth.

The mine access road from the mine to Eagle Bay under Alternative 1a and Alternative 2, and the western part of the north access road under Alternative 3, cross mostly glacial and alluvial deposits in the UTC, Newhalen River, Eagle Bay Creek, Chekok Creek, and Canyon Creek drainages. East of Knutson Mountain, groundwater-bearing surficial deposits are more limited in extent to steep, narrow drainages with large areas of exposed bedrock in between. Alluvium, alluvial fan, and mass wasting deposits in Knutson Creek, Pile River, Iliamna River, and Chinkelyes and Williams creeks may host surficial aquifers. Small areas of ground moraine and lake terrace deposits in the Pile and Iliamna river valleys may also contain shallow groundwater. It is possible that groundwater may be present near the surface along steep slopes in weathered or fractured bedrock in this area. At the Diamond Point port site under Alternative 2, shallow groundwater may be present in alluvial fan material in the small drainage on the northern side of Cottonwood Bay.

Water and Sediment Quality

The EIS analysis area for water and sediment quality includes the project footprint, and areas adjacent to or downstream of—and potentially affected by—project elements and alternatives.

Water quality studies were reviewed to quantify chemical and physical parameters of the existing quality of the water at the mine site and surrounding areas that would potentially be impacted. Baseline surface water resources can generally be characterized as cool, clear waters with near-neutral pH that are well-oxygenated, low in alkalinity, and generally low in nutrients and other trace elements. Some differences in water quality between watersheds and trends in water quality along streams were noted, based on repeated monthly or quarterly testing of samples in the NFK, SFK, and UTC over the 9 year sampling period. The environment does contain natural variance and exceedances of Alaska water quality criteria in surface water for metals such as aluminum, arsenic, copper, lead, and manganese, which is attributable to the geology and mineralization of the area. Mercury was not detected in approximately 95 percent of samples tested.

Groundwater samples from relatively close to the deposit area have a higher proportion of sulfate, suggesting that the groundwater in this area is influenced by oxidation of the sulfide minerals associated with the deposit. Although sulfides appear to be oxidizing locally in the Pebble deposit area, the groundwater is not acidic overall. Of the 26 trace elements for which samples were analyzed, all were present above laboratory analysis detection limits in at least some of the samples, with aluminum, calcium, iron, and magnesium present at substantially higher concentrations than the other elements. Mean concentrations of a number of metals in groundwater, including aluminum, copper, iron, lead, manganese, and zinc, exceed water quality criteria, with higher values generally present in bedrock groundwater, as compared to overburden groundwater.

Sediment from ponds and minor drainages in the mine site area show higher concentrations of anions and cations such as sulfate, ammonia, and sodium than do other waterbodies in the vicinity. Comparing sediment from the major drainages, copper was the only element showing significant variation, likely caused by the difference in bedrock composition across drainages. Copper concentrations were particularly high in SFK sediment, likely due to copper-rich bedrock at the headwaters. In comparison to sediment quality guidelines, the highest detected concentrations of four metals (arsenic, chromium, copper, and nickel) exceeded concentrations that may have an adverse effect on benthic organisms (both the threshold effects and higher probable effects levels). These samples were from sediment in the SFK drainage (for arsenic and copper) and UTC drainage (for chromium and nickel). The mean concentration of arsenic exceeded the threshold effects level across the study area.

3.2.2 Expected Effects (Environmental Consequences) of Alternatives

Surface Water Hydrology

Environmental consequences are discussed in Section 4.16, Surface Water Hydrology.

NA No Action Alternative

Under the No Action Alternative, federal agencies with decision-making authorities on the project would not issue permits under their respective authorities. The Applicant's Preferred Alternative would not be undertaken, and no construction, operations, or closure activities specific to the Applicant's Preferred Alternative would occur. Although no resource development would occur under the Applicant's Preferred Alternative, PLP would retain the ability to apply for continued mineral exploration activities under the State's authorization process (ADNR 2018 RFI 073), or for any activity not requiring federal authorization. In addition, there are many valid mining claims in the area, and these lands would remain open to mineral entry and exploration by other individuals or companies.

It would be expected that current State-authorized activities associated with mineral exploration and reclamation, as well as scientific studies, would continue at levels similar to recent post exploration activity. The State requires that sites be reclaimed at the conclusion of their State-authorized exploration program. If reclamation approval is not granted immediately after the cessation of activities, the State may require continued authorization for ongoing monitoring and reclamation work as it deems necessary.

As permitted, the activities would not be expected to cause any new effects on surface water hydrology.

PLP would be required to reclaim any remaining sites at the conclusion of their exploration program. If reclamation approval is not granted immediately after the cessation of reclamation activities, the State of Alaska may require continued authorization for ongoing monitoring and reclamation work as deemed necessary. Although these activities would also cause disturbance, reclamation would benefit the mine setting.

A1a Alternative 1a

The duration of the impact to streamflow would be long-term, lasting beyond the construction phase in some streams and reaches, but would generally be less during post-closure than during construction or operation. The one exception is NFK Tributary 1.19, which is in the mine site footprint. NFK Tributary 1.19 would be removed during construction and would not be replaced.

Potential direct and indirect effects on surface water hydrology from the project may include:

- Stream channels being eliminated or reduced by construction and fill placement associated with the development and operation of the mine
- Streamflow changes resulting from mine operation (e.g., pit dewatering, collection of surface drainage in the mine site, water treatment plant discharges, and closure and post-closure water management practices)
- Increased stream bank and channel erosion due to removal of the natural vegetation, construction in streams, or the construction of earthen structures (e.g., dams, road embankments, pads) before they become fully vegetated

The project would be designed for zero-discharge of untreated contact water during construction, operations, and closure. Water management strategies have been developed to achieve this design and maintain sufficient fresh water for ore processing and other uses at the mine site. These management strategies and the comprehensive water modeling system were considered in analysis of impacts to surface water hydrology. Section 3.16 and Section 4.16, Surface Water Hydrology, describe the comprehensive water modeling system.

Surface water quantity and distribution in the NFK River, SFK River, and possibly UTC watersheds would be affected during construction through diversion and collection of surface water, initial drawdown of groundwater at the open pit area in preparation for mining activities, and WTP discharge. It is anticipated that the magnitude of the impact during construction would be no greater than the magnitude of the impact at the end of mine (peak operations). The geographic extent of the impact on the NFK and the

SFK streamflows during construction would extend to just below the confluence of the two rivers. After the flows combine at the confluence of the NFK and SFK rivers, discernible changes in flow would be unlikely, and are expected to be within historic and seasonal variation in the Koktuli River. Other potential impacts during construction include potential for increased upland and stream channel erosion due to removal of vegetation, and construction within streams of earthen structures; water ponding could occur adjacent to the upstream site of access roads, where drainage could be disrupted by lack of a drainage structure; potential water depth increase immediately upstream of culverts.

Streamflow in the NFK, SFK, and UTC watersheds would be affected by the project during operations, when the primary goal of water management would be to minimize the generation of contact water. Other objectives include managing fresh water (non-contact water), stormwater runoff (runoff from facilities, non-contact water), mine drainage (contact groundwater or surface water), process water (contact wastewater generated from operations), and inflow to and discharge from the WTPs. Water not diverted before becoming contact water would be collected and used as process water, or treated and discharged to the environment at specific discharge locations in the watersheds. Various water management structures would be used during operations such as the WMPs, bulk TSF, pyritic TSF, SCPs, and diversion channels. The volume of water requiring treatment during operations is expected to vary based on the climatic conditions and management of water volume in WMPs to plan for sufficient water supply for mill operations during extended dry periods. The average annual flows were calculated for the relatively dry, average, and relatively wet conditions in the mine site water balance model.

The predicted change in streamflow for specific reaches in the NFK, SFK, and UTC basins is based on conditions at end of mine using a base case scenario with 50 percent exceedance probability WTP discharge. The base case scenario is described in Section 4.16, Surface Water Hydrology. The downstream boundary of the analysis area is the confluence of the NFK and SFK rivers and Iliamna Lake at the mouth of the UTC. For each reach studied, estimated average monthly streamflow was compared to baseline average monthly streamflow, and estimated annual average monthly streamflow was compared to baseline annual average monthly streamflow. Impacts to streamflow are described as percent more or less than baseline. The results of the analyses indicate that during operations, the impacts to streamflow on the NFK and SFK would be greater than on the UTC, and that reaches closest to the mine site would experience greater impacts to streamflow than reaches farther from the mine site.

The estimated change in streamflow with treated water discharge at end of mine in reaches studied furthest ("Reach A") from the mine site for the NFK, SFK, and UTC are summarized below:

- NFK Reach A—Near the confluence of the NFK and SFK. The average monthly streamflow with a 50 percent exceedance probability is estimated to vary from 23.5 percent more to 12.1 percent less than the baseline streamflow. The annual average monthly streamflow change with a 50 percent exceedance probability is estimated to be 0.2 percent less than the baseline streamflow.
- SFK Reach A—Near the confluence of the NFK and percent exceedance probability is estimated to vary from 0.8 percent less to 2.8 percent less than the baseline streamflow. The annual average monthly streamflow change with a 50 percent exceedance probability is estimated to be 2.2 percent less than the baseline streamflow.
- UTC Reach A—Near the mouth of the UTC. The average monthly streamflow with a 50 percent exceedance probability is estimated to vary from 0.8 percent more to 0.2 percent less than the baseline (i.e., pre-mine) streamflow. The annual average monthly streamflow change with a 50 percent exceedance probability is estimated to be 0.2 percent more than the baseline streamflow.

The geographic extent of the measurable impact on the average monthly streamflows to the UTC is likely to be confined to the upper reaches of the stream. Section 4.16, Surface Water Hydrology, describes streamflow and estimated changes for other reaches and tributaries in the affected basins.

Closure is divided into four main phases after operations as listed below. Key surface water management activities for each phase are described in Section 4.16, Surface Water Hydrology.

- Phase 1—Closure Year 1 to Year 15
- Phase 2—Closure Year 16 to until the pit is full (approximately Year 23)
- Phase 3—Closure Year 23 to Year 50
- Phase 4 (post-closure)—Closure Year 51 to Year 51+

Discharge from the WTPs is an important element in maintaining streamflow in the NFK and SFK rivers and UTC. It is expected that on average (Table K4.16 17, Phase 1 Base Case, 50th percentile [50 percent exceedance probability]) the total amount of water to be treated and discharged would be greatest in Phase 1, less in closure Phase 3, and least in closure Phase 4; with the possible exception of Phase 2. It is anticipated that there would be no WTP discharge in the 8 years of Phase 2, while the water level rises in the open pit (see Groundwater Hydrology).

Estimated streamflow changes during closure and post-closure using the base case scenario with 50 percent exceedance probability WTP discharge indicate that impacts to streamflow on the NFK and SFK would be greater than on the UTC, and stream reaches closest to the mine site would experience greater impacts to streamflow than reaches farther from the mine site. During closure, mainstem stream reaches would experience changes in average monthly and annual average monthly streamflow. The estimated change in streamflow during closure in reaches studied furthest ("Reach A") from the mine site for the NFK, SFK, and UTC are summarized below:

- NFK Reach A would vary from 10 percent more to 5.6 percent less than the baseline average monthly streamflow, and the annual average monthly streamflow would be 0.0 percent less than the baseline annual average monthly streamflow.
- SFK Reach A, average monthly streamflow would vary from 5.8 percent more to 0.3 percent less than the baseline average monthly streamflow, and the annual average monthly streamflow would be 1.7 percent more than the baseline annual average monthly streamflow.
- UTC Reach A, average monthly streamflow would vary from 0.6 percent more to 0.0 percent less than the baseline average monthly streamflow, and the annual average monthly streamflow would be 0.2 percent more than the baseline annual average monthly streamflow.

Streamflow changes during closure for all conditions evaluated in other reaches and tributaries closer to the mine site are described in Section 4.16, Surface Water Hydrology. The results of the stream change computations indicate that average monthly and annual average monthly streamflow on the NFK, SFK, and UTC watersheds are likely to change as a result of mining, including closure phases; although the magnitude of the change is likely to be much less on the UTC. The duration of the impact on streamflow would last from some time during construction to sometime post-closure. The geographic extent of the impact to average monthly streamflows on the NFK and the SFK rivers may extend just below the confluence of the NFK and SFK rivers. After the flows combine at the confluence of the NFK and SFK rivers, discernible changes in flow would be unlikely, and are expected to be within historic and seasonal variation in the Koktuli River. The geographic extent of a measurable impact on the average monthly streamflows in the UTC is likely to be confined to the upper reaches of the stream.

There is a potential for increased upland and stream channel erosion due to removing structures and rehabilitating the mine site during closure phases 1 through 3. Generally, these activities would reduce the potential for erosion. However, if an unexpected storm occurred at a time of significant surface disturbance, it might increase erosion for a limited time. The geographic extent of the erosional scars would probably be limited to the mine site, but sediment deposition could occur outside the mine site, and an increased stream sediment load could possibly extend into the Koktuli River.

During closure phase 4 (post-closure), the potential for increased upland and stream channel erosion above background conditions is possible. However, with time, the potential should decrease. The geographic extent of an impact would also continue to lessen with time, and would probably be confined to the upper reaches of the NFK and SFK rivers and UTC by closure phase 4. The potential for increased erosion downstream from road culverts would decrease as the culverts are removed and the channels restored. Where culverts remain, the magnitude, duration, and extent of the impact would be much the same as during operations.

During closure (phases 1 through 4), the potential for increased water ponding adjacent to the upstream side of roads, where drainage is disrupted by the lack of a drainage structure, is considered very small. This is because the roads would have been in place for a long period of time, and such areas are expected to have been remedied. Additionally, it is anticipated that many of the roads would be removed and rehabilitated; thereby removing the potential impact. If such a situation was to occur, the magnitude, duration, and extent of the impact would be similar to or less than that during construction.

For the culverts that remain, the potential for increased water depth immediately upstream from a culvert is considered the same as during operations. The potential magnitude, duration, and extent of the impact would also be similar to or less than that during construction.

Bridges and culverts would be constructed along the transportation corridor. Stream crossings for action Alternatives and associated variants associated with the roads and pipelines would be designed to minimize potential impacts on surface water hydrology, water quality, and fish passage. Erosion and sediment control best management practices (BMPs), including routine maintenance of drainage ditches and stream crossings, would be implemented and maintained during the mine operation period. Based on the use of BMPs and good maintenance, the magnitude of the impact would be small. The duration of the impact would be about as long as it takes for the vegetation to reestablish. The extent of the impact resulting from sediment transported by streams would be on the order of hundreds of feet to miles, depending on many site- and event-specific factors.

Where the natural gas pipeline follows the roads, it would be in a trench adjacent to the driving surface of the roads. Although final design of the pipeline has not been completed, it is anticipated that the stream crossings would be constructed by a combination of placing the pipeline in a trench dug across the stream (open cut); boring the pipeline under the stream (HDD); or hanging the pipeline on a bridge structure. The magnitude, duration, extent, and potential for these impacts would be the same as for vegetation removal and excavation associated with road construction.

Surface water used during construction and operations would be extracted from designated sites along the transportation corridor. The Alaska Department of Fish and Game (ADF&G) establishes fish habitat permit requirements that apply to water extraction activities, while the Alaska Department of Natural Resources (ADNR) has requirements for temporary water use authorizations. The magnitude and duration of the maximum projected surface water use along the transportation corridor during the 4 year construction phase would be a total of 63 million gallons. Estimated average extraction rates would range from 500 to 1,000 gallons per minute, depending on the streamflow/volume of the waterbody. Final estimated quantities for specific uses would be determined during final design and permitting. All surface water extraction would require compliance with approved state permits (if issued), stipulations, and reporting requirements to protect stream flow, fish, and fish habitat.

Water withdrawal would be required to be permitted and conducted within the requirements of ADF&G and ADNR for a water withdrawal permit (if issued). It is reasonable to assume that the rate and volume of water withdrawals would be monitored at each source to demonstrate permit requirements are met. Therefore, the intensity of the impacts to surface water resources would be generally expected to result in changes in water quantity, likely within the limits of historic and seasonal variation.

A1 Alternative 1 and Variants

The magnitude, duration, extent, and likelihood of impacts to surface water hydrology under Alternative 1 would be the same as those described under Alternative 1a.

The port access road alignment under Alternative 1 is the same as described under Alternative 1a. The mine access road would extend from the mine site south to the north ferry terminal on Iliamna Lake. Under Alternative 1, spur roads would include those described under Alternative 1a, and would also include the Iliamna spur road. The Iliamna spur road would be an unpaved road, approximately 9 miles long, connecting the mine access road to the existing road system supporting the communities of Iliamna and Newhalen.

Twenty potential water extraction sites have been identified to support project construction and operations of Alternative 1. Appendix K2, Alternatives, provides information for each water extraction site, including the location, waterbody type, use, years and season of use, and estimated extraction rate and volumes. The annual volume of water that would be extracted under Alternative 1 for all water extraction sites is 49 million gallons, including 6 million gallons along the Iliamna spur road. Final estimated quantities for specific uses would be determined during final design (PLP 2018 RFI 022). The magnitude, duration, extent, and likelihood of impacts to surface water hydrology under Alternative 1 are expected to be the same as those described under Alternative 1a.

A2 Alternative 2 and Variants

The magnitude, duration, extent, and likelihood of impacts to surface water hydrology under Alternative 2 and its variants are expected to be the same as those described under Alternative 1a, except for the upstream shift (compared to the centerline construction in Alternative 1a) of the main TSF embankment by about 40 feet upstream (Tributary NK 1.19, gaging station NK 119A).

The mine access road under Alternative 2 is the same as for Alternative 1a—mine site to Eagle Bay ferry terminal. The port access road would connect the Pile Bay ferry terminal with a port at Diamond Point. The magnitude, duration, extent, and likelihood of surface water hydrology impacts associated with the road segments from the mine site to Eagle Bay, and Pile Bay to Diamond Point port would be similar to the types of impacts described for Alternative 1a, except the road length under Alternative 2 is less than Alternative 1a, and the road segments for Alternative 2 would result in fewer stream crossings than Alternative 1a.

Impacts from ferry operations from Eagle Bay to Pile Bay would have magnitude, duration, extent, and likelihood of impacts to surface water hydrology similar to Alternative 1a.

Impacts to surface water hydrology at Diamond Point port would be similar to those described under Alternative 1a for Amakdedori port. Approximately 650,000 cubic yards of seabed material would be dredged to provide for a barge approach channel and turning basin on the southern side of the causeway. Berms around these stockpiles would contain the sediments, as needed, and collect seepage and stormwater runoff for treatment in settling ponds prior to discharge.

The main moored lightering location would be in Iniskin Bay offshore from the Diamond Point port site. An alternate lightering location would be in Kamishak Bay in the lee of Augustine Island, based on weather conditions during operations (the same as Alternative 1a).

A3

Alternative 3 and Variant

Under Alternative 3, the magnitude, duration, extent, and likelihood of impacts to surface water hydrology related to the mine site would be the same as under Alternative 1a. The road corridor in Alternative 3 would increase the project footprint, because the north road route would have a longer road corridor. The magnitude, duration, extent, and likelihood of impacts associated with stream crossings would be the same as those for crossings described under Alternative 1a, but there would be more waterbody crossings under Alternative 3.

The magnitude, duration, extent, and likelihood of impacts to surface water hydrology would be the same as described under Alternative 1a for the portion of the pipeline corridor beginning on the Kenai Peninsula, and crossing Cook Inlet to Ursus Cove, then buried overland to Cottonwood Bay, and landfall would be at the port site (north of Diamond Point) in Iliamna Bay. Impacts would be similar to those described under Alternative 2 for the portion the pipeline corridor from Diamond Point to the mine site. The onshore pipeline-only segments are longer under Alternative 3 than under Alternative 1a.

The magnitude, duration, extent, and likelihood of impacts to surface water hydrology under this Alternative would be the same as for Alternative 1a, except with longer road and pipeline corridors under Alternative 3, and a slightly increased footprint in the construction corridor.

Under the Alternative 3 Concentrate Pipeline Variant, the amount of WTP water released at discharge locations at the mine site would be reduced by approximately 1 to 2 percent. The reduction in WTP-released discharge would be a result of the need for water to create the concentrate slurry, and to flush the concentrate pipeline during maintenance. Reduced discharge water from WTPs could result in a greater reduction in streamflows than those described under Alternative 1a. With the return water pipeline option, the concentrate would be dewatered at the port, and the return waterline would transfer water back to the mine site. This option would not result in any additional footprint, and would preclude the need for discharge of treated water at the port site.

CE

Cumulative Effects

Effects of the project on surface water hydrology would include changes to recharge, reduction, movement, and distribution of surface water (e.g., streams, lakes, marine waters), floodplain values, and shoreline erosion/accretion. The analysis area for cumulative effects on surface water hydrology includes all watersheds in which project-related activity would occur, where direct and indirect effects on surface water hydrological systems, including surface and groundwater quantity and flow, could reasonably be expected to occur. A number of the actions identified are considered to have no potential of contributing to cumulative effects on surface water hydrology in the analysis area. These include offshore-based developments; activities that may occur in the analysis area, but are unlikely to result in any appreciable impact on surface water flow; or actions outside of the cumulative effects analysis area.

Past and present actions affecting surface water conditions in the analysis area are minimal. Current development consists of a small number of towns, villages, and roads with existing stream crossing structures such as culverts and bridges. Additional activities include mining exploration; non-mining-related projects such as transportation, and oil and gas exploration, have included site-specific exploratory drilling and temporary support camps, which are typically seasonal, involve a small footprint, and are subject to inspection and reclamation requirements. Past road construction outside of communities include the Williamsport-Pile Bay Road, and roads in the vicinity of Iliamna, Newhalen, and Nondalton. Community development activities have centered around individual communities, and involve housing, utility, and transportation improvements. These actions have resulted in little to no regional changes to surface water, including streamflow, lakes, and surface water/groundwater interaction.

RFFAs that could contribute cumulatively to effects on surface water hydrology in the analysis area are limited to those activities that would occur in the Nushagak River or Kvichak River watersheds, or in other waterbodies intersected by the transportation and pipeline corridors in both Bristol Bay and Cook Inlet watersheds.

Groundwater Hydrogeology

Environmental consequences are discussed in Section 4.17, Groundwater Hydrology.

NA No Action Alternative

Under the No Action Alternative, federal agencies with decision-making authorities on the project would not issue permits under their respective authorities. The Applicant's Preferred Alternative would not be undertaken, and no construction, operations, or closure activities specific to the Applicant's Preferred Alternative would occur. Although no resource development would occur under the Applicant's Preferred Alternative, PLP would retain the ability to apply for continued mineral exploration activities under the State's authorization process (ADNR 2018 RFI 073) or for any activity not requiring federal authorization. Groundwater along the transportation corridor, pipeline corridor, and at the port sites would remain in its current state. There would be no effects on existing private wells. In summary, there would be little to no direct or indirect impacts on baseline groundwater conditions from implementation of the No Action Alternative.

A1a Alternative 1a

Impacts to groundwater hydrology were evaluated based on baseline data, water management plans, and groundwater modeling. The groundwater flow model was developed and is used for all analysis in the FEIS. The groundwater model includes a complete model calibration and sensitivity analysis report. The modeling work includes updated numerical solution algorithms, additional sensitivity analyses (to address model uncertainty), particle-tracking analyses, and responses to numerous RFIs. The analysis of project impacts on groundwater hydrology using the model addresses five general areas: 1) the open pit and (post closure) pit lake; 2) the main and open pit WMPs; 3) the bulk TSF; 4) the pyritic TSF; and 5) potable water supply wells, quarries, and miscellaneous other mine facilities.

Dewatering of the open pit would be required to facilitate mining. Dewatering results in a groundwater "zone of influence" because the water table is lowered in the pit, and the effect extends laterally beyond the pit area into the adjacent bedrock and overburden aquifers. The zone of influence would deepen and widen as pit excavation progresses and dewatering expands, and would last as long as the dewatering system is operated during construction, operation, closure, and post-closure phases.

The magnitude and extent of impacts would be that groundwater levels would ultimately need to be lowered below the bottom of the final mine pit, which is estimated to be up to 1,950 feet below grade. Pumping water from the pit and from wells in and surrounding the pit would locally change groundwater flow patterns such that groundwater would flow radially inwards and vertically upwards towards the pit. Groundwater/surface water interactions and surface water flows would also be impacted by pit dewatering. Natural groundwater discharge to seeps, wetlands, streams, ponds, or lakes immediately adjacent to the pit may cease or be reduced, resulting in lower surface water base flows, lower pond or lake levels, or lower groundwater levels beneath wetlands.

In terms of magnitude and extent, some wetlands, stream segments, ponds, and lakes in the immediate pit area may be eliminated as the water table is lowered, and water leaks out of these waterbodies during construction and mining operation and into the pit dewatering system. The duration of these impacts would be medium- to long-term, lasting for the life of the project, and some would continue through post-closure (when the zone of influence would be smaller), and are certain to occur if the project is permitted and built. The contiguous zone of influence for the open pit at the end of mining would be approximately 2.4 miles in diameter, although somewhat less in northerly and southeasterly directions. The zone of influence at the end of mining for the top of competent bedrock would be somewhat larger, extending up to approximately 3 miles in diameter.

The extent of primary impacts to groundwater flow associated with the open pit would be in the overburden and bedrock aquifers in the open pit footprint and zone of influence. Local, intermediate, and regional groundwater flow in these aquifers would flow radially towards the pit and be captured by the dewatering system. Groundwater beneath the pit would also flow upwards towards the pit and be captured. The magnitude of impacts to groundwater flow patterns would increase as mining proceeds to the full depth of the pit, and as the zone of influence surrounding the pit becomes wider. The maximum area of the zone of influence for the pit at the end of mining would be about 2,600 acres.

Once mining ceases, dewatering activities would be reduced while PAG waste rock and pyritic tailings are placed in the open pit, and groundwater in the open pit would be allowed to rise. It is estimated it would take 21 to 23 years for the groundwater in the pit to reach the Maximum Management (MM) level (890 feet above mean sea level) at the beginning of closure phase 3. Water would be pumped from the pit lake to maintain the level below the MM level under the remainder of closure phase 3 (through approximately Year 50 of closure) and throughout post-closure. Under these conditions, the pit lake would be classified as a groundwater discharge lake in which groundwater enters the lake from all sides and from beneath the lake, and no water leaves the lake through groundwater flow. Maintenance of the lake at a sufficiently low level that the lake remains as a groundwater-discharge type of lake is termed "hydraulic containment" (i.e., contact water in the pit lake is contained except for that which evaporates or is pumped out, treated, and released).

The groundwater model was used to evaluate and confirm various elevations of the pit lake water surface that could result in loss of hydraulic containment of the pit lake. Results of the evaluation indicate that even under different sensitivity analysis scenarios, the pit lake would not lose hydraulic containment until the pit lake reached a level of 950 feet above mean sea level or more, depending on the scenario. Therefore, the model predicts that all groundwater flow directions are towards the pit lake under the MM level of 890 feet with 50+ vertical feet of water storage available. This amount of water storage would provide for approximately 1 year of water-level recovery in the event of complete failure of all water pumping for any reason. This is estimated from the rate of water level recovery of the pit lake during late-closure conditions, when no pumping of water from the pit lake is planned. Further simulations indicate the conclusions regarding hydraulic containment of the pit lake also applied to hydraulic containment of the tailings and waste rock placed in the bottom of the pit lake during closure under all sensitivity analyses considered.

The water level in the pit lake would be maintained to create a long-term groundwater sink to prevent pit lake water from discharging to the environment. "Long-term" is defined herein as lasting centuries. Pit lake levels would be managed by pumping and treating water from the lake to maintain the MM level in the pit lake, and prevent lake water from discharging into the environment. The presence of a long-term groundwater sink at the pit lake would continue to influence groundwater flow in the immediate vicinity of the pit lake throughout post-closure. However, the influence on groundwater flow would be smaller than in the pit's fully dewatered state during active mining operations. In terms of magnitude and extent, areas of wetlands affected by drawdown during post closure would also be smaller than those affected during operations.

Impacts to groundwater from pit-lake pumping would occur if the project is permitted and constructed, and could include groundwater flow changes that affect the nearby environment. The duration of impacts would be for centuries, and the geographic extent could occur beyond local project component areas in the analysis area.

Groundwater flow would be impacted by the lined WMPs, including local reduction in recharge caused by the presence of the liners and collection of water by the underdrain system. The groundwater model results indicate that groundwater levels would be lowered in the area of the main WMP, extending approximately 0.7 mile north of the main embankment. Groundwater model results indicate that the underdrain system, including drains beneath the embankment, would effectively capture leakage of contact water that could flow through imperfections in the liner. Removing the main WMP after closure would allow natural recharge to be re-established, groundwater elevations to recover, and predevelopment local groundwater flow systems to be restored in the vicinity of the former main WMP.

Impacts to groundwater from the main WMP and open pit WMP would occur if the project is permitted and constructed. The duration of impacts would be medium-term (decades), lasting until the facilities are removed and reclaimed during closure. Effects could slightly exceed historic seasonal variation, but would not extend beyond project component areas.

The bulk TSF would be constructed almost entirely in the NFK watershed, with a series of embankments to impound the tailings and entrained and ponded water. A small area in the southern portion of the bulk TSF lies in the SFK drainage basin. An underdrain system beneath the tailings and the main embankment and a grout curtain at the south embankment would manage seepage water draining through and beneath the main embankment from the tailings. The underdrains would primarily follow existing small drainage courses in the facility footprint. A grout curtain and liner at the south embankment would limit seepage draining through and beneath the south embankment. The thickened bulk flotation tailings discharged to the TSF would settle, and water would collect in a pond on top of the tailings.

The bulk TSF would be covered and allowed to consolidate during closure and early post-closure, but would continue to produce water for the long-term via the drains and underdrains to the north and south SCPs. Long-term pumping of water from the SCPs to the pit lake to prevent escapement of contaminated water is expected to occur. In the future, if monitoring showed that seepage water was no longer exceeding water quality standards, the pumping system would be discontinued and water would be released to the NFK and SFK basins downstream from the north SCP and south SCP, respectively.

The bulk TSF would locally impact groundwater and surface water at the site; this impact is expected to affect groundwater at approximately 2,700 acres at and near the bulk TSF, and would be permanent.

The pyritic tailings and PAG waste rock would be stored in the lined pyritic TSF and include an underdrain system. Construction of the pyritic TSF embankment foundation would require dewatering. Tailings would be placed on top of the liner and covered with water to minimize oxidation and the potential release of acidic contact waters to the environment. Groundwater levels would be reduced by this impoundment due to local reduction in recharge caused by presence of the liner and diversion of groundwater into the underdrain system.

The pyritic tailings would be moved to the bottom of the open pit at the end of mining and submerged in the pit lake to prevent oxidation. The pyritic TSF liner and embankments would be removed at closure, and the site reclaimed by removing impacted materials, regrading, and capping with growth media. Therefore, groundwater flow in this tributary drainage (the one containing the pyritic TSF) to the NFK River is expected to essentially return to pre-mining conditions during post-closure.

Impacts to groundwater from the pyritic TSF facility would occur if the project is permitted and constructed, and would be medium-term, lasting until the facilities are removed and reclaimed during closure. The magnitude and extent of effects could slightly exceed historic seasonal variation, but would not extend beyond project component areas.

There would be no effects on any community groundwater or surface water supplies from the changes in groundwater flows at the mine site. The closest such water systems are about 15 to 20 miles east and southeast of—and on the opposite side of the UTC-Newhalen River watershed divide from—the pit groundwater capture zone. Potable water at the mine site would be supplied by a series of groundwater wells approximately 3,000 feet northeast of the main WMP, outside of the estimated zone of influence around the open pit. The wells would be upgradient or side gradient of the main WMP.

Due to the likelihood of shallow groundwater being present across the mine access road and port access road corridor, it is possible that road cuts could intersect groundwater in some areas and cause a local diversion of groundwater flow, as drainage controls (construction BMPs) direct potential seepage away from the road. In terms of magnitude and extent, approximately 63 million gallons of surface water would be extracted from 22 potential water extraction sites to support project construction and operations of Alternative 1a. The extent of impacts would be limited to the immediate area of the camps, and duration would be medium-term, lasting throughout the mine life, but would be temporary; because once water drawdown ceases, groundwater would no longer be drawn towards the extraction facilities.

Along the pipeline corridor from Amakdedori to the south ferry terminal, the water table is the same as described above for this portion of the transportation corridor, and is expected to be close to the surface along much of the corridor, as evidenced by abundant wetlands, kettle ponds, and exposed bedrock. Potential impacts to groundwater would involve interception of shallow groundwater during trenching and trench dewatering activities. Groundwater could also be captured and locally re-routed along the trench backfill. Impacts could extend beyond the life of the project, because the pipeline may be abandoned in place.

On the Kenai Peninsula, the pipeline would be trenched for a short distance west of the compressor station, and then installed by HDD between the bluff and Cook Inlet from an elevation of about 200 feet to 12 feet MLLW (PLP 2018 RFI 011). The HDD-installed pipeline segment would be expected to intersect aquifers used by private wells in the area. Impacts to the closest well during HDD installation or compressor station construction and operations could include surface disruption, well pressurization effects, fuel spills infiltrating into the subsurface, or natural gas diffusion into the aquifer in the event of a pipeline leak. Dewatering would not be required for HDD drilling (PLP 2018 RFI 051); therefore, groundwater drawdown in the private well would not be expected.

A1 Alternative 1 and Variants

Impacts to groundwater at the mine site, transportation corridor, ferry terminals, Amakdedori port, and natural gas pipeline corridor would the same as described for Alternative 1a. In the Summer Only Ferry Operations Variant, the extent of the expanded container yard at the port site would reach the edge of the Amakdedori floodplain. Therefore, excavations during construction in this area are more likely to intercept shallow groundwater than under Alternative 1 without this variant. The expanded facilities at both the mine and port sites could have a short-term impact on shallow groundwater during construction from drainage controls or fill; and longer-term impacts on surface water/groundwater interactions and groundwater recharge from the installation of liners to control leaks or spills, which would be disturbed during construction, and continue throughout the life of the project. The extent of these effects would be limited to the immediate vicinity of the mine or port. Although long-term, lasting though the life of the project, they would be reasonably restored once mining ends and the port site is reclaimed.

The main difference between Alternative 1 and the Kokhanok East Ferry Terminal Variant is that the extent of the Kokhanok east route is approximately 15 percent shorter, which would reduce potential shallow groundwater and water extraction impacts (if any) associated with access road and pipeline construction. It is also anticipated that fewer streams and wetlands would be impacted. However, the footprint of material sites associated with this variant are larger than Alternative 1, and would therefore have a slightly greater impact on shallow groundwater in the immediate vicinity of the materials sites during construction. Shallow groundwater impacts from construction of the Kokhanok east ferry terminal would be short-term, and similar to those of the south ferry terminal, and would only occur during construction.

A2 Alternative 2 and Variants

The expected magnitude, duration, extent, and likelihood of effects of this Alternative are similar to those described under Alternative 1a for the mine site and natural gas pipeline corridor. Shallow groundwater along the mine access road is the same as for Alternative 1a because this corridor is the same. The effects of Alternative 2 on shallow groundwater along the port access road would likely be less than the effects of Alternative 1a, because the port access road to Williamsport would be shorter than the port access road to Amakdedori, even though the Alternative 2 port access road (Williamsport) has steep terrain and more side-hill cut requirements than the port access road (Amakdedori) under Alternative 1a, which has sparse surficial deposits and fewer cut-slope requirements.

In terms of magnitude and extent, the onshore footprint of the Diamond Point port is larger than the Amakdedori port site because of the need for a dredge materials storage area. The duration of impacts would be short-term, lasting only through construction. Placement of fill in this area could also result in groundwater mounding in the fill, which would likely be mitigated through drainage controls. The expected impacts on groundwater at Diamond Point port from Alternative 2 would be similar to those described under Alternative 1a for Amakdedori port.

The expected magnitude, duration, extent, and likelihood of effects of Alternative 2 on shallow groundwater for the Summer-Only Ferry Operations Variant would be similar to those described for the Summer-Only Ferry Operations Variant under Alternative 1. Impacts for the Pile-Supported Dock Variant would be the same as Alternative 2.

A3 Alternative 3 and Variant

The magnitude, duration, extent, and likelihood of expected effects of Alternative 3 on shallow groundwater at the mine site would be the same as described for Alternative 1a. The expected magnitude, duration, extent, and likelihood of effects of Alternative 3 on shallow groundwater at the Diamond Point port are similar to those described under Alternative 2 for the Diamond Point port. There would be no impacts on groundwater from the caisson dock under Alternative 3. The magnitude and duration of the effects of Alternative 3 on shallow groundwater along the natural gas pipeline corridor are similar to those described under Alternative 2. The extent of affected groundwater resources under both Alternative 2 and Alternative 3 would be greater than Alternative 1a due to the greater pipeline length through areas of groundwater-bearing deposits north of Iliamna Lake.

The duration of the effects of Alternative 3 on shallow groundwater in the transportation corridor are similar to those described under Alternative 1a. The magnitude and extent of affected groundwater resources would be slightly greater than the other alternatives. This is because the north access road under Alternative 3 would be about 9 miles longer than the mine access and port access combined distance for Alternative 1a, 17 miles longer than for Alternative 1, and 29 miles longer than for Alternative 2. The Alternative 3 transportation corridor would require a greater distance of side-hill cuts in steep terrain that could intersect groundwater.

The magnitude and duration of the effects of Alternative 3 on shallow groundwater along the natural gas pipeline corridor are similar to those described under Alternative 2. The extent of affected groundwater resources under both Alternative 2 and Alternative 3 would be greater than Alternative 1a due to the greater pipeline length through areas of groundwater-bearing deposits north of Iliamna Lake.

The magnitude, duration, extent, and likelihood of expected effects of the Concentrate Pipeline Variant on shallow groundwater are similar to those described under Alternative 3 for the transportation corridor and gas pipeline, given that the concentrate pipeline would be placed in the same excavation as the natural gas pipeline along the north access road. The magnitude, duration, extent, and likelihood of impacts to groundwater at the Diamond Point port site under this variant would be the same as Alternative 2 and Alternative 3, because there would be no change in total footprint, and no impacts to groundwater from treatment and offshore discharge of slurry water.

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Cumulative Effects

Potential cumulative effects to groundwater include drawdown of groundwater; reduction in natural recharge to groundwater; changes in groundwater flow patterns from shallow groundwater interception or surface water withdrawals during road and pipeline construction; drawdown of groundwater around potable wells from water supply use; and changes to groundwater flow from HDD activities. The cumulative effects analysis area encompasses the footprint of the project, including Alternatives and variants; the Pebble Project expansion footprint (including road, pipeline and port facilities); and any other RFFAs in the vicinity of the project that would result in potential synergistic and interactive effects. The geographic area considered in the cumulative effects analysis for groundwater hydrology is the near vicinity (i.e., within 0.5 mile to several miles) of all project components where project-related effects on groundwater flow patterns and use could overlap with other past, present, and RFFA surface and groundwater uses.

Past and present activities that have affected groundwater hydrology in the analysis area include development of water supply wells in communities around Iliamna Lake, small-scale wells or seeps associated with cabins and camps along the pipeline route, mining exploration near the project area (e.g., pumping tests, camp water use), and community roads and airports. Impacts associated with these activities include localized changes in groundwater flow patterns, reductions in groundwater in aquifers, and use of streams that are hydraulically connected with groundwater. These past and present actions are expected to continue throughout the project area, primarily in and around Iliamna Lake villages. Other parts of the project would be in more remote areas; characterized as having very little development; and past and present activities are seasonal in nature and do not substantially draw from groundwater resources during mining exploration. Mining exploration activities on state lands are subject to exploration permits, with requirements for inspections, authorizations for the temporary use of water, and appropriate reclamation.

The most important potential future actions in this analysis are those that are likely to contribute to impacts on groundwater flow and quantity in close vicinity to aquifers affected by the project. RFFAs that could contribute cumulatively to groundwater quantity and flow impacts, and that are therefore considered in this analysis, are limited to those activities that would occur in the mine site vicinity, or immediately in or adjacent to the transportation corridor.

The new groundwater model was used to estimate the size of the zone of influence of the expanded pit, which is expected to be the component of the Pebble Project expansion scenario with the largest impacts to groundwater flow systems. Most of the zone of influence would be in the SFK and UTC watersheds, split approximately equally between the two. There would also be a portion of the zone of influence extending into the NFK watershed.

Water and Sediment Quality

Environmental consequences are discussed in Section 4.18, Water and Sediment Quality.

NA No Action Alternative

The No Action Alternative would result in federal agencies with decision-making authorities on the project not issuing permits under their respective authorities. The Applicant's Preferred Alternative would not be undertaken; and no construction, operations, or closure activities specific to the Alternative would occur. Therefore, background water and sediment quality in the mine site vicinity would not change. Certain constituents would still be present in amounts exceeding regulatory levels because of natural mineralization and geochemical weathering processes. Water quality along the transportation and pipeline corridors would continue to reflect the presence of elevated levels of some constituents as described. No project-related geochemical processes or impacts on surface water, groundwater, or sediment quality would occur under this alternative. No project-related geochemical processes or impacts on surface water, groundwater, or sediment quality would occur under this alternative. Any continued exploration by PLP or other entities would not be expected to affect current water and sediment quality trends.

A1a Alternative 1a

Runoff water contacting the facilities at the mine site and water pumped from the open pit would be captured to protect overall downstream water quality. Runoff water collected in mine facilities (e.g., bulk TSF, pyritic TSF) would be expected to require treatment prior to discharge to meet State of Alaska water quality criteria. An Alaska Pollutant Discharge Elimination System (APDES) permit stipulation requires treated water quality monitoring, to ensure discharged water meets applicable water quality criteria.

Assuming these protections are adopted, direct and indirect impacts of treated contact waters to off-site surface water are not expected to occur. However, over the life of the mine, it is possible that APDES permit conditions may be exceeded for various reasons (e.g., treatment process upset, record-keeping errors) as has happened at other Alaska mines. In these types of events, corrective action is typically applied in response to ADEC oversight to bring the WTP discharges into compliance. In terms of magnitude and extent, treated water would be discharged in the NFK, SFK, and UTC drainages.

Ground disturbance during construction has the potential to lead to erosion and introduce suspended sediment and increased turbidity into waterbodies downstream of the mine site, potentially resulting in direct and indirect impacts to water quality. These effects are likely to occur, and the magnitude and extent of direct impacts would include increased turbidity, temperature changes, or changes in water chemistry in downstream waterbodies. Indirect impacts would also be expected to occur. The magnitude and extent of indirect impacts could include changes to dissolved oxygen content, or an increase or decrease in biologic activity in waterbodies resulting from the mine project. The duration and likelihood of impacts would be long-term, and certain to occur if the mine is permitted and constructed. A water management plan would be implemented for construction and operation phases.

Analysis of Fugitive Dust in the FEIS

Key Mitigation Measures:

- Concentrate shipping containers would have locking lids to prevent loss of concentrate along the transportation corridor.
- Concentrate transfer to bulk carriers would use a system designed to minimize fugitive dust.
- Pit and mine site vehicles would be segregated from vehicles using the mine access road to prevent spreading mine site dust along the transportation corridor.
- Heavy equipment would be washed to reduce dust that collects on the wheels, body, and undercarriage of heavy equipment.

Relevant Resources:

- Potential for dust to contribute to surface water quality criteria exceedances is described in Section 4.18, Water and Sediment Quality.
- Dust deposition on wetlands and vegetation is described in Section 4.22, Wetlands and Other Waters/Special Aquatic Sites; and Section 4.26, Vegetation, respectively.
- Impacts of particulate emissions on air quality are described in Section 4.20, Air Quality.
- Impacts of dust on human health are described in Appendix K4.10, Health and Safety.
- Impacts of dust on cultural and historic resources are described in Section 4.7, Cultural Resources.
- Potential for dust to affect soil quality is described in Section 4.14, Soils.
- Potential for dust to affect soil quality is described in Section 4.14.

Dewatering of the open pit is likely to have both direct and indirect impacts on surface water quality, resulting from changes to hydrologic flow regimes between groundwater and surface water, and discharge of pumped groundwater to surface waterbodies. In terms of magnitude and extent, following module WTP processing, water from pit dewatering wells would be discharged to the SFK catchment. The duration of impact would be until the open pit WMP is in place. Discharge would require an APDES permit and must meet prescribed discharge limits and monitoring and reporting requirements.

Waste rock, TSFs, and WMPs would impact surface water or groundwater quality if not properly managed. Contact water that accumulates in on-site tailings and waste rock storage facilities and WMPs would be managed through containment and recycling/reuse so that it would not be released to surface water downstream of these facilities until intended for treatment and discharge. Water in these containments would not be considered WOUS prior to discharge; therefore, such water would not be subject to regulation under the CWA, or subject to APDES permitting requirements while retained in on-site water management facilities.

Variations in treated effluent water quality and reduced streamflow relative to baseline conditions would alter the total mass of individual metals, nutrients, and ions flowing through the environment. The average mass of these constituents flowing through the mine site study area (NFK, SFK, and UTC) was examined to assess overall changes in the environmental mass load of water quality constituents on an average annual basis. The annual mass load during operations is dependent on concentrations in WTP effluent compared to baseline levels, as well as the anticipated streamflow changes to each mainstem stream of the mine site area. Results from estimates for the change in mass load for the total hydrologic environment flowing downstream of the mine site, as well as the change in mass flowing through each mainstem stream, indicate that changes in the average mass of metals flowing through the system are typically within ±10 percent of baseline in the SFK and UTC. The NFK is anticipated to experience greater variability, with changes in most metals within ±25 percent of baseline, and the greatest change being for molybdenum (a 127 percent increase above baseline). Some major ions, including chloride, sulfate, and potassium, are anticipated to experience a more significant increase in mass load as a result of mining operations. For example, the annual mass load of sulfate is anticipated to show an overall 119 percent increase across all three watersheds combined, with higher levels in NFK, and less in SFK and UTC.

Generally, alterations to water chemistry as a result of mass loading from effluent discharge are expected to be higher near the discharge points, and taper downstream as effluent is mixed and diluted with water of baseline quality in receiving streams. The mass load of metals, ions, and nutrients has the potential to be transported into wetlands that are hydrologically connected to the NFK, SFK, or UTC. As a result, there may be an increased potential for chemical reactions of certain constituents.

Fugitive dust from various mine site sources with elevated levels of certain metals would be deposited on soils surrounding the mine site. Impacts on surface water quality would be through erosion or leaching of these metals into runoff leading to downgradient waterbodies, or through deposition directly on waterbodies. PLP has developed a draft fugitive dust control plan for mitigation and control of fugitive dust and wind erosion related to project activities. The final plan would be developed as design advances, and would use BMPs and best available control technology.

Once mining ceases, partial dewatering would be maintained in the open pit to allow the PAG waste rock to be moved from the pyritic TSF to the pit, and to maintain pit wall stability until the PAG waste rock buttresses potentially unstable lower walls of the open pit. Dewatering of the open pit would cease at the end of closure phase 1 once the transfer of these materials is complete. PAG waste rock would be submerged within 2 years of placement as the water level in the pit rises. Once dewatering ceases, groundwater behind the pit walls would begin to rise to create a pit lake.

In terms of magnitude, duration, extent, and likelihood, long-term impacts on surface water quality along the road corridor resulting from erosion at construction sites, material sites, and stream crossings would be expected, potentially causing increased suspended solids and turbidity in downstream waterbodies. Increased turbidity is expected to return to baseline levels within the short-term (e.g., days or weeks) following completion of construction and BMP placement. Erosion and sedimentation would be managed by implementing BMPs. Containment and treatment of surface water runoff at major transportation corridor facilities, including ferry terminals and the port site, and the natural gas pipeline corridor, would minimize effects on adjacent surface water and sediment.

Excavation of the seafloor at the Amakdedori port site prior to caisson placement would result in the removal and burial of substrate beneath the caisson footprints, and a localized increase in TSS and turbidity in Kamishak Bay for the duration of construction activities. Likewise, trenching of the pipeline in the marine substrate of Cook Inlet could cause a short-term, slight increase in naturally high turbidity and increased sedimentation in the vicinity of the pipeline. The risk of HDD drilling fluid affecting drinking water supply wells during pipeline construction on Kenai Peninsula is expected to be localized, and minimized through further evaluation during final design, HDD planning, and pressure monitoring during drilling.

A1 Alternative 1 and Variants

Alternative 1 is similar to Alternative 1a, with a modified transportation and natural gas pipeline corridor in and north of Iliamna Lake. Under Alternative 1, impacts to the mine site would be the same as under Alternative 1a. The magnitude of impact of potential operational scenarios under the Summer-Only Ferry Operations Variant would be an additional effect on substrate, because of the increased operational footprint at the mine site. The impacts would be long-term, and would occur if the Summer-Only Ferry Operations Variant is chosen, and the mine is permitted and built.

The Alternative 1 road system would result in approximately 3 percent fewer stream crossings than Alternative 1a. Water quality and substrate impacts associated with the road segments and material sites would therefore be expected to be incrementally less than Alternative 1a. As in the Alternative 1a, the impacts that would be expected would be potential direct and temporary effects on water quality due to sedimentation and turbidity generated through construction activities, which would be limited by use of BMPs and engineering controls. Under the Summer-Only Ferry Operations Variant, the magnitude and duration of impacts from activities at the Iliamna Lake ferry terminals would be reduced for approximately 6 months per year, during the winter. During the periods of ferry operations, the magnitude of activity would approximately double to account for the reduced length of the operational season.

The transportation corridor under the Kokhanok East Ferry Terminal Variant would have similar effects to those of Alternative 1, with a slight variation in the location of the ferry crossing and stream crossings south of Iliamna Lake. The type of impacts to surface water and substrate at stream crossings would be similar to those described under Alternative 1a, but would affect 10 fewer stream crossings than the Alternative 1 base case. Increased turbidity from road construction activities at stream crossings is expected to return to baseline levels within the short-term (e.g., days or weeks) following completion of construction and BMP placement. Although no turbidity measurements were collected along the road associated with the Kokhanok East ferry terminal variant, baseline conditions at stream crossings in this area are expected to be similar to those collected along the main port access road due to the similar nature of the terrain.

Impacts associated with the port site for Alternative 1 would be greater than described for Alternative 1a due to more invasive construction of a fill causeway and dock structure, as opposed to the caisson-supported dock under Alternative 1a. In terms of magnitude and extent, the Summer-Only Ferry Operations Variant would result in an increased operational footprint at the port site, which would cause increased effects on substrate. The impact of additional fill placement would be permanent, and certain to occur if the Summer-Only Ferry Operations Variant is chosen, the project is permitted, and the port is built.

Vibrations caused by pile-driving during construction could affect sediment substrate; however, these effects would be limited in duration to the actual pile-driving period.

Impacts under Alternative 1 associated with the portion of the natural gas pipeline south of Iliamna Lake and crossing Cook Inlet would be the same as described for Alternative 1a. Impacts to water and substrate quality for the lake crossing would be similar to impacts described for Alternative 1a, with decreased footprint as a result of a shorter lake crossing.

A2 Alternative 2 and Variants

Due to similar seepage design and downstream capture under Alternative 1a and Alternative 2, the downstream dam Alternative for the bulk TSF main embankment under Alternative 2 would likely have impacts on surface water and groundwater quality similar to centerline construction under Alternative 1a. However, impacts to substrate (freshwater sediment) would be greater under Alternative 2 than under Alternative 1a due to increased fill and larger embankment footprint necessary for downstream dam construction.

Under Alternative 2, two road segments would cross approximately half as many waterbodies requiring bridges or culverts as the transportation corridor under Alternative 1a. Water quality and substrate impacts associated with the road segments and material sites would therefore be expected to be incrementally less than Alternative 1a. Ferry operations from Eagle Bay to Pile Bay would have similar impacts on water and substrate quality as ferry operations in Alternative 1a.

Although the Summer-Only Ferry Operations Variant would reduce water quality impacts on the lake during the 6 month winter season, ferry operations and activity would be increased during the 6 months of ferry operations. The likelihood of small spills and contaminated runoff would increase because of the extra container and fuel storage under this variant, although this would be expected to be mitigated by water treatment of runoff.

Impacts from surface water runoff and water treatment at the Diamond Point port terminal, and from dust at the lightering locations, would be the same as described for Alternative 1a. Because of the differences in the approaches to the dock facilities between Amakdedori port and Diamond Point port, dredging of marine substrate at the Diamond Point location would be required to achieve a minimum 20 foot water depth. Depending on the process, periodic maintenance dredging could generate additional material that would be contained in the upland containment. In this case, similar effects on groundwater would be expected, but the volume of dredged material would be expected to be less than that generated during initial dredging activities.

Construction of dock facilities at Diamond Point would have greater direct impacts on marine substrate than either the caisson dock under Alternative 1a or the earthen fill causeway and dock under Alternative 1. The footprint of the earthen fill structures at Diamond Point would cover roughly 3 more acres of marine substrate with fill than the similar design at Amakdedori port under Alternative 1. Placement of the fill causeway and wharf structure at Diamond Point would contribute suspended sediment to the water column, leading to temporary turbidity and redeposition in the vicinity of construction. These effects would be expected to be greater than those of the Alternative 1a and Alternative 1 causeway construction because of the greater amount of fill placement, and because the finer seabed material in Iliamna Bay would be expected to travel farther before settling.

Construction of a pile-supported dock at Diamond Point would result in fewer direct impacts on substrate than a fill causeway, because the piles would be driven through vibratory and hammer methods and would require no fill. Effects would be slightly greater than the effects of constructing a pile-supported dock under Alternative 1 because the footprint of the piles would be about twice as large. Temporary and limited impacts from increased suspended sediment in marine waters would be expected to occur during construction of the pile structure.

For the portion of the natural pipeline corridor crossing Cook Inlet from the Kenai Peninsula, the types and scale of impacts on water and sediment quality would be the same as described under Alternative 1a, despite the shorter pipeline alignment. From the point the pipeline would come ashore at Ursus Cove to the mine site, the Alternative 2 pipeline corridor would cross approximately 35 percent more waterbodies than the Alternative 1a route, but would eliminate the crossing of Iliamna Lake. The increase in waterbody crossings would suggest an incremental increase in the potential for impacts to water and sediment quality, primarily through the local and temporary direct effects of sedimentation during construction. Sedimentation would be minimized through the use of engineering controls and BMPs such as silt fences and bale check dams.

A3 Alternative 3 and Variant

Impacts to water and sediment quality at the mine site would be similar to those of Alternative 1a. Under the Concentrate Pipeline Variant, there would be an estimated decrease in effluent discharge volume by 1 to 2 percent at the mine site, which would result in marginal changes in temperature effects.

The continuous overland access road that would connect the Diamond Point port to the mine site under Alternative 3 is expected to result in turbidity and sedimentation effects similar to those described under the other alternatives, but at an increased number of stream crossings; about 35 percent more than Alternative 1a. The concentrate pipeline variant would result in a marginal increase in turbidity and substrate impacts due to the wider road corridor. There would be no impacts to Iliamna Lake water or sediment quality under this alternative.

At the Alternative 3 port site, impacts to water and marine substrate would greater in magnitude compared to those of the Alternative 2 port site, because of the greater amount of dredging required because of the longer channel and shallower water north of Diamond Point. Impacts from the storage of dredged material would be similar in type to those described under Alternative 2, but greater in magnitude due to the increased volume of dredged material required for this design. Because the dredge storage stockpiles under Alternative 3 are in uplands away from marine waters, there is increased potential for high-salinity runoff and seepage water to adversely impact water and sediment quality along Williams Creek. Under the concentrate pipeline variant, the port WTP would effectively treat dewatering water to meet discharge limits prior to discharge to marine environment, while the return water pipeline option would preclude the need for dewatering and the discharge of treated water at the port site.

The natural gas pipeline would be commonly aligned with the transportation corridor under this alternative, and would align with the same route as the natural gas pipeline under Alternative 2. Impacts to water and sediment quality on the pipeline corridor would be similar to those described for the Alternative 2 transportation corridor.

CE Cumulative Effects

Direct and indirect impacts to water and sediment quality that could contribute to cumulative effects include those caused by ground disturbance and potential erosion; geochemical weathering of mined rock and tailings on the water quality of human-made waterbodies at the mine site; treated water discharge on water and sediment downstream of mine site facilities; dust deposition; effects of tailings, waste rock, and contact water storage on groundwater quality and downstream resources; groundwater migration adjacent to the pit at closure; fill placement and erosion on substrate and sediment quality; marine construction and dredging on substrate and water quality; and effects on drinking water sources.

The cumulative effects analysis area for water and sediment quality includes all watersheds in which project-related activity would occur, where direct and indirect effects on surface water, groundwater, or substrate (encompassing the footprint of the project, including Alternatives and variants, and areas downgradient) could reasonably be expected to contribute to cumulative effects.

Past and present activities that may have affected water and sediment quality in the analysis area include boat operations in Iliamna Lake and Cook Inlet used for fishing and tourism; annual maintenance dredging in Iliamna Bay; communities that generate sewage and solid waste, and use fossil fuels for energy and heat generation; past mining exploration; and dust generation and small fuel leaks/spills along existing roads. In some instances, additional reclamation at exploration sites has been required. In general, past and present actions have had some localized, and in most cases, short-term effects on water and sediment quality.

RFFAs that could contribute cumulatively to surface water quality and sediment impacts, and that are therefore considered in this analysis, are limited to those activities that would occur in the Nushagak River or Kvichak River drainages, or in other waterbodies intersected by the transportation corridor in the Cook Inlet drainage. RFFAs that could contribute cumulatively to impacts on groundwater quality are more limited, consisting only of activities in the mine site area, or immediately in or adjacent to the transportation corridor.

3.3 Fisheries (Fish Values)

3.3.1 Existing Conditions (Affected Environment) Summary

The EIS analysis area for this resource includes watersheds and downgradient aquatic habitats that could be affected by project activities, from streams to marine waters. The analysis area for the mine site under all Alternatives and variants includes portions of the NFK, SFK, and UTC watersheds. This area includes all aquatic habitats potentially directly or indirectly affected by permitted mine site activities. The geographic extent of the analysis area is driven by the modeled 2 percent reduction in suitable habitat in the NFK and SFK drainages. The analysis area for the port and transportation and natural gas pipeline corridors includes all aquatic habitats within 0.25 mile of project infrastructure where potential effects could potentially occur from construction and operations under all Alternatives and variants.

Fish and Aquatic Habitat

Under all alternatives, the mine site would be situated in the NFK, SFK, and UTC watersheds (Figure ES-28). The 36 mile NFK and 40 mile SFK rivers join to form the Koktuli River, which flows 39 miles downstream into the Mulchatna River. The Mulchatna River continues 44 miles before joining the Nushagak River, which then flows another 109 miles into Bristol Bay. UTC flows for approximately 39 miles into Iliamna Lake, which drains into the Kvichak River and flows 50 miles downstream into Bristol Bay. The NFK, SFK, and UTC subbasins encompass approximately 355 square miles, representing approximately 0.9 percent of the 39,184 square-mile Bristol Bay watershed.

Over 20 fish species are known to inhabit the mine site analysis area, including Pacific salmon species Chinook salmon *(Oncorhynchus tshawytscha)*, sockeye salmon *(O. nerka)*, coho salmon *(O. kisutch)*, chum salmon *(O. keta)*, and pink salmon *(O. gorbuscha)*. Resident fish species in tributaries draining the mine site include rainbow trout *(O. mykiss)*, Dolly Varden *(Salvelinus malma)*, Arctic grayling *(Thymallus arcticus)*, and sculpins *(slimy, Cottus cognatus, or coastrange, C. aieuticus)*. The quantification of streambed habitat was based on the most detailed survey data, whether from PLP, the state's Anadromous Waters Catalog, or Alaska Freshwater Fish Inventory survey data, to delineate the distribution and assessment of impacts to resident and anadromous fish species in the mine site analysis area.

North Fork Koktuli River

The NFK drains 64.7 miles of currently documented anadromous stream channels, with a total basin area of about 113 square miles, which represent 0.3 percent of Bristol Bay's 39,184 square-mile watershed (Figure ES-27). The ADF&G Anadromous Waters Catalog lists 12 anadromous fish-bearing tributaries entering the NFK, including Tributary 1.190 and Tributary 1.200, which would contain the majority of the mine site footprint. Both headwater Tributary 1.190 and Tributary 1.200 support rearing habitat for Chinook salmon and coho salmon. Coho spawning habitat occurs in Tributary 1.190. Habitat typing conducted on foot and via aerial imagery reveals that the mainstem NFK downstream of the mine site is an alternating series of riffle and run/glide habitats dominated by riffles (56 to 65 percent), with very few (1 to 2 percent) mainstem pools. Upstream of the mine site in NFK reaches D, E, and F, the NFK contains similar proportions of riffle and run/glide habitats, with increasing frequency of beaver-formed pools in headwater reaches. Chinook salmon, coho salmon, sockeye salmon, and chum salmon have been documented in the NFK watershed. Pink salmon *(Oncorhynchus gorbuscha)* are documented in the mainstem Koktuli River and the UTC, but do not occur in the NFK. Other species found in the NFK watershed include rainbow trout, Dolly Varden, Arctic grayling, lamprey *(Lempira spp.)*, including species such as brook lamprey *(P. planeri)*, threespine stickleback *(Gasterosteus aculeatus)*, ninespine stickleback *(Pungitius pungitius)*, sculpins *(Cottus sp.)*, northern pike *(Esox lucius)*, and whitefish (various species, including round whitefish *[Pros opium cylindraceum]*, humpback whitefish *[Coregonus pidschian]*, and least cisco *[Coregonus sardinella]*).

Chinook salmon spawning habitat occurs throughout the lower 20 miles of the NFK downstream of the mine site, and extends into the upper NFK adjacent to Big Wiggly Lake. The majority of spawning habitat occurs in the first 10 miles of the NFK, approximately 20 miles downstream from the mine site. Juvenile Chinook rearing habitat occurs throughout most of the NFK mainstem, as well as several NFK tributaries. Juvenile Chinook were most commonly observed in riffles and other mainstem habitats, but were also found to occupy low-velocity off-channel habitats.

Coho salmon spawning and rearing habitat is widely distributed in the NFK basin. Baseline field studies indicate preferred coho spawning habitat appears to be in the 10 miles of mainstem immediately downstream of the mine site.

Sockeye salmon spawning habitat primarily occurs in the lower 10 miles of the NFK, but the run extends upstream to the vicinity of Big Wiggly Lake. Although some spawning habitat has been documented in the upper NFK basin, most juvenile rearing habitat occurs downstream of the mine site, based on field observations. Rainbow trout occupy up to 31 miles of habitat in the mainstem NFK and tributaries, including Tributary 1.190. Dolly Varden and sculpin were reported in 40 miles of stream channel, and Arctic grayling are present in at least 28 miles of stream channel.

South Fork Koktuli River

The SFK River extends approximately 40 miles upstream from the confluence with the NFK to the headwaters, including 60 miles of documented anadromous stream habitat and a 107 square-mile drainage area, representing 0.3 percent of the Bristol Bay watershed (Figure ES-27). The low-gradient and gravel-dominated substrate of the mainstem SFK downstream of the mine site provides quality spawning and rearing habitat for resident and anadromous salmonids.

Chinook, coho, sockeye, and chum salmon have been documented in the SFK watershed. Pink salmon have not been documented in the SFK. Other fish species documented in the SFK watershed include rainbow trout, Dolly Varden, Arctic grayling, lamprey, threespine and ninespine stickleback, sculpin (may include slimy and/or coast-range sculpin), northern pike, whitefish (round whitefish, humpback whitefish, and/or least cisco), and burbot *(Lota lota)*. Arctic char have also been documented in the SFK; however, fish surveys completed for the project environmental baseline document did not encounter this species.

Chinook salmon spawning habitat has been documented from the SFK/NFK confluence upstream at least 30 miles to Frying Pan Lake, although more recent sampling indicated preferred spawning habitat occurs in the lower 20 miles of the SFK. The mainstem SFK from SFK Tributary 1.190 and the Frying Pan Lake outlet routinely dries up during base-flow periods; consequently, even though the substrate consists of a high percentage of gravel, that reach does not provide consistent spawning habitat. Chinook habitat does not extend into the upper SFK basin upstream of Frying Pan Lake or in the footprint of the mine site. However, rearing habitat occurs throughout the mainstem downstream of Frying Pan Lake, and in the lower 4 miles of SFK Tributary 1.190, which drains the southern side of Kaskanak Mountain.

Coho spawning habitat in the mainstem SFK extends 31.5 miles almost up to the outlet of Frying Pan Lake, although spawning habitat is limited in the middle intermittent reach. Most spawning habitat was observed via aerial surveys in the lower 20 miles of the mainstem, and in two tributaries: 1.130, and 1.190. Juvenile coho rearing habitat occurs within at least 43.5 miles of stream channel throughout the SFK basin, including the mainstem, tributaries, and headwaters upstream of Frying Pan Lake. Juvenile coho in the SFK routinely use off-channel habitats, including beaver ponds, side channels, and alcoves. Juvenile coho overwintering habitat has been documented in reaches SFK-A and SFK-B.

Sockeye salmon spawning habitat is limited to the lower 20 miles of mainstem reaches (SFK-A, SFK-B, and SFK C), but rearing habitat occurs within 24.4 miles of the SFK. Chum spawning habitat is limited to the lower 20 miles of the river, downstream of the seasonally dry channel. Adult chum salmon appear to target areas of rising groundwater during redd (a redd is a fish spawning nest) site selection; consequently, the highest densities of chum salmon redds occurred in the reach immediately downstream of the dry channel, where accretion of groundwater is most evident. Rainbow trout habitat occurs in over 40 miles of mainstem and tributary reaches of the SFK, including upstream of Frying Pan Lake and tributaries. Dolly Varden and Arctic grayling are common in the SFK subbasin, where they occupy from 45 to 51 miles of stream. Non-salmonid species, including sculpin, stickleback, and northern pike, inhabit at least 54 miles of mainstem and tributary habitat.

Upper Talarik Creek

UTC flows south about 39 miles from its headwaters upstream of the eastern edge of the mine site downstream into Iliamna Lake near the town of Iliamna. The UTC watershed contains 76.2 miles of documented anadromous habitat in a 135 square-mile area, representing 0.3 percent of the Bristol Bay watershed (Figure ES-27). Mine site facilities in the UTC basin would be limited to the mine access road and a water treatment discharge pipe. The eastern edge of the open pit is at the SFK and UTC watershed boundary; consequently, the open pit (primarily through pit dewatering) and associated roads and facilities could affect aquatic habitat in the UTC.

In addition to the four species of Pacific salmon found in the NFK and SFK, the UTC also contains an intermittent run of pink salmon in the lower reaches. The UTC is also known as important habitat for large, adfluvial rainbow trout. Other resident species found in the UTC include Dolly Varden, Arctic grayling, whitefish (may include round whitefish, humpback whitefish, and/or least cisco), sculpin, and two species of stickleback (i.e., threespine and ninespine). Arctic char have been documented in the UTC; however, no Arctic char were observed in environmental baseline surveys.

Chinook salmon spawning and rearing habitat is interspersed over 30 miles of the 39 mile mainstem UTC; however, Chinook spawning habitat in UTC tributaries is limited to a very short reach of UTC Tributary 1.410, and in UTC Tributary 1.190, which receives groundwater flow from the SFK. Juvenile Chinook rearing habitat was observed in almost 25 miles of mainstem and tributary habitat features such as run/glide, pool, and riffles in reaches UT-C through UT-E; juvenile Chinook overwintering habitat has been documented in UTC reaches UT-C, UT-D, and UT-E.

Coho salmon spawning habitat extends 34.7 miles, almost the entire length of the mainstem UTC, and into several UTC tributaries, including 1.600, 1.350, 1.310, and 1.410. The distribution of juvenile coho was similar to that for spawning (35.6 miles), with the addition of several minor tributaries. Densities of juvenile coho were generally similar in mainstem and off-channel habitat; and maximum densities were observed in UTC Tributary 1.410, which drains the western side of the upper basin immediately proximal to the open pit. Coho were observed in November, and again the following April, in reaches UT-D through UT-F, suggesting these reaches may provide overwintering habitat.

Sockeye spawning habitat has been documented in most of the mainstem UTC (32.4 miles) up to the headwaters bordering the mine site, and encompassed several tributaries, including 1.600, 1.900, 1.350, 1.390, and 1.410. Although the spawning habitat is widespread in the UTC, preferred spawning habitat occurs in Reach UTC-A; and in Tributary 1.600, where up to 43 percent of the UTC sockeye run spawned in 2008. Sockeye rearing habitat is also widespread in the UTC basin, although field observations indicate habitat is somewhat limited in the mainstem and tributaries, likely due to the early migration of juveniles into Iliamna Lake. Rainbow trout use multiple habitats, including riffles, glides, pools, and beaver ponds throughout all reaches of the UTC.

Rainbow trout were more commonly observed in the UTC than in the NFK or SFK, and they occupied at least 37 miles of habitat in UTC. Rainbow trout were found in multiple habitats, including riffles, glides, pools, and beaver ponds throughout all reaches of the UTC. Dolly Varden, Arctic grayling, and sculpin are also common in the UTC subbasin, where they occupy 37 to 42 miles of stream habitat. Other non-salmonid species include stickleback, which inhabit much of the mainstem and tributary channels.

Iliamna Lake

Iliamna Lake is a large lake with a surface area of 1,012 square miles. Iliamna Lake and its numerous tributaries provide spawning and rearing habitat for all five species of Pacific salmon and resident salmonid species, including Dolly Varden and rainbow trout. Over 20 fish species have been reported from Iliamna Lake and the Kvichak system, including all five anadromous Pacific salmon (Chinook salmon, coho salmon, chum salmon, pink salmon, and sockeye salmon), Arctic char, and lamprey species. Eight non-anadromous salmonids (adfluvial populations of rainbow trout, Dolly Varden, lake trout, Arctic grayling, humpback whitefish, round whitefish, pygmy whitefish *(P. coulterii)*, and least cisco) occur in Iliamna Lake, along with numerous non salmonid species, including northern pike, slimy sculpin, threespine and ninespine stickleback, burbot, Alaska blackfish *(Dallia pectoralis)*, longnose sucker, and pond smelt *(Hypomesus olidus)*. Iliamna Lake is also heavily used by adfluvial rainbow trout, which use a variety of lake habitats for summer foraging. The most common subsistence fishery is for sockeye salmon; but targeted fisheries also include Arctic grayling and whitefish.

Cook Inlet

Cook Inlet is a semi-enclosed estuary in southcentral Alaska that extends northeast approximately 180 miles from the Gulf of Alaska to Anchorage. The natural areas of Cook Inlet most likely to be affected by the pipeline are the lower Cook Inlet central zone and Kamishak Bay. The lower central zone is defined as the region north of the Barren Islands between Kamishak and Kachemak bays, and south of a line from Anchor Point to Chinitna Bay.

In addition to all five species of Pacific salmon, marine forage fish, groundfish, and shellfish compose prominent fisheries resources in the region, many of which are monitored by ADF&G's Kamishak Bay bottom trawl survey, which provides abundance, biomass, and density estimates for commercially important shellfish and groundfish. The Cook Inlet area also supports several important groundfish species, with highest estimated biomass from Pacific halibut *(Hippoglossus stenolepis)*, Pacific cod *(Gadus macrocephalus)*, and walleye pollock *(Gadus chalcogramma)*. Other important groundfish species include sablefish *(Anoplopoma fimbria)*, dusky rockfish *(Sebastes ciliatus)*, Pacific Ocean perch *(S. alutus)*, redbanded rockfish *(S. babcocki)*, redstripe rockfish *(S. proriger)*, and lingcod *(Ophiodon elongatus)*. Commercially harvested flatfish include arrowtooth flounder *(Reinhardtius stomias)*, butter sole *(Isopsetta isolepis)*, flathead sole *(Hippoglossoides elassodon)*, rock sole *(Lepidopsetta bilineata)*, dover sole *(Microstomus pacificus)*, rex sole *(Glyptocephalus zachirus)*, English sole *(Parophrys vetulus)*, starry flounder *(Platichthys stellatus)*, Alaska plaice *(Pleuronectes quadrituberculatus)*, and yellowfin sole *(Limanda aspera)*. Other demersal fish species include sculpins, longnose and big skates *(Rajidae)*, spiny dogfish *(Squalus acanthias)* and other sharks (various orders and genera), commander squid *(Berryteuthis magister)*, giant Pacific octopus *(Enteroctopus dofleini)*, shortspine thornyhead *(Sebastolobus alascanus)*, and numerous other marine species. Among forage species, Pacific herring *(Clupea pallasii)* and pond smelt are both found in the Cook Inlet management area, and capelin *(Mallotus villosus)*, Pacific sand lance *(Ammodytes hexapterus)*, eulachon *(Thaleichthys pacificus)*, gunnels *(Pholidae)*, Pacific sandfish *(Trichodon trichodon)*, pricklebacks *(Stichaeidae)*, and lanternfish *(Myctophidae)* may occur proximal to the Cook Inlet pipeline route and/or the Amakdedori port include. The Essential Fish Habitat Appendix I provides habitat and life-history information on marine species in lower Cook Inlet.

Commercial and Recreational Fishing

The ADF&G commercial registration Area T and Area H, the Cook Inlet Management Area (including associated federal waters) and ADF&G Statewide Harvest Survey (SWHS) areas S, T, N, and P comprise the EIS analysis area for this commercial and recreational fishing. The EIS analysis area also covers the Area H Cook Inlet Salmon Fishery and the groundfish and shellfish fisheries of the Cook Inlet Management Area.

The inshore waters of Bristol Bay are home to the world's largest sockeye fishery and some of the world's largest natural salmon runs. Between 2011 and 2016, Bristol Bay provided between 4 and 11 percent of all wild salmonid harvests, and between 1.1 and 2.3 percent of world salmon supply. Each year, roughly 2,840 holders of State of Alaska Area T salmon permits have the opportunity to harvest salmon from five major fishing districts managed by the ADF&G. Bristol Bay's economic ecosystem is driven by the annual return of salmon to the region. Average monthly employment in June, July, and August can be more than double that of the winter months, and the opportunity to harvest salmon generates 60 percent of regional self-employment income. The regional Comprehensive Economic Development Plan for the Bristol Bay Region (excluding the Bristol Bay Borough) prioritizes the health of the Bristol Bay salmon fishery as a key economic and cultural driver.

The Area T Bristol Bay salmon fishery (the fishery) is divided into five districts (Naknek/Kvichak, Egegik, Ugashik, Nushagak, and Togiak) encompassing nine major river systems. Across all five districts, sockeye salmon *(Oncorhynchus nerka)* is the most commonly harvested species, representing 94.8 percent of all salmon harvested from 2000 through 2019. In the Naknek/Kvichak district, the Egegik district, and the Ugashik district, sockeye salmon represented 97.5 percent or more of the harvest. In the Nushagak district, sockeye represent nearly 90 percent of the 20 year (2000 through 2019) harvest, with chum salmon *(O. keta)* and pink salmon *(O. gorbushca)* representing 6.8 percent and nearly 2.5 percent of the harvest, respectively.[5] Although Chinook salmon *(O. tshawwytscha)* accounted for less than 0.5 percent of annual Nushagak harvest over the last 20 years, the number of fish harvested averages nearly 35,000 fish annually, making the Nushagak district the most important Chinook salmon fishery, by volume, outside of Southeast Alaska (ADF&G 2018k). On average, the most productive fishing districts are the Nushagak district (8.8 million total salmon/7.9 million sockeye annually) and Naknek/Kvichak district (8.6 million total/8.4 million sockeye), followed by the Egegik (7.3 million total/7.2 million sockeye), the Ugashik (2.9 million total/~2.9 million sockeye), and the Togiak (0.8 million total/0.6 million sockeye).

Subsistence users and recreational anglers access the resource after salmon enter freshwater, and after the fish have escaped the commercial fishery; the ADF&G escapement goals include a portion expected to be harvested by these users. The number of salmon that are not harvested by the fishery is known as the "escapement number."

[5] Unless otherwise stated, 20 year average and 20 year retrospective data refer to the 2000 2019 fishing seasons.

The average price per pound that processors pay permit holders for their salmon depends largely on the condition of world salmon markets, including salmon produced by other wild and farmed sources. In 2019, the Bristol Bay commercial salmon fishery generated $301 million ($US 2019) in ex-vessel payments to all Area T permit holders, making that year the second-best year for permit holders collectively since 2000, and the eighth best year in real (i.e., inflation-adjusted) terms since 1983.[6] The 20 year inflation-adjusted ($US 2019) ex-vessel value of the fishery is approximately $166 million, but over the last 10 years, the ex-vessel value has averaged roughly $219 million per year in real terms.

The fishery has experienced a gradual out-migration of permits from Alaskans to non-Alaskans; from watershed residents to non-watershed Alaskans and non-Alaskans. The rate of loss of permits is not equally spread across communities in the watershed, and is higher among communities who were not part of the Bristol Bay Economic Development Corporation (BBEDC) region, despite the fact that many of these communities are eligible for BBEDC's permit loan program. The non-BBEDC watershed communities include those that are closest to the project, including Iliamna, Nondalton, Pedro Bay, Port Alsworth, and Newhalen.

Although ADEC documents processing facilities in seven Bristol Bay communities, the center of processing in Bristol Bay is in Naknek. The harvest and processing of salmon in the Bristol Bay region provides millions in tax revenues to federal, state, and local governments. These taxes depend on the long-term value of the fishery, the attractiveness of the fishery to investors who build business around the fishery, and total employment in the fishery including processing workers.

The project's natural gas pipeline would originate from just north of Anchor Point, with the highest potential to affect drift net commercial fisheries and saltwater recreational anglers in the vicinity of the pipeline. Although the Upper Cook Inlet Management Area primarily encompasses salmon fisheries, the ADF&G also manages small commercial herring, smelt, and razor clam fisheries in the area boundaries.

The project's natural gas pipeline would pass through ADF&G drift gillnet statistical areas 244 63 and 244 70 before passing into the Lower Cook Inlet Management Area. The pipeline would be south of any set net fisheries in ADF&G statistical area 244 21. The pipeline would cross waters within the three nautical miles of shore managed by the State for groundfish fisheries for Pacific cod, sablefish, rockfish, and walleye pollock. Much of this harvest takes place inside Kachemak Bay, south and east of the pipeline.

The project footprint area hosts numerous freshwater fishing resources that anglers use primarily to target Chinook salmon, sockeye salmon, rainbow trout, and other salmonid species. These well-known fisheries resources support sport fishing lodges, fishing guides, and related services such as air taxis; and generate revenue for the State of Alaska and local municipal governments. There are some special management areas for rainbow trout along the upper Nushagak River and UTC.

3.3.2 Expected Effects (Environmental Consequences) of Alternatives

Fish and Aquatic Habitat

Environmental consequences are discussed in Section 4.24, Fish Values.

Concerns were expressed during scoping about the potential impacts to fish from the project. Commenters were concerned about the effects of ferry operations on resident and migrating fish; gravel pits (material sites) on stream hydrology and fisheries; disruption of habitat that could affect nutrients; water withdrawal on fish habitat; potential contamination from spills, the potential for fugitive dust to add heavy metals to fish streams; impacts to Amakdedori port on salmon and Dolly Varden; and erosion from construction and operations on fish and fish habitat. Commenters also requested that potentially impacted cataloged anadromous streams and anadromous streams that are not currently cataloged be discussed. Concerns about impacts from bridge and culvert placement were also expressed by commenters.

NA No Action Alternative

The No Action Alternative would result in federal agencies with decision-making authorities on the project not issuing permits under their respective authorities. The Applicant's Preferred Alternative would not be undertaken; and no construction, operations, or closure activities specific to the Alternative would occur. Current State-authorized activities associated with mineral exploration and reclamation and scientific studies would be expected to continue at levels similar to recent post-exploration activity. The State requires reclaiming sites at the conclusion of their State-authorized exploration program. If reclamation approval is not granted immediately after the cessation of activities, the State may require continued authorization for ongoing monitoring and reclamation work as it deems necessary.

[6] 2019 data do not include post-season bonuses or adjustments. These data were unavailable at the time of analysis.

A1a

Alternative 1a

Potential impacts to fish values at the mine site include: direct loss of aquatic habitat in the NFK and SFK drainages; fish displacement, injury and mortality; changes in surface water and groundwater flows that could impact fish spawning, rearing, and off-channel habitat; increased sedimentation and turbidity in streams; impacts to fish migration; changes in surface water temperatures; and changes to surface water chemistry. In summary, development of the mine site would permanently remove approximately 99 miles of streambed habitat in the NFK and SFK drainages. Direct effects on fish, including displacement, injury, and mortality, would occur with the permanent removal of stream habitat in the NFK and SFK drainages due to mine site construction. Stream productivity in the NFK and SFK drainages would be reduced to some degree with the loss of physical and biological inputs. These impacts would be permanent, and certain to occur.

The magnitude and extent of impacts from the change in streamflows would be to directly change the quantity and quality of instream spawning and rearing habitat for resident and anadromous fish. Changes in flows could also directly alter available habitat for benthic macroinvertebrate production, which is important for fish growth and survival. Under Alternative 1a, potential impacts along the transportation and natural gas pipeline corridors include direct loss of aquatic habitat at stream crossings, at the Eagle Bay ferry terminal site, and at the south ferry terminal west of Kokhanok. Direct loss of benthic aquatic habitat would also occur along the natural gas pipeline crossings of Iliamna Lake and Cook Inlet. Other potential impacts along the transportation and natural gas pipeline corridors include fish displacement, injury, and mortality at these locations; changes in stream surface water flows; increased sedimentation and turbidity at crossings and terminal sites; and potential impacts to fish migration.

Bridge and culvert design, streamflows, and habitat loss would be reviewed by ADF&G during the State of Alaska permitting process. ADF&G permit stipulations could include seasonal restrictions on instream activities to avoid impacts to habitat during species critical life stages (e.g., spawning and egg development). PLP has committed to designing culverts to meet the USFWS' culvert design guidelines for ecological function (USFWS 2020), which would minimize impact to aquatic habitat. Construction of all stream crossings would avoid spawning migration windows as much as possible; and where potential in-stream work could obstruct passage of fish for longer than 48 hours, diversion methods could be employed under the guidance of the ADF&G. Juvenile and adult fish passage facilities may be incorporated on all water diversion projects (e.g., fish bypass systems). Habitat at the immediate location of culverts would be altered, but fish would continue to use the streams. The duration of habitat disturbance from construction effects would be short-term and temporary, but would be expected to occur if the project is permitted and built.

The magnitude and extent of impacts from construction would include temporary impacts to 628 acres of benthic habitat during installation of the pipeline. Installation of the pipeline would avoid managed weathervane scallop *(Patinopecten caurinus)* beds. Trenching could result in the mortality of benthic fauna. Habitat disturbances resulting from pipeline installation would range from temporary to short-term, and would be minimal in the context of existing available habitat in lower Cook Inlet unaffected by this activity. Changes to fish distribution and abundance from installation of the pipeline would not be expected to occur based on the magnitude and duration of disturbance. Fish species, including commercially managed fish would be expected to avoid the area during construction, but return once construction activities cease.

Direct displacement, injury, or mortality of fish could occur during construction of bridges, culverts, and the overland portions of the natural gas pipeline. ADF&G is responsible for review of permit applications and verification of bridge and culvert designs. Permit stipulations could include seasonal restrictions to protect critical life stages (e.g., spawning and incubation) to avoid or minimize injury or mortality. ADNR and ADF&G are responsible for permitting water withdrawals from fish-bearing waters. Permit conditions would be protective of fish migration and critical life stages.

The natural gas pipeline segment under Alternative 1a would cross the lake from the south ferry terminal to Newhalen. Construction of the natural gas pipeline across Iliamna Lake using trenching could lead to displacement of fish, but would not be likely to cause widespread direct injury or mortality of fish. Construction of the pipeline by trenching at the north and south ferry terminal would cause short-term increase of suspended sediment concentration in the water column. Extent of the impact would be limited to the immediate vicinity of the construction, and could persist for a few days before being cleared away by wind-driven currents and mixing.

Most marine fish would not be expected to suffer direct mortality or injury during pipe-laying operations regardless of the dredge technology used; however, benthic fish species such as flatfishes (e.g., halibut, soles, flounders), lingcod, sculpins *(Cottidae)*, skates, and sand lances would be more vulnerable than pelagic or semi-pelagic fish species, and all fish species could be temporarily displaced from the immediate vicinity of construction activity. There would be permanent, direct mortality of benthic invertebrates beneath the natural gas pipeline footprint on the seabed of Cook Inlet.

Organisms in soft substrates (bivalves and polychaetes) could be more impacted during pipeline construction; however, the pipeline would add a hard substrate to the marine environment, providing additional habitat for marine plants and animals (for example, kelp and mussels) that require a hard substrate. Therefore, the overall effect of pipeline installation would be to alter species diversity in a small area. The pipeline landfall on the Kenai Peninsula would alter a few acres of intertidal habitat. This development would temporarily displace some coastal organisms. The impacts on benthic habitat would be short-term and certain to occur if the natural gas pipeline is constructed.

Except temporary construction impacts, potential impacts on streamflows would not be expected to occur at bridge and culvert crossings. Bridge and culvert design, streamflows, fish passage requirements, and habitat loss would be reviewed by ADF&G per the State's Anadromous Fish Act (AS 16.05.871 .901) during the permitting process. Routine inspection and maintenance of culverts, bridges, and roads would be regularly conducted in compliance with ROW and ADF&G permit conditions, if issued, to ensure that culvert-related erosion, wash-out, or debris blockage do not result in permanent impacts to streamflow or downstream habitat.

Water extraction would be expected to temporarily affect streamflows during construction. Water withdrawals would occur at lakes, ponds, and streams along the road corridor for dust control and hydrostatic testing of the pipeline during the summer construction seasons The ADNR and ADF&G are responsible for permitting water withdrawals from fish-bearing waters. Disposal methods for hydrostatic test water would be developed in accordance with ADEC APDES General Permit AKG320000 for implementing the federal CWA with respect to energy dissipation and sediment control. No chemicals would be added to the hydrostatic test waters. Impacts would be temporary.

The magnitude and extent of potential impacts to groundwater and surface water during pipeline construction would involve interception of shallow groundwater and surface water during trenching activities, which would be captured and locally flow along the trench backfill. Permits would stipulate that surface water flows would be returned to their normal condition. Typical BMPs for surface water management could include maintaining natural surface water patterns; crowning of ditch backfill to allow for settlement to original ground level; contouring of surrounding terrain; construction of settlement infiltration basins; and prompt revegetation of riparian and wetlands and a robust monitoring and maintenance program. Pipeline construction would be subject to design considerations, restoration requirements, and timing windows, as specified by ADF&G. The duration of impacts could extend beyond the life of the project (i.e., permanent), because the pipeline would be abandoned in place. The likelihood of the impact would be certain if the project is permitted and the pipeline is constructed.

In terms of magnitude and extent, the road/pipeline footprint and associated crossing structures would directly impact riparian vegetation, and interrupt floodplain connectivity in some waterbody crossings. Impacts would be most pronounced during high flow events. The duration of the impact to riparian vegetation would be for the life of the project, and would be expected occur if the project is permitted and built.

In terms of magnitude, duration, extent, and likelihood, road construction, maintenance, and use could result in short- and long-term impacts to streams from increased surface erosion and deposition of fine sediments. The duration of construction-related sedimentation would be temporary and short-term, due mitigation and control measures, State of Alaska permit stipulations, and timing windows. Stream crossings associated with the roads and pipelines would be designed to minimize potential impacts on surface water hydrology, water quality, and fish passage. Road and pad maintenance BMPs, including application of dust suppressants during dry periods, routine grading, and routine maintenance of drainage ditches and stream crossings, would be implemented and maintained during mine operations. Additional monitoring, BMPs, and maintenance standards may be required by ROW lease stipulations from state and local governments.

The deposition of fine-sized particles in streams and resulting increases in turbidity are expected to occur during project operations and through post-closure. Implementation of dust suppression, BMPs, and enforcement of slow speed limits at all stream crossings would minimize dust-related impacts to aquatic ecosystems during project operations and post-closure.

Potential impacts to fish values at Amakdedori port would include direct loss of marine habitat; fish displacement, injury, and mortality; changes to marine productivity; increased sedimentation and turbidity; and impacts to fish migration. In terms of magnitude and extent, placement of the caisson dock at the port would permanently impact 2.1 acres of marine benthic habitat. These impacts would be certain to occur if the project is permitted and Amakdedori port is built.

A1

Alternative 1 and Variants

The magnitude, duration, extent, and likelihood of direct and indirect impacts to fish, aquatic habitat, streamflow, productivity, sedimentation and turbidity, and fish migration due to construction and operations at the mine site would be same as those described for Alternative 1a. Potential impacts to fish values along the transportation and natural gas pipeline corridors are similar to those described for Alternative 1a. Other impacts include fish displacement, injury, and mortality at these locations; changes in stream surface water flows; increased sedimentation and turbidity at crossings and terminal sites; and potential impacts to fish migration.

The magnitude and extent of habitat loss from development of the transportation corridor and onshore portions of the natural gas pipeline would be the removal of 6.1 miles of streambed habitat and 6.2 acres of riverine wetland habitat. The corridor would cross 52 waterbodies documented to support resident and anadromous fish. Sixteen of these waterbodies have been documented to support Pacific salmon. The impacts on fish values due to the loss of this aquatic habitat would be greater in extent and magnitude based on the increased loss of streambed habitat and riverine wetlands compared to Alternative 1a.

Docking facilities for the ice-breaking ferry at the north and south ferry terminals under Alternative 1 would include rock and gravel ramps extending approximately 105 feet and 155 feet, respectively, into Iliamna Lake. The magnitude and extent of impacts to aquatic lake habitat would be the removal of approximately 0.1 acre of shallow lake aquatic habitat and 185 feet of shoreline habitat at the north terminal, and 0.7 acre and 738 feet, respectively, at the south terminal.

The magnitude and extent of loss of aquatic habitat from construction, operations, and closure of the Cook Inlet natural gas pipeline under Alternative 1 would be the same as described for Alternative 1a.

The pipeline route crossing the lake under Alternative 1 is slightly shorter than that of Alternative 1a. Therefore, direct impacts of displacement, injury, or mortality of fish and benthic organisms would be the same or slightly less than those described for Alternative 1a. Likewise, the ferry crossing route is shorter and more direct, so impacts of ferry operations under this Alternative would be similar to or less than Alternative 1a.

Fish migration impacts from the access roads, spur road, and the natural gas pipeline under Alternative 1 would be the same or slightly less than those described for Alternative 1a.

Short-term effects on both migratory and non-migratory marine fish species may occur during construction of the port. Marine facilities would include an earthen access causeway and sheet pile jetty instead of a caisson dock under Alternative 1a. The duration of construction impacts would be temporary: fish may be disturbed or displaced, but direct mortalities would not be expected, and fish behavior would be expected to return to prior conditions after the activity ceases. Benthic invertebrates would be impacted in the port footprint. Razor clams have been reported from the Amakdedori area, as well as Augustine Island in Kamishak Bay; however, important harvest locations are well outside of the project area (e.g., Chinitna Bay, Polley Creek, and locations farther north). The impacts would be expected to occur if the project is permitted and the Amakdedori port is constructed.

The Summer-Only Ferry Operations Variant would preclude the need for ice-breaking operations. Impacts to Iliamna Lake under the Summer-Only Ferry Operations Variant would be similar to those described for Alternative 1 during the summer (open water) season. The ferry vessel would be larger than in Alternative 1a and Alternative 1, or there could be two vessels. Increased vessel size and horsepower could result in increased impacts from wake and propeller strike to juvenile fish, as described under Alternative 1a. However, the Summer-Only Ferry Operations Variant would eliminate the potential impacts from ferry operations on juvenile sockeye during winter months.

The access road route for the Kokhanok East Ferry Terminal Variant avoids the need for a bridge across the Gibraltar River. In terms of magnitude and extent, the port access road with the Kokhanok East spur road and pipeline route would have 11 fewer stream crossings compared to Alternative 1a. Six of the crossing locations provide resident fish habitat, and five provide anadromous fish habitat, including the Gibraltar River bridge crossing. The magnitude and extent of impacts would be a reduction in impacts to anadromous and resident fish stream habitat because of the reduction in stream crossings under this variant, as compared to Alternative 1. The duration and likelihood of impacts would be the same as Alternative 1.

The Pile-Supported Dock Variant would install 253 dock pilings instead of the gravel-filled causeway described in Alternative 1. The magnitude and extent of loss of benthic habitat under this variant would be less, at approximately 0.1 acre, compared to approximately 11 acres under Alternative 1. The Pile-Supported Dock Variant would not require the approximately 2,000 lineal feet of large, rocky substrate provided by riprap armoring as required under Alternative 1. The duration and likelihood of impacts would be the same as Alternative 1.

Approximately 253 dock piles would be installed in the intertidal area under this variant. Potential for displacement, injury, and mortality would be greater than Alternative 1 because of the duration and intensity of noise impacts during construction from pile-driving and other sources. Impacts would be similar to those described under Alternative 1a in relation to noise disturbance and displacement of fish. These impacts would be expected to occur if this variant is selected, and the project is permitted and built.

A2 Alternative 2 and Variants

This Alternative would require less overall length of access roads, and use a different design and method of construction (downstream construction) of the main bulk TSF embankment. The impacts to fisheries resources under Alternative 2 would be the same as Alternative 1a, except that some of the impacts would be about 40 feet upstream due to the upstream shift (compared to the centerline construction in Alternative 1a) of the main TSF embankment (Tributary NK 1.19, gaging station NK 119A). The magnitude, duration, extent, and likelihood of impacts to habitat, streamflow, productivity, sedimentation and turbidity, and fish migration would be the same as those described for Alternative 1a.

In terms of magnitude and extent of impacts, Alternative 2 would impact more streams and have one less anadromous and resident fish stream crossing (55) compared to Alternative 1a (56); however, the loss of streambed habitat would be less. Under Alternative 2, all anadromous fish stream crossings would be in the Iliamna Lake/Kvichak and Cook Inlet watersheds. There are 34 fish streams with 1,000 feet of blasting locations on the Alternative 2 corridor, and impacts would be similar to those described under Alternative 1a. The duration and likelihood of impacts would be the same as Alternative 1a.

Based on field-verified stream mapping, the overland pipeline-only portion of the natural gas pipeline would cross 133 streams under Alternative 2. Impacts on fish and fish habitat would be similar to those described for the mine access roads under Alternative 1a, and include loss and alteration of habitat, fish displacement and injury, and changes in stream productivity. Impacts are expected to be short-term in duration and limited to the disturbed area.

The pipeline across Cook Inlet would be constructed as described for Alternative 1a, but the western landfall would be at Ursus Cove. The magnitude, duration, extent, and likelihood of impacts to marine habitat would be less than Alternative 1a (75 miles of pipeline in Cook Inlet compared to 104 miles for Alternative 1a) for the portion of the pipeline from Anchor Point to Ursus Cove. Approximately 638 acres of marine substrate would be temporarily disturbed from trenching activities between Anchor Point and Ursus Cove. This total does not include potential seabed disturbance from anchor placement or cable sweep (the scraping or sweeping of the seafloor from the movement of the anchor cables across the seafloor). Substrate footprint scars within dynamic substrate areas are expected to recover quickly, and marine organisms are likely adapted to the constant rearrangement of the substrate. Habitat losses resulting from pipeline installation would range from temporary to short-term, and would be minimal in the context of existing habitat in lower Cook Inlet unaffected by this activity.

Benthic habitat would be expected to recover relatively quickly, ranging from days to weeks. Submerged boulder areas or isolated rocks and rock outcrop areas could include greater biomass than sandy substrates, increasing the recovery time, which could range from months to years. In terms of magnitude and extent, construction of the dock and port facilities at Diamond Point would have a greater spatial and temporal direct impact on marine fisheries and benthic invertebrates than at Amakdedori port (PLP 2018 RFI 072) under Alternative 1a. The benthic footprint of the Diamond Point port would remove 14 acres of benthic habitat, and would require maintenance channel dredging. The channel maintenance dredging is expected to disturb 56 acres of benthic habitat every 5 years. This would result in a reoccurring impact to 56 acres of benthic habitat for the life of the project. Measurable changes in marine productivity are not expected to occur with this loss of habitat, considering the magnitude of impact compared to the abundance of available nearshore habitat. Under this variant, the crossing of Newhalen River would be north of the crossing location under Alternative 1a. The bridge design under this variant would be similar to the base case, requiring five spans. Impacts would be similar to those described for the south crossing under Alternative 1a.

A3 Alternative 3 and Variant

The magnitude, duration, extent, and likelihood of direct and indirect impacts to fish, aquatic habitat, streamflow, productivity, sedimentation and turbidity, and fish migration from construction and operations at the mine site would be the same as described for Alternative 1a. The magnitude and extent of habitat loss from development of the transportation corridor and onshore portions of the natural gas pipeline under Alternative 3 would eliminate 5.7 miles of streambed habitat and 7.7 acres of riverine wetland habitat.

Although Alternative 3 would have a larger project footprint compared to Alternative 1a, there would be no ferry crossing of Iliamna Lake; therefore, impacts to aquatic habitat and species in the lake would not occur under Alternative 3. The route would cross fewer waterbodies (205) compared to Alternative 1a (233). Compared to other alternates, there are significantly fewer fish streams (16) within 1,000 feet of blasting locations along the corridor.

There are two options considered under this variant: one for the concentrate pipeline only, and another for a return water pipeline with the concentrate pipeline concept. The concentrate pipeline (and optional water return pipeline) would be co-located with the road corridor in a single trench with the natural gas pipeline. Methods of waterbody crossings would be the same as described for Alternative 1a. This variant would result in no additional project footprint at Diamond Point, and preclude the need for the discharge of treated water into Cook Inlet. The Concentrate Pipeline Variant would eliminate the need for a WTP at the port; and instead, would require a return water pump station of appropriate capacity (PLP 2018 RFI 066). This option would result in negligible change in footprint at the port site as compared to Alternative 3, and there would be no additional impact to aquatic resources as a result of the pump station footprint.

The Concentrate Pipeline Variant would result in a slightly greater impact in magnitude to fish and fish habitat than Alternative 3. The concentrate pipeline would be buried during road construction, and the mine access road corridor would be widened by less than 10 percent for inclusion of the pipeline. This could result in a small increase in water quality impacts during construction and fill placement over riparian wetlands. Because only the molybdenum concentrate (2.5 percent of the total concentrate production) would be trucked from the mine site to the port, a large reduction in road traffic would be anticipated, thereby reducing some potential impacts from dust, erosion, and runoff. The duration and likelihood of impacts would be the same as Alternative 3.

CE Cumulative Effects

The cumulative effects analysis area for fish includes the project footprint, including Alternatives and variants, the expanded mine scenario footprint (including road, pipeline, and port facilities), other RFFAs in the vicinity of the project that would result in potential synergistic and interactive effects, and the extended geographic area where direct and indirect effects to fish can be expected from construction and operations. This area includes watersheds and downgradient aquatic habitats, from streams to marine waters, that could be affected by project activities.

RFFAs that could contribute cumulatively to both marine and freshwater aquatic resource impacts include activities that would occur in the Nushagak River or Kvichak River drainages, or in other waterbodies intersected by the transportation corridor in the Cook Inlet drainage. These RFFAs include the Pebble Project expansion scenario; mining exploration activities for Pebble South, Big Chunk South, Big Chunk North, Fog Lake, and Groundhog mineral prospects; Igiugig Hydrokinetic Project, Cook Inlet Oil and Gas Development, Alaska Liquefied Natural Gas, Alaska Stand Alone Pipeline Project, Drift River Oil Facility Demobilization, Lake and Peninsula Borough road improvements, and the continued development of the Diamond Point Rock Quarry.

Under Alternative 1a, and Alternative 1 and Alternative 2 and variants, the Pebble Project expansion scenario would extend operations, and extend impacts along a second linear corridor on the north shore of Iliamna Lake. The construction and operation of a deepwater port in Iniskin Bay would affect fish and aquatic habitat by direct loss of nearshore habitat and discharge of fill that would affect benthic habitat, and disturbance, injury, or mortality. Iniskin Bay is designated as Essential Fish Habitat for all five species of Pacific salmon and several other pelagic and groundfish species. Pacific herring spawn in Iniskin Bay, particularly on the eastern side. Past and present surveys suggest that Iniskin Bay represents a minor contribution to Pacific herring spawning in Cook Inlet. Due to low stock size, the commercial fishery for herring roe in Kamishak Bay has been closed since 1999. However, the capture of young Pacific herring and salmonids suggests that these species use these areas for rearing. The contribution to cumulative impacts under Alternative 3 would be similar to Alternative 1 and Alternative 2, and less than Alternative 1a.

Commercial and Recreational Fisheries

Environmental consequences are discussed in Section 4.6, Commercial and Recreational Fisheries.

NA No Action Alternative

The No Action Alternative would result in federal agencies with decision-making authorities on the project not issuing permits under their respective authorities. The Applicant's Preferred Alternative would not be undertaken, and no construction, operations, or closure activities specific to the Applicant's Preferred Alternative would occur. Although no resource development would occur under the Applicant's Preferred Alternative, PLP would retain the ability to apply for continued mineral exploration activities under the State's authorization process (ADNR 2018 RFI 073) or for any activity not requiring federal authorization. Therefore, no future direct or indirect effects on commercial or recreational fisheries would be expected, and current trends in commercial and recreational fisheries would continue.

Analysis of Impacts to the Bristol Bay Salmon Fishery

The Bristol Bay commercial and subsistence salmon fisheries harvest all five species of Pacific salmon, with sockeye and Chinook salmon considered the most valued. To determine potential effects on fisheries, the FEIS takes a stepwise approach:

Step 1—Analyze Physical Impacts:

- Consider project features that would remove, fill, or otherwise alter aquatic habitat.
- Determine stream flow/dewatering changes (Section 4.16, Surface Water Hydrology).
- Determine water quality (including temperature) changes (Section 4.18, Water and Sediment Quality).

Step 2—Analyze How Physical Impacts Affect Fish Production

- Consider the aquatic habitat loss and modifications described in Section 4.16, Surface Water Quality; Section 4.18, Water and Sediment Quality; and Section 4.22, Wetlands and Other Waters/Special Aquatic Sites.
- Assess if measurable changes in the numbers of returning adult salmon would be expected (Section 4.24, Fish Values).
- Assess if treated effluent discharges and fugitive dust emissions would be expected to adversely affect salmon habitat and behavior (Section 4.24, Fish Values).

Step 3—Analyze how Changes in Fish Production Affect the Commercial and Subsistence Fisheries

- Assess if there would be an expected measurable change in the numbers of returning adult salmon available for harvest (Section 4.24, Fish Values; and Section 4.6, Commercial and Recreational Fisheries).
- Assess if the Bristol Bay brand would be damaged, causing a decrease in the value of each fish (Section 4.6, Commercial and Recreational Fisheries).
- Assess salmon availability to subsistence users (Section 4.9, Subsistence).

Note: Bristol Bay also supports an important recreational fishery. Impacts to that fishery are analyzed in the FEIS using this same stepwise approach.

AV Action Alternatives and Variants

Project construction and operations could have an impact on the commercial fishing community (e.g., crew members or processing), on the recreational sector via recreational fishing, and on revenue generated to state and local government. Potential impacts are influenced by project-related effects on fish population, habitat, and runs, as well as real and perceived effects on the quality of the fish, environment, and fishing experience.

Crew members, permit holders, processors, and local municipalities are all dependent on the total value of the Bristol Bay fishery, which is a function of market price and harvested volume. In terms of the magnitude of the impact, when permit holders harvest fewer fish, the net result is that permit holders receive less net income, crew members are paid less, processors have less product to sell, and municipalities have less economic activity to tax. The ADF&G manages for the maximum sustainable yield of the fishery by ensuring that a minimum, but preferably optimal, number of spawners reach their home rivers. The ADF&G has no control over external factors such as ocean conditions, so it largely manages the number of returning spawners by adjusting commercial and recreational fishing harvest via effort. The ADF&G restricts effort when the strength of the returning run requires less harvest to meet the escapement goals, and liberalizes harvest opportunity when run strength threatens to exceed optimal escapement maximums goals. ADF&G reviews escapement goals every 3 years, and adjusts them when data indicate that system productivity, and the optimal number of spawners, has changed.

Commercial Fishing

The commercial fishing sector is concerned that the existence of the project could lower the perceived quality of Bristol Bay salmon, and therefore lower price. Prices paid in Bristol Bay are nearly always lower than those paid in other Alaska salmon fisheries producing similar products, which reflects the higher transportation expense associated with Bristol Bay's geographic location and the lack of a strong brand identity, which could boost average prices. Other salmon fisheries in Alaska exist in conjunction with non-renewable resource extraction industries. For example, the Cook Inlet salmon fisheries exist in an active oil and gas basin and have developed headwaters of Anchorage and the Matanuska-Susitna areas. The Copper River salmon fishery occurs in a watershed with the remains of the historic Kennecott Copper Mine and the Trans Alaska Pipeline System in the headwaters of portions of the fishery. Both fisheries average higher prices per pound than the Bristol Bay Salmon Fishery.

The Amakdedori port site is in the Chenik sub-district of the Kamishak Bay District. Commercial harvesters may have to change fishing patterns based on the proximity of fishing to port operations, or could experience losses if port operations affected salmon returns. The Diamond Point port site is near a chum salmon fishery that does not experience harvest every year.

On the west side of Cook Inlet and in the Bristol Bay watershed, the natural gas would not directly interact with the Bristol Bay salmon fishery after construction. The pipeline would cross waters fished by the Cook Inlet salmon fishery and Cook Inlet groundfish fisheries. It would not directly interact with the drift net salmon fishery, given that the salmon fishery occurs in the top 30 feet of the water column. Seine gear in the Chenik sub-district could be impacted by the pipeline. Groundfish anglers may need to avoid the pipeline route, or be affected by the disruption of traditional halibut "holes" and the potential for changes in local halibut abundance. Any reduction in harvest by permit holders is immediately transmitted to the processing sector as fewer fish to be processed and sold into the world sockeye market. The lost harvest results in lower total wholesale value for processors. The magnitude of the financial loss depends on the size of the harvest reduction, and individual choices by processor around how to adjust their product mix. Processors make these decisions based on run size, their individual capabilities, and the needs of the world market, which means that any long-term loss in harvest would express itself differently each year based on the aforementioned factors. There would be no measurable change in the number of returning salmon and the historical relationship between ex-vessel values and wholesale values. In addition, there would be no changes to wholesale values or processor operations expected for Alternative 1a. Under normal operations, the Alternatives would not be expected to have a measurable effect on fish numbers and result in long-term changes to the health of the commercial fisheries in Bristol Bay.

Recreational Fishing

With regard to recreational fishing, the extent of project impacts would be displacement of recreational fishing effort by mining activities along a short length of the upper Koktuli River and by road transportation activities along UTC under Alternative 1. All Alternatives would affect upper portions of the NFK and SFK rivers. The Koktuli River does not appear in some ADF&G SWHS publications, because not enough survey respondents report fishing on the river. The river also does not appear in ADF&G Guided Logbook data for 2011 2014. The unpublished ADF&G SWHS estimates for the entire Koktuli River for 2007 2016 average 285 angler days per year. Some of these days would be displaced if they occurred in the project area.

The mine site would not be expected to affect Cook Inlet recreational fisheries. In terms of extent, mine facilities would directly impact portions of the tributaries of the NFK and SFK watersheds, while support and transportation infrastructure would affect the UTC watershed, the Gibraltar River, and Iliamna Lake. These watersheds account for a small portion of overall recreational fishing effort in SWHS areas S, T, and N. The ADF&G SWHS estimates and Guide Logbook Program data indicate that total fishing effort on the Koktuli River and UTC is less than 100 angling days per year each; while total effort in SWHS areas S and T is estimated at over 40,000 days per year. The two most important fisheries that would interact with Alternative 1 are Iliamna Lake and the Gibraltar River. Iliamna Lake and unnamed tributaries host roughly 1,900 to 2,200 angling days per year. In terms of magnitude, this effort is dispersed across the lake and numerous unidentified tributaries without enough SWHS survey responses to allow for individual effort estimates.

Under normal operations, the ferry across the lake would not be expected to limit or affect the quality of these fishing days. The Gibraltar River (approximately 650 angling days per year) primarily hosts fly-in wade and float anglers. The river is currently roadless, and the transportation corridor would create a new road and crossing along the river. The presence of the road and bridge crossing would change the fishing experience on the river, particularly for float anglers who would have to pass the bridge to float the length of the river. Construction activities would be disruptive, but short-term; and the road and bridge would be in place through project operations and post-closure until they are no longer needed.

In terms of magnitude and duration, the change in fishing experience could be perceived as a permanent adverse impact for those anglers expecting a wilderness experience. These impacts would not exist under the Kokhanok East Ferry Terminal Variant or other alternatives, which avoid crossing the Gibraltar River.

The waterbodies affected by Alternative 1 have fewer total recreational angling days than the waterbodies affected by Alternative 2 or Alternative 3. However, the main angling waterbodies affected by Alternative 2 and Alternative 3 (the Newhalen, Pile, and Iliamna rivers) already have some minimal road access from local communities. Alternative 1 differs from Alternative 2 and Alternative 3 in its establishment of new road affecting a waterbody without current road access, and more than 500 recreational fishing days per year; Alternative 2 and Alternative 3 would not affect a river with these qualities.

With respect to the magnitude and extent of impacts in Cook Inlet, Alternative 2 would avoid the potential effects on the Chenik sub-district salmon fishery, the Kamishak Bay Pacific herring fishery, and the Kamishak Bay Weathervane scallop fishery. However, the presence of the Diamond Point port location has the potential to interfere with an intermittent chum salmon fishery around Cottonwood Creek. Long-term adverse impacts to the angling experience would be likely to occur, and the duration would last through closure until the road is no longer used.

CE Cumulative Effects

The EIS analysis area includes commercial and recreational fisheries, the ADF&G Commercial Salmon Fishery Area T and Area H, the Cook Inlet Management Area (including associated federal waters), and the ADF&G SWHS areas S, T, N, and P. Past and present actions that have or are currently affecting commercial and recreational fisheries in the analysis area are minimal. Present activities include mining exploration and non-mining-related projects, such as transportation, oil and gas development, or community development actions. These actions have resulted in a loss of some fish habitat, and aircraft activity associated with mining exploration can degrade the quality of a remote recreational fishing experience.

The list of RFFAs includes a number of potential mineral projects that are likely to be subjected to continued exploration and study (e.g., Big Chunk South, Big Chunk North, Fog Lake, Groundhog, Shotgun, and the Johnson Tract), as well the Pebble Project expansion scenario. In addition, the RFFAs include community, transportation, and utility improvements spurred by economic activity in the area. Each project has the potential to impact localized fish population numbers, contributing to the cumulative effects on commercial and recreational fisheries in the region.

The No Action Alternative would not contribute to cumulative effects on commercial and recreational fishing. Overall, the contribution of Alternative 1a to cumulative effects on commercial and recreational fisheries when taking other past, present, and RFFAs into account, would be minor to moderate in terms of magnitude, duration, and extent, given the limited acreage affected and permit requirements regarding soil disturbance and erosion. Alternative 1, Alternative 2, and Alternative 3 would contribute cumulative effects similar to Alternative 1a, although Alternative 1 would result in slightly more acres, while Alternative 2 and Alternative 3 would result in slightly fewer acres affected by the Pebble Project expansion scenario.

3.4 Wetlands and Other Waters/Special Aquatic Sites

3.4.1 Existing Conditions (Affected Environment) Summary

The EIS analysis area for Wetlands and Other Waters/ Special Aquatic Sites includes the area potentially affected by direct and indirect impacts from project construction and operations. The analysis area collectively includes areas for all project components (mine site, transportation corridor, ports, and natural gas pipeline) under each alternative, including their variant(s). Wetlands in the EIS analysis area are predominantly peatlands. Wet meadows develop in upper drainages, while shrub wetlands become more common along riparian corridors in valley bottoms. In lower drainages, floodplains develop as complex mosaics of forest, shrubland, and aquatic bed in flood channels, bars, and abandoned channels. Saltwater marshes and mudflats are found in protected areas along the coast.

Other waters in the analysis area include the estuarine and marine waters of Cook Inlet and the unvegetated portions of inland lakes, ponds, rivers, and streams. Cook Inlet fills a shallow marine basin; its waters carry a high load of sediment delivered by large glacial rivers at the head of Knik and Turnagain Arms. Iliamna Lake is the largest lake in Alaska; and although flanked by lowlands, its waters are derived in part from alpine glaciers. Smaller lakes and abundant ponds perch on bedrock or are fed by surrounding wetlands. Although no ephemeral streams have been documented in the analysis area, intermittent streams occupy topographic headwaters and feed clear-running perennial streams and rivers that fall to either Bristol Bay or Cook Inlet.

Special aquatic sites occurring in the analysis area include wetlands, mudflats, vegetated shallows, and riffle and pool complexes. These sites possess unique ecological characteristics of productivity, habitat, wildlife protection, or other important and easily disrupted values.

A1a Alternative 1a

The Alternative 1a analysis area is 20,553 acres. Wetlands compose 17 percent of this area; an additional 6 percent of the analysis area is other waters, including 184.7 miles of streams. Quantifiable types of wetlands identified as regionally important, and other special aquatic sites, individually represent 1 percent or less of the Alternative 1a analysis area; slope wetlands are the dominant hydrogeomorphic (HGM) class.

The analysis area for the mine site (11,937 acres) is predominantly in the Headwaters Koktuli River watershed, with a smaller portion in the UTC watershed. The Headwaters Koktuli River watershed drains the NFK and SFK rivers, which flow into Bristol Bay via the Mulchatna and Nushagak rivers. The landscape is composed of glaciated, volcanic-ash–influenced hills and valleys that are free of permafrost. Human-caused disturbance at the mine site is minimal. Uplands represent 73 percent of the mine site, with the remaining 27 percent of the area composed of wetlands and other waters. Of the wetland types present, the broad-leaved deciduous shrub type is dominant. This wetlands type occurs primarily as the slope HGM class, and secondarily as the riverine HGM class. Of the other water types present, ponds are the most abundant type in the mine site analysis area. A total of 132.9 miles of streams is present in the mine site analysis area.

The analysis area for the transportation corridor is 7,494 acres. The transportation corridor crosses the Bristol Bay and Cook Inlet drainage basins; in the Cook Inlet drainage basin, the Amakdedori Creek-Kamishak Bay watershed is the only watershed crossed by the transportation corridor. The watersheds intersected by the transportation corridor in the Bristol Bay drainage basin include the UTC, Newhalen River, Iliamna Lake, and Gibraltar Lake watersheds. Human caused disturbance in the transportation corridor is minimal. Uplands represent 89 percent of the transportation corridor, with the remaining 11 percent of the area composed of wetlands and other waters. Of the wetland types present, the broad-leaved deciduous shrub type is dominant. This wetlands type occurs primarily as the slope and riverine HGM classes. Of the other water types present, ponds are dominant in the transportation corridor. A total of 51.1 miles of streams is present in the transportation corridor analysis area.

The analysis area for Amakdedori port is 118 acres) on the shore of Kamishak Bay near Amakdedori Creek. The port is in the Amakdedori Creek-Kamishak Bay watershed in the Cook Inlet drainage. Topography is generally flat, with dunes located closer to the gravel beach shoreline of Cook Inlet. Uplands represent 82 percent of the port, with the remaining 18 percent of the area composed of wetlands and other waters. Herbaceous wetlands are the only wetland type represented, and are associated primarily with riverine, and secondarily with slope HGM classes. Of the other water types present, marine waters (both intertidal and subtidal) are dominant.

The analysis area for the natural gas pipeline corridor is 1,007 acres. Uplands represent 20 percent of the analysis area, with the remaining 80 percent of the area composed of wetlands and other waters. Of the wetland types present, the broad-leaved deciduous shrub and herbaceous types are codominant. Both of these wetlands types occur primarily as slope, and secondarily as flat HGM classes. Of the other water types present, subtidal marine waters are dominant.

A1 Alternative 1

The Alternative 1 analysis area is 21,860 acres. Wetlands comprise 17 percent of this area; an additional 6 percent of the analysis area is other waters, including 189.0 miles of streams. Quantifiable types of wetlands, identified as regionally important, and other special aquatic sites represent 1 percent or less of the Alternative 1 analysis area; slope wetlands are the dominant HGM class.

The mine site analysis area under Alternative 1 is 11,955 acres. Uplands represent 73 percent of the mine site, with the remaining 27 percent of the area composed of wetlands and other waters. Of the wetland types present, the broad-leaved deciduous shrub type is dominant. This wetland type occurs primarily as the slope HGM class, and secondarily as the riverine HGM class. Of the other water types present, ponds are the most abundant type in the mine site analysis area. A total of 132.9 miles of streams is present in the mine site analysis area.

The Alternative 1 transportation corridor analysis area is 8,820 acres. Uplands represent 89 percent of the area, with the remaining 11 percent of the area composed of wetlands and other waters. Of the wetland types present, the broad-leaved deciduous shrub type is dominant. This wetland type occurs primarily as the slope HGM class. Of the other water types present, ponds are dominant. A total of 55.7 miles of streams is present in the transportation corridor analysis area.

The analysis area for Amakdedori port (185 acres) is similar to Alternative 1a. Uplands represent 65 percent of the port site, with the remaining 35 percent of the area composed of wetlands and other waters. Herbaceous wetlands are the dominant wetland type, and are associated primarily with riverine, and secondarily with slope HGM classes. Of the other water types present, marine waters (both intertidal and subtidal) are codominant.

The analysis area for the natural gas pipeline corridor is 900 acres. Uplands represent 10 percent of the analysis area, with the remaining 90 percent of the area composed of wetlands and other waters. Broad-leaved deciduous shrub and herbaceous are the only wetland types present, and are co-dominant. Both wetland types occur primarily as slope, and secondarily as riverine HGM classes. Of the other water types present, subtidal marine waters are dominant. The natural gas pipeline analysis area contains 0.2 mile of streams.

A2 Alternative 2 – North Road and Ferry with Downstream Dams

The Alternative 2 analysis area is 20,515 acres. Wetlands, a special aquatic site, comprise 17 percent of this area; an additional 7 percent of the analysis area is other waters, including 180.0 miles of streams. Quantifiable wetland types identified as regionally important and other special aquatic sites represent 1 percent or less of the Alternative 2 analysis area.

The downstream dam construction method proposed for the Alternative 2 mine site increases direct disturbance footprint by 107 acres relative to Alternative 1a, Alternative 1, and Alternative 3, thereby increasing the affected environment for wetlands and other waters. The mine site analysis area under Alternative 2 is 12,052 acres. Uplands represent

73 percent of the mine site, with the remaining 27 percent of the area made up of wetlands and other waters. Of the wetland types present, the broad-leaved deciduous shrub type is dominant, and occurs primarily as the slope HGM class. Of the other water types present, ponds are the most abundant type in the mine site analysis area. A total of 133.4 miles of streams is present in the mine site analysis area.

The Alternative 2 transportation corridor analysis area is 5,788 acres. Uplands represent 88 percent of the analysis area, with the remaining 12 percent of the area made up of wetlands and other waters. Of the wetland types present, the broad-leaved deciduous shrub type is dominant, and occurs primarily as the slope HGM class. Of the other water types present, subtidal estuarine waters and perennial streams are codominant. A total of 34.1 miles of streams is present in the transportation corridor analysis area, including 0.2 mile of tidally influenced river.

The analysis area for the Diamond Point port (255 acres) is composed of relatively undisturbed habitat at the juncture of Iliamna and Cottonwood bays. Coastal habitats in the analysis area include sand and pebble substrates interspersed by rocky reefs and mudflats. Uplands represent 46 percent of the Diamond Point port analysis area, with the remaining 54 percent of the area composed of wetlands and other waters. Estuarine intertidal wetlands are the dominant wetland type, which are exclusively associated with the coastal fringe HGM class. Of the other water types present, subtidal estuarine waters are overwhelmingly dominant. A total of 0.8 mile of streams is present in the port analysis area.

The natural gas pipeline corridor analysis area under Alternative 2 is 2,419 acres. Uplands represent 70 percent of the analysis area, with the remaining 30 percent of the area composed of wetlands and other waters. Of the wetland types present, the broad-leaved deciduous shrub and herbaceous types are co-dominant. Both wetland types occur primarily as slope, and secondarily as riverine HGM classes. Of the other water types present, subtidal marine waters are overwhelmingly dominant. A total of 11.6 miles of streams is present in the natural gas pipeline analysis area.

A3 Alternative 3 – North Road Only

The Alternative 3 analysis area is 21,684 acres. Wetlands, a special aquatic site, compose 16 percent of this area; an additional 6 percent of the analysis area is other waters, including 190.4 miles of streams. Quantifiable types of wetlands identified as regionally important and other special aquatic sites represent 1 percent or less of the Alternative 3 analysis area; slope wetlands are the dominant HGM class.

The mine site analysis area under Alternative 3 is the same as Alternative 1a.

The Alternative 3 transportation corridor analysis area is 8,757 acres. Uplands represent 91 percent of the transportation corridor, with the remaining 9 percent of the area composed of wetlands and other waters. Of the wetland types present, the broad-leaved deciduous shrub type is dominant. This wetlands type occurs primarily as the slope HGM class, and secondarily as the riverine HGM class. Of the other water types present, estuarine subtidal, lakes, ponds, and perennial streams are equally dominant. A total of 54.2 miles of streams is present in the transportation corridor analysis area.

The Alternative 3 port location is north of Diamond Point in Iliamna Bay. The port analysis area (160 acres) is composed of relatively undisturbed habitat. Coastal habitats include sand and pebble substrates interspersed by rocky reefs and mudflats. Uplands represent 42 percent of the port analysis area, with the remaining 58 percent of the area composed of wetlands and other waters. Estuarine waters are the dominant habitat type, and are exclusively associated with the coastal fringe HGM class. A total of 0.4 mile of streams is present in the port analysis area.

The natural gas pipeline corridor analysis area under Alternative 3 is 830 acres. Uplands represent 22 percent of the analysis area, with the remaining 78 percent of the area consisting of wetlands and other waters. Of the wetland types present, the broad-leaved deciduous shrub and intertidal estuarine habitat are co-dominant. Of the other water types present, subtidal marine waters are overwhelmingly dominant. A total of 2.9 miles of streams is present in the natural gas pipeline analysis area.

Expected Effects (Environmental Consequences) of Alternatives

Environmental consequences are discussed in Section 4.22, Wetlands and Other Waters/Special Aquatic Sites.

Scoping comments requested that the EIS evaluate: impacts to special aquatic sites and regionally important wetlands; direct impacts from the placement of fill and the removal of wetland vegetation; and indirect impacts of fugitive dust, fragmentation, and dewatering on wetlands and other waters.

Impacts to wetlands, open freshwaters, estuarine waters, marine waters, rivers, streams, and other waters are assessed from a NEPA perspective, which differs from how they are treated under the 404(b)(1) guidelines. The USACE would complete the Section 404(b)(1) analysis as part of the joint ROD.

Potential direct and indirect effects to wetlands and other waters were assessed according to four factors: the magnitude (or intensity of the impacts); the duration (how long the impact would last); the extent (the area of the impact); and the likelihood of the effect (the certainty that the impact would occur, should the project be permitted). The severity of impacts is summarized by the relative abundance of the resource, perceived value of the resource, and sensitivity of the resource to the impact, as appropriate. The relative abundance of a resource is evaluated as the percent of the total wetland and/or other water area, estimated from the National Wetland Inventory (NWI) at the USGS Hydrologic Unit Code (HUC) 10 watershed scale. The perceived value of the resource is summarized by type of special aquatic site or regionally important wetland. The sensitivity of the resource is presented for fragmentation and dewatering and is evaluated by HGM class.

The loss of wetlands from development of the mine site represent about 6 percent of mapped wetlands in the Headwaters Koktuli River watershed. Depending on the alternative, discharge of dredged or fill material would permanently impact between 2,226 and 2,261 acres of wetlands and other waters, including between 104.1 and 105.8 miles of streams. The majority of permanent impacts would result from development of the mine site, and would occur in the Headwaters Koktuli River watershed. Depending on the alternative, these losses represent from 92 to 97 percent of the total permanent impacts to wetlands and other waters across all project components.

A summary of impacts to wetlands and other waters for the action Alternatives is shown in Table ES-1.

NA No Action Alternative

Under the No Action Alternative, federal agencies with decision-making authorities on the project would not issue permits under their respective authorities. The Applicant's Preferred Alternative would not be undertaken, and no construction, operations, or closure activities specific to the Applicant's Preferred Alternative would occur. Although no resource development would occur under the Applicant's Preferred Alternative, PLP would retain the ability to apply for continued mineral exploration activities under the State's authorization process (ADNR 2018 RFI 073) or for any activity not requiring federal authorization. In addition, there are many valid mining claims in the area, and these lands would remain open to mineral entry and exploration by other individuals or companies. It would be expected that current State-authorized activities associated with mineral exploration and reclamation, as well as scientific studies, would continue at levels similar to recent post-exploration activity. The State requires that sites be reclaimed at the conclusion of their State-authorized exploration program. If reclamation approval is not granted immediately after the cessation of activities, the State may require continued authorization for ongoing monitoring and reclamation work as it deems necessary. Although these activities would also cause some disturbance, reclamation would benefit wetlands and other waters.

A1a Alternative 1a

The total direct impact to wetlands and other waters under Alternative 1a would be the discharge of dredged or fill material to 3,084 acres of wetlands and other waters, including 110.0 miles of streams. Of this area of impact, 2,226 acres of wetlands and other waters, including 105.4 miles of streams, would be permanently impacted, whereas 858 acres of wetlands and other waters, including 4.6 miles of streams, would be temporarily impacted. Indirect impacts under Alternative 1a related to the fragmentation, deposition of dust, and dewatering of aquatic resources collectively have the potential to impact a total of 1,662 acres of wetlands and other waters, including 75.3 miles of streams.

The mine site is predominantly in the Headwaters Koktuli River watershed, with a lesser presence in the UTC watershed. The Headwaters Koktuli River watershed is 170,632 acres, with 36,458 acres classified as wetlands and other waters. In terms of magnitude and extent, construction and operations of the mine site under Alternative 1a would have direct and indirect impact on 2,953 acres,[7] representing 8 percent of wetlands and other waters in the Headwaters Koktuli River watershed. The UTC watershed is 87,539 acres, with 13,193 acres classified as wetlands and other waters. The mine site would have direct and indirect impact on 68 acres, or less than 1 percent of wetlands and other waters in the UTC watershed. Although NWI wetland mapping covers the entirety of the Headwaters Koktuli River watershed, only 91 percent of the UTC watershed has been mapped by NWI. Therefore, the area of wetlands and other waters presented for the UTC watershed is likely underestimated.

The transportation corridor, natural gas pipeline corridor, and Amakdedori port project components would collectively affect eight HUC 10 watersheds under Alternative 1a. Based on available NWI mapping, wetlands and other waters comprise 4,716,529 acres of the combined area of these watersheds (6,249,945 acres). In terms of magnitude and extent, these three project components would have direct and indirect impacts on 1,728 acres of wetlands and other waters, representing less than

[7] Total accounts for overlap among areas of indirect impact at the mine site.

Table ES-1: Summary of Key Issues for Wetlands and Other Waters

Variant	Impact	Aquatic Resource	Alternative 1a		Alternative 1		Alternative 2		Alternative 3	
			Acres	Miles	Acres	Miles	Acres	Miles	Acres	Miles
All Project Components										
Base Case	Permanent	Wetlands	2,102	-	2,102	-	2,102	-	2,090	-
		Other Waters	124	105.4	124	105.8	159	104.1	142	105.4
	Temporary	Wetlands	60	-	60	-	41	-	31	-
		Other Waters	799	4.6	799	3.9	740	9.0	742	6.2
	Indirect	Wetlands	1,301	-	1,263	-	1,124	-	1,196	-
		Other Waters	361	75.3	378	75.2	478	65.8	413	79.5
Mine Site										
Base Case	Permanent	Wetlands	2,051	-	2,051	-	2,073	-	2,051	-
		Other Waters	111	99.7	111	99.7	111	100.3	111	99.7
	Temporary	Wetlands	<1	-	<1	-	<1	-	<1	-
		Other Waters	<1	<0.1	<1	<0.1	<1	<0.1	<1	<0.1
	Indirect	Wetlands	774	-	774	-	771	-	774	-
		Other Waters	82	29.9	82	29.9	82	29.8	82	29.9
Summer-Only Ferry Operations Variant	Permanent	Wetlands	-	-	2,052	-	2,074	-	-	-
		Other Waters	-	-	112	100.0	112	100.6	-	-
	Temporary	Wetlands	-	-	<1	-	<1	-	-	-
		Other Waters	-	-	<1	<0.1	<1	<0.1	-	-
	Indirect	Wetlands	-	-	773	-	770	-	-	-
		Other Waters	-	-	82	29.6	82	29.5	-	-
Concentrate Pipeline Variant	Permanent	Wetlands	-	-	-	-	-	-	2,051	-
		Other Waters	-	-	-	-	-	-	111	99.7
	Temporary	Wetlands	-	-	-	-	-	-	<1	-
		Other Waters	-	-	-	-	-	-	<1	<0.1
	Indirect	Wetlands	-	-	-	-	-	-	774	-
		Other Waters	-	-	-	-	-	-	82	29.9
Transportation										
Base Case	Permanent	Wetlands	51	-	52	-	29	-	38	-
		Other Waters	10	5.7	10	6.1	34	3.3	28	5.7
	Temporary	Wetlands	38	-	36	-	22	-	26	-
		Other Waters	9	3.9	8	3.7	17	2.2	14	3.9
	Indirect	Wetlands	525	-	487	-	314	-	422	-
		Other Waters	266	45.3	252	45.2	298	30.6	323	48.5
Summer-Only Ferry Operations Variant	Permanent	Wetlands	-	-	52	-	29	-	-	-
		Other Waters	-	-	10	6.1	43	3.3	-	-
	Temporary	Wetlands	-	-	36	-	22	-	-	-
		Other Waters	-	-	8	3.7	17	2.2	-	-
	Indirect	Wetlands	-	-	487	-	314	-	-	-
		Other Waters	-	-	252	45.2	291	30.8	-	-
Kokhanok East Ferry Terminal Variant	Permanent	Wetlands	-	-	49	-	-	-	-	-
		Other Waters	-	-	8	5.9	-	-	-	-
	Temporary	Wetlands	-	-	33	-	-	-	-	-
		Other Waters	-	-	7	3.4	-	-	-	-
	Indirect	Wetlands	-	-	448	-	-	-	-	-
		Other Waters	-	-	221	42.4	-	-	-	-

Table ES-1: Summary of Key Issues for Wetlands and Other Waters (cont.)

Variant	Impact	Aquatic Resource	Alternative 1a		Alternative 1		Alternative 2		Alternative 3	
			Acres	Miles	Acres	Miles	Acres	Miles	Acres	Miles
Transportation (cont.)										
Newhalen River North Crossing Variant	Permanent	Wetlands	-	-	-	-	29	-	-	-
		Other Waters	-	-	-	-	34	3.3	-	-
	Temporary	Wetlands	-	-	-	-	22	-	-	-
		Other Waters	-	-	-	-	17	2.2	-	-
	Indirect	Wetlands	-	-	-	-	314	-	-	-
		Other Waters	-	-	-	-	296.5116	30.6	-	-
Port										
Base Case	Permanent	Wetlands	-	-	-	-	-	-	<1	-
		Other Waters	2	-	11	-	14	<0.1	3	<0.1
	Temporary	Wetlands	-	-	-	-	-	-	-	-
		Other Waters	5	-	4	-	72	0.1	88	0.1
	Indirect	Wetlands	1	-	1	-	1	-	<1	-
		Other Waters	14	0.1	46	0.1	69	0.8	1	0.4
Summer-Only Ferry Operations Variant	Permanent	Wetlands	-	-	<1	-	-	-	-	-
		Other Waters	-	-	11	-	14	<0.1	-	-
	Temporary	Wetlands	-	-	<1	-	-	-	-	-
		Other Waters	-	-	4	-	72	0.1	-	-
	Indirect	Wetlands	-	-	3	-	1	-	-	-
		Other Waters	-	-	50	0.2	69	0.8	-	-
Pile-Supported Dock Variant	Permanent	Wetlands	-	-	-	-	-	-	-	-
		Other Waters	-	-	<1	-	4	<0.1	-	-
	Temporary	Wetlands	-	-	-	-	-	-	-	-
		Other Waters	-	-	6	-	79	0.1	-	-
	Indirect	Wetlands	-	-	1	-	1	-	-	-
		Other Waters	-	-	14	0.1	28	0.8	-	-
Concentrate Pipeline Variant	Permanent	Wetlands	-	-	-	-	-	-	<1	-
		Other Waters	-	-	-	-	-	-	4	<0.1
	Temporary	Wetlands	-	-	-	-	-	-	-	-
		Other Waters	-	-	-	-	-	-	88	0.1
	Indirect	Wetlands	-	-	-	-	-	-	<1	-
		Other Waters	-	-	-	-	-	-	1	0.4
Natural Gas Pipeline										
Base Case	Permanent	Wetlands	-	-	-	-	<1	-	-	-
		Other Waters	1	-	4	-	<1	0.5	-	-
	Temporary	Wetlands	21	-	4	-	19	-	5	-
		Other Waters	785	0.6	749	0.2	651	6.6	639	2.2
	Indirect	Wetlands	-	-	-	-	38	-	<1	-
		Other Waters	-	-	-	-	29	4.7	7	0.8
Kokhanok East Ferry Terminal Variant	Permanent	Wetlands	-	-	-	-	-	-	-	-
		Other Waters	-	-	4	-	-	-	-	-
	Temporary	Wetlands	-	-	4	-	-	-	-	-
		Other Waters	-	-	759	0.2	-	-	-	-
	Indirect	Wetlands	-	-	-	-	-	-	-	-
		Other Waters	-	-	-	-	-	-	-	-

Notes: Permanent and temporary impacts are direct impacts. Impact areas and lengths for variants are given as the total for that component; stream lengths are provided as a supplemental metric for the evaluation of impact; the areas of streams are also included in the total areas of "wetlands and other waters." The term "stream" is used collectively to include both seasonally flooded, intermittent streams and permanently flooded, upper perennial streams.

1 percent of the wetland and other waters habitat mapped for the combined watershed area. Although NWI mapping covers the entirety of the Cook Inlet and Stariski Creek-Frontal Cook Inlet watersheds, coverage for the remaining six watersheds averages 53 percent, with a range of 6 percent to 95 percent. Therefore, the areas of wetlands and other waters presented for these watersheds are likely underestimated.

The impact to navigable waters under Alternative 1a would occur in the Newhalen and Gibraltar rivers and Iliamna Lake and Cook Inlet, and would directly impact a total of 804 acres. Of this total area of direct impact, 12 acres would be permanent impacts largely associated with the construction of the Amakdedori port and ferry terminals; and 792 acres would be temporary impacts largely associated with the installation of the natural gas pipeline.

Special aquatic sites that would be directly and permanently impacted under Alternative 1a include mudflats, riffle and pool complexes, vegetated shallows, and wetlands. Quantifiable categories of regionally important wetlands that would be directly and permanently impacted under Alternative 1a include fens, and forested and riparian wetlands.

The greatest magnitude of impact to special aquatic sites would be to wetlands (2,012 acres), including regionally important riparian wetlands (127 acres), fens (72 acres), and forested wetlands, followed by riffle and pool habitat (46 acres, including 88.3 miles of upper perennial stream), mudflats (13 acres), and vegetated shallows (2 acres).

A1 Alternative 1 and Variants

The total direct impact to wetlands and other waters under Alternative 1 is the discharge of dredged or fill material to 3,084 acres of wetlands and other waters, including 109.7 miles of streams. Of this area of direct impact, 2,226 acres of wetlands and other waters, including 105.8 miles of streams, would be permanently impacted; 858 acres of wetlands and other waters, including 3.9 miles of streams, would be temporarily impacted. Indirect impacts under Alternative 1 related to the fragmentation, deposition of dust, and dewatering of aquatic resources collectively have the potential to impact a total of 1,642 acres of wetlands and other waters, including 75.2 miles of streams.

The mine site footprint under Alternative 1 is the same as Alternative 1a, the direct and indirect impacts of which are summarized under Alternative 1a.

Collectively, the transportation corridor, natural gas pipeline corridor, and Amakdedori port project components would affect seven HUC 10 watersheds under Alternative 1. Based on available NWI mapping, wetlands and other waters compose 4,693,149 acres of the combined area of these seven watersheds (6,130,237 acres). In terms of magnitude and extent, these three project components would have direct and indirect impacts on 1,664 acres of wetlands and other waters, representing less than 1 percent of wetland and other waters habitat mapped for the combined watershed area. Although NWI mapping covers the entirety of the Cook Inlet and Stariski Creek-Frontal Cook Inlet watersheds, coverage for the remaining five watersheds averages 44 percent, with a range of 6 to 91 percent. Therefore, the areas of wetlands and other waters presented for these watersheds are likely underestimated.

The total direct impact to navigable waters under Alternative 1 occurs in Gibraltar River, Iliamna Lake, and Cook Inlet, and would impact a total of 779 acres. Of this total area of direct impact, 25 acres are permanent impacts largely associated with the construction of the Amakdedori port and ferry terminals; and 754 acres are temporary impacts largely associated with the construction of the natural gas pipeline.

Special aquatic sites that would be directly and permanently impacted under Alternative 1 include mudflats, riffle and pool complexes, vegetated shallows, and wetlands. Quantifiable categories of regionally important wetlands that would be directly and permanently impacted under Alternative 1 include fens and riparian wetlands.

The greatest magnitude of impact to special aquatic sites would be to wetlands (2,102 acres), including regionally important riparian wetlands (130 acres) and fens (73 acres), followed by riffle and pool habitat (46 acres, including 88.5 miles of upper perennial stream), mudflats (13 acres), and vegetated shallows (2 acres).

Although the extent of impacts is expected to occur in six of the seven watersheds intersected by Alternative 1, 97 percent of impact to special aquatic sites and regionally important wetlands is expected in the Headwaters Koktuli River watershed, and would be largely associated with the construction and operation of the mine site. Direct, permanent impacts to special aquatic sites and regionally important wetlands would affect 6 percent of the wetlands and other waters mapped in the Headwaters Koktuli drainage. Impacts to special aquatic sites and regionally important wetlands are calculated to represent 1 percent of waters and wetlands mapped in the Gibraltar Lake watershed; however, because only 6 percent of the Gibraltar Lake watershed has been mapped by NWI, the representation of impacts on the watershed scale is likely over estimated.

The Summer-Only Ferry Operations Variant would involve summer-only operation of the ferry across Iliamna Lake. Instead of daily transportation to the Amakdedori port, concentrate would be stored in a container-based system that would be stockpiled at the mine site during the period when the lake is frozen. The containers would be stored in a laydown area at the mine site, requiring relocation of the sewage tank pad. This change in configuration would increase the direct permanent impacts to wetlands and other waters by 1.7 acres of broad-leaved deciduous shrub wetlands, 0.4 acre of ponds, and 0.2 acre, including 0.3 mile, of intermittent stream habitat. Concentrate containers would also be stockpiled at Amakdedori port, requiring increased storage capacity; increasing the magnitude of the permanent and temporary impacts on wetlands at Amakdedori port by 0.4 acre and 0.3 acre, respectively. The duration and extent of impacts would be the same as the Alternative 1 base case. Increased truck traffic would be expected to increase the deposition of fugitive dust emissions along the transportation corridor; however, the area of direct impact would be expected to be the same as the Alternative 1 base case.

The Kokhanok East Ferry Terminal Variant would decrease the magnitude of permanent impacts on wetlands and other waters associated with the transportation corridor from 61 acres (including 6.1 miles of streams) to 57 acres (including 5.9 miles of streams); and temporary impacts from 44 acres (including 3.7 miles of streams) to 40 acres (including 3.4 miles of streams). The magnitude of fugitive dust impacts to wetlands and other waters would also be reduced, from 739 acres, including 45.2 miles of streams, to 670 acres, including 42.4 miles of streams. The deposition of fugitive dust is considered an indirect but long-term consequence of project development. The extent of impacts would be the same as the Alternative 1 base case for the transportation corridor. Changes in the natural gas pipeline corridor under the Kokhanok East Ferry Terminal Variant would result in a net addition of 11 acres of temporary impacts to Iliamna Lake waters. The extent would remain unchanged from the Alternative 1 base case for the natural gas pipeline corridor.

The Pile-Supported Dock Variant proposes a pile-supported dock design at Amakdedori port. The variant would decrease the magnitude of permanent impacts on wetlands and other waters from 11 acres to 0.2 acre, but would increase temporary impacts from 4 acres to 6.3 acres. Due to the smaller direct footprint of a pile-supported dock, permanent impacts related to the alteration of water currents and circulation patterns in the nearshore environment are expected to be less than either the caisson or earthen fill dock designs. However, temporary impacts associated with the driving of piles would disturb a greater area than the caisson or earthen fill dock designs. Both the reduction of permanent impacts and the increase in temporary impacts would occur in the marine waters of the Amakdedori Creek-Frontal Cook Inlet watershed. Construction of a pile-supported dock at Amakdedori port would decrease the exposure of wetlands and other waters to the potential deposition of dust from 47 acres to 15 acres. This reduction is due to the concrete deck of the pile-supported dock, which is not expected to be a source of fugitive dust. The extent and duration of indirect impacts would be unchanged from the Alternative 1 base case.

Digital Simulation of Amakdedori Port

A2 Alternative 2 and Variants

The total direct impact to wetlands and other waters under Alternative 2 is the discharge of dredged or fill material to 3,042 acres of wetlands and other waters, including 113.1 miles of streams. Of this area of direct impact area, 2,261 acres of wetlands and other waters, including 104.1 miles of streams, would be permanently impacted; 781 acres of wetlands and other waters, including 9.0 miles of streams, would be temporarily impacted. Indirect impacts under Alternative 2 related to the fragmentation, deposition of dust, and dewatering of aquatic resources collectively have the potential to impact a total of 1,602 acres of wetlands and other waters, including 65.8 miles of streams.

The mine location, mining methods, and facilities would remain the same as those under Alternative 1a, but Alternative 2 would use an Alternative downstream method for construction of the bulk TSF. In terms of magnitude and extent, construction and operations of the mine site under Alternative 2 would have direct and indirect impacts on 2,950 acres, representing 8 percent of wetlands and other waters in the Headwaters Koktuli River watershed. The UTC watershed is 87,539 acres, with 13,193 acres classified as wetlands and other waters. The mine site would directly and indirectly impact 68 acres, representing less than 1 percent of wetlands and other waters in the UTC watershed. Although NWI wetland mapping covers the entirety of the Headwaters Koktuli River watershed, only 91 percent of the UTC watershed has been mapped by NWI. Therefore, the area of wetlands and other waters presented for the UTC watershed is likely underestimated.

The transportation corridor, natural gas pipeline corridor, and Diamond Point port project components would collectively affect nine HUC 10 watersheds under Alternative 2. Based on available NWI mapping, wetlands and other waters compose 4,771,931 acres of the combined area of these watersheds (6,385,867 acres). In terms of magnitude and extent, these three project components would have direct and indirect impacts on 1,608 acres of wetlands and other waters, representing less than 1 percent of the wetland and other waters mapped for the combined watershed area. Although NWI wetland mapping covers the entirety of six watersheds intersected by the transportation corridor, natural gas pipeline corridor, and the port components under Alternative 2, coverage for the remaining three watersheds (Iliamna Lake, Newhalen River, and UTC) averages 81 percent, with a range of 57 to 95 percent. Therefore, the areas of wetlands and other waters presented for these watersheds are likely underestimated.

The total direct impact to navigable waters under Alternative 2 would occur in the Newhalen and Iliamna rivers, Iliamna Lake, and Cook Inlet, and would impact a total of 782 acres. Of this total area of direct impact, 49 acres are permanent impacts largely associated with the construction of ferry terminals and the Diamond Point port; 734 acres are temporary impacts largely associated with the construction of the natural gas pipeline.

Special aquatic sites that would be directly and permanently impacted under Alternative 2 include mudflats, riffle and pool complexes, vegetated shallows, and wetlands. Quantifiable categories of regionally important wetlands that would be directly and permanently impacted under Alternative 2 include fens and estuarine, riparian, and forested wetlands. The greatest magnitude of impact to special aquatic sites would be to wetlands (2,102 acres), including regionally important riparian wetlands (132 acres), fens (73 acres), forested wetland (3 acres), and estuarine wetlands (less than 1 acre), followed by riffle and pool habitat (46 acres, including 87.6 miles of upper perennial stream), mudflats (31 acres), and vegetated shallows (2 acres).

The Summer-Only Ferry Operations Variant would increase the direct permanent impacts to wetlands and other waters at the mine site by 1.5 acres; this increase would be permanent and occur exclusively in the Headwaters Koktuli River watershed. Although the area of direct disturbance would be greater under this variant, the configuration of facilities results in a smaller cumulative area of indirect impact. Compared to the Alternative 2 base case, the magnitude of indirect impacts would be 1 acre less, with impacts to streams reduced by 0.3 mile. Under this variant, concentrate containers would be stored at a laydown area along a coastal stretch of the Williamsport-Pile Bay Road, thereby increasing the size of the transportation corridor. The magnitude and duration of effects would be the direct permanent impacts to an additional 10 acres of wetlands and other waters largely composed of estuarine intertidal waters (9 acres) in Iliamna Bay. The magnitude of indirect impacts would decrease by 7 acres for estuarine intertidal habitat, but increase by 0.2 mile for intermittent stream habitat exposed to the deposition. The decrease in area of indirect impact relates to the location of the container storage area in the area of potential dust deposition for the Alternative 2 base case. In this way, the direct footprint of disturbance for the variant supersedes a portion of the indirect impact area for the base case. Both changes in magnitude would occur in the Chinitna River-Frontal Cook Inlet watershed. The duration and extent of indirect impacts would be unchanged from the Alternative 2 base case for the transportation corridor.

Under the Newhalen River North Crossing Variant, the transportation corridor would cross the Newhalen River north of the base case location. Because the Newhalen River North Crossing Variant locates the bridge to avoid direct impacts to wetlands, the magnitude, duration, and extent do not differ from the Alternative 2 base case for the transportation corridor. The rerouting of the transportation corridor under this variant would expose an additional 1.1 acres of lake waters to dust deposition, but would avoid potential dust impacts to 2.9 acres of wetlands and streams. Therefore, the magnitude of indirect impact to wetlands and other waters under the Newhalen River North Crossing Variant is 1.8 acres less than the Alternative 2 base case. The duration and extent would be the same as the Alternative 2 base case for the transportation corridor.

The Pile-Supported Dock Variant considers a pile-supported dock design at Diamond Point port. This design would reduce the area of direct permanent impact from 14 acres to 4 acres, but would increase temporary impacts from 72 to 79 acres; changes would affect subtidal estuarine waters only. Due the smaller footprint of a pile-supported dock, permanent impacts related to the alteration of water currents and circulation patterns in the immediate nearshore environment are expected to be less than those associated with the earthen fill dock design. However, temporary impacts associated with the driving of piles would cause greater temporary disturbance. Dredging would still occur with this variant. The extent of impact would be unchanged from the Alternative 2 base case for the Diamond Point port. Construction of a pile-supported dock at Diamond Point port would decrease the exposure of wetlands and other waters to the potential deposition of dust from 71 acres to 29 acres. Potential impacts to 19 acres of subtidal estuarine marine waters are avoided by the design of the pile-supported dock, which is decked in concrete and would not be expected to generate significant dust. The extent and duration of potential indirect impacts from fugitive dust deposition would remain unchanged from the Alternative 2 base case for the Diamond Point port.

A3 Alternative 3 and Variant

The total direct impact to wetlands and other waters under Alternative 3 is the discharge of dredged or fill material to 3,005 acres of wetlands and other waters, including 111.6 miles of streams. Of this area of direct impact area, 2,231 acres of wetlands and other waters and 105.4 miles of streams would be permanently impacted; 773 acres of wetlands and other waters, including 6.2 miles of streams, would be temporarily impacted. Indirect impacts under Alternative 3 related to the fragmentation, deposition of dust, and dewatering of aquatic resources collectively have the potential to impact a total of 1,609 acres of wetlands and other waters, including 79.5 miles of streams.

The mine site footprint under Alternative 3 is the same as Alternative 1a, the direct and indirect impacts of which are summarized under Alternative 1a.

The transportation corridor, natural gas pipeline corridor, and Diamond Point port project components would collectively affect nine HUC 10 watersheds under Alternative 3. Based on available NWI mapping, wetlands and other waters compose 4,771,931 acres of the combined area of these watersheds (6,385,867 acres). In terms of magnitude and extent, these three project components would have direct and indirect impacts on 1,595 acres of wetlands and other waters, representing less than 1 percent of the wetland and other waters habitat mapped for the combined watershed area. Although NWI wetland mapping covers the entirety of six watersheds intersected by the transportation corridor, the natural gas pipeline corridor, and the port components under Alternative 3, coverage for the remaining three watersheds (Iliamna Lake, Newhalen River, and UTC) averages 81 percent, with a range of 57 to 95 percent. Therefore, the areas of wetlands and other waters presented for these watersheds are likely underestimated.

Because Alternative 3 does not include a crossing of Iliamna Lake, the Newhalen and Iliamna rivers and Cook Inlet are the only navigable waters impacted. The total direct impact to navigable waters under Alternative 3 would be 769 acres. Of this total area of direct impact, 32 acres would be permanent impacts largely associated with the construction the port; 737 acres would be temporary impacts largely associated with the construction of the natural gas pipeline.

Special aquatic sites that would be directly and permanently impacted under Alternative 3 include mudflats, riffle and pool complexes, vegetated shallows, and wetlands. Quantifiable categories of regionally important wetlands that would be directly and permanently impacted under Alternative 2 include fens, and estuarine, riparian, and forested wetlands. The greatest magnitude of impact to special aquatic sites would be to wetlands (2,090 acres), including regionally important riparian wetlands (132 acres), fens (72 acres), forested wetlands (5 acres), estuarine wetlands (less than 1 acre), followed by riffle and pool habitat (92 acres, including 88.5 miles of upper perennial stream), mudflats (57 acres), and vegetated shallows (4 acres).

Although the extent of impacts is expected to occur across all eight of the watersheds intersected by Alternative 3, 94 percent of the impact to special aquatic sites and regionally important wetlands is expected in the Headwaters Koktuli River watershed, and would be largely associated with the construction and operation of the mine site. Direct, permanent impact to special aquatic sites and regionally important wetlands would affect 6 percent of the wetlands and other waters mapped in the Headwaters Koktuli drainage.

The Concentrate Pipeline Variant considers delivery of copper-gold concentrate to Diamond Point port via a pipeline, and includes an option to construct an additional pipeline to return filtrate to the mine site. This variant would slightly increase the road corridor width due to the co-location of the concentrate, optional return water, and natural gas pipelines in a single trench at the toe of the road embankment. This would increase the average width of the road corridor by less than 10 percent and less than 3 feet for the water return pipeline. Because the Alternative 3 base case road width is conceptually engineered to accommodate the concentrate pipeline and optional return water pipeline, change to the magnitude, duration, or extent of direct or indirect impacts to wetlands and other waters in the transportation corridor that would occur under the Concentrate Pipeline Variant would be minor, commensurate with the transportation corridor being up to 10 percent wider.

At the port, three additional caissons to support concentrate loading would be placed in the temporary dredge area for the Alternative 3 base case. Therefore, 0.25 acre of temporary impact is transitioned to permanent impact under this variant. This change in impact type occurs in estuarine subtidal waters. There would be no change to the duration or extent of direct impacts to wetlands and other waters at the port under this variant. Implementation of a concentrate and water return pipeline would reduce traffic in the transportation corridor, lessening the severity of impacts associated with dust deposition, but the magnitude and extent of potential dust deposition under this variant would not be expected to differ from the Alternative 3 base case.

CE Cumulative Effects

The cumulative effects analysis area for wetlands and other waters is the maximum geographic extent of the footprint of the project, including all Alternatives and variants, the expanded mine footprint (including road, pipeline, and port facilities), and the area where direct and indirect effects to wetlands and other waters can be expected from project construction and operations, as well as any other past, present, and RFFAs that are in the vicinity of, and have the potential to contribute to the impacts of the project.

Past and present actions that have affected or are currently affecting wetlands and other waters in the analysis area are minimal, because most of the area is undisturbed. The USACE prepared HUC estimates of the total acreages authorized to be filled for the 13 watersheds potentially affected by the project; the current area of wetlands filled, by percent of wetlands and other waters mapped by NWI in the watershed, ranges from 0 percent of the Headwaters Koktuli River and several other watersheds, to 4 percent of the Stariski Creek-Frontal Cook Inlet watershed on the Kenai Peninsula.

RFFAs include projects that are anticipated to impact wetlands and other waters through dredging, the discharge of dredged material, the excavation or placement of fill, deposition of dust, as well as the fragmentation and dewatering of aquatic resources, including the Pebble Project expansion scenario. Cumulative impacts to wetlands and other waters associated with the proposed Alternatives and the Pebble Project expansion scenario would transect 13 watersheds. Based on NWI mapping, a total area of 4,841,687 acres of wetlands and other waters occurs in these watersheds. Assuming a maximum cumulative impact of 15,331 acres of wetlands and other waters (Alternative 1a), 0.3 percent of the combined wetland and other waters area of these watersheds would be lost or degraded with expansion of the mine. Although expansion of the mine would result in impacts to wetlands and other waters across multiple watersheds, the Headwaters Koktuli River and UTC watersheds would experience the greatest magnitude of impact. In these watersheds, loss of wetlands and other waters would increase from 6 percent to 23 percent under mine expansion.

3.5 Spill Risk

Scoping comments expressed concerns over spills of various potentially hazardous substances that would be used for the proposed project. The EIS addresses the potential consequences of large spills or releases of diesel fuel, natural gas, copper-gold ore concentrate, chemical reagents, bulk and pyritic tailings, and untreated contact water. Because the potential spill scenarios addressed herein are hypothetical, this section cannot provide the same level of quantitative impacts analysis as is provided in other sections of the EIS. Quantitative analysis (modeling) is provided for the release scenarios of tailings and untreated contact water.

How Full Dam Failure Scenarios Are Evaluated in the FEIS

Key Mitigation Measures to Prevent Failures:

- Bulk TSF design would not include a full water cover.
- Bulk TSF main embankment would be a flow-through design to promote drainage.
- Tailings would be thickened, not slurried.
- At closure, bulk TSF would be covered, allowed to dewater, and would become a stable landform.
- Pyritic TSF would be maintained with a full water cover during the 20 year mine life, and then returned to the open pit (eliminates need to store pyritic tailings long-term behind a dam).
- Dams are proposed to be constructed using downstream and centerline methods, not the upstream method.

FEIS Analysis:

- Section 4.27, Spill Risk, describes how USACE assessed probability of dam failures.
- Section 3.15 and Section 4.15, Geohazards and Seismic Conditions, assess earthquake potential.
- Failure models by the EPA and Nature Conservancy are reviewed in Appendix K4.27, Spill Risk.
- Recent dam failures in other countries (e.g., Brazil, Canada) are reviewed in Appendix K4.27, Spill Risk.
- USACE determined the probability of a full dam breach to be very low for the bulk TSF (i.e., would require a lengthy causal chain of unlikely events).

Note: Most historical full dam failures have occurred from TSFs with full water cover and upstream dam design – see Appendix K4.27.

3.5.1 Spill Impacts Analysis

For most of the spill scenarios analyzed, the potential impacts would be similar across all alternatives. Where there is significant variation across alternatives, individual Alternatives are addressed as relevant, such as the Diamond Point port, and the Alternative 3 transportation corridor, which eliminates the potential for spills from the ferry into Iliamna Lake.

Section 4.27, Spill Risk, of the EIS broadly addresses the fate and behavior of spilled materials across a wide range of spill circumstances, including varied spill volumes, location, duration, seasons, etc. Seven hypothetical spill scenarios were selected for further detailed analysis of potential impacts, including spill response. Selected scenarios generally have a low probability of occurrence, and relatively higher potential consequences. Impacts analysis in an EIS does not benefit from evaluation of spill scenarios that are so remotely improbable that the risk presented is negligible. Therefore, the Spill Risk section excludes impact analysis of some spill scenarios that have been determined to be highly unlikely.

Release scenarios for diesel and ore concentrate spills were selected based on historic data and statistical evaluation of their probabilities. Two scenarios for diesel spills and two scenarios for concentrate spills were selected for impacts analysis. Releases of natural gas from the pipeline would likely be temporary and of low consequence, and are addressed briefly. Large spills of chemical reagents would be highly unlikely and are addressed briefly.

To determine scenarios for tailings and untreated contact water releases to be analyzed in the EIS, the USACE conducted an EIS-Phase Failure Modes and Effects Analysis risk assessment. One release scenario was selected for impact analysis for each material: bulk tailings, pyritic tailings, and untreated contact water. Anticipated spill response has been included in each scenario, and would be expected to minimize potential impacts.

The impacts analysis area for some of the spill scenarios extends beyond that of the other potential impacts analyzed in the EIS. The hypothetical marine diesel spill analysis area includes lower Cook Inlet; and the hypothetical tailings release scenarios analysis areas extend about 230 river miles downstream of the mine site to the lower Nushagak River, where it feeds into Bristol Bay.

3.5.2 Diesel Spills

Diesel is one of the most widely transported hazardous substances. Small spills of diesel (e.g., less than 50 gallons) are very common, while very large spills (e.g., greater than 10,000 gallons) are rare.

Two hypothetical diesel spill scenarios were selected for impacts analysis: 1) a release of 3,000 gallons of diesel due to a tanker truck rollover along one of the proposed access roads; and 2) a 300,000 gallon spill of diesel destined for the mine site from a marine tug barge hauling diesel through lower Cook Inlet into Kamishak Bay.

Road Corridor Diesel Spill – Potential physical impacts from the truck rollover scenario include temporary to short-term contamination of air, soil, surface water, groundwater, and waterbody substrate in the vicinity of the spill. If spilled diesel reaches flowing water, impacts could extend downstream. Diesel readily evaporates and biodegrades in the environment, so these impacts would not be expected to last more than several weeks. Contaminated soils and groundwater could be excavated or remediated as needed. Air pollution would be temporary and localized.

Biological impacts would be temporary, and limited to the vicinity of the spill, and could include temporary acute impacts to wetland vegetation, including potential mortality; temporary toxicity to some wildlife; temporary and localized toxicity to birds, including potential mortality; and temporary acute toxicity to fish, including potential mortality.

Potential impacts to commercial and recreational fishing would be unlikely, and impacts to subsistence would be localized and temporary. There could be real or perceived risks of contamination to drinking water and subsistence resources. A release of diesel could cause stress to community members in close proximity from real or perceived risks of contamination, and potentially impact human health.

Marine Diesel Spill - Physical impacts from the marine diesel spill scenario could include contamination of seawater for potentially miles around the spill location. Diesel spilled into marine water would float on the surface, and naturally evaporate and disperse within 2 to 3 weeks with no recovery efforts. Spill response efforts could reduce the magnitude and duration of the spill. Air pollution would be temporary and localized.

Diesel could spread southward to the shores of Shuyak and Afognak islands (north of Kodiak Island) and/or Cape Douglas, depending on sea conditions, and could be washed on shore. Impacts to surface water, groundwater, and wetlands on shore would be unlikely, but could occur. Impacts to terrestrial wildlife would be minimal. Impacts to marine mammals could occur during the 2 to 3 weeks diesel would float on the surface; individuals or groups could potentially be injured or die.

The Diamond Point port area under Alternative 2 and Alternative 3 has additional biological resources that could be impacted by a spill, compared to Amakdedori port.

Impacts to birds (especially seabirds) and fish would vary depending on weather and sea conditions at the time of the spill, and could include acute toxicity and potential mortality. Impacts to birds and fish would be temporary to short-term, and could occur across impacted areas of lower Cook Inlet. Potential impacts from a marine diesel spill to TES could be of high magnitude, depending on the species and the fate of the spilled fuel.

Real or perceived impacts of a spill could briefly impact the socioeconomics of the area. There could be impacts to the limited commercial fisheries in the lower Cook Inlet area, depending on the timing of the spill. Short-term impacts to subsistence would be expected from this scenario, again dependent on timing of the spill and fate of the diesel. A diesel marine spill could cause psychosocial stress resulting from community anxiety. Health impacts could also include potential diesel or diesel fume exposure.

3.5.3 Natural Gas Release

Impacts from a potential release of natural gas from the proposed pipeline would be limited to short-term air quality degradation and limited release of greenhouse gases (GHG). Due to the remote nature of the pipeline, no health and safety impacts would be expected.

3.5.4 Copper-Gold Concentrate Spills

Ore concentrate (concentrate) is composed of finely ground rock and mineral particles that have been processed from raw ore to concentrate the economic metallic minerals. For Alternative 1a, Alternative 1, and Alternative 2, copper-gold concentrate processed at the mine site would be transported by truck and ferry to the port in specialized heavy-steel bulk shipping containers with locking lids. At the port, containers would be transferred from truck trailers onto lightering vessels and transported to waiting bulk carrier vessels, where the concentrate would be loaded deep into the ships' holds for transport to off-site smelters. For the Alternative 3 base case, concentrate would be transported exclusively by truck from the mine site to the port. The Alternative 3 Concentrate Pipeline Variant would include a concentrate pipeline to transport concentrate slurry from the mine site to Diamond Point port.

Two hypothetical scenarios were analyzed for impacts of a gold-copper concentrate release: 1) a spill of 80,000 pounds of concentrate due to a transport truck rollover; and 2) a spill of 54,000 pounds of concentrate slurry from the concentrate pipeline considered in the Alternative 3 Concentrate Pipeline Variant.

Potential impacts from both scenarios are summarized together here for: 1) impacts from a spill onto dry land or isolated waterbodies; and 2) impacts from a spill into flowing water. The concentrate slurry release scenario is distinct in that it has an aqueous phase that would include dissolved (bioavailable) metals. The extent of impacts would vary with the location of the spill, particularly if the spill reaches flowing water. Magnitude and duration of impacts would vary with the volume of the spill and the effectiveness of recovery efforts.

Impacts from a Spill of Concentrate on Land or in Isolated Waterbodies - Concentrate spilled on dry land or in isolated waterbodies would be recovered to the extent practicable. Reviews of past spills of concentrate at Red Dog Mine show that concentrate spills on land are generally fully recovered.

The PAG material and metals contained in the concentrate solids would require years to decades to generate acid or leach metals into the environment. If concentrate is recovered as described in the anticipated spill response, no contamination from metals or acid would impact soil or water resources. Residual amounts of concentrate left behind could generate acid or leach metals over years to decades; however, due to dilution, no measurable impacts would be expected.

Concentrate solids or concentrate slurry spilled on land that is able to dry out has the potential to become airborne fugitive dust in the form of particulate matter and particulate hazardous pollutants. Assuming the spill response as included in the scenario, any fugitive dust produced would likely not have measurable impacts on air quality.

Vegetation that is buried by spilled concentrate solids or slurry could experience temporary, localized impacts. Wildlife could experience limited localized impacts from burial of food sources, burial of small mammals by concentrate, or disruption from cleanup activities. For a spill during the summer, there is a low potential for bird species that nest on the ground to be impacted if a spill covers up their nest or young. If cleanup activities occur during the summer breeding season in close proximity to nests, some species may abandon their nests, which may result in breeding failure or loss of clutches.

If any of the spilled concentrate is released into an enclosed waterbody such as a pond or a lake, the concentrate solids would sink to the bottom and contribute to sedimentation. The fine particles would bury the natural substrate, and could smother benthic organisms or eliminate benthic habitat. Recovery efforts could remove spilled concentrate from pond or lake bottoms where practicable, although the impact to benthic habitat would likely occur prior to recovery efforts. Additionally, dredging to remove spilled concentrate could cause further disruption of the aquatic habitat. The aqueous phase of the concentrate slurry could have acute impacts on the aquatic environment from elevated metals.

Impacts from a Spill of Concentrate into Flowing Water - If concentrate solids or concentrate slurry is spilled into flowing water, the fine-grained spilled concentrate would be difficult to recover, and would be transported downstream, increasing the geographic extent of impacts. The concentrate solids would cause a temporary increase in TSS and sedimentation in downstream waters. Elevated TSS could extend down drainages that intersect the road corridor or the concentrate pipeline corridor, and extend to the shores of Iliamna Lake or Kamishak Bay before being diluted by the larger waterbodies.

Potential impacts to fish from increased TSS and sedimentation include temporary decreased success of incubating salmon eggs; reduced food sources for rearing juvenile salmon; modified habitat; and in extreme cases, mortality to eggs and rearing fish in the immediate area of the spill. This could impact a small fraction of the total salmonid eggs in a stream, and would not result in any measurable impacts on future salmon populations or the wildlife that depend on salmon. Likewise, the probability of impacts on commercial salmon harvest values would likely be extremely low. Impacts to TES or marine mammals from concentrate spills would not be expected.

The metals contained in the concentrate would require decades to leach into water. Any metals leached from concentrate spilled into a waterway would be produced very slowly over years to decades, and would be heavily diluted by stream water, so that no measurable impacts would occur. Generation of acid from PAG materials in the concentrate would not occur when concentrate is submerged under water. The dissolved metals in the aqueous phase of the concentrate slurry could have acute impacts on the aquatic environment that would likely be temporary and localized.

A concentrate spill into flowing water could temporarily displace recreational angling efforts in the vicinity of the spill if the event or cleanup occurred during the open water fishing season. A concentrate release would likely cause concerns over contamination for local subsistence users that could cause users to avoid the area and alter their harvest patterns. A release of concentrate could cause stress to community members in close proximity from real or perceived risks of contamination, therefore potentially impacting human health.

Concentrate spills could have localized, temporary effects on recreational resources. Spill recovery efforts could generate temporary, localized noise.

The potential for release of fugitive dust during concentrate transport is also addressed in Section 4.27, Spill Risk. The proposed project would implement extensive mitigation to reduce the potential for fugitive dust generation, including fully sealed and locking lids on transport trucks, and an automated system that opens the lids to the containers only once they are deep inside the holds of the waiting marine vessels.

3.5.5 Reagent Spills

Reagents are chemicals that promote or restrict certain chemical reactions in the process of separating metals from crushed ore. Section 4.27, Spill Risk, reviews the chemical reagents to be used, and their fate and behavior when released into the environment. Chemical reagents would be transported in 1 ton bags or specialized containers/tanks. The reagents would be contained in secondary containment at all times during transport and use. Any spill of chemical reagents would therefore likely be contained, and not released to the environment, so that full analysis of environmental impacts was determined to be unnecessary in the EIS.

3.5.6 Tailings Releases

Past tailings spills have caused adverse impacts to downstream environments, property damage, and some have resulted in human casualties. Long-term environmental contamination has occurred when spilled tailings are not recovered, and are able to leach metals and generate acid over time periods of decades. Most historic tailings dam failures have occurred from dams constructed by upstream methods, as opposed to the centerline and downstream constructed dams proposed by the Applicant.

The Applicant proposes to separate pyritic tailings (high level of PAG, requiring subaqueous storage) from bulk tailings (primarily non-PAG) in two separate TSFs. The pyritic tailings would be stored in a TSF with a full water cover during operational years. Pyritic tailings would be placed in the open pit during mine closure, eliminating the need for a perpetual water-covered TSF, and limiting the spill risk to operational years only.

The bulk tailings would not require a water cover, and would be stored in a TSF with a “flow-through” embankment and drainage provisions to promote unsaturated conditions in the tailings. The water reduction measures in the Applicant’s TSF design would serve to reduce the probability of a large tailings release compared to historic TSFs that have experienced failures. The bulk TSF would remain in place in perpetuity in “dry” closure, further reducing the long-term spill risk.

The bulk tailings release scenario selected for analysis involves an earthquake (greater than the Operating Basis Earthquake) that causes shearing of the two tailings delivery pipelines, and a total release of 1.56 million cubic feet of bulk tailings slurry into the NFK drainage over 6 hours. The pyritic tailings release scenario selected for analysis involves operational error(s) and lift construction difficulties that result in a partial breach of the tailings embankment. All of the ponded water and a portion of the tailings are released from the TSF, for a total release of 185 million cubic feet into the SFK over approximately 3 weeks.

The release scenarios were modeled with hydrologic and hydrodynamic models, which predict the downstream extent of impacts. Both tailings release scenarios result in downstream water quality impacts that extend down the Nushagak River, with the pyritic tailings release resulting in higher-magnitude impacts. Potential impacts of these releases are summarized together here.

PI Physical Impacts of Tailings Release Scenarios

Temporary overbank flooding would occur in the tributaries adjacent to the TSFs during both tailings release scenarios, as well as limited flooding directly downstream along the SFK during the pyritic tailings release scenario. A slight increase in downstream flow would last a few days from the bulk tailings release to a few weeks for the pyritic tailings release.

Tailings solids would be expected to be deposited on about 46 acres during the bulk tailings release; and 220 acres during the pyritic tailings release. Spilled tailings would be recovered to the extent practicable. Small amounts of tailings that may remain on land or in waterways would likely be naturally flushed downstream by precipitation, overland flow, and stream water over months to years. Some small amounts of tailings solids may settle in side channels, and some may be incorporated into the stream's natural sediment bedload.

Metals contained in the tailings solids would require years to decades for measurable metals leaching (ML) or generation of ARD in the environment. If spilled tailings are recovered as described in the spill response, no measurable ML or ARD would be expected. Small amounts of tailings that are not recovered could leach metals or generate acid very slowly over years to decades, but the metals and acid would be heavily diluted by rain, overland flow, and stream water; and would be unlikely to result in exceedance of water quality criteria (WQC).

Soils near the release site and in areas of overbank flooding could experience limited erosion and contamination with metals. Soils could be stabilized and excavated, as needed, and the habitats restored.

Most of the fine tailings particles would be transported downstream, causing elevated TSS in exceedance of WQC for approximately 230 miles downstream as far as the Nushagak River Estuary, where the river feeds into Nushagak Bay, part of greater Bristol Bay. Elevated TSS would initially last up to a week from the bulk tailings release, and several weeks from the pyritic tailings release.

Additional TSS would be generated due to ongoing erosion and sedimentation from potential stream destabilization during the release floods, particularly from the higher-volume pyritic tailings release. Additional ongoing elevated TSS could persist for months to years, depending on the speed and effectiveness of stream reclamation efforts that would control streambed erosion.

Tailings fluids (contact water used to mix the bulk tailings slurry, and pyritic supernatant fluid) would contain concentrations of some metals that exceed WQC. Tailings fluids from both releases would have elevated concentrations of the following metals relative to the applicable WQCs: antimony, arsenic, beryllium, cadmium, copper, lead, manganese, mercury, molybdenum, selenium, silver, and zinc, with the addition of cobalt for the pyritic tailings release.

Most of the dissolved metals would be transported downstream with the initial release floods. A small amount of metals may contaminate soils near the release location; impacted soils could be excavated as needed.

The metals would be diluted in downstream waters to various degrees, depending on stream flow (seasonal). Metals with the highest concentrations would continue to exceed WQC for tens of miles downstream.

For the bulk tailings release, based on mean annual discharge (MAD) levels of stream flow:

- Copper concentrations would exceed the most stringent WQC to the Koktuli River below the NFK and SFK confluence, about 23 miles downstream from the mine site.
- Molybdenum, zinc, lead, and manganese concentrations would exceed the most stringent WQC until the Mulchatna River below the Koktuli River confluence, about 62 miles downstream.
- Cadmium concentrations would exceed the most stringent WQC until the Mulchatna River below the Stuyahok River confluence, about 78 miles downstream from the mine site.

For the higher-volume pyritic tailings release, based on MAD levels of stream flow:

- Copper would remain at levels exceeding the most stringent WQC until the Mulchatna River below the Koktuli River confluence, about 80 miles downstream of the mine site.
- Zinc, lead, and manganese would remain at levels exceeding the most stringent WQC until the Nushagak River below the Mulchatna River confluence, about 122 miles downstream of the mine site.
- Cadmium and molybdenum would remain at levels exceeding the most stringent WQC as far downstream as the Nushagak River Estuary where it enters Nushagak Bay, part of the greater Bristol Bay, about 230 miles downstream from the mine site.

Elevated metals concentrations in downstream waters are expected to last no more than 1 week for the bulk tailings release, and several weeks for the pyritic tailings release. No measurable impacts to groundwater quality would be expected from these scenarios.

Noise could be generated from spill recovery operations, including increased vehicle and/or helicopter traffic, and use of heavy machinery and other cleanup equipment. Any potential fugitive dust produced from settled tailings would likely not have measurable impacts on air quality.

BI Biological Impacts of Tailings Release Scenarios

Wetland vegetation may be temporarily covered in limited areas where solid tailings particles are deposited, estimated to be no more than 46 acres beneath the bulk tailings release site, and about 220 acres beneath the pyritic tailings release site. Wetlands near the release sites may also be contaminated with elevated metals and residual toxins from the tailings fluids.

Small mammals and species that cannot easily avoid flood conditions could be washed downstream, or forced to seek higher ground during the initial tailings release floods. Erosion from flooding may alter bird and wildlife habitat in the immediate downstream areas for months to years, pending reclamation efforts. There could be moderate impacts to wildlife and birds from the elevated metals. Potential impacts to fish could impact birds and wildlife that rely on fish as a food source, particularly avian prey populations. Areas around the spill locations would continue to provide foraging habitat for wildlife species.

For both tailings release scenarios, fish and other aquatic organisms would be simultaneously impacted by the elevated TSS and metals concentrations in the water, leading to potential physical injury, loss of habitat and food, and potentially lethal metals toxicity. In the short-term, and immediately downstream of the spill, potentially lethal acute metal toxicity may occur in fish and other sensitive aquatic species. Over days to weeks in downstream locations, sub-lethal effects, such as impairment of olfaction, behavior, and chemo/mechanosensory responses, may also occur in these receptors, specifically due to copper.

Based on the site-specific toxicity results and the predicted exposure regime (only for several days), impacts on fish due to metals toxicity would be limited for the bulk tailings release, and likely overshadowed by impacts via physical injury, and loss of habitat and food. For the pyritic release, acute impacts (lethality) on fish due to metals toxicity would not occur within the predicted time frame and extent of WQCs exceedances. Sub-lethal impacts on fish are unknown, especially because these sub-lethal impacts, if any, would occur at the longer time frame beyond a week after the initial physical impacts (TSS) subside. However, chronic exposures to elevated metals above baseline are not predicted beyond several weeks.

Acute impacts from TSS and metals would last approximately 1 week after the bulk tailings release scenario, with further intermittent increases in TSS as remaining tailings are transported downstream, and damage from stream erosion is stabilized. Impacts from elevated metals could last for 5 to 6 weeks after the pyritic release scenario, while TSS impacts could last for months to years, depending on the effectiveness of stream restoration efforts.

Impacts to fish from either tailings release scenario would only be anticipated in the immediate vicinity of a spill.

SI Social Impacts of Tailings Release Scenarios

Clean-up efforts following either spill release could potentially increase local employment opportunities for less than 1 year. Real or perceived impacts of the spill could cause a longer-term decline on employment, income, and sales if commercial and recreational fishing and/or tourism were to suffer. Potential adverse impacts from the spill event could disproportionately impact minority and low-income communities.

Commercial fishing could be impacted, depending on impacts to fish in the affected drainages. Recreational anglers fishing these waters could experience a temporary reduction in harvest rates or catch per unit effort rates if the sub-lethal effects reduced target species' ability or desire to feed/strike at anglers' lures.

Tailings spills could cause psychosocial stress resulting from community anxiety over a tailings release, particularly in areas of valued subsistence and fishing activities. There could be exposures to potentially hazardous materials, including metals, particularly in the pyritic tailings release, and communications and precautions about both acute and chronic exposures would help allay public concerns. Subsistence users may choose to avoid the area and alter their harvest patterns, due to potential perceptions of subsistence food contamination that extend throughout the area.

3.5.7 Untreated Contact Water Release

Contact water is defined as surface water or groundwater that has contacted mining infrastructure. Contact water stored in the main WMP would be elevated in several metals that would exceed WQC.

The selected scenario analyzed for impacts involves liner damage from ice hitting the geomembrane liner during spring break-up, resulting in a slow release of 5.3 million cubic feet of untreated contact water from the main WMP into the NFK over a period of 1 month. This release volume is less than 4 percent of the average volume of contact water stored in the main WMP.

Due to the slow release of the untreated contact water, no flood wave would be produced; therefore, there would be no health and safety impacts due to flooding.

Untreated contact water released into the downstream drainages would contain elevated levels of aluminum, arsenic, beryllium, cadmium, copper, lead, manganese, mercury, molybdenum, nickel, selenium (a metalloid), silver, and zinc in exceedance of the most stringent WQC. The released untreated contact water would be diluted by stream water as it flows downstream, yet some metals concentrations could remain elevated above WQC for up to 45 miles downstream of the mine site, just before the confluence with the Swan River. WQC exceedance would last for the entire month of the release.

PI Physical Impacts of Untreated Contact Water Release Scenario

Soil directly beneath the point of release could experience limited erosion and contamination by metals. Soils could be stabilized and excavated, as needed, and the habitats restored.

Surface water downstream from the release would be elevated in several metals above WQC, particularly cadmium, lead, manganese, molybdenum, and zinc. Depending on stream flow conditions, metals concentrations in exceedance of WQC could persist in stream water in the Tributary NFK 1.120, NFK, and the mainstem Koktuli just upstream from the confluence of the Swan River as follows (downstream distances are estimated):

- Molybdenum for about 15 to 45 miles downstream
- Cadmium for a shorter downstream distance than molybdenum; cadmium would require 60 percent of the dilution required by molybdenum
- Lead, manganese, and zinc would require less than one-quarter of the dilution compared to molybdenum; therefore, concentration of these metals would exceed their WQC for a shorter downstream extent compared to molybdenum
- Copper would require about 10 percent of the dilution required by molybdenum, and would be diluted to below its WQC within several miles of the release site

These metals would remain at elevated levels above WQC for a month or more during and after the release. Groundwater quality would not be likely to be impacted by this scenario.

BI Biological Impacts of Untreated Contact Water Release Scenario

Wetland vegetation in a limited area near the release site could experience temporary reduction of growth or mortality. There could be moderate-magnitude impacts to wildlife and bird species from increased levels of metals in the impacted drainages as far downstream as the confluence of the mainstem Koktuli River with the Swan River. Potential impacts to fish could impact birds and wildlife that rely on fish as a food source, particularly avian prey populations. The duration could be from months to years depending on impacts to fish populations. No population-level impacts to wildlife species are expected.

Potential impacts to fish from the release of untreated contact water would be similar to those described above for elevated metals impacts from the pyritic release scenario. Acute toxicity due to metals would not occur; however, prolonged exposure to metals concentrations in slight exceedance of WQC may result in sub-lethal effects. Wildlife and birds that depend on fish and aquatic invertebrates as prey could experience moderate-intensity impacts, depending on the level of metals toxicity in fish and aquatic invertebrates. The scenario may have low-intensity indirect effects on the marine mammals of Bristol Bay, based on the sub-lethal metals' toxicity impacts of their fish prey from the impacted watersheds.

SI Social Impacts of Untreated Contact Water Release Scenario

Real or perceived impacts of the spill could cause a longer-term decline on employment, income, and sales if commercial and recreational fishing and/or tourism were to suffer. Potential adverse impacts from the release of untreated contact water could disproportionately impact minority and low-income communities. Commercial fishing could be impacted, depending on impacts to fish in the affected drainages. Recreational anglers fishing these waters could experience a temporary reduction in harvest rates or catch per unit effort rates if the sub-lethal effects reduced target species' ability or desire to feed/strike at anglers' lures. Subsistence users may choose to avoid the area and alter their harvest patterns. Spills of untreated contact water could cause psychosocial stress, particularly in areas of valued subsistence and fishing activities.

3.5.8 Spills from Iliamna Lake Ferry

Scoping comments included concerns regarding spills from the proposed Iliamna Lake ferry. Available incident data for ferries and similar vessels, including the best available analog for the ferry, Canada's Williston Transporter, were reviewed to determine historic levels of incidents and probability of occurrence. The probability of a large spill from the proposed lake ferry was judged to be significantly less than the historic spill probability for marine barges, which is already very low.

The proposed ferry would be custom-built specifically for Iliamna Lake conditions, and for hauling project-specific materials. Materials would be transported in secondary containment located away from the shell of the vessel, so that the containers would likely not be impacted in the event of a collision. The 1 inch-thick heavy-steel shell required for ice breaking would result in very low potential for damage to the ferry from grounding or a collision.

Although subject to potentially extreme weather conditions, the operational environment in the lake is expected to be generally less harsh than the marine environment affecting marine barges. Ferry operations would be suspended as needed during extreme weather.

Based on the historic data, as well as these design and operational features, spills of diesel, concentrate, and reagents from the proposed ferry were determined to be so improbable as to have negligible risk, and were therefore eliminated as scenarios for impacts analysis in the EIS.

3.5.9 Expected Effects of Alternatives

NA

No Action Alternative

The No Action Alternative would result in federal agencies with decision-making authorities on the project not issuing permits under their respective authorities. The Applicant's Preferred Alternative would not be undertaken; and no construction, operations, or closure activities specific to the Alternative would occur. Therefore, no future spills related to construction and operation of the mine would be expected. However, PLP would retain the ability to apply for and continue mineral exploration activities under the State's authorization process, as well as any activity that would not require federal authorization. In addition, there are many valid mining claims in the area, and these lands would remain open to mineral entry and exploration by other entities. The potential for spills from these activities would remain the same as current conditions.

AV

Alternatives and Variants

The probabilities and consequences of hypothetical spills are similar across alternatives. Notable differences among the Alternatives include the following:

- Alternative 2 would include construction of the bulk TSF main embankment by the downstream method, rather than the centerline method proposed for the other alternatives. Centerline versus downstream dam designs may have different spill risk, although built to same Factor of Safety.
- Alternative 3 would not include the Iliamna Lake ferry, thereby eliminating the potential for spills from the ferry into Iliamna Lake.
- Alternative 3 Concrete Pipeline Variant would include a concentrate pipeline to transport concentrate as slurry from the mine site to Diamond Point port, rather than transport by truck and ferry, as proposed for the other alternatives.
- The transport of natural gas by overland pipeline from the port under Alternative 2 and Alternative 3 eliminates the potential for gas releases into Iliamna Lake.
- Variation in rocky shoals and sea conditions between the two port locations could alter the probability of a marine tug-barge allision.
- Differences in road length and grade across the various road corridors could slightly affect the probability of a truck-related spill.

3.6 Climate Change

Climate change has the potential to result in environmental impacts relevant to the proposed project and its Alternatives in three primary ways:

- Effects of the project on climate change as indicated by GHG emissions. Project-caused GHG emissions are discussed and analyzed in Section 4.20, Air Quality.
- Effects of climate change on the project area, which examines the impacts of climate change on a proposed action that could affect sensitive populations or environmental resources. Climate change as a cumulative effect is considered under this category. Climate change trends are integrated into resource discussions in Chapter 3, Affected Environment, while climate change as a cumulative effect is discussed in the cumulative effects subsection of Chapter 4, Environmental Consequences.
- Effects of climate change on proposed project infrastructure, addressing the effects on the proposed project infrastructure from climate change, and accounting for potential climate change effects on a proposed action over the course of its anticipated useful life, especially in areas that may be vulnerable to specific effects of climate change. Climate change effects on proposed project infrastructure are addressed in Chapter 4, Environmental Consequences.

The EIS Chapter 3, Affected Environment, discussion on trends includes:

- Section 3.1, Introduction to Affected Environment, provides a framework for discussion of climate change in the EIS, and the location in the EIS of climate change information.
- Section 3.9, Subsistence, discusses climate change in the context of traditional resource use change.
- Section 3.16, Surface Water Hydrology, discusses how water balance modeling incorporates cyclical and predicted climate data to account for changes in climate.
- Section 3.17, Groundwater Hydrology, discusses how climate variability incorporated into water balance modeling informs the groundwater model.
- Section 3.18, Water and Sediment Quality, discusses climate trends and oscillations for temperature specifically.
- Section 3.20, Air Quality, provides detailed information about air quality and climate change in the context of estimated predicted future temperature and precipitation values.
- Section 3.22, Wetlands and Other Waters/ Special Aquatic Sites, includes discussion of the potential impacts on wetlands and other waters in a changing climate. Section 3.26, Vegetation, provides similar discussion on trends, such as changes in phenology that may affect vegetation.
- Section 3.23, Wildlife Values, includes detailed analysis of potential impacts of climate change on terrestrial wildlife, birds, and marine mammals, including TES.
- Section 3.24, Fish Values, discusses climate change in the context of hydrological changes and potential large-scale shifts in populations.
- Section 3.25, Threatened and Endangered Species, also includes discussion of climate change trends for Steller's eider.

The EIS Chapter 4, Environmental Consequences, discussion on contributions of the project to GHG emissions, or impacts of climate change on the proposed project, is primarily discussed in the physical science sections. Discussion includes:

- Section 4.15, Geohazards and Seismic Conditions, describes the potential for increased landslide and related effects due to precipitation trends.
- Section 4.16, Surface Water Hydrology, provides analysis of water balance models specific to the project components and operations that incorporate climate variability.
- Section 4.17, Groundwater Hydrology, also discusses climate variability in the context of analyzing water flow and balance in project components such as the pit lake.
- Section 4.20, Air Quality, includes a detailed analysis of project-related GHG emissions.

4.0 IMPACT AVOIDANCE, MINIMIZATION, AND MITIGATION

The EIS serves in part to inform the public and review agencies of design features, BMPs, and avoidance and minimization measures that are included in the project. PLP's proposed mitigation measures are described in Chapter 5, Mitigation. These measures would be non-discretionary because they are included in the project design. USACE views these elements as part of the project, and considers PLP's proposed mitigation measures as inherent to the proposed project, as well as applicable components of the other action alternatives. To the extent possible, these measures, including any potential impacts associated with these measures, were considered when assessing the impacts of the project on the resources.

Changes to the Applicant's proposed project subsequent to the initial Pebble Project Department of the Army Application for Permit POA-2017 271, have led to the identification of the Applicant's Preferred Alternative in the FEIS, and have further reduced project impacts. These changes, summarized in Chapter 5, Mitigation, Table 5 3, were introduced as a result of agency and/or public comments received during the scoping and DEIS comment periods, as a result of the analyses presented in the DEIS, or as a result of ongoing optimizations of the project by the Applicant to further reduce environmental impacts and improve project safety.

Additional mitigative measures identified or recommended during the NEPA process have been compiled (see Appendix M1.0, Mitigation Assessment), and will be considered by the USACE and other agencies as part of their permit decisions to further minimize project impacts. These measures have been assessed with the goal of disclosing the likelihood that the measures would be adopted by the Applicant, or implemented as a condition in a state, federal, or local permit by the responsible agencies as part of their permit decisions following completion of the NEPA process. Specific mitigation conditions would be determined following completion of the environmental review, and would be included in the ROD for any permit that may be issued.

PLP's description of measures to avoid and minimize impacts to wetlands and other WOUS, air quality, wildlife and aquatic habitat, areas of cultural significance, and areas of known subsistence use is included in Tab 23 of the Pebble Project Department of the Army Application for Permit POA-2017 271 (PLP 2020f). Many of these measures are also captured in Chapter 5, Mitigation, Table 5 2 and Table 5 3.

Regulatory standards and criteria for mitigating impacts to aquatic resources that result from work authorized by permit under the USACE Regulatory Program were established on April 10, 2008 by the USACE and the EPA in a rule, entitled "Compensatory Mitigation for Losses of Aquatic Resources; Final Rule" (33 CFR Part 332 [USACE] and 40 CFR Part 230 [EPA]). The rule emphasizes the sequence to be followed for mitigating impacts to aquatic resources. All practicable steps to avoid and/or minimize impacts to aquatic resources must be taken before proposing compensatory mitigation to offset project impacts. Once all efforts to avoid and minimize impacts have occurred, remaining impacts may be offset by compensatory mitigation. Compensatory mitigation is the restoration (reestablishment or rehabilitation), establishment (creation), enhancement, and/or in certain circumstances preservation of aquatic resources to offset unavoidable adverse impacts.

PLP has prepared a draft Compensatory Mitigation Plan (CMP) (PLP 2020 RFI 056a) outlining their proposed approach for compensatory mitigation to offset environmental losses resulting from unavoidable impacts to aquatic resources (see Appendix M2.0, Applicant's Draft Compensatory Mitigation Plan). PLP is proposing compensatory mitigation for the project's unavoidable permanent impacts to WOUS and aquatic resource functions in the watersheds. However, PLP is not proposing compensatory mitigation for the project's temporary impacts, because those WOUS and functions would be expected to recover in the short-term after restoration. PLP's Restoration Plan for Temporary Impacts (PLP 2019 RFI 123) describes the process and measures PLP proposes to implement to restore the temporarily impacted areas on land.

PLP's CMP includes three proposals for Permittee Responsible Mitigation:

- Water quality improvements achieved through improvements and repairs to the public sewage management systems in the communities of Nondalton, Newhalen, and Kokhanok
- Pacific salmon habitat restoration achieved through the removal of barriers to passage resulting from damaged or underperforming road culverts
- Habitat restoration, wildlife protection, and water quality improvement achieved through the removal of marine debris from beaches in Kamishak Bay

The need for compensatory mitigation and the determination if the Applicant's proposal adequately offsets aquatic resource losses would be determined as part of the ROD.

PLP's monitoring summary report (PLP 2019 RFI 135) provides a conceptual-level overview of the management and monitoring plans (MMPs) expected for the project, and focuses on the monitoring aspects of 11 selected MMPs. Draft or conceptual-level plans have been developed for several of these MMPs in response to RFIs, and provide information on preliminary monitoring activities. Specific monitoring locations are included in the monitoring summary report. Additionally, PLP has committed to implement adaptive management strategies for all MMPs, except where certain actions are explicitly required by a permit or regulation.

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