Volume 2:
Chapter 3

US Army Corps
of Engineers

Pebble Project EIS

Draft Environmental Impact Statement

February 2019

www.PebbleProjectEIS.com

PEBBLE PROJECT

DRAFT ENVIRONMENTAL IMPACT STATEMENT

VOLUME 2: CHAPTER 3

FEBRUARY 2019

US Army Corps of Engineers
Alaska District
PO Box 6898
JBER, Alaska 99506-0898
www.PebbleProjectEIS.com

3.0 AFFECTED ENVIRONMENT

3.1 INTRODUCTION TO AFFECTED ENVIRONMENT

Chapter 3, Affected Environment, describes the existing environment that would be affected by the proposed project and alternatives under consideration in this Environmental Impact Statement (EIS). This chapter is intended to help readers and agency decision-makers find the information they need to evaluate the affected environment, and to understand the impacts and consequences discussed in Chapter 4, Environmental Consequences. Each Chapter 3 section (Section 3.2 through Section 3.26) has a corresponding section in Chapter 4 (Section 4.2 through Section 4.26).

Each resource section in Chapter 3 (Section 3.2 through Section 3.26)[1] discusses:

- The area of analysis (see "Scope of Analysis" subheading below).
- The overall existing condition of the resource, including the natural and physical environment.
- The types of potential impacts typically associated with the proposed project and the alternatives for that resource.

The project is discussed in Chapter 3 and Chapter 4 by its four major components. See Chapter 2, Alternatives, for detailed descriptions of differences between alternatives. Note that the three action alternatives in Chapter 3 and Chapter 4 are referred to as "Alternative 1," "Alternative 2," and "Alternative 3" without including the word "action" in front of the alternative name as is done in Chapter 2. Project components include:

- **Mine Site:** Includes the footprint at the mine site (minus milepost 24-29 of the mine access road, which is included in the transportation corridor). The footprint is the same for Alternative 1 and Alternative 3, and is slightly larger for Alternative 2.
- **Transportation Corridor:** Includes the footprint of access roads (including milepost 24-29, which overlaps with the mine site footprint), spur roads, ferry terminals, ferry route, and all associated infrastructure. The transportation corridor footprint varies between the three action alternatives.
- **Port:** Includes the footprint of the port, dock, all associated infrastructure, navigation aids, and lightering locations. There are two port locations. Alternative 1 includes the Amakdedori port site. Alternative 2 and Alternative 3 include the Diamond Point port site.
- **Natural Gas Pipeline Corridor:** Includes the pipeline route and all associated infrastructure from the Kenai Peninsula across Cook Inlet to the mine site. The natural gas pipeline corridor footprint varies between the three action alternatives.

3.1.1 Other Resources

The National Environmental Policy Act (NEPA) provides the lead agency with discretion to determine, based upon the scoping process, which categories of resources merit detailed

[1] Note that in Chapter 3 and Chapter 4, waters of the US (abbreviated as WOUS) as defined under the Clean Water Act and determined to be jurisdictional under USACE authority (see Appendix J for the Preliminary Jurisdictional Determination from USACE) are discussed collectively with wetlands and other waters; all WOUS, wetlands, or other waters are together termed "wetlands and other waters." The term WOUS may appear in Chapter 3 and Chapter 4 under specific regulatory context.

analysis, and which categories do not. This determination and impacts to resources that did not warrant detailed analysis are briefly addressed in Section 4.1, Introduction to Environmental Consequences. In addition, although a resource category may not have warranted detailed discussion in a separate section of the EIS, the EIS may still discuss impacts to or aspects of the resource in connection with other resources. This is particularly the case where the resource has relevance to US Army Corps of Engineers (USACE) public interest review under Section 404 of the Clean Water Act (CWA). Table 3.1-1 identifies these resource categories and where environmental consequences for them are addressed elsewhere in this EIS. Note that affected environment for resources not specifically discussed in Section 3.2 through Section 3.26 is discussed along with environmental consequences in Section 4.1, Introduction to Environmental Consequences.

Chapter 4 also includes Section 4.27, Spill Risk. There is no corresponding section in Chapter 3 as spill risk would be considered an environmental consequence to the resources discussed in Section 3.2 through Section 3.26. Although many environmental protections and precautions would be built into the mine design and operations, including mitigation measures and spill and emergency response plans, concern was expressed about spills during scoping. Detailed analysis on fate and behavior, historical data, existing response capacity, mitigation, and scenarios on diesel spills, natural gas releases from the natural gas pipeline, copper-gold ore concentrate spills, chemical reagent spills, bulk and pyritic tailings release, and untreated contact water release, are analyzed in Section 4.27, Spill Risk.

Table 3.1-1: Chapter 3 and Chapter 4 Section Location of Resource Discussion

USACE Public Interest Review Factor	Chapter 3 and Chapter 4 Discussion Location
Conservation	Both affected environment and environmental consequences are discussed in Section 4.1, Introduction to Environmental Consequences
Economics	Section 3.3 and Section 4.3, Needs and Welfare of the People—Socioeconomics
Aesthetics	Section 3.11 and Section 4.11, Aesthetics
General Environmental Concerns	Both affected environment and environmental consequences are discussed in Section 4.1, Introduction to Environmental Consequences
Wetlands	Section 3.22 and Section 4.22, Wetlands and Other Waters
Historic Properties	Section 3.8 and Section 4.8, Historic Properties
Fish	Section 3.24 and Section 4.24, Fish Values
Wildlife Values	Section 3.23 and Section 4.23, Wildlife Values
Soils	Section 3.14 and Section 4.14, Soils
Flood hazards	Subsection in Section 3.16 and Section 4.16, Surface Water Hydrology
Floodplain values	Subsection in Section 3.16 and Section 4.16, Surface Water Hydrology
Land use inclusive of subsistence subset	Section 3.2 and Section 4.2, Land Ownership, Management, and Use, and Sections 3.9 and 4.9, Subsistence
Navigation	Section 3.12 and Section 4.12, Transportation and Navigation
Shore erosion and accretion	Subsection in Section 3.16 and Section 4.16, Surface Water Hydrology

Table 3.1-1: Chapter 3 and Chapter 4 Section Location of Resource Discussion

USACE Public Interest Review Factor	Chapter 3 and Chapter 4 Discussion Location
Recreation	Section 3.5 and Section 4.5, Recreation
Water supply and conservation	Subsection in Section 3.17 and Section 4.17, Groundwater Hydrology
Water quality	Section 3.18 and Section 4.18, Water and Sediment Quality
Energy needs	Both affected environment and environmental consequences are discussed in Section 4.1, Introduction to Environmental Consequences
Safety	Section 3.10 and Section 4.10, Health and Safety
Food and fiber production	Section 3.21 and Section 4.21, Food and Fiber Production
Mineral needs	Both affected environment and environmental consequences are discussed in Section 4.1, Introduction to Environmental Consequences
Considerations of property ownership	Section 3.2 and Section 4.2, Land Ownership, Management, and Use
Needs and welfare of the people	Section 3.3, Needs and Welfare of the People—Socioeconomics
Noise	Section 3.19 and Section 4.19, Noise

Note:
This table does not list every resource discussed in Chapter 3 and Chapter 4. Additional sections include: Sections 3.4 and 4.4, Environmental Justice; Sections 3.6 and 4.6, Commercial and Recreational Fisheries; Sections 3.7 and 4.7, Cultural Resources; Sections 3.8 and 4.8, Historic Properties; Sections 3.13 and 4.13, Geology; Sections 3.14 and 4.14, Soils; Sections 3.15 and 4.15, Geohazards; Sections 3.20 and 4.20, Air Quality; Sections 3.25 and 4.25, Threatened and Endangered Species; and Sections 3.26 and 4.26, Vegetation.
Source: USACE 2017

3.1.2 Scope of Analysis

3.1.2.1 EIS Analysis Area

The EIS analysis area refers to the entire area of resource analysis, which is specific to each resource discussed in Section 3.2 through Section 3.26. While the EIS analysis area can be delineated based on the physical footprint of the action alternatives, potential resource impacts are considered in a spatial context appropriate to each resource. The EIS analysis area is defined in each Chapter 3 and Chapter 4 section.

The resource-specific EIS analysis area is provided to assist the USACE in evaluating reasonably foreseeable significant adverse effects on the human environment per Council on Environmental Quality (CEQ) guidance. 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 (USACE 2017, Memorandum for Record, Subject: Determination to conduct an environmental impact statement level of analysis for Department of the Army Permit Application POA-2017-271, lead agency determination, and scope of analysis).

In addition, for certain resources, Chapter 3 summarizes supplemental affected environment information downstream of EIS analysis areas to allow impact assessment of spill scenarios in Section 4.27, Spills.

The project area refers to the exact project footprint for each action alternative.

3.1.2.2 Project Location and Watersheds

This section provides a general overview of the proposed project location and the US Geological Survey (USGS) watersheds in the Bristol Bay drainage and the Cook Inlet drainage. Detailed information on the project physical setting is provided in various Chapter 3 resource sections. Hydrology is discussed in Section 3.16, Surface Water Hydrology and Section 3.24, Fish Values. Detailed information on climate and meteorology is provided in Section 3.20, Air Quality. Detailed information on land cover is discussed in Section 3.22, Wetlands and Section 3.26, Vegetation.

The proposed mine site is approximately 200 miles southwest of Anchorage. The communities of Iliamna, Newhalen, and Nondalton are each approximately 17 miles from the proposed mine site. The proposed project is located within two major watersheds, the Bristol Bay watershed and the Cook Inlet watershed.

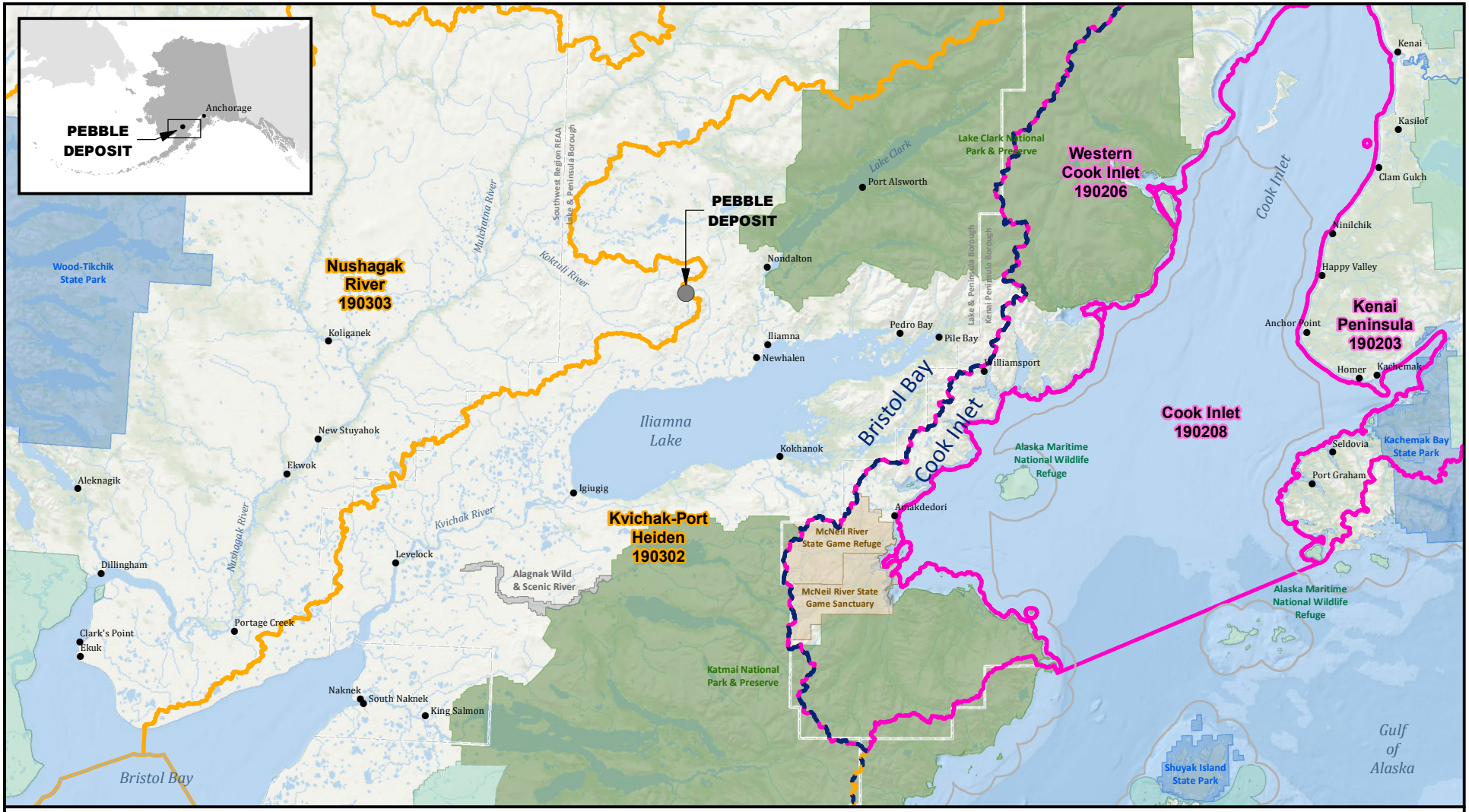
A watershed is defined as the area of land drained by a river and its tributaries. The US is divided and sub-divided by watershed into successively smaller hydrologic unit codes (HUCs) that are arranged or nested within each other. Each hydrologic unit is identified by a unique HUC consisting of two to eight digits based on the four levels of classification in the hydrologic unit system (USGS 1999). The proposed project is located in southwest Alaska in Alaska Region watershed HUC 19 (first level classification, or HUC 2) in HUC 1903 (Southwest Alaska) and HUC 1902 (Southcentral Alaska) (second level classification, or HUC 4) (USGS 2018e). The Southwest and Southcentral Alaska HUC 4 level watersheds are further broken down into HUC 6 level watersheds (third level classifications)

The Bristol Bay watershed and the Cook Inlet watershed are discussed and referred to in Chapter 3. The area of analysis is defined in each resource section in Section 3.2 to Section 3.26 as the EIS analysis area (see definition above). The EIS analysis area may vary from USGS mapping of HUC 6 level watersheds. Figure 3.1-1 depicts the HUC level 6 watersheds that occur in either the Bristol Bay watershed or the Cook Inlet watershed that the proposed project would occur in, for reference.

The Bristol Bay watershed (including the Kvichak and Nushagak rivers) occurs in a portion of HUC 1903. The Bristol Bay watershed includes the proposed mine site and the western portions of the transportation corridor and natural gas pipeline up to where these components cross into HUC 1902. The mine site would be located primarily in HUC 190303 (Nushagak River) (third level classification, or HUC 6). A small portion of the mine site, and the HUC 1903 portions of the transportation corridor and natural gas pipeline components (including overland, buried, ferry routes, or subsea routes), would be located in HUC 190203 (Kvichak-Port Heiden) (third level classification, or HUC 6) (USGS 2018e).

The Cook Inlet watershed (including the Cook Inlet) occurs in a portion of HUC 1902. The Cook Inlet watershed includes the proposed port location (for Alternative 1, Amakdedori port site; for Alternative 2 and Alternative 3, Diamond Point port site) and the eastern portions of the transportation corridor and natural gas pipeline corridor that would occur in HUC 1902. The port sites (both Amakdedori port site and Diamond Point port site) would occur in HUC 190206 (Western Cook Inlet) (third level classification, or HUC 6). The transportation corridor and natural gas pipeline corridor components (including overland routes, undersea routes, and navigation aids) would occur in HUC 190208 (Cook Inlet) (third level classification, or HUC 6). A portion of the natural gas pipeline component would occur on the Kenai Peninsula at the start of the natural gas pipeline in HUC 190203 (Kenai Peninsula) (third level classification, or HUC 6).

Figure 3.1-1 depicts the Bristol Bay watershed and the Cook Inlet watershed, delineated by HUC 6 watersheds (USGS 2018e).



Sources: PLP 2018d; ADNR; USGS 2018e

US Army Corps of Engineers

10 0 10 20

Miles

- Cook Inlet Watershed
- Bristol Bay Watershed
- Bristol Bay and Cook Inlet Drainage Basin
- Pebble Deposit
- Borough Boundary
- Three Nautical Mile Line
- National Park
- National Wildlife Refuge
- Alaska State Park
- Wild and Scenic River
- State Game Refuge/Sanctuary

BRISTOL BAY AND COOK INLET WATERSHEDS

PEBBLE PROJECT EIS

FIGURE 3.1-1

3.1.3 Resource Interrelationships

Although resources are discussed in Chapter 3, and the impacts on those resources analyzed in Chapter 4 in discrete sections, these resources are dynamic and interrelated. A change in one resource can have cascading or synergistic impacts to other resources.

The site of the proposed project and the nature of open-pit mining activity 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 above-mentioned water-related resources and fish and aquatic resources. Impacts to water, fish, and wildlife resources would in turn have impacts on subsistence resources; for example, water quality may affect fish populations, which in turn may influence subsistence 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 in both Chapter 3 and Chapter 4.

3.1.4 Traditional Ecological Knowledge

In recent decades, Alaska Natives have been promoting their complex bodies of knowledge and understanding to be recognized by state and federal agencies regarding climate change, flooding and erosion, surface/groundwater hydrology, landscapes, fish and wildlife life histories and migratory patterns, and seasonal distributions/use of subsistence resources. This traditional ecological knowledge (TEK) is just as important as modern means of transportation and hunting technology in supporting safe and efficient subsistence harvest activities.

The USACE has taken the following approach to incorporating TEK into this EIS:

- Reviewing scoping comments to determine what relevant TEK was provided.
- Reviewing pertinent sections of the Environmental Protection Agency (EPA) Watershed Assessment (An Assessment of Potential Mining Impacts on Salmon Ecosystems of Bristol Bay, Alaska, EPA 2014).
- Reviewing pertinent sections of the Pebble Environmental Baseline Document (EBD) Chapter 23, Subsistence (SRB&A 2011b) to identify any relevant material that can be considered TEK and attributed to an individual or organization.
- Reviewing meeting notes from all government-to-government meetings for relevant TEK, as appropriate.

Specific topics that the USACE considered for inclusion as TEK include:

- Information on surface/groundwater hydrology and water quality in the project area. This would include areas of high water table, variations in stream flow and underlying causes, timing of breakup and freeze-up, and areas where water quality might be affected by natural and human-made causes.
- Information on location, frequency, and trends with regard to natural hazards such as flooding, erosion, river and lake ice, avalanches, and rockslides.
- Observations of trends, patterns, or changes in weather and climate, including storms, rainfall, and snowpack.
- Information on fish, wildlife, birds, and marine mammals in the EIS analysis area, including distribution and seasonal presence, population trends, migration patterns, habitat areas, behavior, and changes over time.

- Information on the vegetation in the EIS analysis area, including species used for subsistence, areas of occurrence, and changes over time.
- Important areas, access routes, and seasons of subsistence activity, use and sharing of subsistence resources, and changes over time.
- Culturally important areas in the project area from a historic and contemporary perspective.
- Areas being used by guides and commercial operators for sport fishing, hunting, and wildlife viewing that could be directly or indirectly impacted by the project, and changes to those areas over time.
- Information important to navigation in the project area.
- Information on where residents are collecting surface water for residential use.

TEK has been incorporated into relevant resource sections. TEK information collected is found in Appendix K3.1.

3.1.5 Climate Change

Climate change has the potential to result in environmental impacts relevant to the proposed project and its alternatives in three primary ways (AECOM 2018p). These include:

1. Effects of the project on climate change. This category addresses the effect of the proposed action on climate change as indicated by greenhouse gas (GHG) emissions, per the CEQ 2014 Revised Draft Guidance on Consideration of Greenhouse Gas Emissions and Climate Change in NEPA Reviews (CEQ 2014), per rescission of the 2016 Final Guidance on Greenhouse Gases and Climate Change.
2. Effects of climate change on the project area. This category addresses the implications of climate change for the environmental effects of the proposed action; or in other words, examines the impacts of climate change on a proposed action that could affect sensitive populations or environmental resources (CEQ 2014). Climate change as a cumulative effect is considered under this category, per CEQ 1997 Considering Cumulative Effects under the NEPA (CEQ 1997) and CEQ 2014.
3. Effects of climate change on proposed project infrastructure. This category addresses the effects on the proposed project infrastructure from climate change, and considers 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, per CEQ 2014.

This EIS addresses these three ways in the following locations:

1. Project-caused GHG emissions are discussed and analyzed in Section 4.20, Air Quality.
2. Climate change trends are integrated into discussion if appropriate to the resource in Section 3.2 through Section 3.26 (Affected Environment). Climate change as a cumulative effect is discussed in a subsection if appropriate to the resource in Section 4.2 through Section 4.27 (Environmental Consequences).
3. Climate change effects on proposed project infrastructure are addressed if appropriate to the resource in Section 4.2 through Section 4.27 (Environmental Consequences).

3.1.6 Incomplete and Unavailable Information

The process of data gap analysis for the EIS is detailed in a technical memorandum (AECOM 2018q, Pebble Project – Final Data Gap Analysis). A summary is provided in this section, data gap screening information can be found in Table 3.1-2.

For each data gap, the process of the CEQ guidance questions in determining if data is required for analysis is described in the memo. The CEQ regulations in 40 Code of Federal Regulations (CFR) Part 1502.22 provide direction on how to address incomplete information, which are referred to as "data gaps" in this memo. These specific regulations need to be viewed in concert with other CEQ NEPA regulations including, for example 40 CFR Part 1502.24, which covers methodology and scientific accuracy.

The CEQ regulations make it clear that when there is incomplete or unavailable information for the evaluation of reasonable foreseeable significant adverse effects, the federal agencies "shall always make clear that such information is lacking."

The CEQ regulations at 40 CFR Part 1502.22(a) instruct that if incomplete information 1. is relevant to reasonably foreseeable significant adverse impacts; 2. is essential to a reasoned choice among alternatives; and 3. the overall costs of obtaining it are not exorbitant, the agency shall include the information in the EIS. This documentation complies with 40 CFR Part 1502.22(b)(1-4) requirements that the agency shall develop statements for inclusion within the EIS the following:

> (1) A statement that such information is incomplete or unavailable.
>
> (2) A statement of the relevance of the incomplete or unavailable information to evaluating reasonably foreseeable significant adverse impacts on the human environment.
>
> (3) A summary of existing credible scientific evidence that is relevant to evaluating the reasonably foreseeable significant adverse impacts on the human environment.
>
> (4) The USACE's evaluation of such impacts based upon theoretical approaches or research methods generally accepted in the scientific community.

Comments received during scoping raised concerns that some of the data are not current because significant PLP data collection efforts were conducted several years ago. This data gap analysis considers the age of the data, the sufficiency of the data in terms of quality and quantity, and whether these factors meaningfully affect the evaluation of impacts. This data gap analysis considered whether and to what degree the age of the data affects relevancy to impact analysis.

Table 3.1-2: Data Gaps Screening

Missing Information Screening Questions (40 CFR Part 1502.22)	Data Gap and Responses
Essential to a reasoned choice among the alternatives?	**Data Gap 1: Detailed Reclamation Plan** A detailed reclamation plan is potentially essential to a reasoned choice among the alternatives. A detailed reclamation plan would provide an understanding of temporary versus permanent impacts to wetlands and other waters and vegetation between alternatives. A detailed reclamation plan would also provide rationale and details on what a successful reclamation approach would be, and provide specific number of acres of planned reclamation in specific locations, which may differ among alternatives. For

Table 3.1-2: Data Gaps Screening

Missing Information Screening Questions (40 CFR Part 1502.22)	Data Gap and Responses
	example, an alternative with greater acres impacted may have a higher proportion of sites suitable for reclamation activities, and thus be preferable over an alternative with fewer acres impacted, but a lower proportion of sites suitable for reclamation activities. For the Draft EIS (DEIS), all fill impacts to wetlands and other waters are considered permanent as there has not been sufficient information provided on the specifics, location, and level of reclamation provided by Pebble Limited Partnership (PLP). A draft conceptual Compensatory Mitigation Plan (CMP) has been prepared by PLP, and is included in Appendix M. Detailed information about each compensatory mitigation opportunity proposed would be included in an attachment to a future version of a CMP.
How could missing information be acquired?	For each project component (mine site, transportation corridor, port, and natural gas pipeline corridor), in each alternative and variant, identify which features are considered temporary or permanent disturbances to wetlands or other waters. Provide detail on reclamation activities for each site, including measures of assessing successful reclamation.
What would it take to acquire the missing information?	PLP would need to provide a detailed reclamation plan that addresses all alternatives and variants.
Relevance to reasonably foreseeable significant adverse impacts	A reclamation plan would provide an understanding of magnitude, duration, extent, and potential success of reclamation activities between alternatives and variants.
Existing credible scientific evidence	The reclamation plan would be developed in accordance with federal and state mining closure land use regulations.
USACE evaluation of impacts based on selected approach	The DEIS approach likely overestimates the permanent impacts described in the DEIS. While the specific location and type of reclamation activity is unknown, the DEIS provides context for impacts to wetlands or other waters by describing the affected environment in Chapter 3, and providing quantified information on acres of impacts in Chapter 4. The available information is sufficient to provide reasonable estimates for purposes of the DEIS.
Missing Information Screening Questions (40 CFR Part 1502.22)	**Data Gap 2: Wetland and Vegetation Mapping Gaps** Gaps include: Alternative 1, Kokhanok East Ferry Terminal Variant: The spur road from the south access route to the Kokhanok east ferry terminal variant location and the Kokhanok East Ferry Terminal Variant location. PLP had planned to collect bathymetry and other field data in this location in field season 2018 but was limited by weather and other logistical issues; PLP did not collect field data for this location (PLP 2018-RFI 078, September 27, 2018). Alternative 2 and Alternative 3: The natural gas pipeline corridor from Ursus Cove to Cottonwood Bay. The general route and location was identified by PLP after field season 2018 ended, so no field data was collected (PLP 2018-RFI 080, October 12, 2018).

Table 3.1-2: Data Gaps Screening

Missing Information Screening Questions (40 CFR Part 1502.22)	Data Gap and Responses
	Alternative 2: The ferry terminal site location and spur road near Pile Bay. The footprint and location for the ferry terminal was identified by PLP after field season 2018 ended, so no field data was collected (PLP 2018-RFI 080, October 12, 2018). Alternative 2: The access road from the northern access route to the Eagle Bay ferry terminal site and the Eagle Bay ferry terminal site location. A general route and location was identified by PLP after field season 2018 ended, so no field data was collected (PLP 2018-RFI 080, October 12, 2018).
Essential to a reasoned choice among the alternatives?	Yes; while the FEIS would provide precise information of the type of wetlands and vegetation that would be impacted by the project and how those impacts vary among the alternatives and variants, the available information is sufficient to provide reasonable estimates for purposes of the DEIS. More detailed information would supplement and augment these estimates in the FEIS.
How could missing information be acquired?	All action alternatives and variants would require wetland and vegetation mapping prior to the FEIS. For the DEIS, estimates of wetland and vegetation impacts for the DEIS can be made by applying publicly available data.
What would it take to acquire the missing information?	The FEIS will require mapping and field verification for all action alternatives and variants. The gap areas were not mapped during the 2018 field season and it is not possible to map the wetlands prior to the DEIS publication because of winter conditions. For the DEIS, information is available to allow estimation of the impacts. Available data include National Wetlands Inventory (NWI) and National Aeronautics and Space Administration (NASA) wetlands data.
Relevance to reasonably foreseeable significant adverse impacts	Understanding how the alternatives affect wetlands and vegetation is needed to determine significance of impacts.
Existing credible scientific evidence	NWI and NASA data are not as precise as field data, but are sufficient for estimation for the DEIS. NWI and NASA data is generally sufficient to identify the broad scale impacts for the alternatives and variants and show differences of impacts among alternatives. For the USACE to make a decision for permitting under Section 404(b)(1) of the Clean Water Act or Section 10 of the Rivers and Harbors Act, the FEIS would need to assess all locations of wetlands and other waters.
USACE evaluation of impacts based on selected approach	The DEIS approach provides an assessment of the impacts among the alternatives and variants. This assessment would be refined for the FEIS. Information provided in the DEIS may not be precise enough to make a permit decision, but is sufficient for a DEIS.
Missing Information Screening Questions (40 CFR Part 1502.22)	**Data Gap 3: Subsistence** More current subsistence data (i.e., post-2008) is not available. Although subsistence data coverage is extensive for the Bristol Bay drainage; unavailable, older, or limited data sets for project area communities will be acknowledged

Table 3.1-2: Data Gaps Screening

Missing Information Screening Questions (40 CFR Part 1502.22)	Data Gap and Responses
	in the "Affected Environment" section (Chapter 3) and Appendix K (Technical Appendices) as known data gaps. For Cook Inlet communities, the extent of subsistence harvest activity, particularly fishing, in the project area on the western side of Cook Inlet has not been documented and limited information is available.
Essential to a reasoned choice among the alternatives?	Potentially. It is common that current and site-specific information on subsistence use activities and areas are not available for a proposed project during NEPA compliance. However, data available in the Pebble Project EBDs and from the Alaska Department of Fish and Game (ADF&G) provide fairly comprehensive coverage of the proposed mine site locations and transportation routes. Changes may occur in the area and intensity of subsistence activity as the location of resources change and as needs change, but such change typically occurs in a larger area historically used by a community and is documented in available information. In addition, there is anecdotal information from scoping comments regarding use of some areas, such as in the vicinity of the Amakdedori port site. Through relying on the existing data sets, considering the anecdotal information from scoping comments, and allowing for some evolution of use areas and intensity, the available information is adequate for assessing the potential impacts of the proposed action alternatives and variants.
How could missing information be acquired?	The interview-based studies in the EBDs conducted by Stephen R. Braund and Associates (SRB&A) in concert with the ADF&G could be updated to provide current use areas and trends.
What would it take to acquire the missing information?	Data collection would require extensive interview-based studies of the communities in the project area. Public comment on the DEIS may further inform the analysis if users provide comments about subsistence use areas and intensity; those comments would help inform the FEIS.
Relevance to reasonably foreseeable significant adverse impacts	Updated information would provide a more current picture of subsistence use in the immediate vicinity of the mine site, transportation corridor, port, and natural gas pipeline facilities. However, based on the existing information, the analysis of potential impacts assumes that subsistence harvest activities are occurring in these areas, and takes into account the previously documented areas of highest overlapping use and the historical areas of where subsistence harvest and access have occurred.
Existing credible scientific evidence	Data collected by SRB&A (from 2004 through 2008) and the ADF&G Subsistence Division for the applicant are available in the EBDs. Data collection coverage includes 19 Bristol Bay drainage communities, plus Lime Village in the Kuskokwim River drainage. SRB&A data analysis was complete for 12 communities as of release of the EBD. However, this EBD data set is now 10 to 15 years old, but that is not atypical for available data in much of the state. In addition, the methodology used to identify areas of overlapping subsistence use and document the areas

Table 3.1-2: Data Gaps Screening

Missing Information Screening Questions (40 CFR Part 1502.22)	Data Gap and Responses
	historically used for subsistence harvest by resource for individual communities allows making conservative assumptions for potential impacts that could occur over time.
USACE evaluation of impacts based on selected approach	The DEIS will acknowledge this data gap for subsistence harvest use areas and rates of harvest/sharing, and assume that harvest areas and rates may have changed—but may still follow historical trends, or may be similar to that of nearby communities.
Missing Information Screening Questions (40 CFR Part 1502.22)	**Data Gap 4: Cultural Resources and Historic Properties** Cultural anthropology and ethnographic data (including information regarding cultural landscapes, sacred sites, and traditional cultural properties), and data to help inform more analysis for archaeology and historic sites. Field survey coverage of the mine site is relatively comprehensive based on previous EBD studies, and for the Amakdedori port site based on 2018 field work. However, the transportation route from the mine site to Amakdedori has not been field surveyed. Resources identified in the Alaska Heritage Resource Survey have been assessed and areas of historic cultural used were identified in prior interviews conducted by SRB&A. SRB&A has also modelled cultural resource site potential based on wetlands and slope. Based on the available information, it is possible that there are undiscovered cultural resources sites, particularly in areas that have not been subject to a field survey. Such surveys usually focus on the applicant's proposed alternative and are not routinely conducted to alternatives and variants identified in the EIS. As the specifics of the proposed action may change in the course of the NEPA process, additional field surveys may occur while the EIS is being completed.
Essential to a reasoned choice among the alternatives?	Potentially. With limits to areas subject to field surveys, the comparison between alternatives and variants would rely on cultural resource sites identified to date, material from interviews, and potential modelling.
How could missing information be acquired?	A Cultural Landscape Analysis requires oral history studies and additional field surveys, although some information is available from interviews conducted for the EBD. Consultation being conducted as part of developing the Section 106 Programmatic Agreement is occurring simultaneously with preparation of the NEPA document, and may result in identification of more information. Ethnographic analysis specific to project component areas, alternatives, and variants can be extrapolated from existing reports that could be supplemented by completing a project-specific ethnographic analyses (involves oral history, place name research, and interdisciplinary analysis). Updates would need to be made to historic and prehistoric context to cover alternatives and introduce additional historic themes that are not detailed in the generic prehistoric context in the SRB&A reports. For place name data and areas of low and high potential for presence of cultural resources, SRB&A compiled data from existing sources, but this analysis is primarily limited to the

Table 3.1-2: Data Gaps Screening

Missing Information Screening Questions (40 CFR Part 1502.22)	Data Gap and Responses
	mine site area and would need to be acquired for coverage of other project components, alternatives, and variants. Additional field survey of unsurveyed project components to identify and evaluate sites would provide missing information. Off-shore marine archaeological analysis, including review of shipwreck data and analyses of site potential for port facilities and alternatives route crossings would provide missing information. This information was acquired via PLP's 2018 field work, and will be augmented by additional work scheduled for field season 2019.
What would it take to acquire the missing information?	Information that would be applicable to meeting this data gap would be derived from tribal consultation through the National Historic Preservation Act Section 106 process and is expected to result in updated information being provided for cultural landscape analyses, ethnographic reports, place name maps, and information on locations of sacred sites/traditional cultural practices, harvest areas, or other ethnographic locations. This information would be incorporated into the FEIS and the project Programmatic Agreement with the State Historic Preservation Office.
Relevance to reasonably foreseeable significant adverse impacts	None of the sites identified to date have been evaluated for eligibility in the National Register of Historic Places, but this is not atypical during the preparation of an EIS.
Existing credible scientific evidence	The SRB&A EBDs and the Alaska Heritage Resource Survey database primarily cover archaeological sites and/or historic buildings.
USACE evaluation of impacts based on selected approach	The USACE evaluation of impacts based upon the selected approach would be informed by the Programmatic Agreement and the Section 106 process. The DEIS is an important step to preparing a FEIS, as it discusses the range of cultural resource types as known, and offers a discussion limited to the available information from the SRB&A EBDs and the Alaska Heritage Resource Survey. The USACE impact evaluation is completed via the FEIS for consideration when making a decision documented in a Record of Decision.

Source: AECOM 2018q

This page intentionally left blank.

3.2 LAND OWNERSHIP, MANAGEMENT, AND USE

This section describes the regulatory setting, along with the baseline conditions of land ownership, land management, and existing land use patterns in the Environmental Impact Statement (EIS) analysis area, which is the project footprint for land ownership and management, and adjacent lands for land use. Relevant land use plans are discussed and land status maps display land ownership for the EIS analysis area (Figure 3.2-1A through Figure 3.2-1E). Additional details on recreational, subsistence, and cultural uses of lands in the EIS analysis area are found in the related analyses in Section 3.5, Recreation; Section 3.7, Cultural Resources; and Section 3.9, Subsistence.

3.2.1 Land Ownership

Land ownership was determined using general land status data, which are accurate to the scale of 1 square mile (one section), and data of the project footprint.

The entire project area would be on lands owned by the State of Alaska, or privately owned by Alaska Native Claims Settlement Act (ANCSA) Native regional (typically subsurface estate) or village corporations (surface estate). Land ownership is shown in Table 3.2-1. The transportation corridor includes spur roads to communities under Alternative 1.

Alternative 1 would not bisect any Native Allotments. The Alternative 2 components would bisect five Native Allotments, and Alternative 3 would bisect four. The Diamond Point port and facilities would be located on Native Allotment AKAA 4592a and AKAA 4225B (Alternatives 2 and 3).

Table 3.2-1: Land Ownership in Acres

Owner	Alternative 1	Alternative 2	Alternative 3
Mine Site			
State of Alaska	8,086	8,241	8,086
Summer-Only Ferry Operations Variant			
State of Alaska	8,124	8,279	8,087
Transportation Corridor			
State of Alaska	961.6	459.4	533.9
Cook Inlet Region, Inc.	--	6.8	6.8
Alaska Peninsula Corporation	442.7	--	--
Iliamna Natives Limited	61.8	308.6	325.5
Pedro Bay Corporation	--	186.1	645.1
Tyonek Native Corporation	--	106.1	106.1
Seldovia Native Association, Inc.	--	38.4	38.4
Salamatof Native Association, Inc.	--	3.2	3.2
Native Allotment AKAA 4592A	--	2.0	2.0
Native Allotment AKAA 6025B	--	6.1	--
Native Allotment AKA 63274A	--	--	5.1
Native Allotment AKAA 51014	--	15.5	15.5
Kokhanok East Ferry Terminal Variant			
State of Alaska	438.3	NA	NA

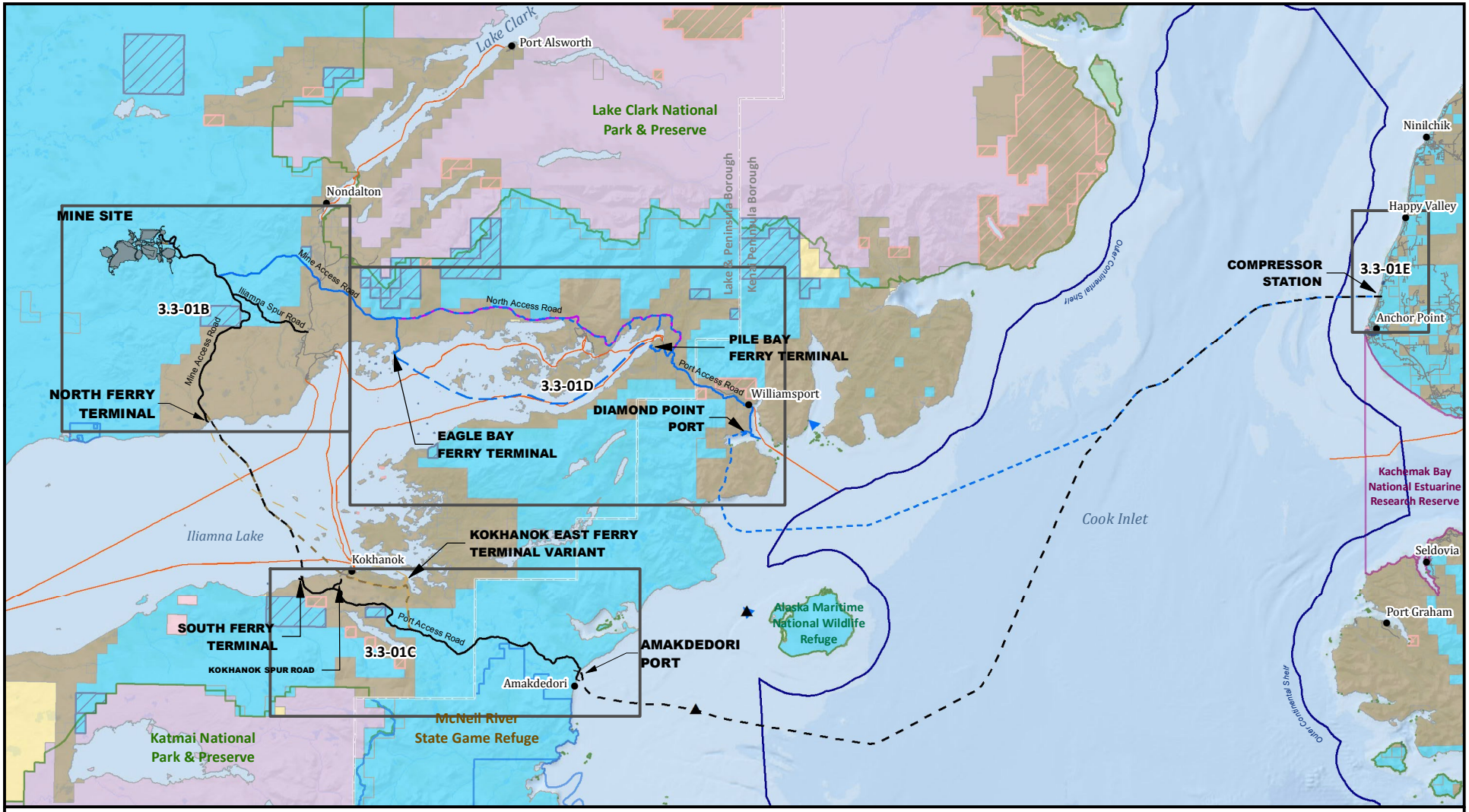
Table 3.2-1: Land Ownership in Acres

Owner	Alternative 1	Alternative 2	Alternative 3
Alaska Peninsula Corporation	172.1	NA	NA
Summer-Only Ferry Operations Variant			
Cook Inlet Region, Inc.	--	6.8	NA
Pedro Bay Corporation	--	157.3	NA
Tyonek Native Corporation	--	120.8	NA
Salamatof Native Association, Inc.	--	3.2	NA
Seldovia Native Association, Inc.	--	38.7	NA
Native Allotment AKAA 4592A	--	2.0	NA
Native Allotment AKAA 6025B	--	6.1	NA
Native Allotment AKAA 51014	--	24.6	NA
Amakdedori Port			
State of Alaska	26.7	NA	NA
Summer-Only Ferry Operations Variant			
State of Alaska	45.6	NA	NA
Pile-Supported Dock Variant			
State of Alaska	16.4	NA	NA
Natural Gas Pipeline			
State of Alaska	33.0	146.7	26.8
Cook Inlet Region, Inc.	--	77.9	77.9
Alaska Peninsula Corporation	21.8	--	--
Iliamna Natives Limited	--	91.6	--
Pedro Bay Corporation	--	756.6	--
Tyonek Native Corporation	--	<0.1	<0.1
Salamatof Native Association, Inc.	--	28.7	28.7
Native Allotment AKA 63274A	--	4.7	--
Native Allotment AKAA 4592A	--	<0.1	<0.1
Kokhanok East Ferry Terminal Variant			
State of Alaska	33.0	NA	NA
Alaska Peninsula Corporation	45.8	NA	NA
Pile-Supported Dock Variant			
Tyonek Native Corporation	NA	<0.1	NA
Salamatof Native Association, Inc.	NA	<0.1	NA
Native Allotment AKAA 4592A	NA	<0.1	NA
Kenai Compressor Station			
State of Alaska	4.8	4.8	4.8
Diamond Point Port			
Cook Inlet Region, Inc.	NA	42.3	42.3
Tyonek Native Corporation	NA	9.1	9.1
Native Allotment AKAA 4225B	NA	33.2	33.2
Native Allotment AKAA 4592A	NA	16.6	16.6

Table 3.2-1: Land Ownership in Acres

Owner	Alternative 1	Alternative 2	Alternative 3
Pile-Supported Dock Variant			
Cook Inlet Region, Inc.	--	42.3	NA
Tyonek Native Corporation	--	9.1	NA
Native Allotment AKAA 4225B	--	33.2	NA
Native Allotment AKAA 4592A	--	16.6	NA
Concentrate Pipeline Variant			
Cook Inlet Region, Inc.	NA	NA	42.5
Tyonek Native Corporation	NA	NA	9.3
Native Allotment AKAA 4225B	NA	NA	33.2
Native Allotment AKAA 4592A	NA	NA	16.9
Ferry Terminals			
Alaska Peninsula Corporation	30.3	--	NA
Iliamna Natives Limited	--	8.9	NA
Pedro Bay Corporation	--	20.4	NA
Kokhanok East Ferry Terminal Variant			
Alaska Peninsula Corporation	15.9	NA	NA
Material Sites			
State of Alaska	150.6	173.0	212.8
Alaska Peninsula Corporation	80.8	--	--
Iliamna Natives Limited	9.4	167.3	189.1
Pedro Bay Corporation	--	39.7	273.1
Tyonek Native Corporation	--	29.0	29.0
Seldovia Native Association, Inc.	--	12.9	12.9
Kokhanok East Ferry Terminal Variant			
State of Alaska	169.2	NA	NA
Alaska Peninsula Corporation	78.9	NA	NA
Summer-Only Ferry Operations Variant			
Pedro Bay Corporation	--	39.7	NA
Seldovia Native Association, Inc.	--	12.9	NA
Tyonek Native Corporation	--	29.0	NA

Notes:
NA = Not applicable
Source: BLM 2017 (GIS)



Sources: ADNR 2015, 2017, 2018; BLM 2013, 2017, 2018; NERRS 2000; NOAA 2011; USFWS 2017

US Army Corps of Engineers

5 0 5 10
Miles

Administrative Boundaries
- Outer Continental Shelf
- Borough Boundary
- State Easement ADL 230875
- Bureau of Land Management
- Fish and Wildlife Service
- Forest Service
- Military
- National Park Service
- Native Patent or IC
- Native Selected
- Private
- State Patent or TA
- State Selected
- Alaska Special Use Lands Designation
- State Recreation Area
- Federal Conservation System Unit
- Kachemak Bay National Estuarine Research Reserve

Alternative 1
- Lightering Locations
- Transportation Corridor
- Natural Gas Pipeline
- Ferry/Port Site
- Mine Site

Kokhanok East Ferry Terminal Variant
- Transportation Corridor
- Ferry Route
- Natural Gas Pipeline

Alternative 2
- Transportation Corridor
- Ferry Route

Alternative 2/3
- Lightering Location
- Natural Gas Pipeline
- Port Site

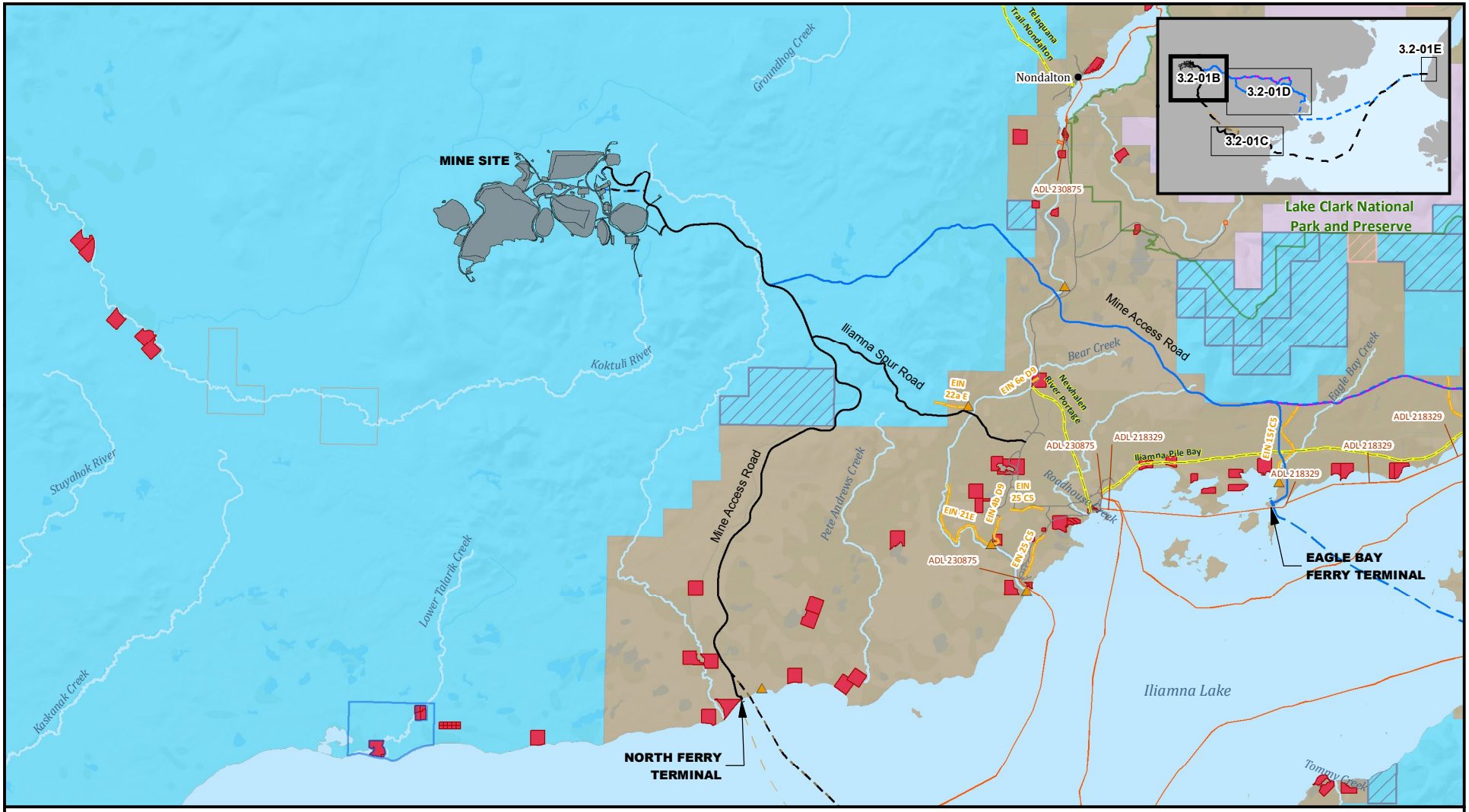
Alternative 3
- Transportation Corridor

Other Features
- Local Roads
- Page Index

GENERALIZED LAND STATUS OVERVIEW MAP

PEBBLE PROJECT EIS

FIGURE 3.2-1A



Sources: ADNR 2015, 2017, 2018; BLM 2013, 2017, 2018; NERRS 2000; NOAA 2011; USFWS 2017

US Army Corps of Engineers®

1 0 1 2
Miles

Administrative Boundaries
- Bureau of Land Management
- National Park Service
- Native Patent or IC
- Native Selected
- State Patent or TA
- State Selected
- State Special Use Lands Designation
- State Easements
- Native Allotments
- 17(b) Easement Site
- 17(b) Easement Trail
- RS 2477
- Local Roads

Alternative 1
- Transportation Corridor
- Natural Gas Pipeline
- Ferry/Port Site
- Mine Site

Kokhanok East Ferry Terminal Variant
- Transportation Corridor
- Natural Gas Pipeline
- Ferry Terminal

Alternative 2
- Transportation Corridor
- Ferry Route
- Ferry Site

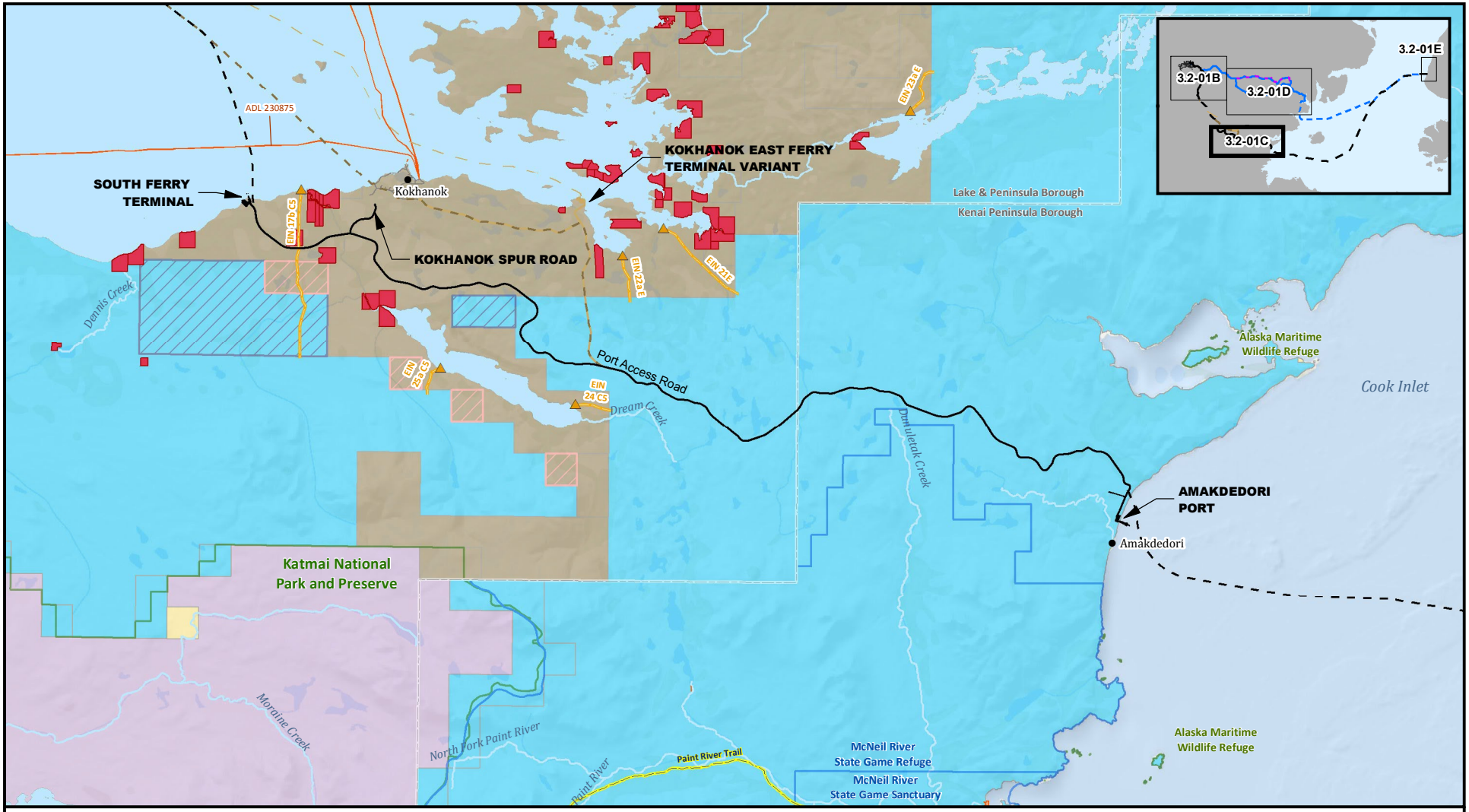
Alternative 2/3
- Natural Gas Pipeline
- Port Site

Alternative 3
- Transportation Corridor

GENERALIZED LAND STATUS
MINE SITE TO NORTH FERRY TERMINAL

PEBBLE PROJECT EIS

FIGURE 3.2-1B



Sources: ADNR 2015, 2017, 2018; BLM 2013, 2017, 2018; NERRS 2000; NOAA 2011; USFWS 2017

US Army Corps of Engineers

1 0 1 2
Miles

Administrative Boundaries
- Bureau of Land Management
- National Park Service
- Native Patent or IC
- Native Selected
- State Patent or TA
- State Selected
- State Easements
- Native Allotments
- State Special Use Lands Designation
- Federal Conservation System Unit
- 17(b) Easement Site
- 17(b) Easement Trail
- RS 2477
- Borough Boundary
- Local Roads

Alternative 1
- Transportation Corridor
- Natural Gas Pipeline
- Ferry/Port Site
- Mine Site

Kokhanok East Ferry Terminal Variant
- Transportation Corridor
- Natural Gas Pipeline

- Ferry Terminal

Alternative 2
- Transportation Corridor
- Ferry Route
- Ferry Site

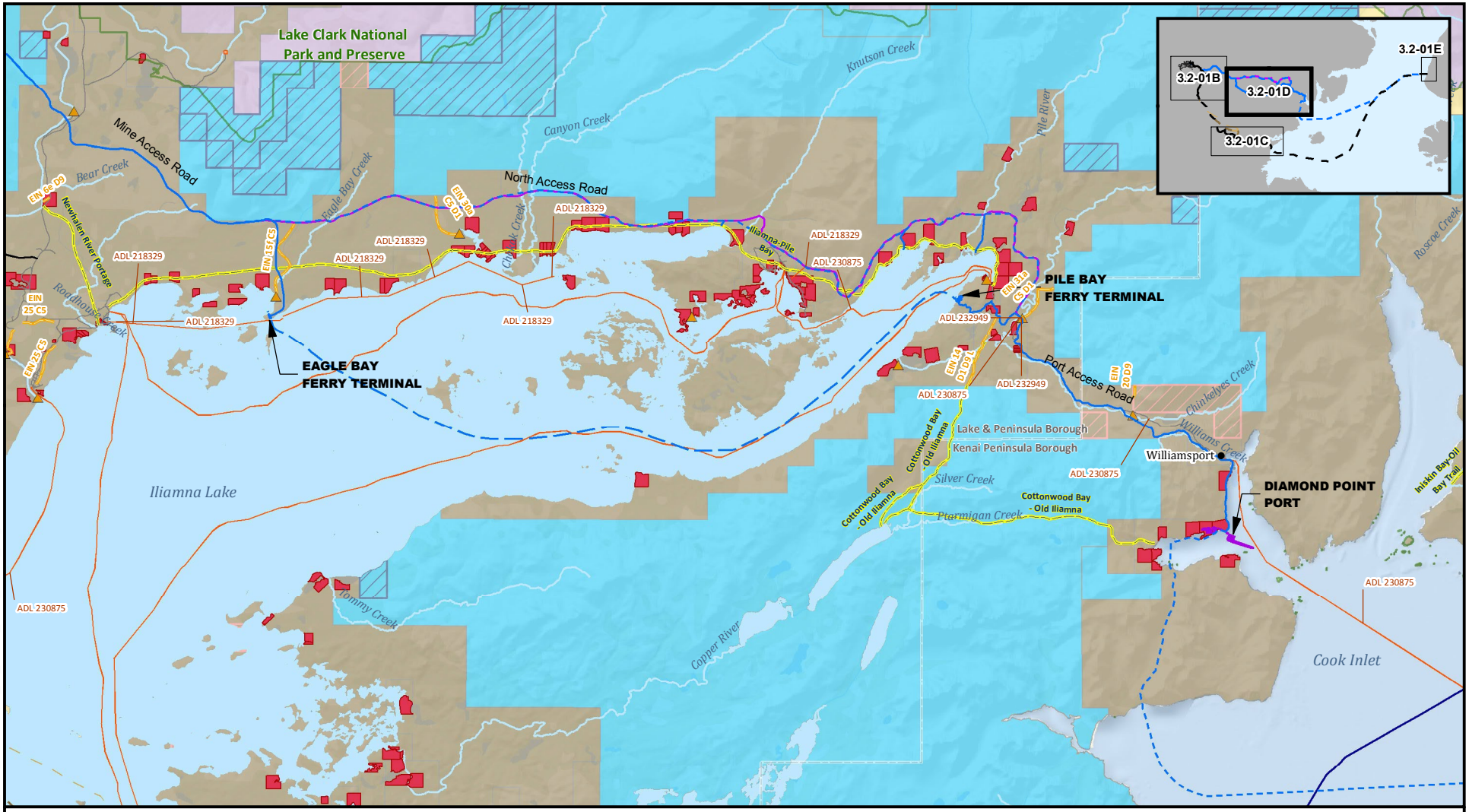
Alternative 2/3
- Natural Gas Pipeline
- Port Site

Alternative 3
- Transportation Corridor

GENERALIZED LAND STATUS
SOUTH FERRY TERMINAL TO AMAKDEDORI PORT

PEBBLE PROJECT EIS

FIGURE 3.2-1C



Sources: ADNR 2015, 2017, 2018; BLM 2013, 2017, 2018; NERRS 2000; NOAA 2011; USFWS 2017

US Army Corps of Engineers

1 0 1 2
Miles

Administrative Boundaries
- Bureau of Land Management
- National Park Service
- Native Patent or IC
- Native Selected
- State Patent or TA
- State Selected
- State Easements
- Native Allotments
- Federal Conservation System Unit
- 17(b) Easement Site
- 17(b) Easement Trail
- RS 2477
- Borough Boundary
- Outer Continental Shelf
- Local Roads

Alternative 1
- Transportation Corridor
- Natural Gas Pipeline
- Ferry/Port Site
- Mine Site

Kokhanok East Ferry Terminal Variant
- Transportation Corridor
- Natural Gas Pipeline

- Ferry Terminal

Alternative 2
- Transportation Corridor
- Ferry Route
- Ferry Site

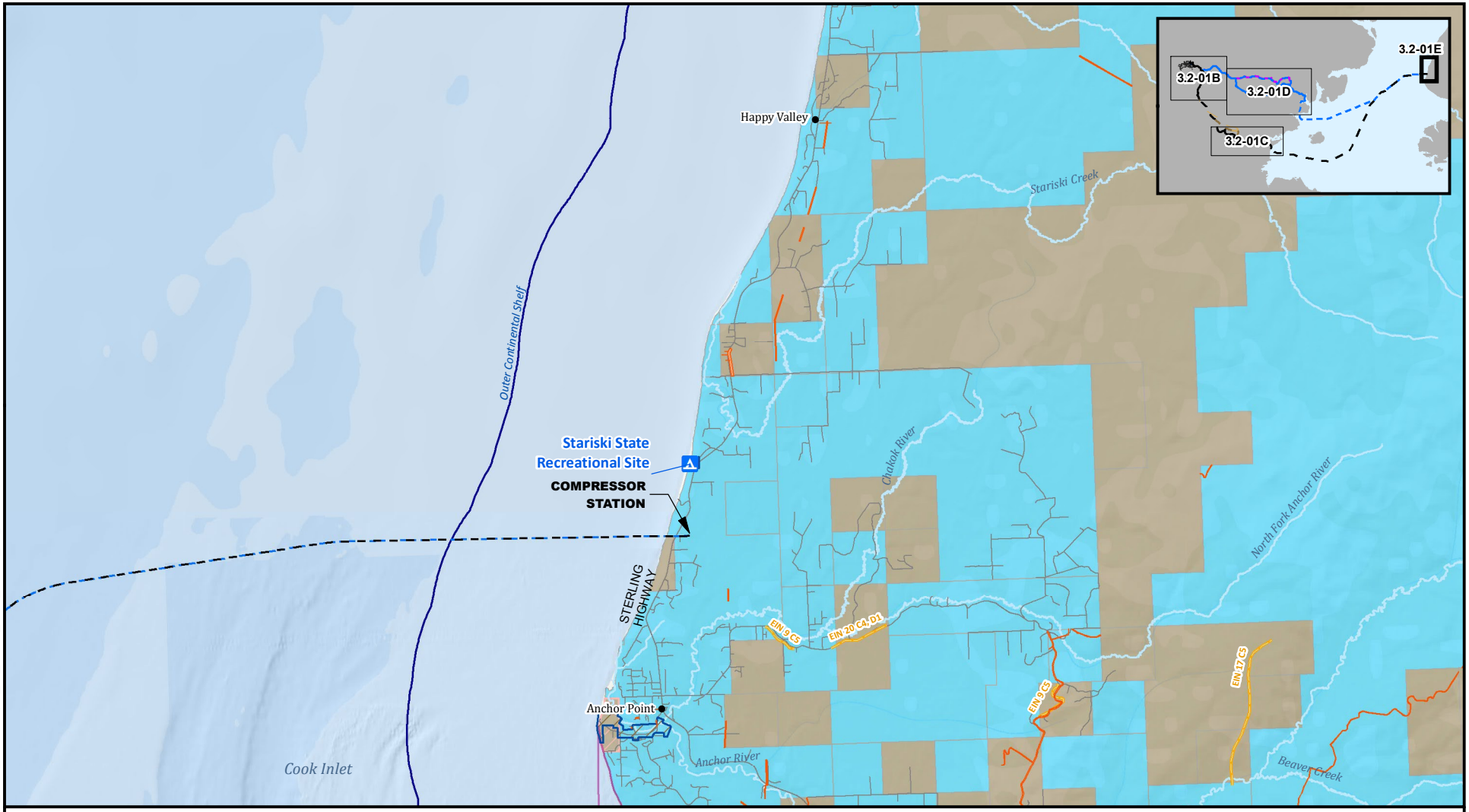
Alternative 2/3
- Natural Gas Pipeline
- Port Site

Alternative 3
- Transportation Corridor

GENERALIZED LAND STATUS
EAGLE BAY TO DIAMOND POINT PORT

PEBBLE PROJECT EIS

FIGURE 3.2-1D



Sources: ADNR 2015, 2017, 2018; BLM 2013, 2017, 2018; NERRS 2000; NOAA 2011; USFWS 2017

US Army Corps of Engineers

1 0 1 2

Miles

Administrative Boundaries
- Native Patent or IC
- Native Selected
- State Patent or TA
- State Recreation Area
- State Easements
- Kachemak Bay National Estuarine Research Reserve

- Stariski State Recreational Site
- Outer Continental Shelf
- Local Roads

Alternative 1
- Transportation Corridor
- Natural Gas Pipeline
- Ferry/Port Site
- Mine Site

Kokhanok East Ferry Terminal Variant
- Transportation Corridor
- Natural Gas Pipeline
- Ferry Terminal

Alternative 2
- Transportation Corridor
- Ferry Route
- Ferry Site

Alternative 2/3
- Natural Gas Pipeline
- Port Site

Alternative 3
- Transportation Corridor

GENERALIZED LAND STATUS
ANCHOR POINT TO HAPPY VALLEY

PEBBLE PROJECT EIS

FIGURE 3.2-1E

3.2.1.1 Legal Access

In the EIS analysis area, there are mechanisms to ensure consistent surface access to public lands, and in some instances, private parcels or traditional access areas. These mechanisms for access include Revised Statute (R.S.) 2477 Rights-of-Way (ROWs), ANCSA Section 17(b) Easements, Alaska National Interest Lands Conservation Act Sections 811 and 1110, State Section Line Easements, and State Public Access Easements.

Revised Statute 2477 Rights-of-Way

Section 8 of the 1866 Mining Act states that, "the right-of-way for the construction of highways over public lands, not reserved for public uses, is hereby granted." In 1873, the provision was separated from the Mining Act and re-enacted as R.S. 2477. In 1938, it was re-codified as 43 United States Code (USC) Section 932. In 1976, the Federal Land Policy and Management Act repealed both the 1866 Mining Act and R.S. 2477, but all ROWs that existed on the date of the repeal (October 21, 1976) were preserved under 43 USC Section 1769 through a savings provision for prior established rights.

Through statute or administrative action, the State of Alaska recognizes approximately 6,750 R.S. 2477 routes throughout the state (Alaska Statute [AS] 19.30.400). However, the validity of the grant is not dependent on those state recognitions.

There are no state-recognized R.S. 2477 easements in the footprint of Alternative 1. Alternatives 2 and 3 would cross the Iliamna-Pile Bay R.S. 2477 ROW, as listed in Table 3.2-2 and shown in Figure 3.2-1D.

Table 3.2-2: Revised Statute 2477 Rights-of-Way in the Project Area

ID	Name	Alternative	Project Component(s)
RST 396	Iliamna-Pile Bay	2	Mine Access Road
RST 396	Iliamna-Pile Bay	2	Natural Gas Pipeline (crosses in two locations)
RST 396	Iliamna-Pile Bay	2	Transportation Corridor (Pipeline Construction Access)
RST 396	Iliamna-Pile Bay	3	Transportation Corridor / Natural Gas Pipeline (crosses in four locations)

Note: Project components cross the ROW in one location, unless otherwise noted.
Source: ADNR 2018 (GIS)

Section Line Easements

Section line easements are state-recognized easements for highway purposes that run along a surveyed section line of the rectangular survey system (11 Alaska Administrative Code [AAC] 51.025). Lands acquired by the state after March 26, 1951, including some lands in the project area, are subject to a section line easement that remains in existence unless vacated by proper authority. Easements are public ROWs, 33-, 50-, 66-, 83-, or 100-feet wide. The state asserts that all 33- and 66-foot wide section line easements were acquired under R.S. 2477, regardless of whether trails have ever been developed along them. Section line easements are authorized in law and may be established when the rectangular survey of a section line occurs. Prior to survey, the state asserts the easements exist centered on the protracted section line; however, the easement must be surveyed before it can be used. Section line easements are used primarily for transportation. The project area would encompass several section line easements.

Alaska Native Claims Settlement Act Section 17(b) Easements

Under Section 17(b) of ANCSA, the US reserves linear access easements to public land and water on lands that have been or will be conveyed to Alaska Native Village and Regional corporations (ADNR 2013b). Easements can take the form of 60-foot wide roads, 25- and 50-foot trails, or 1-acre site easements for vehicle parking, temporary camping, or loading/unloading. These easements are reserved to allow for public access through ANCSA lands to reach public lands and waterways. They do not authorize public access to the private land that the easement crosses (BLM 2009). The Bureau of Land Management (BLM) has management authority for the United States for these easements unless that authority has been otherwise delegated.

ANCSA Section 17(b) easements have specific allowable uses that are stated in the conveyance document. They cannot be reserved or retained for recreational purposes, but can provide access to recreational opportunities on publicly owned land or for change in mode of transportation. Uses beyond those expressly granted should be approved by the property owner to avoid trespass issues between the user and the property owner.

Alternative 1 would intersect 1 Section 17(b) easement, on the southern shore of Iliamna Lake. Alternative 2 and Alternative 3 would intersect 2 Section 17(b) easements; both begin at the northern shore of Iliamna Lake and continue north (Table 3.2-3).

Table 3.2-3: ANCSA Section 17(b) Easements in the Project Area

ID	Description	Alternative(s)	Project Component
EIN 17b C5	Access trail east of the mouth of Gibraltar Creek on the southern shore of Iliamna Lake, southerly to public land (25 foot trail).	1	Transportation Corridor, Natural Gas Pipeline
EIN 15f C5	Proposed access trail from EIN 15c on Eagle Bay on Iliamna Lake northerly to public lands (25 foot trail).	2, 3	Transportation Corridor, Natural Gas Pipeline
EIN 30a C5 D1	Proposed access trail from EIN 30 on the west shore of an unnamed lagoon of Iliamna Lake (25 foot trail).	2	Natural Gas Pipeline
		3	Transportation Corridor, Natural Gas Pipeline

Note:
Project components cross the easement in one location, unless otherwise noted.
Source: ADNR 1990; BLM 2018 (GIS reference)

State Public Access Easements

Three 100- to 400-foot wide State Public Access Easements exist on state land along the project components. Under these easements, the State of Alaska reserved public access for present and future needs along the corridors as well as authorization for trail improvements, trail maintenance and safety cabins. The State Public Access Easements in the project area are listed in Table 3.2-4.

Table 3.2-4: State Public Access Easements in the Project Area

ID	Description	Alternative	Project Component(s)
ADL 230875	United Utilities, Inc. exclusive ROW for hybrid fiber optic cable and microwave broadband communications network. In the project area, it would bisect in Iliamna Lake and Cook Inlet.	1, 2, 3	Transportation Corridor (ferry route, Alternatives 1 and 2 only)[2] , Natural Gas Pipeline[1]
ADL 218329	Pedro Bay Improvement Corporation, Inc. (obsolete).	2, 3	Transportation Corridor (Alternative 3 only), Natural Gas Pipeline
ADL 232949	Alaska Department of Transportation and Public Facilities design and construction ROW, central region (obsolete).	2, 3	Transportation Corridor, Natural Gas Pipeline

Notes:
Project components cross the easement in one location, unless otherwise noted.
[1] Crosses in two locations under the proposed alternative. Under the Kokhanok east ferry terminal variant, the pipeline would cross in two locations, and the ferry route would cross in three locations.
[2] Crosses in nine locations.
Source: LM 2010; ADNR 2018 (GIS reference)

3.2.2 Land Management

3.2.2.1 State Management

The Alaska Department of Natural Resources (ADNR), under AS 38.04.065 Land Use Planning and Classification and 11 AAC 55.010-.030, "shall, with local governmental and public involvement under AS 38.05.945, adopt, maintain, and, when appropriate, revise regional land use plans that provide for the use and management of State of Alaska-owned lands." Plans applicable to the EIS analysis area include the Bristol Bay Area Plan (ADNR 2013a), the Nushagak and Mulchatna Rivers Recreation Management Plan (ADNR 2005), and the Kenai Area Plan (ADNR 2001).

All resource and land uses, including mining and recreation, are considered and evaluated under state management. Unless closed by the legislature, or a less-than-640-acre tract closed by administrative order, all state land is open for multiple uses. The State of Alaska's Generally Allowed Uses on State Land provides a general explanation of the state's use management framework.

The transportation corridor (port access road) and natural gas pipeline under Alternative 1 would be within a mile (less than 300 feet at its closest) to the boundary of (but would not occupy) the McNeil River State Game Refuge and Sanctuary, which is managed by the Alaska Department of Fish & Game (ADF&G) in accordance with the McNeil River State Game Refuge and Sanctuary Management Plan (ADF&G 2008a). Amakdedori port under Alternative 1 would be within 2 miles of the boundary of the McNeil River State Game Refuge and Sanctuary. Section 3.5, Recreation, includes more information about management in the refuge and sanctuary.

Bristol Bay Area Plan

The Bristol Bay Area Plan was the outgrowth of a cooperative federal-state land use planning process mandated by the Alaska National Interest Lands Conservation Act. It was developed during the early 1980s, and was revised in 2005 to address the outstanding municipal entitlements of the three boroughs in the planning area (i.e., Bristol Bay, Lake and Peninsula, and Aleutians East), revise the tideland designations, address regional economic changes and

changing land use patterns, and to allow ADNR to lease portions of the area for oil and gas development.

The plan was substantially revised again in 2013 after litigation, which focused on the concern of loss of protection to important habitat and recreation areas when much of the plan area was redesignated for general use. This revision was in response to an agreement with the plaintiffs in Nondalton Tribal Council et al. versus the State of Alaska, which dismissed the litigation in exchange for ADNR's agreement to address the issues raised in the lawsuit through the existing administrative process for amending area land use plans and reclassifying land.

The Bristol Bay Area Plan divides the Bristol Bay area into 20 regions with management units. The mine site would be located in Region 6, and the transportation corridor would be in Regions 6, 9, and 10 under Alternative 1 and 6, 8, and 9 under Alternatives 2 and 3. Region 6 is designated for mineral development, and managed to ensure that impacts to the anadromous and high value resident fish streams are avoided, reduced, or mitigated as appropriate in the permitting processes. Additionally, impacts to moose wintering habitat are to be taken into consideration during mine permit review, and the upper Koktuli River also is managed for recreation. Regions 8, 9, and 10 are managed for a variety of uses including mineral exploration and development, public recreation and tourism, and protection of anadromous fish and wildlife resources and habitat. Region 8 is also managed for settlement. State-owned lands within these regions are identified to be retained in public ownership and managed for multiple use. The state selected much of the land in the planning area because of its mineral potential. Most of the area of mine itself is designated with the primary use of mineral development. An additional goal for this region is for the state to provide support for mining by aiding in the development of infrastructure, such as ports and roads (ADNR 2013a). The plan retains all of the mineral closing orders (MCO) including MCO 393, which closes certain streams to mineral entry and development and designates them habitat.

Iliamna Lake is managed under Region 9, co-designated under Public Recreation and Tourism-Dispersed and Habitat land designations. The navigable waters of this lake are to be managed so that its public recreation and habitat values are maintained. Development authorizations in these waters may be appropriate insofar as essential habitat and public recreation values are maintained. Authorizations in these waterbodies should not interfere with navigability, important habitat values, or recreational uses (ADNR 2013a).

Nushagak and Mulchatna Rivers Recreation Management Plan

The Nushagak and Mulchatna Rivers Recreation Management Plan is a component of the Bristol Bay Area Plan. This plan is continued as an element of the 2013 Bristol Bay Area Plan in the navigable waters of the Nushagak-Mulchatna drainage basin. In response to previous plans and to public concern about subsistence use and increased recreational use in the region, ADNR, ADF&G, and the Bristol Bay Coastal Resource Service Area entered into a cooperative agreement to manage these rivers. No project components would be covered by the plan, but the mine site is approximately 20 miles upriver of units 16, 17, 18, and 19 of the plan. Units 16, 17, 18, and 19, are managed as primitive or semi-primitive and some permanent and temporary facilities may be prohibited (ADNR 2005).

The Bristol Bay Area Plan includes goals that identify the need to manage land; protect fish, wildlife, and water; and provide a diversity of commercial and non-commercial public use opportunities. To meet goals in the Bristol Bay Area Plan, state land in the Nushagak and Mulchatna planning area is to be managed to provide a mix of commercial and non-commercial public use opportunities, ensure availability of public use sites to meet the needs of all users,

protect habitat and other natural resources, and maintain options for future recreation management. Major streams in the Nushagak and Mulchatna drainage basin are in MCO 393.

Kenai Area Plan

The Kenai Area Plan divides the Cook Inlet area into 12 regions with management units. Amakdedori port and Diamond Point port would be located in Region 12, and parts of the natural gas pipeline component for all alternatives would be in Region 7 and Region 12. State-owned lands in these regions are identified to be retained in public ownership and managed for multiple uses. The area around Amakdedori port is managed as habitat for bear spring feeding, moose, Dolly Varden, Arctic char, ducks, and geese. Cook Inlet waters at Amakdedori are managed for recreation. At Diamond Point, the project facilities would be on lands that are private or owned by Native Corporations, but state lands and waters are designated in the plan for habitat and recreation. The plan has management guidelines for the development of transportation and utilities, which include cultural surveys, and protection of hydrologic systems and roads near wetlands. The plan also provides guidelines for waterfront development for soil erosion and fuel storage (ADNR 2001).

3.2.2.2 Borough Management

Lake and Peninsula Borough

The mine site, the natural gas pipeline, and much of the transportation corridor would be within the boundaries of the Lake and Peninsula Borough (LPB). The LPB, as a non-unified home rule borough, is required to provide for planning, platting, and land use regulations on an area-wide basis (both inside and outside of cities) in the borough.

The LPB's planning commission was established to perform the area-wide functions of planning, platting, and zoning; their recommendations are then transmitted to the LPB assembly, which sets policy and exercises legislative power in the borough (LPB n.d.). The commission prepares and revises the LPB Comprehensive Plan (LPB 2012). The LPB Comprehensive Plan provides general goals and policy recommendations to address pressing issues in the region.

The plan includes the following strategies for planning for wise land use and environmental protection: periodically review (and if appropriate improve) enforceable development standards (e.g., stream setbacks), and periodically review (and if appropriate, improve) the LPB's large project review process. Unlike some comprehensive plans, it does not make land use regulations, but is linked to community action plans for each of the LPB's communities, including those in the EIS analysis area. In addition to the LPB Comprehensive Plan, the LPB has prepared Village Strategic Plans for the following communities: Port Alsworth, Nondalton, Newhalen, Pedro Bay, Kokhanok, and Levelock. These brief plans outline core values, an envisioned future, and strategic direction for the period of 2017 to 2022.

LPB permits include Chapters 9.07 Development Permit and 9.08 Large Project Permits of the LPB code, and have requirements that apply to local approval of the Pebble Project. The Large Project Permit requires that the project comply with socioeconomic and with fiscal impact criteria that are outlined in the ordinance. These include activities within 100 feet of an anadromous stream, reclamation plans, and socioeconomic and fiscal impact reports.

Kenai Peninsula Borough

A portion of the proposed natural gas pipeline under all alternatives would be within the Kenai Peninsula Borough (KPB). The Amakdedori and Diamond Point ports and the port access roads or the north access road would also be within the KPB boundaries. As a second-class borough,

the KPB is required to provide for planning, platting, and land use regulations on an area-wide basis (both inside and outside of cities) in the borough in accordance with AS 29.40. Land use in the KPB is guided by the KPB Comprehensive Plan (KPB 2005, 2017). The Code of Ordinances dictates the KPB's powers and operations.

Zoning in the KPB is unrestricted outside of the KPB's cities and Local Option Zone Districts, none of which are located in the EIS analysis area. However, the KPB does regulate floodplain development, and development near certain anadromous fish streams throughout the borough, including Amakdedori Creek, near the port site under Alternative 1. Such activities may require a permit from the KPB.

The KPB Comprehensive Plan recognizes the borough's vicinity to the project area and acknowledges that proposed infrastructure would be located in the borough, although the plan does not contain goals, objectives, or implementation actions specific to development for the project on lands in the KPB.

3.2.2.3 Alaska Native Regional and Village Corporations

In 1971, President Richard Nixon signed ANCSA into law. Under ANCSA, aboriginal land claims were settled in exchange for $962.5 million in compensation, as well as approximately 40 million acres of land (Norris 2002). ANCSA established 12 for-profit Alaska Native regional corporations and 225 Alaska Native village corporations to administer the settlement lands and compensation funds. A 13th regional corporation was later added for Alaska Natives living outside the state. Alaska Natives enrolled as shareholders in the village and regional corporations where they lived at the time of enactment. The regional and village corporations land entitlement was generally proportionate to the population of these corporations at the time of enrollment. In most cases, the surface estate is owned by the village corporations, with the subsurface estate owned by the associated regional corporations.

Alaska Native corporation land is often held in large tracts and used for subsistence purposes or developed/sold to generate revenue. Alaska Native corporation-owned lands in the proposed transportation corridors and natural gas pipeline corridors consist of parcels with surface and subsurface rights owned by Cook Inlet Region Inc. (CIRI), and surface rights owned by various village corporations. Complete ownership for all alternatives is listed above in Table 3.2-1.

As private land, uses on land owned by Alaska Native corporations are subject to approvals of the surface and subsurface landowners. The Bristol Bay Native Corporation (BBNC) manages their lands to uphold three primary values: fiscal, environmental, and social, in order to protect the fish that have sustained the culture of the people through history (BBNC 2018). Some of the project components would be located on CIRI property. CIRI manages their lands to strike a balance between sustainably developing resources to improve opportunities for shareholders, and protecting the land for future generations (CIRI 2018). Parts of the port access road under Alternative 1 would be located on Alaska Peninsula Corporation property. The Alaska Peninsula Corporation mission is "to preserve and enhance the quality of life of Alaska Peninsula Corporation shareholders and to protect our culture while managing our assets in a manner which enhances their value" (APC 2018). Village corporation missions often include protection for the natural and cultural environment, and allowance of some development.

3.2.2.4 Native Allotments

Native Allotments are parcels of land up to 160 acres that are owned by an individual issued under the 1906 Native Allotment Act. The lands are held in trust by the federal government and generally require the Bureau of Indian Affairs oversight for sales, gift deeds, leases, permits,

partitions, ROWs, and sand and gravel leases. Alternatives 2 and 3 would bisect Native Allotments.

3.2.2.5 Federal Management

The project footprint for any of the alternatives would not intersect with federal land. Under Alternative 1, the mine access road and natural gas pipeline corridor would be within 9 miles of Lake Clark National Park and Preserve (NPP). The port access road would be within 8 miles from Katmai NPP, and more than 20 miles from Alagnak Wild River. The natural gas pipeline corridor would pass near a portion of the Alaska Maritime National Wildlife Refuge and the Kachemak Bay National Estuarine Research Reserve (NERR). The mine and port access roads would be within 1 mile of lands that are selected by the State and managed by the BLM.

Under Alternatives 2 and 3, the transportation corridor and natural gas pipeline would be within 5 miles of Lake Clark NPP, and within approximately 1 mile of lands that are selected by the State or Native corporations and managed by the BLM. The natural gas pipeline corridor would pass approximately 7 miles from a portion of the Alaska Maritime National Wildlife Refuge (all alternatives) and within 4 miles of the boundary of the Kachemak Bay NERR.

The Submerged Lands Act grants individual states' rights to the natural resources of submerged lands from the coastline of Alaska to 3 nautical miles offshore. The act also reaffirmed the federal claim to the lands of the Outer Continental Shelf (OCS), which consists of those submerged lands seaward of state jurisdiction. The act led to the passage of the Outer Continental Shelf Lands Act which outlines the federal responsibility over the submerged lands of the OCS. The Bureau of Safety and Environmental Enforcement (BSEE) oversees safety, environmental protection, and conservation of resources related to the exploration for and development of offshore resources on the OCS. BSEE authorization is required for the ROW encompassing the natural gas pipeline between the Kenai Peninsula and the proposed port facility for all alternatives for the portion of the ROW that would lie on the OCS of Cook Inlet.

National Park Service

The National Park Service (NPS) manages Lake Clark NPP, Katmai NPP, and the Alagnak Wild River. The transportation corridor and the mine site components would occur in the vicinity of, but not on, these lands. These project components would therefore not be subject to the NPS's land management jurisdiction. Section 3.5, Recreation, includes more information about management in each NPS unit.

US Fish and Wildlife Service

The US Fish and Wildlife Service (USFWS) manages the Alaska Maritime National Wildlife Refuge, a portion of which would be within 10 miles of the natural gas pipeline corridor, and some refuge islands would be within 20 miles of the Amakdedori port site. These project components would not be subject to USFWS's land management jurisdiction, as the project components would be near, but not on, USFWS land. Section 3.5, Recreation, includes more information about management in the refuge.

Bureau of Land Management

The mine access road and the port access road would occur within 1 mile of, but not on, BLM-managed lands under Alternative 1. This project component would therefore not be subject to BLM's land management jurisdiction. The project alternatives would cross one or more ANCSA Section 17(b) easements, discussed above.

National Oceanic and Atmospheric Administration

The Kachemak Bay NERR is a state/federal partnership with the University of Alaska and the National Oceanic and Atmospheric Administration (NOAA); it was designated to promote informed management of the nation's estuaries and coastal habitats (KBNERR 2016). The pipeline compressor station would be located approximately 4 miles from the reserve and would therefore not be subject to the NOAA land management jurisdiction.

3.2.2.6 Local Management

Some communities in the project area have developed community plans including comprehensive, capital improvement, land use, strategic, transportation, vision, and other planning documents. Such planning exercises determine community goals, objectives, and management strategies for enacting public policy on transportation, utilities, land use, recreation, housing, and other topics of importance to the community. In the case of all potentially affected communities, local management plans provide guidance, but planning and permitting decision-making is exercised at the Borough level. No physical, project-related infrastructure would be developed on lands that are in local jurisdiction, but indirect effects could occur from management of some resources (such as water quality or air quality) on adjacent lands.

3.2.3 Land Use

The prevalent land uses around the EIS analysis area are fish and wildlife habitat, subsistence, and low-intensity recreational activities, which do not require developed facilities. Land development in the Bristol Bay area is generally limited to the areas in and around geographically isolated communities, fish processing facilities, and small fishing and hunting lodges. Developments include roads, airstrips, and docks.

Residential and commercial land use in the vicinity of the mine site is limited and includes the communities of Newhalen (population 230), Nondalton (population 144), and Iliamna (population 100), each located approximately 17 miles from the mine site. Use around the transportation corridor is also limited and includes the community of Kokhanok (population 173) located approximately 2 miles from the Alternative 1 port access road, or the community of Pedro Bay (population 32) located within 1 mile of the Alternative 3 transportation corridor. Many residents practice a lifestyle reliant on subsistence activities, and sport and commercial hunting, fishing, wildlife viewing, and boating also occurs in the area (DCCED 2018) (see Section 3.5, Recreation; Section 3.6, Commercial and Recreation Fisheries; and Section 3.9, Subsistence for details). There are additional mining claims near the project area filed by Northern Dynasty Minerals and other mining exploration firms. Some claims have been relinquished, while others remain active for the purposes of exploration.

Iliamna Lake is used for recreational activities, sport fishing, and subsistence activities, including fishing and seal hunting. The lake is also heavily used for transportation by boat in open water or by snowmachine when there is sufficient ice cover.

The Amakdedori port site is used for some subsistence activity, and cultural education for nearby communities. The Diamond Point port site is used for resource extraction. The transportation corridor under Alternatives 2 and 3 includes the Williamsport-Pile Bay Road, which is used for the portage of fishing boats and some cargo from Cook Inlet to the Bristol Bay fishery.

On the Kenai Peninsula, there is a higher use of the land for recreation, and scattered residential and commercial development along the Sterling Highway where the natural gas

pipeline component would cross it. The highway is traveled in all seasons, but sees particularly high use in the summer when recreation and tourism activities increase. Where the natural gas pipeline corridor would cross Cook Inlet, the water is used for transportation, barging, boating, commercial fishing, recreational and subsistence fishing, sightseeing, and provides habitat for fish and wildlife.

This page intentionally left blank.

3.3 NEEDS AND WELFARE OF THE PEOPLE – SOCIOECONOMICS

This section addresses the monetized economy of the communities most likely to be affected by the proposed project. In addition to jobs involving labor for wages, subsistence activities are an indispensable component of the socioeconomic system of rural Alaska communities. Although subsistence frequently involves no monetary exchange, the addition of food procured by hunting and fishing can be a significant contributor to household and community welfare. In addition, employment can provide income necessary to support subsistence harvest activities. Subsistence activity and the importance of subsistence as it relates to income and its support in stabilizing communities during economic downtimes are discussed in Section 4.9, Subsistence. Similarly, cultural ties to the area can impact the socioeconomic welfare of a community. The sociocultural dimensions are discussed in Section 3.9, Subsistence and Section 3.7, Cultural Resources.

The Environmental Impact Statement (EIS) analysis area for this section includes the State of Alaska, regions, and communities where aspects of the monetized economy, including population, employment, income, housing, and education, would be impacted by the construction, operation, and closure of all components of each alternative of the proposed project. Specific communities are listed in Table 3.3-1.

Table 3.3-1: Population Characteristics of Affected Communities

Area	Population[1]			Age[2]				Gender[2]	
	2010	2018	Change 2010-2018	Under 18	18-64	65 and Over	Median Age	Male	Female
Lake and Peninsula Borough	1,631	1,663	2.0%	28%	64%	8%	32.3	51%	49%
Igiugig	50	52	4.0%	37%	54%	9%	29.0	39%	61%
Iliamna	109	102	-6.4%	29%	63%	8%	34.8	48%	52%
Kokhanok	170	168	-1.2%	28%	64%	8%	28.1	50%	50%
Levelock	69	81	17.4%	38%	52%	10%	24.5	44%	56%
Newhalen	190	214	12.6%	39%	58%	3%	25.3	54%	46%
Nondalton	164	129	-21.3%	26%	68%	6%	31.8	48%	52%
Pedro Bay	42	33	-21.4%	0%	83%	17%	57.3	56%	44%
Port Alsworth	159	227	42.8%	46%	49%	5%	18.9	44%	56%
Dillingham Census Area	4,847	5,021	3.6%	31%	61%	8%	30.1	52%	48%
Dillingham	2,329	2,382	2.3%	30%	60%	10%	31.6	49%	51%
Ekwok	115	106	-7.8%	25%	61%	14%	28.3	48%	52%
Koliganek	209	205	-1.9%	34%	57%	9%	26.6	52%	48%
New Stuyahok	510	496	-2.7%	39%	53%	8%	24.8	58%	42%
Kenai Peninsula Borough	55,400	58,471	5.5%	23%	62%	15%	40.6	52%	48%
Bristol Bay Borough	997	879	-11.8%	23%	67%	10%	41.8	58%	42%

Table 3.3-1: Population Characteristics of Affected Communities

Area	Population[1]			Age[2]				Gender[2]	
	2010	2018	Change 2010-2018	Under 18	18-64	65 and Over	Median Age	Male	Female
Anchorage	291,826	295,365	1.2%	25%	66%	9%	33.1	51%	49%
Alaska	710,231	736,239	3.7%	25%	65%	10%	33.9	52%	48%

Source: [1]ADOL 2019; [2]USCB 2018

3.3.1 Regional Setting

3.3.1.1 Overview of the State and Regional Economy

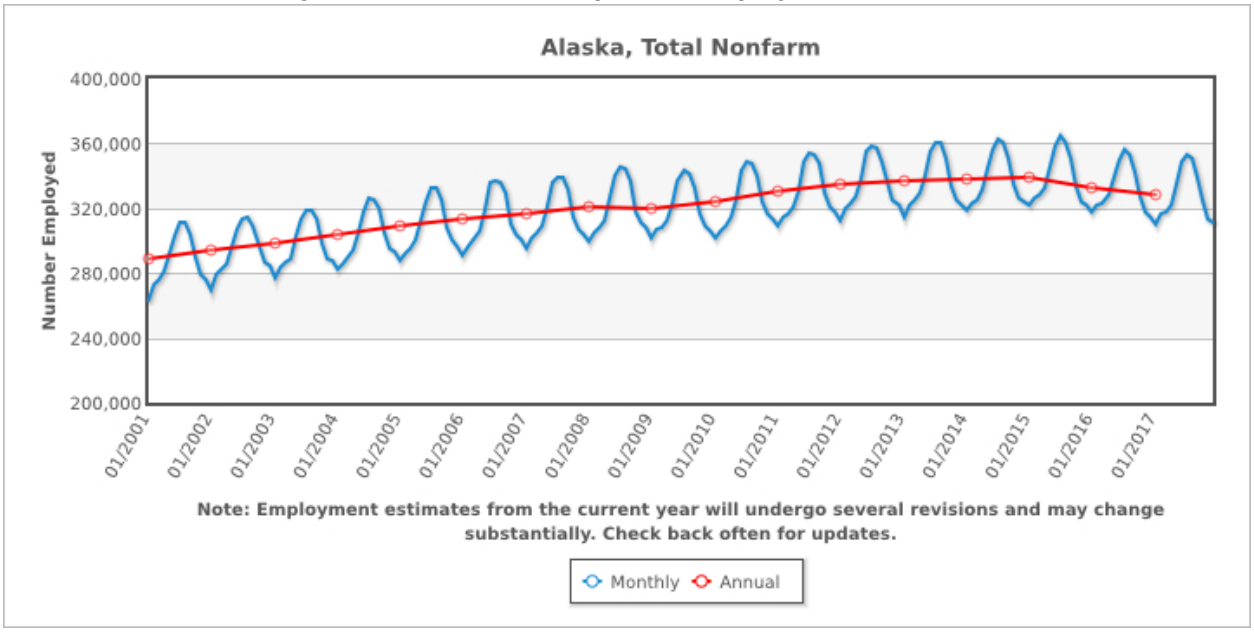
The State of Alaska relies on revenue from natural resource extraction as a primary source of income. Alaska collects oil and gas production taxes and royalties based on the assessed value of the gross product. The state also receives production royalty payments from production of minerals on a state mining claim or state lands; state and local governments also collect and share property tax on facilities built to support resource development.

Alaska has a long history of boom-bust cycles associated with resource extraction (e.g., oil and gold) that have impacted this tax revenue and the state economy. To help smooth revenue and investments, the State of Alaska established the Alaska Permanent Fund (APF), which was incorporated into the Alaska constitution in 1977. The APF is a permanent natural resource trust fund used to pay citizen dividends, manage inflation, and support the general fund. To support the fund, a percentage of the State's income from mineral extraction is placed in the APF. As of August 2017, the APF had a market value of $60 billion (USDOI 2018).

Local communities and regions can also experience boom-bust cycles related to projects that occur in their area. These cycles can occur from the influx of workers and income during the construction cycle, to the more moderate employment during operations, to the loss of a major employer in the area after closure. In Alaska as a whole, recent recessions have more typically been triggered by a drop in oil prices, resulting in slowdown of spending in the oil industry and a drop in state revenues. With regard to the mining industry, cyclical metal prices can affect mining industry investment. However, most of the large operating mines in Alaska have been successful in finding additional reserves adjacent to their mine, extending their operating life and postponing a potential "bust" cycle.

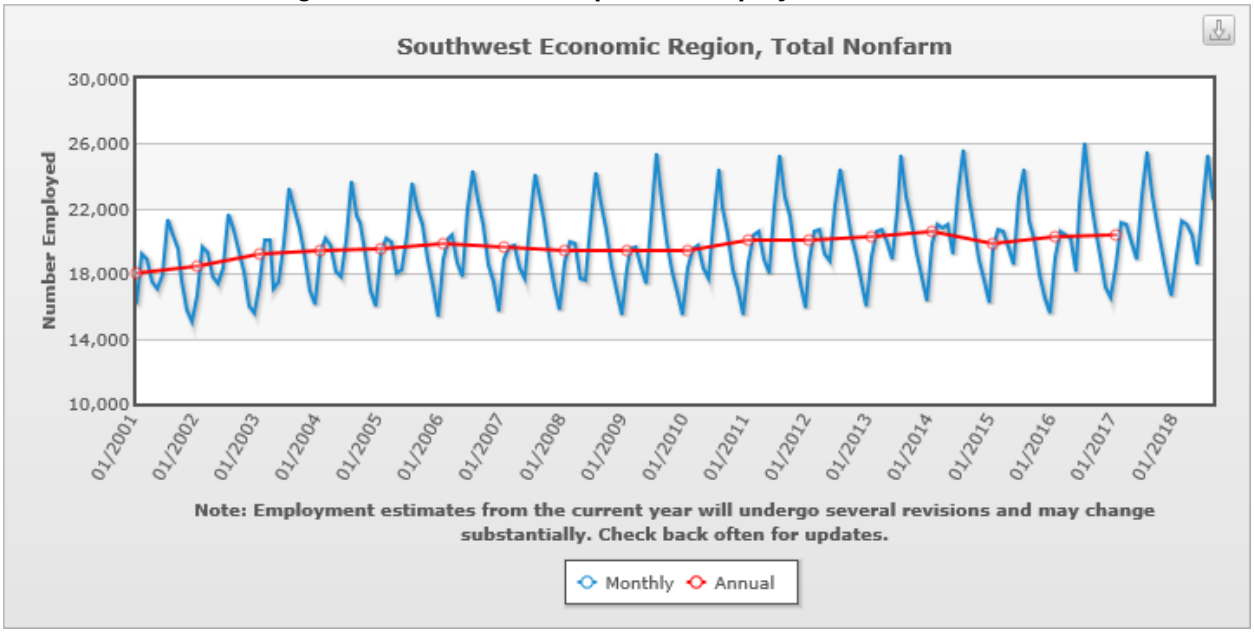
Regardless of any boom-bust cycles, employment in Alaska varies greatly throughout the year. Many of the jobs in Alaska are seasonal, leading to large fluctuation in employment between the summertime peaks and the wintertime lows. Figure 3.3-1 and Figure 3.3-2 show the cyclical characteristic of seasonal employment in Alaska and the Southwest Economic Region, respectively. Much of the seasonal employment is related to the commercial fishing and tourism industries. Some workers with year-round employment also participate in seasonal work activities. Subsistence activities can co-exist with, and help stabilize, the effects of seasonal employment.

Figure 3.3-1: Seasonal Impact on Employment in Alaska



Source: ADOL 2018

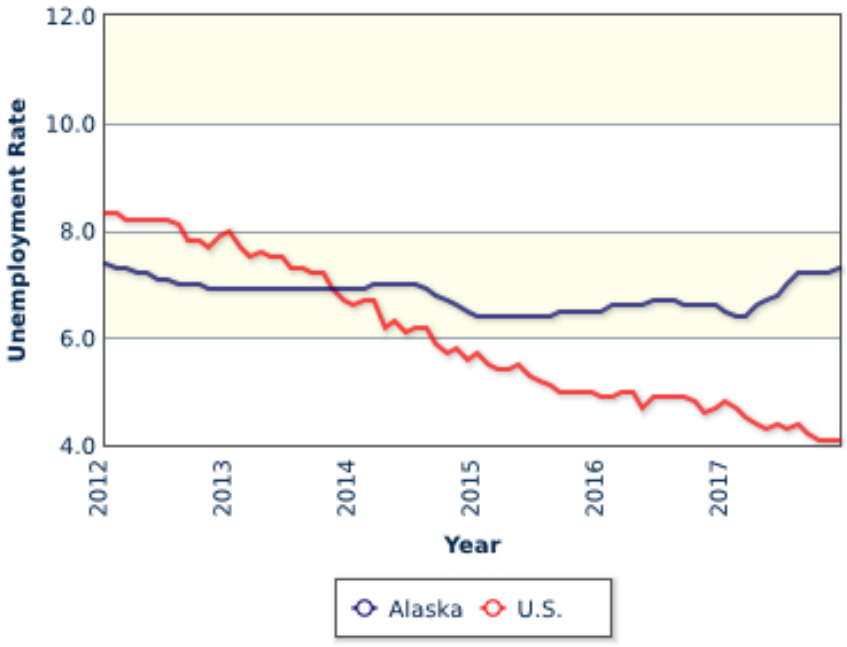
Figure 3.3-2: Seasonal Impact on Employment in Alaska



Source: ADOL 2018

Although the unemployment rate for the US as a whole has been decreasing for a number of years, the unemployment rate in Alaska has remained relatively steady, at about 7 percent (Figure 3.3-3). However, rural communities have limited employment opportunities and have unemployment rates that are generally higher than the statewide average.

Figure 3.3-3: Recent Trends in Unemployment Rate



Source: ADOL 2018

With regard to the economies of the portions of Alaska potentially affected by development of the project, there are three distinct profiles. The area on the eastern side of Cook Inlet, Anchorage and the Kenai Peninsula Borough (KPB), generally have a more diverse economy, although there is still some seasonality in employment. The lower area of the Dillingham Census Area and coastal portions of the Lake and Peninsula Borough (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; they are more typical of small roadless rural Alaskan communities, with economic activities limited to local government, Alaska Native organizations, and some support of commercial recreation and tourism. Refer to Section 3.6, Commercial and Recreational Fisheries, for more information.

Southern Kenai Peninsula Borough

In relation to more rural Alaskan communities, the Kenai Peninsula Borough's economy is more diverse, with a mix of emerging and established industries. The top five performing industries by total employment are health care and social services, local government, retail trade, accommodations and food services, and commercial fishing; while the top two industry categories by employee wages are utilities and oil, gas, and mining. In 2016, Kenai Peninsula workers earned over $3 billion in wages (KPB 2017).

While the oil and gas sector provides significant employment and revenue to the borough, non-oil and gas mining only represents a small portion of the economic activity, accounting for less than 0.2 percent of the Kenai Peninsula's total private employment and wages (KPB 2017). Seasonal fluctuations in employment affect many of the other industry sectors, including tourism and hospitality, commercial fishing, and construction.

Lake and Peninsula Borough

As noted in the LPB Comprehensive Plan Update (LPB 2012), there are three primary components of the economy:

1. **Commercial Fishing.** Portions of both the Lake and Peninsula Borough are part of the world-renown Bristol Bay fishery. Residents living in the region participate in the fishery to a varying degree through commercial fishing, as well as through support of commercial and sport fishing. Commercial fisheries permit holders residing in the Lake and Peninsula Borough have steadily decreased over the last 30 years as permits have transferred out of region, although the value of permits and fish caught has held steady. Commercial fishing continues to be a major way of living for some residents in the region, and constitutes over half of all self-employed workers. See Section 3.6, Commercial and Recreation Fisheries, for more information. Communities around the proposed mine site rely less on commercial fishing as an industry than those closer to Bristol Bay.
2. **Local Government.** A large percentage of employment in the Lake and Peninsula Borough is in local government, with the majority employed by the school districts and tribal governments. These jobs are important to the community because they tend to have higher pay and offer year-round employment.
3. **Other Industries and Small Businesses.** After accounting for the primary economic sectors (commercial fishing and local government), residents of the region are engaged in a range of business activities, including transportation and utilities, state government, health services, tourism, and other small businesses, although the employment opportunities in smaller communities are limited. Although the region supports a multi-million dollar sport fishing and hunting industry, a large majority of the earnings do not go to local residents. In addition, most tourism is seasonal, and the opportunities conflict with other economic sectors and activities, such as commercial fishing, construction, and subsistence.

Many communities have been exploring small business opportunities for residents to increase local employment. However, most communities in the region have too small of a population to support a single service provider, so new businesses will often have to plan for a regional market to be successful. As indicated previously, the region also engages heavily in subsistence activities.

Dillingham Census Area

Dillingham Census Area's economic base is highly seasonal, and predominantly driven by the harvest and processing of Bristol Bay sockeye salmon, which has been a dominant influence on the local culture and economy for over 130 years (City of Dillingham 2010). The region has three onshore salmon processing facilities and several floating facilities/processors (SWAMC 2018). For more information on commercial fishing employment and income, see Section 3.6, Commercial and Recreational Fisheries. In general, wild resources continue to be the economic engine of the area, whether for commercial, subsistence, or recreational purposes. Many communities in the region are heavily involved in subsistence activities (City of Dillingham 2010).

Local government provides employment in regional communities such as Dillingham, King Salmon, and Naknek, and in smaller communities. The City of Dillingham is the largest community in the Dillingham Census Area and is the center of economic, transportation, government, and public services. King Salmon also benefits from federal employment associated with the National Park Service (NPS), US Fish and Wildlife Service (USFWS), and

other agencies. Commercial fishing, fish processing, cold storage, and support of the fishing industry are the primary sectors that sustain the economy of the area (SWAMC 2018).

3.3.1.2 Overview of the Cost of Living

In general, the cost of living in Alaska is higher than most areas of the US. In 2017, Alaska was ranked as the third most expensive state based on the costs of living in the four largest Alaskan cities (i.e., Anchorage, Juneau, Fairbanks, and Kodiak), which were all well above the national average. Although fuel costs have been decreasing in recent years, health care premiums increased 29 percent from 2016 to 2017. Alaska has the highest health care premiums (purchased on the open market) of any state (ADOL 2017a).

Although taxes tend to be lower in Alaska, the cost of transportation, food, energy, and fuel is higher. Transportation is one of the main reasons the costs of living are higher in Alaska (ADOL 2017a, 2008), which is compounded in rural areas. Getting food, fuel, and other goods to Alaska is a little more expensive than other parts of the US, and then the items need to be transported over a large geographic area to small population clusters. In some communities, staple goods, such as food and fuel, cost over twice as much as they do in Anchorage because the items need to be transported by barge or air. Costs were found to be highest in communities served by air and seasonally by barge. In the LPB, the cost of fuel has been historically higher in Iliamna Lake communities, and population decline is partly driven by an increasingly high cost of living in remote communities (LPB 2012). In Igiugig, for example, the 2018 fuel price per gallon was $6.75 for home heating oil, $7.76 for gasoline, and $10.17 for propane (McDowell 2018a).

Although the cost of living can be high in rural communities, subsistence hunting and fishing supplements the needs of families and communities. However, supporting subsistence hunting and fishing activities can be expensive in rural communities because of the higher cost of supplies, such as fuel, ammunition, and vehicles, and employment provides needed income to support subsistence.

3.3.1.3 Overview of the Regional Infrastructure

The following sections provide a brief overview of the infrastructure in Alaska, with a focus on the region surrounding the potential mine site.

Education

Alaska is composed of 54 school districts (ADEED 2018), which serve about 143,000 students. For fiscal year 2015, the National Center of Education Statistics reported that Alaska has one of the highest expenditures per pupil (NCES 2018). Alaska spent $2.9 billion on education, with a per pupil expenditure of $20,191, 76 percent higher than the national average of $11,454.

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. Because schools are often the largest electricity customer, the closing of a school leaves fewer customers to support the electricity network, and can lead to higher energy prices for the residents of the community (LPB 2012).

Opportunities for higher education in Alaska exist through a number of colleges and universities throughout the state, including five 2-year community colleges, three primary branches of the University of Alaska, and four private institutions. In addition, through the Western

Undergraduate Exchange, residents of Alaska can attend colleges and universities at participating schools in 16 states and US territories, and pay no more than 150 percent of the in-state tuition.

Lake and Peninsula Borough. The LPB School District has 13 public schools, from Port Alsworth in the north to Perryville in the south. However, a number of Lake and Peninsula Borough communities are facing population loss and potential school closings; the Dena'ina school in Pedro Bay closed in November 2010 (LPB 2012). Although communities have local road systems, only Iliamna and Newhalen (and Nondalton, seasonally) are connected by road and have a common school, which makes it impossible to combine schools in other communities facing population decline.

Bristol Bay Borough. The Bristol Bay Borough School District is composed of the elementary and middle/high school in Naknek (total enrollment 118). Although communities have local road systems, only King Salmon and Naknek are connected by road and have a common school.

Dillingham Census Area. The Southwest Region School District has seven public schools with a total enrollment of 705 students (SRSD 2009), from Manokotak in the south to Koliganek in the north. The Dillingham City School District had a total enrollment of 473 in 2016/2017. Although communities have local road systems, only Aleknagik and Dillingham are connected by road, but each have their own schools.

Transportation

Most Alaskan communities have local roads, but approximately 82 percent of these communities have no connection to the contiguous road system or interregional roads (ADOT&PF 2018a). With small populations in remote, scattered locations, the per-capita costs of building and maintaining transportation infrastructure is high, and building new roads to connect the communities is unlikely. Alaska will continue to rely on a combination of air, road, and marine transportation to serve the population. Brief descriptions of these modes of transportation are provided below. See Section 3.12, Transportation and Navigation, for more information on the existing transportation systems.

Air

Large portions of Alaska are only accessible by air or water. These communities depend on aviation for access to non-subsistence foods, mail, and health care. The people of Alaska are eight times more likely to use aviation as transportation than people in the rest of the US (ADOT&PF 2018a). Aviation in Alaska is a huge economic engine, contributing approximately $3.5 billion annually to the state's economy.

Most communities in the region rely on air transportation for movement of people and goods into and within the region. Iliamna Airport is the primary air transportation hub for the region near the mine site, and Dillingham is a hub for the lower river communities; Port Alsworth and King Salmon are also important hubs for the region. Scheduled air service provides transportation of passengers to the regional hubs, while air taxis and charter service transport passengers from the hubs to local communities. For most of the year, air cargo is the only means of transporting goods to many of the communities in the area, including heating fuel (McDowell Group et al. 2011a). In addition to serving local communities, small aircraft provide primary transportation associated with recreation and tourism activities, including sport hunting and fishing, wildlife viewing, and visitation to federal and state parks and reserves.

Road

The ADOT&PF maintains 5,609 centerline miles of highways, 3,737 miles of which are paved. The highway system provides connectivity for freight and travel from the lower 48 states through Canada into Alaska; and from Alaska's economic hub, Anchorage, to those communities that are connected to the road system, which includes the southern Kenai Peninsula portion of the area affected by the Pebble Project. These hub towns and cities are the main population centers spread across the state, where goods are typically shipped to reach more remote communities by road, marine, and air transportation (ASCE 2018). However, the Bristol Bay region and the project area on the western side of Cook Inlet are not connected to the southcentral Alaska road system.

Surface transportation between villages is primarily done on trails on snowmachines or all-terrain vehicles, and most villages have local road systems. Village and rural roadways consist mainly of unpaved roads, walkways, trails, and boardwalks in areas outside of Alaska's hub towns. Local roadways in rural areas are typically maintained by local village governments and regional native corporations. The roads, walkways, trails, and boardwalks are of importance to community members because they serve as routes to health care facilities, schools, airports, and in some cases, subsistence hunting and fishing locations (ASCE 2018).

In the immediate study area, the Iliamna/Newhalen area has the most extensive local road system in the areas near the mine site. King Salmon/Naknek and Dillingham have a relatively extensive road network for the lower river communities. Elsewhere, road systems and vehicle use are limited (McDowell Group et al. 2011a).

In addition to community-based road systems, the Williamsport-Pile Bay Road provides access between Cook Inlet and Bristol Bay, via a 15-mile road to Iliamna Lake and down the Kvichak River. This road allows summer season transportation of fishing vessels bound for Bristol Bay commercial fisheries, as well as some goods and supply transport to lake and river communities. The road is owned and maintained by the State of Alaska.

Section 3.12, Transportation and Navigation, includes more information on local road systems.

Marine

Ports and harbors across Alaska provide services that support critical economic activities. These facilities play a vital role in the communities they serve by providing bulk goods and services and local employment opportunities; promoting economic diversification and transhipping Alaska products such as seafood; and supporting cultural and subsistence lifestyles. In 2015, 40.8 million tons of goods were moved out of the state and 3.4 million tons of goods into the state via marine transport. Ports and harbors are also critical to the Alaska commercial fishing industry, which supports six of the top ten fishing ports by volume in the US (ASCE 2018).

Many of the communities in the region can be seasonally accessed via water to deliver cargo, such as fuel and other objects too heavy or bulky to ship by air. Many of the regional communities are on Iliamna Lake, which can be accessed from the Kvichak River and the Williamsport-Pile Bay Road. However, Kvichak River access has been hindered due to low water levels and shoaling (McDowell Group et al. 2011a).

In addition to commercial marine traffic, personal watercraft, particularly skiffs, are a major means of travel to subsistence activities and travel between communities during the open water season on lakes and rivers. During the period when ice allows safe travel, snowmachines provide similar access. Refer to Section 3.12, Transportation and Navigation, for more information.

Health Services

Public health services are available in communities in the EIS analysis area, but may be limited in the smaller communities. In general, healthcare services include only small clinics operated by regional providers, including Bristol Bay Area Health Corporation and the Anchorage-based Southcentral Foundation. Because of easier access to Anchorage, many of the residents in the Iliamna and Lake Clark communities receive hospital care in Anchorage. Many residents in the Bristol Bay area receive hospital care in Dillingham (McDowell Group et al. 2011a).

The Bristol Bay Area Health Corporation is a regional provider that operates a hospital, sub-regional clinics, and village clinics in the Bristol Bay region. Health clinics are also supported by the boroughs. In addition, state and federal agencies have special responsibilities to support health care for Alaska Natives (McDowell Group et al. 2011a). See Section 3.10, Health and Safety, for additional information on health services.

Water, Sewer, and Solid Waste

Alaska's water and wastewater systems can be generally divided into two categories: municipal, and rural. Most municipal systems that serve more densely populated areas have long-term operations, maintenance staff, and funding. The state has over 280 rural communities, 31 of which have no centralized water or wastewater system. For those rural communities that have water and wastewater systems, operating and maintaining systems are challenged by the high cost of energy, lack of population to support higher-than-average maintenance costs, and a shortage of experienced operators to maintain the systems (ASCE 2018).

Many of the unincorporated communities have water and/or sewer systems funded through the Alaska Native Tribal Health Consortium and the State's Village Safe Water Program. The Alaska Department of Environmental Conservation (ADEC) administers the Village Safe Water Program, which is working with rural communities to develop sustainable sanitation facilities. Many of the water and sewer improvements depend on federal funding (KPB 2017).

In rural Alaska, community water and sewer systems are primarily composed of four types: washeterias and central watering points; individual wells and septic systems; water and sewer truck or trailer haul systems; and piped water and sewer systems. There are no unserved communities in the study area (ADEC 2018a).

In the EIS analysis area, water systems are present in:

- Igiugig
- Iliamna
- Kokhanok
- Levelock
- Nondalton
- Newhalen
- Port Alsworth

Limited road access makes dealing with solid waste a challenge. Most waste must be disposed of in the community, unless it can shipped out, which is expensive. Many rural communities have local facilities such as landfills, incinerators, or burn boxes to handle solid waste. The ADEC supports many landfill facilities (ASCE 2019).

3.3.2 Potentially Affected Communities

Construction and operation of the proposed mine would have impacts to local and regional socioeconomic conditions. This section provides information about the current socioeconomic conditions of potentially affected communities. Potentially affected communities were identified based on potential impacts from any of the major components of the proposed project. The following subsections describe the general social and economic characteristics of the potentially affected communities. For additional information on each community, see McDowell Group 2018a.

3.3.2.1 Population

Table 3.3-1 presents population characteristics of the affected communities. Many of the potentially affected communities in the LPB (where the mine would be located) are relatively small. Although some communities have seen an increase in population from 2010 to 2018, others have decreased. Refer to Section 3.4, Environmental Justice, for the racial characteristics of the potentially affected communities.

Table 3.3-2 shows the population projections through 2045 at the borough and state level. The population of the LPB through 2045 is not projected to increase by much, whereas the population for Alaska is projected to increase about 22 percent by 2045. The Dillingham Census Area would see a modest increase, whereas the Bristol Bay Borough is projected to decrease by 34 percent.

Table 3.3-2: Population Projections for EIS Analysis Area

Area	2018[1]	2025[2]	2035[2]	2045[2]
Lake and Peninsula Borough	1,663	1,708	1,720	1,751
Dillingham Census Area	5,021	5,289	5,556	5,984
Kenai Peninsula Borough	58,471	62,845	66,271	68,423
Bristol Bay Borough	879	790	675	581
Anchorage	295,365	318,629	330,821	339,171
State of Alaska	736,239	802,352	854,104	899,825

Source: [1]ADOL 2019; [2] ADOL 2016

3.3.2.2 Economy and Income

The median household income and unemployment vary across the affected communities (Table 3.3-3). Iliamna had the highest median household income of $93,750 of the communities reviewed, while the community of Levelock had the lowest, at less than $25,000 (note that there is a substantial margin of error in some cases). In comparison, the median household income for Alaska is approximately $76,000, and $58,000 for the US. The unemployment rate also varied across the affected communities, from a low of zero percent in some communities, to a high of almost 31 percent in Kokhanok. In addition to household income, subsistence contributes to the mixed-cash economy of the region; the importance of subsistence as it relates to income is discussed in Section 3.9, Subsistence.

Table 3.3-3: Median Household Income and Unemployment Rate of Affected Communities

Area	Median Household Income (margin of error)	Unemployment Rate (margin of error)
Lake and Peninsula Borough	$45,208 ($3,882)	13.2% (2.6%)
Igiugig	$48,750 ($29,077)	0.0% (46.4%)
Iliamna	$93,750 ($28,620)	6.1% (6.0%)
Kokhanok	$41,250 ($24,297)	30.8% (7.5%)
Levelock	$25,000 ($17,803)	16.3% (8.5%)
Newhalen	$36,250 ($18,127)	8.0% (7.2%)
Nondalton	$38,750 ($11,951)	25.0% (11.9%)
Pedro Bay	$53,750 ($8,466)	18.2% (21.2%)
Port Alsworth	$86,667 ($12,567)	1.3% (3.2%)
Dillingham Census Area	$58,708 ($5,073)	11.4% (1.7%)
Dillingham	$75,764 ($8,256)	5.1% (1.7%)
Ekwok	$28,750 ($6,988)	39.5% (20.7%)
Koliganek	$53,750 ($20,943)	11.1% (9.6%)
New Stuyahok	$43,750 ($8,768)	23.8% (6.0%)
Kenai Peninsula Borough	$65,279 ($2,335)	8.6% (1.0%)
Bristol Bay Borough	$79,500 ($10,833)	6.8% (3.0%)
Anchorage	$82,271 ($1,398)	5.8% (0.4%)
Alaska	$76,114 ($979)	7.7% (0.2%)

Note:
Because of the small sample size in smaller communities, the values reported by the US Census Bureau may be misleading (i.e., may show large differences between communities that may not exist). Therefore, margin-of-error values are presented to show the potential range of the reported values.
Source: USCB 2018

In many of the communities, the employment of local residents in the potentially affected communities relies heavily on the local government and education and health services industry sectors. Trade/transportation/utilities (26 percent in Port Alsworth) and professional/business services (17 percent in both Iliamna and Newhalen) can also be a major employer in some communities. The local government industry sector accounted for the greatest percentage of employees for all of the communities in the LPB, which is where the mine would be located. State and local government jobs are particularly important to these small communities, because they are often year-round and relatively high paying. Although federal government employment is not included in the table below, it generally represents a small percentage of the average monthly employment (i.e., less than 5 percent in the LPB, and less than 2 percent in the Dillingham Census Area).

The commercial salmon fishery provides a large number of seasonal employment opportunities in the harvesting and processing sectors. However, these opportunities vary with location in the area potentially affected by the Pebble Project, with more opportunities available in the Dillingham and Naknek areas compared to communities up the Kvichak River and on Iliamna Lake. In addition, with the outmigration of commercial salmon permits and the nature of the processing industry, some of these opportunities are filled by residents from outside the region

and state. Details on commercial fishing are discussed in Section 3.6, Commercial and Recreational Fishing.

As stated previously, a large proportion of households in the EIS analysis area participate in subsistence activities and depend on the wild food resources procured by hunting and fishing. Details for each community are included in Section 3.9, Subsistence.

3.3.2.3 Housing

In the EIS analysis area, the housing stock consists primarily of single-family detached homes, which account for over 90 percent of the housing units (USCB 2018). Of the occupied housing units, approximately two-thirds of the units are owner-occupied, while the rest are rental properties. It should be noted that throughout the EIS analysis area, many of the communities show a high percentage of vacant housing units, with some communities over 50 percent. This is likely due to a number of factors, including counting a large number of seasonal-use dwellings (e.g., camps/cabins), declining populations, and housing units that are in a state of disrepair (LPB 2012). Table 3.3-4 shows total and occupied housing units in the EIS analysis area.

Table 3.3-4: Housing Units

Area	Total Housing Units (margin of error)	Occupied Housing Units (margin of error)
Lake and Peninsula Borough	1,406 (104)	408 (104)
Igiugig	20 (8)	14 (7)
Iliamna	60 (9)	20 (10)
Kokhanok	59 (15)	43 (14)
Levelock	45 (14)	34 (11)
Newhalen	44 (12)	32 (11)
Nondalton	90 (14)	43 (14)
Pedro Bay	29 (6)	8 (6)
Port Alsworth	71 (14)	38 (14)
Dillingham Census Area	2,444 (59)	1,405 (77)
Dillingham	1,039 (69)	751 (78)
Ekwok	51 (13)	28 (11)
Koliganek	61 (10)	51 (11)
New Stuyahok	140 (21)	112 (20)
Kenai Peninsula Borough	31,016 (135)	21,779 (421)
Bristol Bay Borough	941 (40)	358 (37)
Anchorage	115,748 (203)	106,012 (864)
Alaska	313,937 (249)	252,536 (1,271)

Note:
Because of the small sample size in smaller communities, the values reported by the US Census Bureau may be misleading (i.e., may show large differences between communities that may not exist). Therefore, margin-of-error values are presented to show the potential range of the reported values.
Source: USCB 2018

3.3.2.4 Education

Education is provided through state and local funding, through school districts in existing borough governments or areas outside those boroughs. In general, communities in the EIS analysis area have a high school graduation rate above 80 percent, and those with bachelor's degrees or higher ranges from 10 to 25 percent (Table 3.3-5). The graduation rates and number of those holding a bachelor's degree or higher, are higher in more densely populated areas, such as Anchorage and KPB. In comparison, across the US, the high school graduation rate is approximately 87 percent, and about 30 percent have a bachelor's degree or higher. As indicated previously, declining populations threaten the ability to keep schools open in some communities, particularly in the LPB.

Table 3.3-5: Education Characteristics of Potentially Affected Communities

Area	School Enrollment Pre-K – 12[1]	High School Graduate or Higher[2]	Bachelor's Degree or Higher[2]
Lake and Peninsula Borough	343	88%	16%
Igiugig	19	86%	21%
Iliamna	Included with Newhalen	97%	19%
Kokhanok	34	81%	8%
Levelock	22	83%	2%
Newhalen	67	90%	17%
Nondalton	26	85%	11%
Pedro Bay	0	100%	11%
Port Alsworth	62	99%	49%
Dillingham Census Area	1,092	86%	17%
Dillingham	483	91%	22%
Ekwok	15	69%	0%
Koliganek	56	83%	20%
New Stuyahok	141	78%	3%
Kenai Peninsula Borough	9,027	93%	24%
Bristol Bay Borough	128	93%	20%
Anchorage	47,624	93%	35%
Alaska	133,381	92%	29%

Sources: [1]ADEED 2018; [2]USCB 2018

This page intentionally left blank.

3.4 ENVIRONMENTAL JUSTICE

The affected environment for environmental justice includes definitions of minority and low-income populations; a discussion of race, ethnic origin, and a discussion of the relationship between environmental justice and subsistence resources, socioeconomics, cultural resources, and community health. The Environmental Impact Statement (EIS) analysis area for this section includes the EIS analysis areas described in Section 3.3, Needs and Welfare of the People—Socioeconomics, Section 3.9, Subsistence, and Section 3.10, Health and Safety. This includes the six Iliamna Lake communities that would be most impacted economically and through subsistence resources by project, and regional communities in the Bristol Bay area who may experience economic impacts from the project.

3.4.1 Definitions of Minority and Low-Income Populations

Executive Order 12898 (1994) requires federal agencies to identify and address disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority communities and low-income populations. 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 the 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.

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 by the Council on Environmental Quality (CEQ) (CEQ 1997). Historically, minority and low-income populations have suffered a greater share of adverse environmental and health impacts related to industry and development projects relative to the benefits. In addition, impacts to Alaska Native populations may be different from impacts on the general population due to a community's distinct cultural practices (CEQ 1997). Therefore, agencies would consider impacts to subsistence and sociocultural characteristics as a component of the environmental justice analysis.

3.4.2 Minority and Low-Income Populations

The project's potentially affected population includes those who live, work, or subsist in the EIS analysis area. Table 3.4-1 presents available community-level racial and ethnic characteristics as well as the percent living below the poverty level for the population in the EIS analysis area that would be affected during construction and operations of the mine site, transportation corridor, port, and natural gas pipeline for all alternatives. Figure 3.4-1 shows minority and low-income communities in the EIS analysis area.

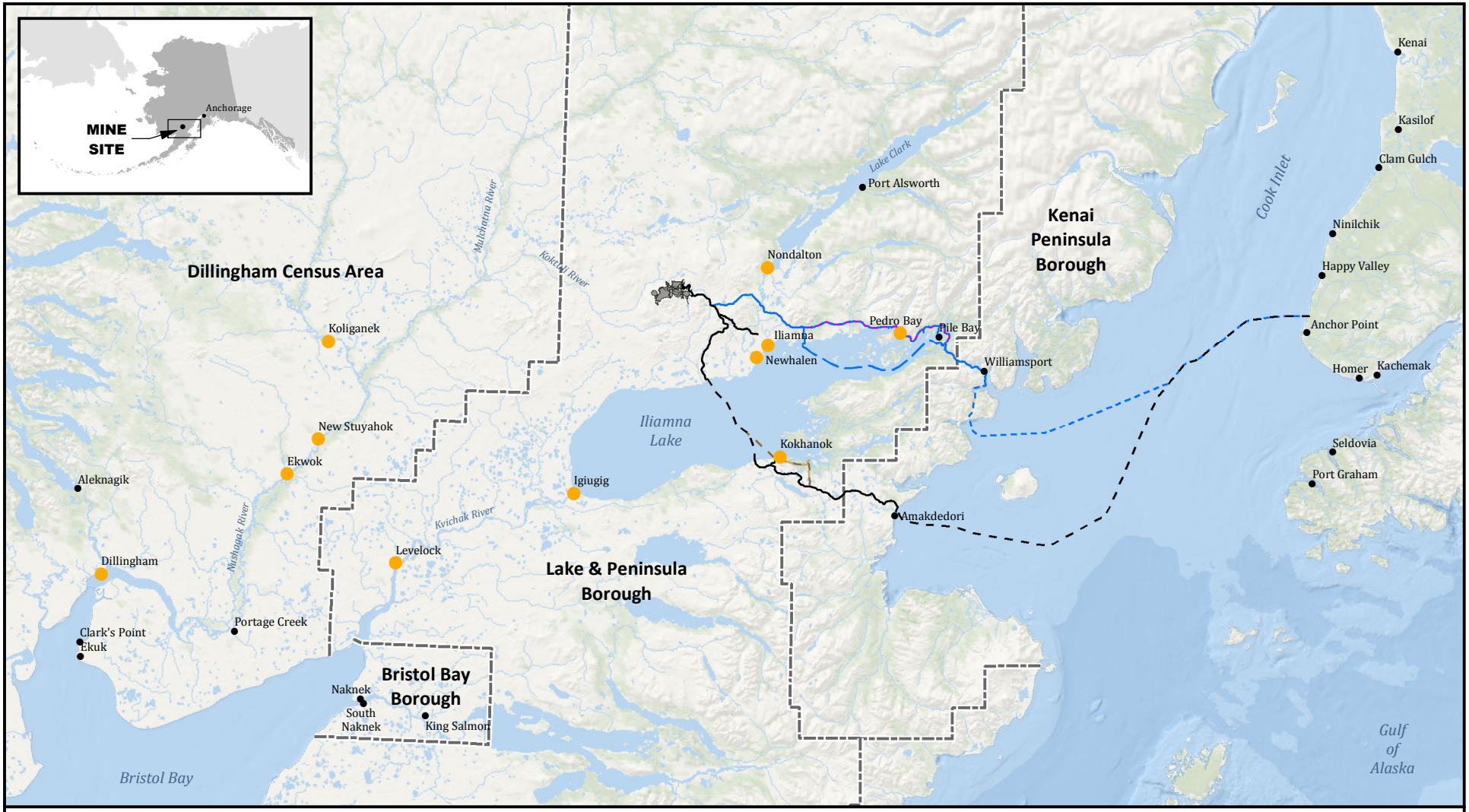
Data in this section were obtained from the US Census Bureau 2013-2017 American Community Survey (ACS). Estimates from the ACS are all "period" estimates that represent data collected over a period of time (as opposed to "point-in-time" estimates, such as the decennial census, that approximate the characteristics of an area on a specific date). The primary advantage of using multi-year estimates in this analysis of low-income populations is the increased statistical reliability of the data for less populated areas and small population subgroups. Statistics for the State of Alaska are provided as a reference.

Table 3.4-1: Ethnicity, Racial, and Poverty Characteristics of the EIS Analysis Area, 2017 (Percent of Total Population)

	White[1]	Black or African American[2]	Alaska Native and American Indians[2]	Asian[2]	Native Hawaiian and Other Pacific Islander[2]	Some Other Race[2]	Hispanic or Latino[3]	Total Minority	Living bleow Poverty Threshold
Lake and Peninsula Borough	22.4	0.7	67.6	2.2	.02	0.2	1.5	70.7	16.5
Igiugig	10.9	0	89.1	0	0	0	2.2	89.1	2.2
Iliamna	16.9	0	75.4	0	0	0	0	75.4	15.4
Kokhanok	8.1	0	91.9	0	0	0	1.3	91.9	24.3
Levelock	2.1	0	97.9	0	0	0	101	97.9	26.3
Newhalen	9.6	0	82.5	0	0	0	7.0	82.5	17.7
Nondalton	13.6	0	73.6	0	0.9	1.8	0	73.6	29.1
Pedro Bay	16.7	0	50.0	0	0	0	0	50.0	0.0
Port Alsworth	68.8	0.6	10.2	0	0	0	0	10.8	3.3
Kenai Peninsula Borough	83.6	0.5	7.3	1.5	0.3	0.7	4.0	9.6	11.0
Bristol Bay Borough	52.0	0.4	34.6	1.4	0.3	2.3	4.5	36.7	7.1
Dillingham Census Area	17.5	0.4	72.9	1.5	0	0.7	3.1	74.8	16.6
Dillingham	28.0	0.8	56.5	1.4	0	1.4	6.7	58.7	9.7
Ekwok	0	0	100	0	0	0	0	100	39.1
Koliganek	9.4	0	82.9	0	0	0	0	82.9	10.6
New Stuyahok	0.4	0	97.3	0	0	0	0	97.3	24.2
Anchorage Municipality	63.7	5.5	7.3	9.3	2.4	2.2	8.9	24.5	8.1
State of Alaska	65.3	3.2	14.2	6.2	1.2	1.4	6.8	24.8	10.2

Notes:
Minority population = Total population – (White, non-Hispanic population + Some Other Race Alone, non-Hispanic population).
[1] Alone, non-Hispanic.
[2] Alone or in combination with one or more other races.
[3] Of any race.
Source: USCB 2018

Most Alaskan communities tend to have a bi-modal racial structure. Most commonly, communities either have a substantial majority of the community that identify as White and other ethnic groups, or a majority that identify as Alaska Native or American Indian (Himes-Cornell et al. 2013). These trends are consistent with the EIS analysis area. As shown in Table 3.4-1, the majority of individuals in the Kenai Peninsula, Bristol Bay Borough, and Anchorage Municipality identify as White, whereas the majority of individuals in the Lake and Peninsula Borough (LPB) and the Dillingham Census Area identify as Alaska Native or American Indian.



Sources: PLP 2018; ADNR

US Army Corps of Engineers

10 0 10 20
Miles

- Minority/Low-Income Community
- Borough Boundary

Alternative 1
- Mine Site
- Transportation Corridor
- Natural Gas Pipeline

Kokhanok East Ferry Terminal Variant
- Transportation Corridor
- Natural Gas Pipeline

Alternative 2
- Transportation Corridor
- Natural Gas Pipeline
- Ferry Route

Alternative 3
- Transportation Corridor

MINORITY AND LOW-INCOME COMMUNITIES IN THE EIS ANALYSIS AREA

PEBBLE PROJECT EIS

FIGURE 3.4-1

The Kenai Peninsula Borough (KPB), Bristol Bay Borough, Municipality of Anchorage, and Port Alsworth in the LPB are not considered minority or low-income communities. Igiugig and Pedro Bay are considered minority communities but not low-income communities. Iliamna, Kokhanok, Levelock, Newhalen, Nondalton, and the Dillingham Census Area as a whole are considered both minority and low-income communities. Of these communities, Levelock, Kokhanok, and Newhalen have the largest percentage of minority individuals. Kokhanok, Nondalton, and Levelock have the highest percentage of persons below poverty level.

In addition, median incomes through communities in the region are less than half the statewide average of $76,114. High rates of the population living below the poverty level and low median income are partly based on economies being largely subsistence based, as wage employment is limited (Himes-Cornell et al. 2013). Many residents seek additional wage employment outside of their community. It should be noted that ACS data are based on wage earnings and do not take into account the value of subsistence in the local economy (see Section 3.3, Needs and Welfare of the People–Socioeconomics, for further discussion of employment and income in the EIS analysis area).

Table 3.4-2 evaluates if communities in the EIS analysis area meet the CEQ definitions of minority and low-income communities. Igiugig, Iliamna, Kokhanok, Levelock, Newhalen, Nondalton, and Pedro Bay in the LPB; Dillingham, Ekwok, Koliganek, and New Stuyahok in the Dillingham Census Area; and the Dillingham Census Area as a whole meet CEQ definition of minority and/or low-income communities. Therefore, this environmental justice analysis will consider if the project results in disproportionately high and adverse human health or environmental effects on those populations.

Table 3.4-2: Determination of Minority and Low-Income Communities with Environmental Justice

	Total Minority	Poverty Rates in excess of Poverty Rate for the State of Alaska	Meets Minority or Low-Income Definitions for Environmental Justice
Lake and Peninsula Borough	Yes	Yes	Yes
Igiugig	Yes	No	Yes
Iliamna	Yes	Yes	Yes
Kokhanok	Yes	Yes	Yes
Levelock	Yes	Yes	Yes
Newhalen	Yes	Yes	Yes
Nondalton	Yes	Yes	Yes
Pedro Bay	Yes	No	Yes
Port Alsworth	No	No	No
Kenai Peninsula Borough	No	No	No
Bristol Bay Borough	No	No	No
Dillingham Census Area	Yes	Yes	Yes
Dillingham	Yes	No	Yes
Ekwok	Yes	Yes	Yes
Koliganek	Yes	No	Yes

Table 3.4-2: Determination of Minority and Low-Income Communities with Environmental Justice

	Total Minority	Poverty Rates in excess of Poverty Rate for the State of Alaska	Meets Minority or Low-Income Definitions for Environmental Justice
New Stuyahok	Yes	Yes	Yes
Anchorage Municipality	No	No	No
State of Alaska	No	No	No

Source: Data summarized from Table 3.4-1

As stated above, impacts to Alaska Native populations may be different from impacts on the general population due to a community's distinct cultural practices; impacts associated with subsistence are a component of the environmental justice analysis. Section 3.9, Subsistence, and Appendix K3.9 describe subsistence resources, harvest, and sharing patterns for subsistence-based communities in the EIS analysis area. These communities include Igiugig, Iliamna, Kokhanok, Levelock, Newhalen, Nondalton, Pedro Bay, and Port Alsworth in the LPB, Ninilchik and Seldovia in the KPB; King Salmon, Naknek, and South Naknek in the Bristol Bay Borough; and Aleknagik, Clark's Point, Dillingham, Koliganek, Manokotak, and New Stuyahok in the Dillingham Census Area. The proportion of minority and low-income populations in the communities not listed in Table 3.4-1 are generally similar to those shown in Table 3.4-1 for the KPB, Bristol Bay Borough, and Dillingham Census Area. Other communities in the KPB and Bristol Bay Borough are not considered minority and low-income communities because there is a high proportion of White residents and the percentage of populations at income levels below the poverty level are generally low. The populations in the Dillingham Census Area are considered minority and low-income communities, with a high proportion of Alaska Native residents and a high percentage of populations at income levels below the poverty level (Himes-Cornell et al. 2013; State of Alaska 2017).

3.4.3 Relationship to Subsistence, Health, and Environment

Environmental justice analysis is an intersection between several resource topics. The relationship includes subsistence users, subsistence resources, cultural practices, socioeconomic characteristics, and community health, with a potential for both beneficial and adverse impacts. Socioeconomic impacts associated with population, housing, and employment are described in Section 3.3, Needs and Welfare of the People–Socioeconomics. Section 3.9, Subsistence, describes subsistence resources and harvest patterns for subsistence-based communities in the EIS analysis area. Project-related impacts to human health are described in Section 4.10, Health and Safety, including effects from changes in air quality and water quality, as well as concerns about contamination and subsistence food consumption. Each alternative is evaluated in Section 4.4, Environmental Justice, for possible disproportionate impacts to minority and low-income communities using the information provided in the socioeconomic, subsistence, and human health sections of this EIS; determinations are made on whether environmental justice effects would occur.

This page intentionally left blank.

3.5 RECREATION

For the purposes of this section, the Environmental Impact Statement (EIS) analysis area is defined as the area from Lake Clark National Park and Preserve south to Katmai National Park and Preserve and from the Nushagak River east to the western Kenai Peninsula. Figure 3.5-1 shows these designations and other regional recreation areas. This area is, for the most part, remote and undeveloped. These lands and waters support a wide variety of dispersed recreation activities including sport hunting, hiking, camping, and snowmachining. Due to the economic importance of fishing in this region, recreational and commercial fishing are discussed in a separate section; see Section 3.6, Commercial and Recreational Fishing, for more information. See Section 3.9, Subsistence, for information on subsistence hunting and fishing in the EIS analysis area.

3.5.1 Recreation Management

3.5.1.1 State Lands

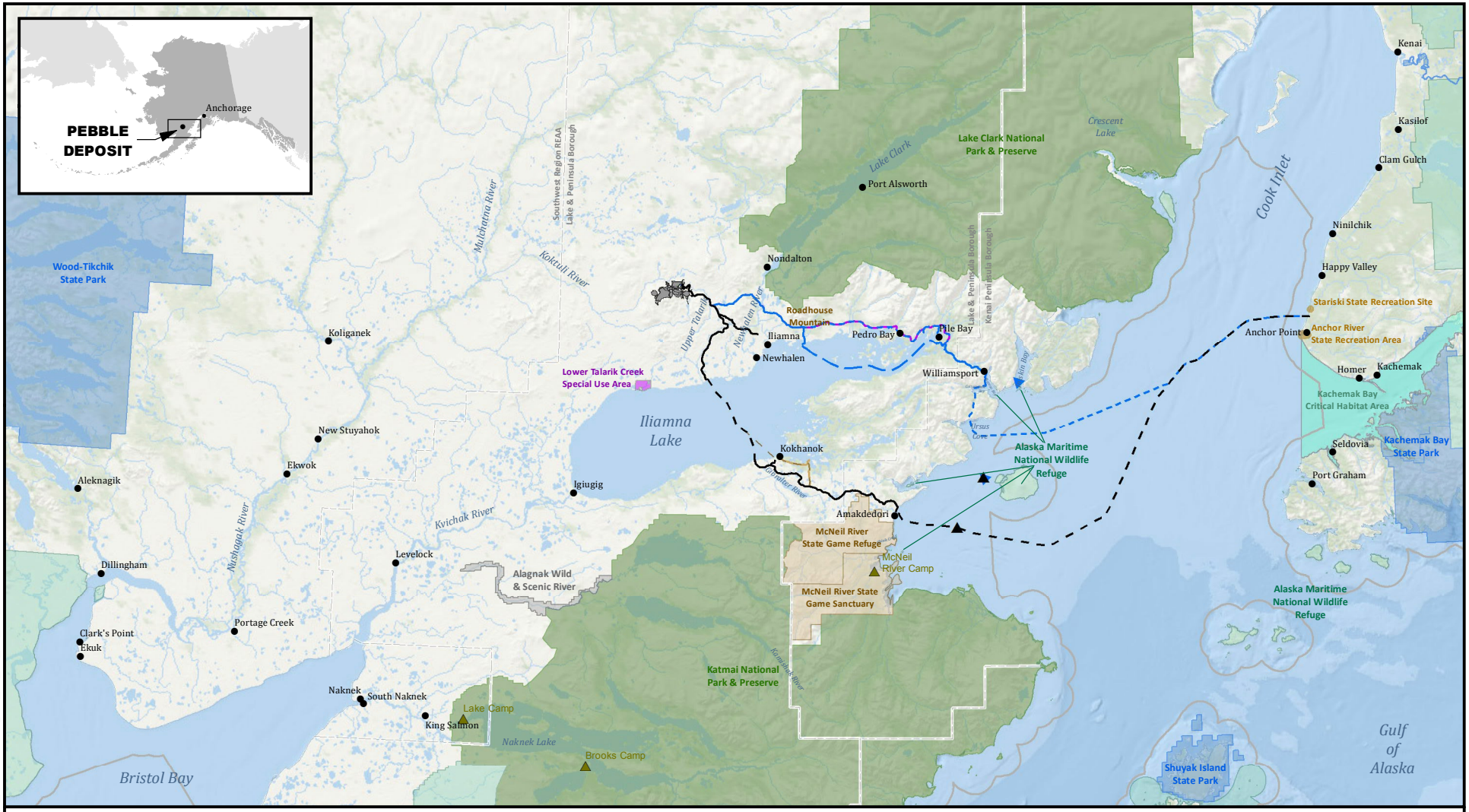
Alaska Department of Fish and Game

McNeil River State Game Refuge and Sanctuary

The McNeil River State Game Sanctuary (MRSGS) and Refuge (MRSGR) are located immediately south of the Amakdedori port site and port access road. They extend north and east from Katmai National Park and Preserve, to the shores of Kamishak Bay. The refuge portion is located north of the sanctuary. The MRSGS hosts visitor facilities (campground, visitor support buildings, trails) and a brown bear viewing program, which primarily occurs at McNeil River, Mikfik Creek, and along the coast. The MRSGR does not have any developed visitor facilities and is located north of the MRSGS. Most bear-viewing activities within the refuge occur near Chenik Creek. Guided bear viewing and private visitor bear viewing occurs during the month of July. The boundary of the refuge portion would be within 1 mile of the Alternative 1 transportation corridor (250 feet at its nearest point) and 2 miles from Amakdedori port. It would be more than 10 miles from Alternative 2 or 3 components.

The McNeil River State Game Refuge and Sanctuary were established for the purpose of preserving wildlife habitats and unique brown bear concentrations. The 2008 Management Plan includes policies that support low intensity recreational uses such as information and education, camping, boating, hunting, trapping, fishing, hiking, photography, and wildlife viewing (ADF&G 2008a).

The MRSGS is closed to all hunting and trapping, while the MRSGR is closed to brown bear hunting, but open to other hunting and trapping. Fishing is allowed in portions of the refuge and sanctuary.



Sources: PLP 2018; ADNR

US Army Corps of Engineers

10 0 10 20
Miles

Alternative 1
- Lightering Locations
- Mine Site
- Transportation Corridor
- Natural Gas Pipeline

Alt 1 Kokhanok East Variant Pipeline
- Natural Gas Pipeline
- Transportation Corridor

Alternative 2
- Transportation Corridor

Alternative 2/3
- Lightering Location
- Natural Gas Pipeline

Alternative 3
- Transportation Corridor

- Camps
- Borough Boundary
- Three Nautical Mile Line
- National Park
- National Wildlife Refuge
- Alaska State Park
- Wild and Scenic River
- State Game Refuge/Sanctuary
- Critical Habitat Area
- State Recreation
- Special Use Area

REGIONAL RECREATION AREAS

PEBBLE PROJECT EIS

FIGURE 3.5-1

Kachemak Bay Critical Habitat Area

Kachemak Bay, located south of Homer, has been designated as a State of Alaska Critical Habitat Area and a National Estuarine Research Reserve, the largest in this system of reserves (NOAA no date). The bay has year-round fish and shellfish populations and hosts tens of thousands of seabirds, shorebirds, and waterfowl in the spring, summer, and fall. The main access to the bay is from the Homer Spit, though access is also available from Seldovia and other small communities around the bay. Popular recreation activities in the bay include sport fishing and wildlife watching tours in the summer and clamming on low tides throughout the year. The area is open to most public uses without a permit (ADF&G 2018o). The Critical Habitat Boundary is southwest of Anchor Point, about 4 miles from the natural gas pipeline for all alternatives.

Alaska Department of Natural Resources

Bristol Bay Area Plan

The Bristol Bay Area Plan directs the management of state lands just inland of Cook Inlet, west to Bristol Bay. The plan includes a stated goal to provide land for accessible outdoor recreational opportunities with recreational facilities where the demand warrants. The EIS analysis area would occur in Regions 6, 8, 9, and 10 of the plan area.

In Region 6, the EIS analysis area (specifically the mine site and a portion of the transportation corridors for all alternatives) is in Unit 23 – Pebble and Unit 24 – Pebble Streams. Both of these units are designated Minerals, a designation that is given to areas associated with significant resources that may experience mineral exploration or development. A variety of general uses are allowed on state lands without a permit from the Division of Mining, Land, and Water. Such uses include hiking, backpacking, skiing, horseback riding, using a vehicle (below a certain weight depending on the type of vehicle), landing an aircraft, using watercraft, hunting, fishing, trapping, harvesting plants, recreational gold panning, hard-rock mineral prospecting or mining, and non-commercial camping (ADNR 2011). The Bristol Bay area plan states that recreational uses in the Bristol Bay area include camping, hunting, sport fishing, river excursions, and wildlife viewing, rafting, and jetboat tours. Permanent facilities related to commercial recreation are prohibited in Unit 23 (ADNR 2013a).

In Region 8, Alternatives 2 and 3 transportation corridors would be located in two units: Unit 5 – Newhalen River, and Unit 6 – Roadhouse Mountain. Unit 5 is designated as Settlement to facilitate remote recreational use and community expansion west of the Newhalen River. The Bristol Bay Area Plan also notes that there are several lakes accessible by floatplane in this unit (ADNR 2013a). Unit 6, which encompasses lands around Roadhouse Mountain, is designated as General Use to be managed for a variety of uses, including dispersed recreation. In addition, some forms of recreation use, including commercial, may be appropriate in the unit (ADNR 2013a).

In Region 9, the Alternative 1 transportation corridor southeast of Iliamna Lake would be in Unit 7 – Tommy Creek/Chigmit. Unit 7 is designated General Use and is to be managed for a variety of uses, including dispersed recreation. General Use areas are not intended for intensive forms of development other than occasional use at specific sites, usually associated with mining, oil and gas exploration, or recreation (ADNR 2013a). The Alternative 3 transportation corridor would be located in small portions of Unit 1A – Moose Wintering Areas – NE Iliamna Lake. This unit is designated Habitat and Public Recreation and Tourism – Dispersed. This unit is managed for dispersed recreation and habitat values. The joint designation of Habitat and Public Recreation and Tourism – Dispersed Use applies to navigable rivers in the region (along with

Iliamna Lake); authorizations in these waterbodies should not interfere with recreational uses or navigability (ADNR 2013a).

In Region 10, a portion of the Alternative 1 transportation corridor (north of Iliamna Lake) and a portion of the Alternatives 2 and 3 transportation corridors would be in Unit 1 – Upper Talarik Creek and Unit 2 – Pebble 2. Unit 1 is designated General Use and is to be managed for a variety of uses including public recreation and tourism. Unit 2 is designated Minerals and Habitat. Specifically, Upper Talarik Creek, in both units 1 and 2, is to be protected for its recreation, habitat, and water resource values. Permanent, commercial recreation-related facilities are prohibited in Unit 2. The plan also notes that impacts to dispersed recreation along Talarik Creek should be avoided in Unit 2 (ADNR 2013a).

The Nushagak River and the Mulchatna River headwaters and lands that provide the waters for these rivers (e.g., Koktuli River) include the mine site lands, and are managed by the Alaska Department of Natural Resources (ADNR) under the Nushagak and Mulchatna Rivers Recreation Management Plan (ADNR 2005). More information is provided in Section 3.2, Land Ownership, Management, and Use.

Lower Talarik Creek Special Use Area

The Lower Talarik Creek Special Use Area was established in 1999 and is designated as a public recreation and public use tourism site. This area is located 10 miles from the mine site and 10 miles from the Alternative 1 transportation corridor. This area is used for commercial and non-commercial sport fishing and hunting (ADNR 2013a).

Kenai Area Plan

The Kenai Area Plan directs the management of state lands on the Kenai Peninsula and the west side of Cook Inlet. The eastern end of the gas pipeline (under all alternatives) would be in Region 7, while the Amakdedori port, Diamond Point port, the eastern end of the Alternative 1 transportation corridor, and the western end of the underwater portion of the gas pipeline corridor (under all alternatives) would be located in Region 12 of the plan area.

On the Kenai Peninsula, the eastern end of the gas pipeline (for all alternatives) would be located in Unit 552 – Deep Creek to Anchor Point Tidelands, which is designated Habitat, Harvest, and Public Recreation and Tourism – Dispersed Use. The compressor station would be located on state lands just inland of Unit 552; the Kenai Area Plan notes that there are outstanding scenic and recreation values, clam digging, and beach combing in this unit. The nearest public recreation areas are the 60-acre Stariski State Recreation Site, located 1.2 miles north of the compressor station, and Anchor River State Recreation Area at the mouth of the Anchor River, 3.5 miles south of the compressor station. Both sites offer camping and picnicking; Stariski does not offer water access, whereas Anchor River provides boat and fishing access. Both sites are accessible via the Sterling Highway.

In Region 12, Alternative 1 components including a portion of Amakdedori port, the western end of the underwater portion of the gas pipeline, and the Kamishak Bay lightering location would be located in Unit 522A – Region 12 General Use Tidelands, which is designated Public Recreation and Tourism – Dispersed Use. The Kenai Area Plan notes that beaches in this unit are used for aircraft landing and there is commercial fishing activity in the unit (ADNR 2001).

The eastern end of the Alternative 1 transportation corridor and a portion of the Amakdedori port would be located in Unit 19 – Bruin Bay Uplands, which is designated Habitat. This unit contains habitat for brown bear (spring feeding), moose, Dolly Varden/Arctic char, seabird nesting, ducks and geese, and herring spawning. The head of Bruin Bay, located north of Alternative 1

facilities, is highly scenic and has nice beaches (ADNR 2001). Given the habitats and species in this unit and expanse of state lands, there is likely some hunting, fishing, wildlife viewing, and beach combing use in Unit 19.

The Alternative 1 pipeline would also pass south of Augustine Island, while the Alternative 2 and 3 gas pipeline would pass north of the island and a lightering location for all alternatives would be located west of the island. The island itself is under an Interagency Land Management Assignment to the University of Alaska for research and is managed for scientific and education purposes. The island is also part of the Alaska Maritime National Wildlife Refuge. The plan states that any authorized recreational uses of the island should minimize impacts on research opportunities and natural processes on the island. State lands are in Unit 522A both immediately south of the island as well as slightly north of the island. The plan designates this unit as Public Recreation and Tourism and notes that these areas attract recreationists that range throughout the area and may have a high potential for dispersed recreation because of desirable recreation conditions (ADNR 2001). It is assumed that recreation opportunities in the waters surrounding the island include sightseeing, fishing, wildlife viewing, and boating.

The Diamond Point port under Alternatives 2 and 3 would be located within Region 12 Unit 587 – Iniskin Peninsula and Bay Tidelands and Unit 522A (described above). The Iniskin Bay lightering location would also be located in Unit 587, which is designated Habitat. This unit contains habitat for waterfowl, harbor seals, Pacific herring spawning and migration, juvenile fish/shellfish rearing, anadromous fish, and bears. Commercial fishing occurs in this unit and there may be potential requests for mooring buoys for ships to use during log loading (ADNR 2001). There is likely recreational fishing and wildlife viewing use within Unit 587.

The portion of the gas pipeline for Alternatives 2 and 3 in Cottonwood Bay and Ursus Cove crosses Unit 522A (described above), Unit 590 – Head of Cottonwood Bay Tidelands, and Unit 594 – Ursus Cove Tidelands. Units 590 and 594 are both designated Habitat. Commercial fishing activity occurs in both Units 590 and 594. Given the fish habitat within this unit, there is likely also recreational fishing use of both units.

3.5.1.2 Federal Lands

National Park Service

The National Park Service (NPS) is charged with promoting and regulating the use of national parks and preserves to conserve the natural and cultural areas, scenery, and wildlife for the enjoyment of present and future generations. The following section provides information on the recreational uses and management of the three NPS units in the regional recreation area of the project.

Lake Clark National Park and Preserve

Lake Clark National Park and Preserve includes the private community of Port Alsworth and is not accessible by road. The boundary of the park and preserve is located about 15 miles northeast of the mine site and 3 miles from the Alternatives 2 and 3 transportation corridors (at the closest point, which is the north side of Roadhouse Mountain). The park covers the eastern two-thirds of the park unit and the preserve is a north-to-south strip of land adjacent to the western side of the national park. Most of the park is designated Wilderness and it is the sixth largest park unit in the nation.

The purpose of Lake Clark National Park and Preserve is to “protect a region of dynamic geologic and ecological processes that create scenic mountain landscapes, unaltered watersheds supporting Bristol Bay red salmon, and habitats for wilderness dependent

populations of fish and wildlife, vital to 10,000 years of human history" (NPS 2009c). It is managed to provide for visitor access, recreation, and use within the park unit, including development, access, commercial use, visitor use, visitor information, and interpretive materials (NPS 1984). The preserve is primarily land determined suitable and is included in lands proposed to Congress for Wilderness designation; as such, it is managed to maintain its wilderness eligibility.

The park's 2010 Long Range Interpretive Plan describes desired visitor recreational experiences as opportunities to hike, explore, and camp in a trail-less wilderness with no signs of human impact, experience solitude in a pristine unchanged natural landscape of extraordinary scenic quality and character, fish for all species that inhabit the park, discover the subsistence lifestyle, circumnavigate Lake Clark via kayak, see the watershed of Bristol Bay protected in perpetuity including clean water and clean shorelines, see salmon spawning, hunt for moose, spruce hens and other species, pick berries, collect drinking water, hear natural sounds, experience the remote natural landscape encompassing the cultural heritage and history of the region, and other descriptions of undeveloped recreational opportunities (NPS 2010).

The following recreational activities are available in Lake Clark National Park and Preserve: sightseeing, backpacking/overnight camping, boating, wildlife viewing, group camping, hiking/walking, kayaking, mountaineering, paddleboarding, photography, sport fishing, sport hunting, skiing, and snowshoeing (NPS 2018a).

Katmai National Park and Preserve

The Katmai National Park and Preserve boundary is located approximately 7 miles south of the Alternative 1 transportation corridor at its nearest point. This NPS unit is primarily national park, with the preserve located adjacent to the western part of the northern boundary of the park. Most of the park is designated Wilderness and it is the fifth largest park unit in the nation. There are also over 20,000 acres of privately owned lands in the unit (Kevin Waring and Associates 2011b).

The purpose of Katmai National Park and Preserve is "to protect, study, and interpret active volcanism surrounding the Valley of Ten Thousand Smokes, extensive coastal resources, habitats supporting a high concentration of salmon and brown bears, and an ongoing story of humans integrated with a dynamic subarctic ecosystem" (NPS 2009d).

The following recreational activities are available in Katmai National Park and Preserve: sightseeing, backpacking/overnight camping, boating, wildlife viewing, group camping, hiking/walking, kayaking, photography, sport fishing, and sport hunting (NPS 2018a).

Alagnak Wild River

The Alagnak River is designated a Wild River in the Wild and Scenic Rivers System. The Wild and Scenic Rivers Act was enacted to protect certain rivers with outstanding natural, cultural, and recreational values for the benefit and enjoyment of present and future generations. The Alagnak Wild River consists of 67 miles of river corridor that is mostly (93 percent) federally owned, with some privately owned Native allotments and other private inholdings within the river corridor. The Wild River begins downstream of Kukaklek Lake and flows westward, though the last 12 miles of the Alagnak River are outside the designated corridor. The river was designated a Wild River in 1980, and there is no road access to it (Kevin Waring and Associates 2011b). This river is located approximately 50 miles south of the Alternative 1 transportation corridor at its nearest point.

The following recreational activities occur in the Alagnak Wild River: sightseeing, backpacking/overnight camping, boating, wildlife viewing, group camping, hiking/walking, photography, and sport fishing (NPS 2018a).

US Fish and Wildlife Service

Alaska Maritime National Wildlife Refuge

The Alaska Maritime National Wildlife Refuge (NWR) includes 3.4 million acres (USFWS 2013a) from Forrester Island in southeastern Alaska, to the tip of the Aleutian chain, and almost to Utqiaġvik on the Arctic Ocean (USFWS 2011a). In the EIS analysis area, there are several islands that are near proposed project facilities. Augustine Island would be 7.5 miles north of the Alternative 1 pipeline and approximately 6 miles south of the Alternatives 2 and 3 pipeline, as well as 2.5 miles east of the Amakdedori and Iniskin offshore lightering location (for all alternatives). Cook Inlet islands east of McNeil River State Game Refuge would be 7.5 miles south of Amakdedori port and the Alternative 1 gas pipeline. White Gull Island in Iliamna Bay would be 2.6 miles from Diamond Point port. Several islands at the mouth of Iniskin Bay would be 7.5 miles from the Diamond Point port and less than 1 mile from the offshore lightering location in Iniskin Bay.

The purposes of the Alaska Maritime NWR are conservation, treaty obligations, subsistence use, scientific research, and water quality/quantity. The wildlife resources in the Alaska Maritime NWR attract recreational visitors. As stated in the Land Protection Plan for the NWR, "the Alaska Maritime Refuge is managed to conserve native fish and wildlife populations and their habitats, while providing opportunities for subsistence, compatible types of recreation, and research" (USFWS 2011a). Recreational use of the NWR includes hunting, wildlife viewing, photography, interpretation/environmental education, hiking, and camping (USFWS 2014a).

3.5.1.3 Private Land

Land owned by Native corporations and Native allotments are considered to be private property and therefore are not open for public recreational use. Permission and/or permits for access and seasonal recreational use of these lands must be obtained from the landowner. Similar to nearby State lands, it is likely that hunting and fishing are the primary permitted/allowed recreation uses of private land in the EIS analysis area.

3.5.2 Regional Recreation

The region around the project site is primarily accessed via small aircraft, except for the Kenai Peninsula area near the east end of the gas pipeline (under all alternatives), which is accessible via road. There is a limited road system that connects Iliamna with Newhalen and supports sport fishing activities and lodges. The few developed public recreation facilities that are present in the area are generally accessed via air or water.

3.5.2.1 Recreation Opportunities

Sport Fishing

Sport fishing is the primary major recreational activity that occurs in the EIS analysis area. Rivers like the Nushagak, Mulchatna, Newhalen, Gibraltar, Kvichak, and Upper Talarik Creek, as well as Iliamna Lake, Lake Clark, and all surrounding aircraft accessible lakes support recreational fishing for species of salmon, rainbow trout, and other freshwater fish. Sport fishing use is increasing in the area; much public use is guided, with operators flying their clients to a

place for the day from nearby lodges or base out of camps established nearby. Sport fishing is managed by the Alaska Department of Fish and Game (ADF&G) through a permit system for guides, regulations, and the board process. ADF&G uses a number of tools such as effort, catch, harvest information, abundance, and size composition to manage sport fishing. Near Iliamna, sport fishing has decreased in the past decades along the Newhalen River. For more information on sport fishing, as well as recreational lodges and guiding operations in the area, see Section 3.6, Commercial and Recreational Fisheries.

Sport Hunting and Trapping

Hunting, primarily for moose, caribou, and bear, is a major recreation activity in the region (Kevin Waring and Associates 2011b). Much of the region is open to sport hunting, except Lake Clark National Park, Katmai National Park, and McNeil River State Game Sanctuary. However, hunting and trapping are allowed by the NPS and State of Alaska in the Lake Clark National Preserve, Katmai National Preserve, and McNeil River State Game Refuge (excluding brown bears in the refuge) (ADF&G 2018e; NPS 2017g, 2018a). Hunting and trapping are also allowed in the Alagnak Wild River and on certain islands in the Alaska Maritime NWR (NPS 2016a; USFWS 2014a). State lands are open to hunting unless otherwise restricted by the ADF&G, which manages hunting in Alaska. Hunting on private property, including on village corporation lands and Native allotments, requires landowner permission.

The NPS and State of Alaska cooperatively manage wildlife resources in the three regional NPS units (Lake Clark, Katmai, Alagnak Wild River), and hunters in these units must follow current state and federal hunting regulations and must have all required licenses and permits (NPS 2016a, 2017g, 2018a). The Lake Clark National Preserve is divided into three authorized hunting guide areas and there are currently two concessioners authorized to guide sport hunters in these areas and Alaska residents may hunt without a guide (NPS 2017g). There are also two concessioners authorized to guide sport hunters at Katmai National Preserve (NPS 2018a). The McNeil River State Game Refuge is open to hunting and trapping of species except brown bears (ADF&G 2018e).

The region is in Game Management Units (GMUs) 9 (most of the region), 17B (western portion of EIS analysis area), and 15C (Kenai Peninsula). The EIS analysis area is specifically in GMUs 9B, 17B, and 15C. The species hunted in GMU 9 include brown bear, caribou, Dall sheep, moose, wolf, and wolverine. Species hunted in GMU 17B include black bear, brown bear, emperor goose, moose, wolf, and wolverine. Species hunted in GMU 15 include black bear, brown bear, caribou, Dall sheep, moose, mountain goat, wolf, and wolverine. In Alaska, non-residents who hunt for brown bear, mountain goat, and Dall sheep need to be personally accompanied by a licensed hunting guide or an Alaska resident 19 years or older who is a close relative. Though numbers of hunters by GMU are not available, Table 3.5-1 below shows 2017 harvest information by animal species and GMU (ADF&G 2018-RFI 089).

Table 3.5-1: 2017 Harvest Data by Species and GMU

Species	GMU 9B	GMU 17B	GMU 15C
Brown bear	31	35	15
Black bear	1	6	159
Moose	42	45	176
Caribou	16	74	3
Wolf	9	33	13

Table 3.5-1: 2017 Harvest Data by Species and GMU

Species	GMU 9B	GMU 17B	GMU 15C
Wolverine	5	12	7
Goat	0	0*	39
Sheep	0	0*	2

Note: * These species are not hunted in this GMU.
Source: ADF&G 2018-RFI 089

Water-Related Recreation (Boating)

Various forms of boating (e.g., canoeing, kayaking, rafting, and power boating) are popular in most recreation areas in the region. Whitewater and non-whitewater river boating opportunities are available in the three NPS units in the region.

Boating occurs on the Mulchatna River all the way to its confluence with the Nushagak River. The Koktuli River is also floated to its confluence with the Mulchatna River, both by individuals and as part of guided float trips. Commercial rafting and jetboat tours also occur on the Newhalen River (ADNR 2013a).

River-based boating opportunities vary based on season, amount of rainfall, and temperatures. Generally, river levels are lowest in early spring and increase throughout spring and early summer as spring rains fall and snow melt occurs, with river levels generally peaking in July and then declining into the fall (NPS 2015a).

Due to lack of road access to the region, and because many visitors travel to the area by small plane, boating equipment that can be brought to the region by visitors is limited. Guided trips are available in the national parks, and via other companies in and around the region.

Lake boating opportunities occur during the ice free season, and are available on several lakes in both Lake Clark and Katmai national parks and preserves. Motorboating opportunities are available at Lake Clark and Crescent Lake in Lake Clark National Park and Preserve, and Naknek Lake in Katmai National Park and Preserve (NPS 2017h, 2018a). All three lakes are popular destinations for visitors. In 2017, there were 10 companies authorized to provide boating trips in Lake Clark National Park and Preserve (NPS 2018a). The Lake Camp area at Naknek Lake in Katmai National Park and Preserve is accessible via the road from King Salmon and contains a boat ramp, parking area, picnic area, and restrooms. In Katmai National Park and Preserve in 2017, there were 11 companies authorized to provide boating trips (NPS 2018a).

McNeil State Game Refuge is open to boating (ADF&G 2018e). Powerboating, canoeing, and kayaking opportunities are available in Cook Inlet, such as along the Lake Clark National Park and Preserve boundary. Boating opportunities, including guided kayaking trips (AELO 2018), are also available at Iliamna Lake, Alaska's largest body of freshwater (Van Lanen 2012), though most use of the lake is for sport fishing or subsistence fishing. Access is available from Iliamna, Newhalen, Igiugig, Pedro Bay, Pile Bay, and Kokhanok, and private docks along the lake. In early June, around 60 commercial fishing boats make the trek from Homer to Bristol Bay via Iliamna Lake and the Kvichak River. The boats also make the return trip from Bristol Bay back to Homer along the same route at the end of the summer (Dischner 2015a).

Kayaking and boating opportunities are also available on the east side of Cook Inlet near the terminus of the gas pipeline at the Anchor River State Recreation Area. Tractor-assisted boat launching is available at this location. Such activities primarily occur during the summer months.

The mouth of Anchor River at the Anchor Point State Recreation Site is heavily used for boat launching, as well as camping, sport fishing, and beach combing (ADNR 2001).

Wildlife and Nature Viewing

The region surrounding the EIS analysis area offers highly valued opportunities for wildlife and nature viewing. The most popular wildlife viewing activity in the region is brown bear viewing, both inland and along Cook Inlet, with the best opportunities provided at food-rich locations, such as major salmon rivers and the Cook Inlet shoreline. Bear viewing is especially popular at Lake Clark and Katmai national parks, and McNeil State Game Refuge and Sanctuary. Popular locations for bear viewing at Lake Clark National Park and Preserve include Chinitna Bay, Crescent Lake, Silver Salmon Creek, Shelter Creek, and Tuxedni Bay (NPS 2017c). Katmai has many food-rich areas where bears tend to congregate, such as Brooks Camp, in the preserve, and along the Cook Inlet coast. Bears can be found in the Katmai backcountry (NPS 2018a).

McNeil State Game Refuge and Sanctuary was designated a wildlife sanctuary in 1967 to protect the world's largest concentration of wild brown bears. McNeil River Falls are located about a mile from the mouth of McNeil River; the falls slow the movement of salmon heading upstream to spawning grounds, causing salmon to congregate. Large numbers of brown bears can be seen at McNeil State Game Refuge and Sanctuary in early July through mid-August (ADF&G 2018b).

Notable bird watching opportunities are also available at most recreation areas in the region. Raptors, waterfowl, seabirds, shorebirds, songbirds, and upland birds can be found throughout the region. One hundred eighty seven species of birds have been documented at Lake Clark National Park and Preserve (NPS 2017d) and millions of sea birds, endemics, and birds from Asia can be found in the Alaska Maritime NWR (USFWS 2016a).

Though bear viewing opportunities are world-class within the region, opportunities for viewing other wildlife species are also available at all of the recreation areas within the region. At McNeil State Game Refuge and Sanctuary, harbor seals, moose, caribou, wolves, wolverines, red foxes, and arctic ground squirrels can also be seen (ADF&G 2018b). There are also wildlife viewing opportunities at Iliamna Lake, which contains a population of freshwater seals (Van Lanen 2012; ADNR 2013a).

Other nature-related opportunities available in the region include nature photography, beach combing, clam digging, and berrypicking (LPB 2018a). Often these activities are combined with activities such as bear viewing, sightseeing, backpacking, hiking, and camping during the summer and fall.

Flightseeing/Sightseeing

Due to the lack of road access in the region and the heavy use of small planes and floatplanes for transportation, there are many opportunities for flightseeing in the region. Flightseeing (i.e., sightseeing by plane) is an effective way to see the broader landscapes of the region and even see wildlife and bird species, particularly in the two national park units. Flightseeing occurs primarily during the summer months from June through September. There were 32 and 39 authorized air taxi commercial use authorization (CUA) holders in 2017 that offered flightseeing opportunities in Lake Clark and Katmai national parks, respectively, with most operators originating out of Anchorage, Homer, King Salmon, Kodiak, and Soldotna (NPS 2018a).

Camping/Backpacking/Hiking

Due to the relative lack of developed facilities or trails and presence of large expanses of wilderness, backcountry recreation activities such as camping, backpacking, and wilderness hiking are popular in the two national park units. There are also a few developed camping opportunities at both national parks. Between the two parks, there are very few developed trail opportunities, with less than 5 miles of trail in Katmai National Park, and 6.8 miles of trail in Lake Clark National Park (NPS 2016b, NPS no date LC). In 2017, there were 29 authorized CUA holders that provided guided hiking or overnight backpacking services in Katmai National Park, and 22 in Lake Clark National Park (NPS 2018c, 2018d).

Primitive camping opportunities are also provided in the Alagnak Wild River (NPS 2015a). Developed, though low impact, camping and hiking opportunities are available in the McNeil State Game Refuge and Sanctuary (ADF&G 2018c).

Camping is allowed on most of the Alaska Maritime NWR, though no developed campgrounds exist in the NWR (USFWS 2014a).

On state land, access, travel, improvements and structures, and other miscellaneous uses are generally allowed and managed by the Division of Mining, Land, and Water. Camping is also available on the east side of the Cook Inlet near the terminus of the gas pipeline at the Stariski State Recreation Site and Anchor River State Recreation Area, which also offers hiking opportunities.

Due to harsh winter weather conditions in the region, camping, backpacking, and hiking activities generally occur during the summer months, from June through September.

Other Opportunities

Biking on ice using fat tire bikes is a new winter use in Lake Clark National Park and Preserve. There is currently no restriction on bike use in the park (NPS 2016d). Other winter activities in the region include cross-country skiing, snowshoeing, trekking, riding snowmachines, birding, and night sky and aurora viewing. There is recreational use of Roadhouse Mountain to the northeast of Iliamna, as well as some all-terrain vehicle (ATV) use on trails around the Iliamna and Upper and Lower Talarik Creek areas, which are used for transportation, subsistence, and recreation.

3.5.2.2 Recreation Facilities

Commercial Lodges

Commercial lodges are the main form of lodging in the region due to the lack of consistent visitation to support hotels and motels. In 2012, there were 38 lodges in the area with active business licenses (Kevin Waring and Associates 2015d). There are clusters of commercial lodges at Port Alsworth, King Salmon, Naknek, Iliamna/Newhalen, Homer, Pedro Bay, and Kokhanok, as well as along the Kvichak, Mulchatna, and Alagnak rivers (ADNR 2013a). There are also commercial lodges scattered around the region on private inholdings in Lake Clark and Katmai national parks (NPS 2015a, 2017f). Commercial lodges often provide guide services for hunting, fishing, and other recreation activities on private property, Native corporation land, and/or public lands. Therefore, commercial lodges provide a home base for many recreationists, as well as a starting point for trips onto public lands. See Section 3.6, Commercial and Recreational Fisheries, for more details on the commercial lodges present in the region.

Public Recreation Facilities

Public recreation facilities in the region include lodges, campgrounds, cabins, a primitive camping area, trails, and visitor centers. The only public lodge facilities within the region are located at Katmai National Park. There are two lodges in the park, Brooks Lodge and Grosvenor Lodge, both operated by a concessioner. In addition to a lodge, Brooks Camp includes a campground for 60 people, a visitor center, ranger station, and an auditorium with daily ranger-led programs. Facilities at Brooks Camp are available from June 1 to September 18. There is also a six-person public use cabin, Fures Cabin, on the Bay of Islands on Naknek Lake in Katmai National Park that is available from June 1 to September 17. There are 5 miles of trail in the national park and one scenic overlook. The Lake Camp area at Naknek Lake in Katmai National Park and Preserve contains a boat ramp, parking area, picnic area, and restrooms (NPS 2018a).

Developed facilities at Lake Clark National Park include a cabin and primitive camping area. The maintained trails in the park are the Tanalian Trails that begin in Port Alsworth and continue to Tanalian Falls or Tanalian Mountain (NPS 2017e).

McNeil River Camp at McNeil State Game Sanctuary provides 14 camp sites, a trail to the viewing areas, a public use cook cabin for food storage and cooking, restrooms, a wash house, and staff facilities (ADF&G 2018c).

The two state park units on the Kenai Peninsula near the terminus of the gas pipeline both include camping and picnicking facilities. There are 13 camp sites and some picnic sites at Stariski State Recreation Site. There are 186 campsites total in five separate campgrounds at Anchor River State Recreation Area, along with 20 picnic sites and a boat launch.

There are no developed facilities in the Alagnak Wild River, but the US Fish and Wildlife Service (USFWS) has a visitor center nearby in King Salmon. The Alaska Maritime NWR does not include any recreation facilities in the region other than a visitor center in Homer (USFWS 2014a).

3.5.2.3 Recreation Access

Air-based Access

Air-based travel via small plane is the main form of access to recreation areas in the region, primarily from Anchorage, Homer, Iliamna, King Salmon, Port Alsworth, Kodiak, Dillingham, and Soldotna. Airport facilities located near the EIS analysis area include Iliamna, Igiugig, Levelock, Big Mountain, Koggiung, Kvichak-Diamond J, Kokhanok, and Pedro Bay (ADNR 2013a). Only certain air-based operators are allowed to operate in the three NPS units, McNeil State Game Refuge and Sanctuary, and Alaska Maritime NWR (NPS 2018a; USFWS 2014a; ADF&G 2018f). Different operators can land on different surfaces depending on the landing gear of the plane (e.g., floats/amphibious gear, wheels, skis/wheeled skis) and therefore have various seasons and conditions in which they can operate.

Overland Access

The EIS analysis area on the west side of Cook Inlet is not connected by road to the rest of the state. Access to the region is by boat or plane, and then there are limited road options. Much of the area is traversed in the winter by snowmachine. Road access to or in the public recreation areas in the region is limited to Katmai National Park, in the vicinity of Iliamna/Newhalen, and from the Sterling Highway between Soldotna and Homer on the east side of the region. There are unpaved and paved roads between the town of Naknek (located west of the park) and Lake

Camp on Naknek Lake in the park. These roads allow access from nearby towns to the boat ramp facility in the park on Naknek Lake. There is also an unpaved road from Brooks Camp to the Valley of Ten Thousand Smokes viewpoint at the Three Forks Overlook (NPS no date). Daily bus tours are provided by the concessioner from Brooks Camp to the overlook when the camp is open (June 1 to September 18) (NPS 2018a).

On the east side of the region, the Sterling Highway provides road access to the Stariski State Recreation Site and Anchor River State Recreation Area on the Kenai Peninsula.

Locally in the EIS analysis area, skiffs, ATVs, snowmachines, and trucks are the primary modes of local surface transportation around Iliamna Lake (ADNR 2013a).

Water-Based Access

Inland of Cook Inlet, water-based access to public recreation areas occurs on major rivers and lakes. Small boats can travel up the Naknek River to Lake Camp in Katmai National Park and boats can travel the Alagnak Wild River as well (Kevin Waring and Associates 2011b; NPS 2015a). Lake Clark and Naknek Lake provide water-based access to portions of Lake Clark and Katmai national parks, respectively. Water-based access can also be provided at Iliamna Newhalen, Pedro Bay, Kokhanok, Igiugig and Nondalton. In and along the shoreline of Cook Inlet, water-based access is essential to reaching public recreation destinations such as the eastern portions of Lake Clark and Katmai national parks and the Alaska Maritime NWR. Commercial boat operators operate in the three NPS units and Alaska Maritime NWR (NPS 2018a; USFWS 2014a).

3.5.2.4 Recreation Settings

Apart from a few developed sites previously described, the regional public recreation areas generally provide a primitive, remote recreation setting where solitude is common and there are no lights or sounds from human development. In popular areas (primarily popular bear viewing locations), the few developed sites such as Lake Camp and Brooks Camp, and areas closer to villages/towns, the recreation setting may include views of limited human development and other visitors, though the setting is still primarily remote and primitive.

3.5.2.5 Regional Recreational Use and Users

Given the lack of easy access and limited, dispersed development in the region, overall recreational use is estimated to be relatively low for all public recreation areas in the region compared to other parts of the state. Southwest Alaska shows among the lowest level of tourism compared to other areas of the state in general, with only 17 percent of visitors to Alaska traveling to southwest Alaska (ADNR 2013a). Of those visitors traveling to southwest Alaska, only 3 percent travel to this part of Alaska as their sole destination, with the majority of these visits to Katmai National Park and Wood-Tikchik State Park (ADNR 2013a). However, there are areas in the region that receive moderate to high use relative to the region and some areas have experienced significant increases in visitation in recent years. These areas tend to be the more accessible locations in the national parks and the McNeil State Game Sanctuary, or areas on the Kenai Peninsula that are accessible by road; others are accessible by small aircraft.

Between 2009 and 2017, Katmai National Park and Preserve averaged 40,031 visitors per year (NPS 2018e). During the same period, Lake Clark National Park and Preserve averaged 13,402 visitors per year through its commercial services program. Visitor use at Lake Clark National Park and Preserve has been increasing over the last 10 years to almost 17,000 visitor use days, with the number of visitor use days increasing dramatically for bear viewing, sport fishing, and

photography, while participation in other activities has stayed fairly constant (NPS 2018d); however, Lake Clark itself has seen a 200 percent increase in commercial visitation between 2012 and 2017. This does not include recreational use by visitors not using commercial services such as local residents boating, fishing, skiing, or otherwise using Lake Clark and the surrounding lands. In 2017, Lake Clark reported 22,755 in total visitation, which is over double the amount of visitation in 2010 (9,931) (NPS 2018e). Over the same time period, commercial visitor use at Katmai National Park and Preserve has generally fluctuated between 25,000 and 30,000 visitor use days (NPS 2018c). According to monthly visitation data, peak use of these two areas is from June to September. This is when the majority of annual use occurs, especially at Katmai National Park and Preserve, with 97 to 100 percent of the park's visitation occurring during these months. In the last 6 years, about 80 percent or more of visitation to Lake Clark National Park and Preserve has been during the peak season (June to September). The Long Range Interpretive Plan for Katmai National Park and Preserve notes that most of the park's visitors participate in two primary activities: bear viewing and sport fishing; there are virtually no drop-in visitors due to the effort needed to reach the park (NPS 2009a).

The number of bear-viewing visitors at McNeil River Camp was an average of 178 people per year between 2008 and 2017. The number of bear-viewing visitors at McNeil River Camp is capped at 257 visitors per year. In 2017, there were 1,092 user days (i.e., the participation in a recreational activity at a given resource during a 24-hour period by one person) associated with the bear-viewing program at McNeil River Camp in McNeil State Game Refuge and Sanctuary, and another 513 user days reported by guides or the public using the Kamishak River and Chenik Creek areas of the refuge and sanctuary, primarily for fishing and bear viewing (ADF&G 2018a). The annual visitation to the Kamishak River and Chenik Lake areas likely varies due to the number of commercial transporter permits issued and used at each of these areas each year. There are no visitation estimates available for the Alagnak Wild River, Alaska Maritime NWR, or state lands/park sites.

Overall, due to the remoteness and lack of easy access and lodging facilities, it is expensive to visit the recreation areas in the region. As stated in the Alaska Maritime NWR Land Protection Plan, "recreational use is limited by the difficult logistics and expense of visiting remote islands. However, it is possible that the demand for visitor services will increase in the future as adventure travel becomes increasingly popular" (USFWS 2011a). This may be true for other areas as well.

3.5.3 Recreational Use at Project Components

3.5.3.1 Mine Site

Recreational use at the mine site consists of some sport hunting and fishing, as well as occasional snowmachine use. Flights taking recreationists to various destinations in the region and the state may also pass over the mine site. Though there is no existing estimate of recreational use at the mine site, given the remoteness of the mine site and relative closeness of Lake Clark National Park and Preserve and other more well-known and accessible fishing and hunting destinations, recreational use at the mine site is likely low.

3.5.3.2 Alternative 1 Transportation Corridor

Within the transportation corridor there is recreational use of Roadhouse Mountain to the northeast of Iliamna, as well as use of some ATV trails around Upper and Lower Talarik creeks and the Iliamna and Kokhanok areas for transportation, subsistence, and recreation. There are no visible ATV trails along the access road corridor nearing the mine site or along the access road nearing Amakdedori port.

There are also recreational opportunities (primarily fishing) in the general transportation corridor area, particularly along the Newhalen River and Upper Talarik Creek by the north access road. There are also recreational opportunities in the Gibraltar River and Gibraltar Lake portions of the south access road corridor, where some local lodges advertise guided fishing, hunting, and sightseeing trip options (Haugen, Bush, and Rice 2003). Recreational sport hunting and snowmachine use may occur occasionally within the road corridors.

At Iliamna Lake, both motorized and non-motorized boating occur (AELO 2018), both as an activity in itself and as a means of accessing other recreation opportunities, primarily fishing. Recreation resources and uses in Region 9 of the Bristol Bay Area Plan, which contains Iliamna Lake, are primarily related to use of the lake for boating and fishing, and to commercial and non-commercial sport fishing and hunting (ADNR 2013a). Snowmachine use occurs on the lake in the winter; however, most of this use is for transportation and subsistence and minimally for recreation.

There is no recreational use estimate for the transportation corridor. Due to its inaccessibility and location of nearby higher quality recreation opportunities, recreational use of the port access road and mine access road corridors, the Kokhanok spur roads, and the Iliamna spur road is expected to be low.

3.5.3.3 Amakdedori Port

The Amakdedori port would be located on state lands designated for habitat use by the Kenai Area Plan (ADNR 2001). The Kenai Area Plan also notes that the head of Bruin Bay, located north of the Alternative 1 facilities, is highly scenic and has nice beaches (ADNR 2001). The Kenai Area Plan does not discuss recreational use at the port site specifically, although there may be recreational boating, overflights, hunting, fishing and incidental wildlife viewing and beach combing near the port site. Scoping comments mentioned local bear hunting use at the port site. There is no existing estimate of recreational use at the port site, though there is some boating use on the Cook Inlet. Due to the large size of the inlet and other nearby locations with known fishing and wildlife viewing opportunities, there is probably low use of the port site itself for recreation other than some local bear hunting use.

3.5.3.4 Alternative 1 Natural Gas Pipeline Corridor

Recreational use along the pipeline alignment in Cook Inlet and on the Kenai Peninsula surrounding the pipeline and compressor station consists of boating on Cook Inlet; beach combing, clamming, fishing, and hunting in and around where the compressor station would be located; and recreational use at the state park sites on the Kenai Peninsula. Boating on Cook Inlet is both an activity in itself and a means of accessing other recreation opportunities such as fishing, wildlife viewing, birdwatching, and beach combing, as well as access to the recreation areas on the west side of the Cook Inlet. The Stariski State Recreation Site, located near where the compressor station would be, offers camping and picnicking opportunities. The Anchor River State Recreation Area offers boating, camping, fishing, picnicking, wildlife viewing, and hiking opportunities. There is no existing estimate of recreational use for the Cook Inlet or either state park unit site. Recreational opportunities and use on the western end of the pipeline corridor would be the same as described for the Amakdedori port site and transportation corridor.

3.5.3.5 Alternatives 2 and 3 Transportation Corridor

There are recreational use opportunities along the Newhalen River and at Iliamna Lake, as well as on Iliamna River. Fishing is the primary recreational opportunity in these areas, including guided sport fishing opportunities from lodges in the northern Iliamna Lake area, particularly

around Pedro Bay. One lodge in the northern lake area offers guided kayaking trips on Iliamna Lake (AELO 2018). The Bristol Bay Area Plan notes that recreation resources and uses in Region 9, which contains Iliamna Lake, are primarily related to use of the lake for boating and fishing, and to commercial and non-commercial sport fishing and hunting. Recreational sport hunting use may also occur elsewhere in the transportation corridor. Tourism is increasing on the lake and each summer thousands of sport fishermen visit the area for trophy rainbow trout fishing on the lake (ADNR 2013a). There is no existing estimate of recreational use, including Iliamna Lake, though given the presence of lodges and communities around northern Iliamna Lake, there is likely more recreational use in the Alternatives 2 and 3 transportation corridors than the Alternative 1 transportation corridor.

3.5.3.6 Diamond Point Port

The Diamond Point port site would be located at the junction of Iliamna Bay and Cottonwood Bay. There is known commercial fishing use of this area (ADNR 2001) and likely recreational fishing opportunities as well. There are also opportunities for wildlife viewing in Iliamna Bay as there are large colonies of seabirds at the mouth of the bay as well as brown bears, moose, and shorebirds in the area (ADNR 2001). Therefore, there may also be opportunities for hunting. There is no existing estimate of recreational use at the port site.

Though there may be opportunities for recreational boating in the bays, there is one concentrated boat traffic effort in Iliamna Bay every year. In early June, around 60 commercial fishing boats make the trek from Homer to Bristol Bay via Iliamna Lake and the Kvichak River. The boats cross the Cook Inlet and head to Williamsport to be transported on the road from Williamsport to Pile Bay (Dischner 2015b). The boats also make the return trip from Bristol Bay back to Homer along the same route at the end of the summer (Dischner 2015a).

3.5.3.7 Alternatives 2 and 3 Natural Gas Pipeline Corridor

Under Alternatives 2 and 3, the natural gas pipeline would come into Ursus Cove and then cross land north to reach Cottonwood Bay and the Diamond Point port site. Ursus Cove is a known bear hunting location (H&H Alaskan Outfitters 2018) and both Ursus Cove and Cottonwood Bay are known commercial fishing locations (ADNR 2001). Both Ursus Cove and Cottonwood Bay may also be used for other hunting activities, recreational fishing, and wildlife viewing given the large seabird colonies at the mouth of Iliamna Bay as well as the presence of moose and shorebirds around Iliamna Bay (ADNR 2001). There is no existing estimate of recreational use in Ursus Cove or Iliamna Bay.

3.6 COMMERCIAL AND RECREATIONAL FISHERIES

For this section, the Environmental Impact Statement (EIS) analysis area is limited to river systems hydrologically connected to the project that contribute to the Bristol Bay salmon fishery and to the Cook Inlet saltwater environment. As will be discussed below, the EIS analysis area includes commercial and recreational fisheries, the Alaska Department of Fish and Game (ADF&G) commercial registration Area T and Area H, the Cook Inlet Management Area (including associated federal waters), and the ADF&G Statewide Harvest Survey (SWHS) areas S, T, N, and P.

3.6.1 Bristol Bay Commercial Fishery

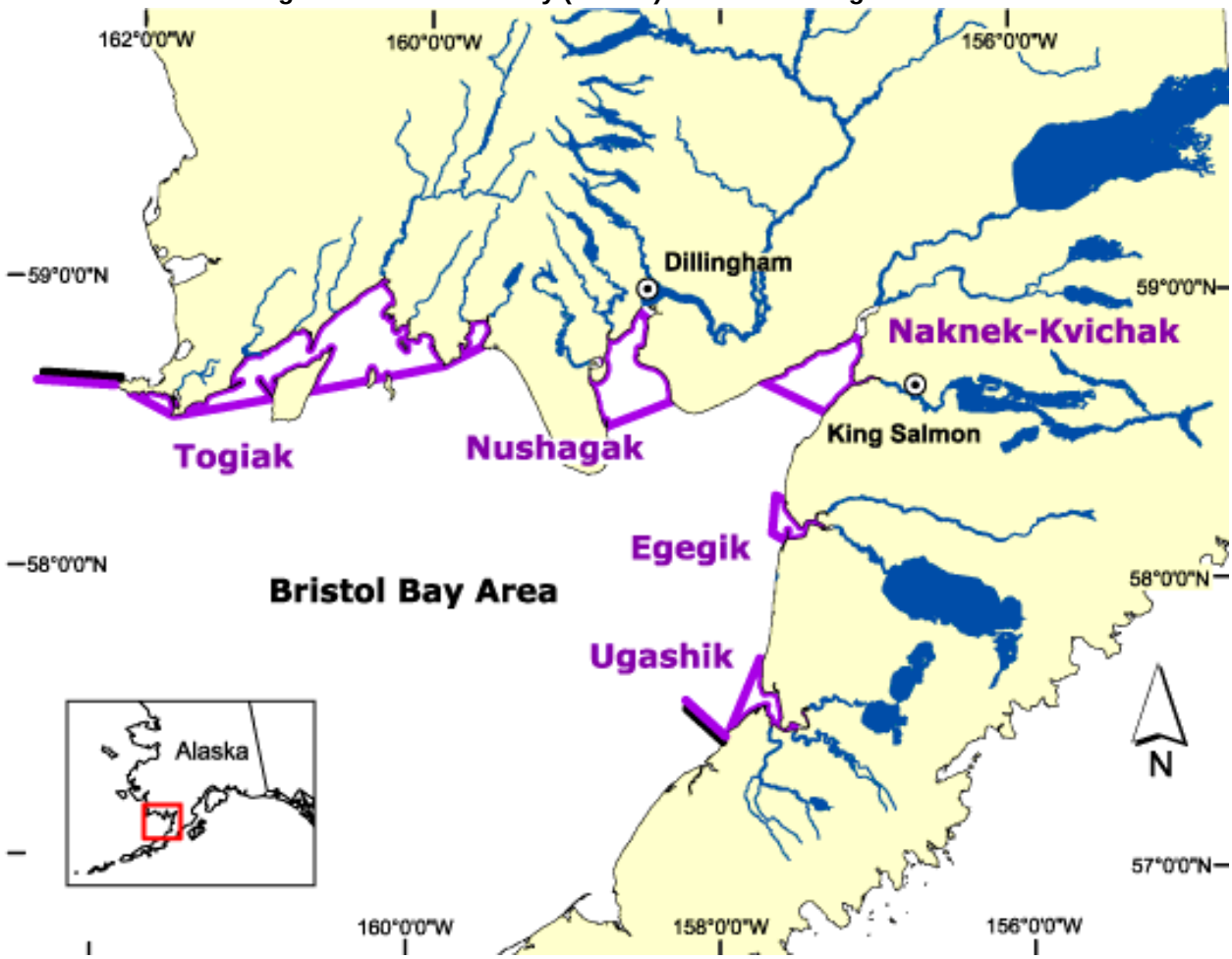
The inshore waters of Bristol Bay are home to the world's largest sockeye fishery and some of the world's largest natural salmon runs. Between 2000 and 2010, Bristol Bay provided 45 percent of the world's sockeye harvest, 7 percent of the world's wild salmon harvests and 2 percent of world salmon supply (EPA 2014). Between 2011 and 2016, Bristol Bay provided between 4 percent and 11 percent of all wild salmonid harvests and between 1.1 and 2.3 percent of world salmon supply (FAO 2018). Each year, roughly 2,840 holders of State of Alaska Area T salmon permits (shown in Figure 3.6-1) have the opportunity to harvest salmon from five major fishing districts managed by the ADF&G[1]. 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 salmon harvest generates 60 percent of regional self-employment income (Abrahamson 2011).

In comparison to the inshore state waters salmon fishery, fisheries outside of the 3-mile limit of state waters are limited by the federally managed Nearshore Bristol Bay Trawl Closure Area. The closure area bans trawl fishing in federal Bristol Bay waters, with the exception of the seasonal opening of a very small area west of Cape Constantine and Nushagak Point. With localized federal conservation measures in place to protect juvenile red king crab, the Area T Bristol Bay salmon fishery is the only commercial fishery in the Bristol Bay portion of the EIS analysis area.

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 project would include a compressor station located on the Kenai Peninsula and underwater natural gas pipeline which would pass through a small portion of the Area H Management Area.

[1] In Alaska, commercial fishing salmon permits are issued by the State and can be used in one specific fishery as defined by state regulations. The State assigns each fishery a letter designation. The designation for Bristol Bay is "Area T."

Figure 3.6-1: Bristol Bay (Area T) Salmon Fishing Districts



Source: ADF&G 2018k

3.6.1.1 The Bristol Bay Salmon Fishery

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. Only the Kvichak drainage in the Naknek/Kvichak district, and the Nushagak/Mulchatna drainage (via the Mulchatna) in the Nushagak district, are hydrologically connected to the project. Across all five districts, sockeye salmon are the most commonly harvested species, representing 97 percent or more of the harvest in the Naknek/Kvichak district, the Egegik district, and the Ugashik district (see Table K3.6-1 in Appendix K3.6). In the Nushagak district, sockeye represent 86 percent of the 20-year harvest with chum salmon and pink salmon representing 7 percent and 6 percent of the harvest, respectively. While Chinook salmon account for just 1 percent of annual Nushagak harvest, the number of fish harvested averages 40,000 annually, making the Nushagak district the most important Chinook salmon fishery, by volume, outside of Southeast Alaska (ADF&G 2018k). The Togiak district also harvests sizeable portions of chum salmon and pink salmon, with those species accounting for 19 percent and 8 percent of the 20-year harvest, respectively. Over the last 20 years, the fishery's average annual harvests were 23 million sockeye salmon, 950,000 chum salmon, 500,000 pink salmon, 80,000 coho salmon, and 50,000 Chinook salmon (ADF&G 2018m).

Harvest varies significantly across the five fishing districts and in each district from year to year. On average, the most productive fishing districts are the Naknek/Kvichak district (8.2 million fish annually), followed by the Nushagak (7.3 million), the Egegik (6.8 million), the Ugashik (2.9 million), and the Togiak (0.7 million). Harvest size in each district can vary substantially due to the overall size of salmon runs. The ADF&G manages each district to ensure that the required number of salmon reach their spawning grounds to maximize long-term productivity. The number of salmon that are not harvested by the fishery is known as the "escapement number." Harvest numbers tend to vary more than escapement numbers because the escapement goal is a set range, while fishing effort is the tool used to balance between the number of fish returning and the escapement goal. In particular, the Naknek/Kvichak district is known for its varying run strength. The 20-year minimum harvest in this district was 602,061 fish compared to an average of over 8 million fish, and a maximum near 17 million fish. Thus, the largest harvest was 28 times the smallest harvest. In the Nushagak district, which is connected to the project area by surface waters, and Ugashik district, which is not connected to the project area via surface waters, the largest harvest was nearly 13 times the smallest harvest. In the other districts, the largest to smallest ratio was less than 5.5:1. In all districts, the average harvests from 2008 to 2017 have been larger than the average harvests from 1998 to 2007. Harvests by district are shown in Table K3.6-2 in Appendix K3.6.

The 20-year average escapements for each of the districts are 6.4 million fish in the Naknek/Kvichak district (which contains two major river systems), 2.6 million fish in the Nushagak district, 1.3 million fish in the Egegik district, 1 million fish in the Ugashik district, and 0.2 million fish in the Togiak district (see Table K3.6-3 in Appendix K3.6). In all districts except the Togiak district, average escapement has been higher in the past 10 years than in the 10 years between 1998 and 2007. Subsistence users and recreational anglers access the resource after salmon enter freshwater, and after the fish have escaped the commercial fishery; ADF&G's escapement goals include a portion expected to be harvested by these users.

Administration of the Bristol Bay fishery occurs through two different sets of permits: drift net permits and set net permits. Drift nets are nets attached by one end to boats, while set nets are attached to land. On average, drift net permit holders harvest four out of every five fish harvested in the fishery, but the ratio has been as low as two out of every three fish (Table 3.6-1). Drift net permit holders are able to move from district to district during and between fishing seasons to adjust to changing run sizes and timings. Set net permit holders hold long-term tenure to selected fishing sites which are registered with the State of Alaska and often handed down from generation to generation and generally cannot change sites without identifying a new site in another watershed and moving their operations. In the event of lost productivity in a specific watershed, the set net permit holders with sites located at the mouth of that watershed would experience a disproportionate level of economic harm. At the same time, drift net permit holders who have mobility in where they fish can mitigate changes in individual watershed productivity by moving their operations. Set net permit holders in other watersheds would not experience harm if the productivity in their watersheds did not change and the overall price for salmon in the fishery did not change.

Table 3.6-1: Sockeye Drift Net and Set Net Harvest Split (Percent)

	20-Year Min.	20-Year Max.	20-Year Median	20-Year Average	1998-07 Average	2008-17 Average
Drift Net Portion	66	86	81	80	80	81
Set Net Portion	34	14	19	20	20	19

Source: ADF&G 2018m

3.6.1.2 Nushagak and Kvichak District Historical Harvest and Escapement

As previously discussed in this section, the EIS analysis area is limited to river systems hydrologically connected to the project area, which contribute to the Bristol Bay salmon fishery. Only the Naknek/Kvichak district and the Nushagak district contain rivers that are hydrologically connected to the project area.

The Naknek/Kvichak district contains three of the nine major river systems in the Bristol Bay fishery, but only the Kvichak River is hydrologically connected to the project area. Over the last 20 years, the river contributed 45 percent of the average annual inshore sockeye salmon return, which is 45 percent of the total average run strength in the district (see Table K3.6-4 and Figure K3.6-1 in Appendix K3.6).The Kvichak River is known for its variable sockeye salmon run strength; the smallest return to this river in the last 20 years was just 707,000 fish, while the largest run was 15.5 million fish. At the same time, the average sockeye salmon return to the river system from 2008 to 2017 was more than double the average return from 1998 to 2007 (ADF&G 2018m).

The Nushagak district is also comprised of three large river systems: the Wood River, the Igushik River, and the Nushagak River. The Nushagak River is hydrologically connected to the project via the Mulchatna River system, but the other two river systems are not. The Wood River, fed by the Wood-Tikchik Lake system, is the dominant sockeye salmon producer in the district and accounted for 62 percent of the estimated run strength over the last 20 years. The return to this system averaged almost 5.8 million fish per year between 1998 and 2017. In comparison, the Nushagak River accounted for over 2.3 million sockeye salmon per year between 1998 and 2017, or 25 percent of the district total. The Nushagak River also experiences significant variations in run strength. While not as extreme as the variations found on the Kvichak River, the largest run in the past 20 years was over 11 times the size of the smallest run (see Table K3.6-5 and Figure K3.6-2 in Appendix K3.6).

In the context of other Bristol Bay rivers and other Alaska rivers such as the Kenai River and the Copper River, the Nushagak River does not particularly stand out for the average size of its sockeye salmon run. The Wood River is the dominant producer of sockeye in Nushagak district. The Nushagak district stands out for the size of its Chinook salmon run. Between 1997 and 2016, on average, the entire Bristol Bay commercial fishery harvested 32,908 Chinook each year, and 25,623 of these fish (78 percent) came from the Nushagak district. The 20-year average Chinook run size for the Nushagak is almost 179,000 fish (ADF&G 2018m), which makes the Nushagak system one of the most productive for Chinook salmon in Alaska. Average run sizes for Chinook in other river systems in Alaska are approximately 260,000 in the Kuskokwim drainage, 166,000 in the Yukon drainage, 100,000 to 200,000 in the Susitna drainage, 56,000 in the Kenai River, and 55,000 in the Copper River (JTC 2018; Poetter and Tiernan 2017; ADF&G 2008c, 2016a; Russell et al. 2017).

3.6.1.3 The Value of the Fishery

Annually, the Bristol Bay salmon fishery creates thousands of jobs and hundreds of millions of dollars in economic activity and wages. A 2013 study by the Institute for Social and Economic Research at the University of Alaska-Anchorage found that in 2010 the industry created 12,000 season jobs in Bristol Bay (equal to 2,000 annual jobs), another 1,000 jobs involved in shipping, secondary product processing, and retailing after the fish left Bristol Bay and 6,800 in ancillary and indirect employment in industries which serve fishing and processing operations in Bristol Bay. In total, the fishery generated $1.5 billion in output value (i.e., the value of goods and services produced) and $500 million in income (Table 3.6-2).

Table 3.6-2: Bristol Bay Economic Contribution, 2010

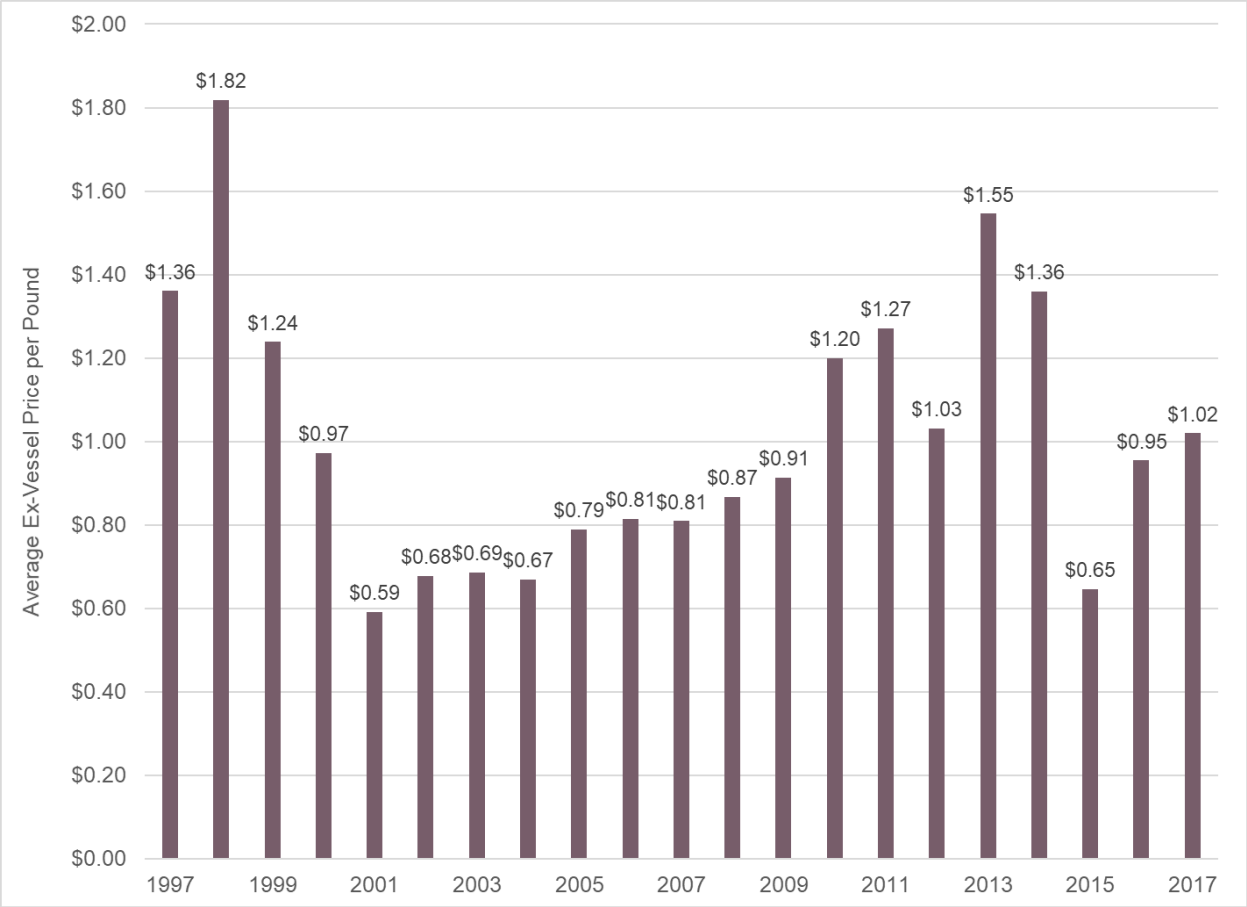
Annual average employment: 9,800 jobs	Output value: $1.5 billion	Income: $500 million
Fishing and Processing in Bristol Bay		
12,000 seasonal jobs (= 2,000 annual jobs)	$390 million	$140 million
Shipping, secondary processing, and retailing after Bristol Bay		
1,000 jobs	$110 million	$40 million
Multiplier impacts in other industries		
6,800 jobs	$970 million	$320 million

Source: Knapp, Guettabi, and Goldsmith 2013

The drivers of this economic contribution are the quantity of the salmon harvest and the value of that product on the world market. 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. Individual and collective efforts around marketing, improving product quality, and developing new markets and products can also have long-term effects on the value of salmon at harvester level. The connection to a world commodity market means that ex-vessel prices (i.e., the price paid to the permit holder at the point of delivery) for salmon can vary markedly from year to year. In 2017, permit holders in Bristol Bay received an average of $1.02 per pound. Four years earlier they received $1.55 per pound, which was the highest average price since 1998; 2 years earlier they received $0.65 per pound on average (Figure 3.6-2)[2]. Between 2008 and 2017, the average price swing from year to year was +/- 20 percent.

[2] All prices are in $US 2017.

Figure 3.6-2: Average Price per Pound for Bristol Bay Sockeye, 2017



Source: ADF&G 2018m

With the exception of 1998, when prices for sockeye were at their modern high, the prices that Bristol Bay permit holders receive for their salmon are lower than prices received for the same species of fish caught in other major Alaskan salmon fisheries. Over the past 20 years, the ex-vessel prices for sockeye salmon in the Cook Inlet, Copper River, Prince William Sound, and Southeast Alaska fisheries averaged 50 percent, 150 percent, 60 percent, and 54 percent higher, respectively, than the price paid for Bristol Bay sockeye (Table 3.6-3). The price differential can be explained by a number of factors, including the remoteness of the Bristol Bay fishery, which increases transportation and operating costs for processors, and the historic lack of a strong brand identity for Bristol Bay fish (in comparison to the Copper River fishery, which does have a strong brand identity). In recent years, Bristol Bay permit holders have worked with processors to increase quality throughout the chain of custody and to establish a brand identity (BBRSDA 2018). The annual data show that the price gap tends to be smaller when demand for sockeye is high and increases when demand for sockeye is low.

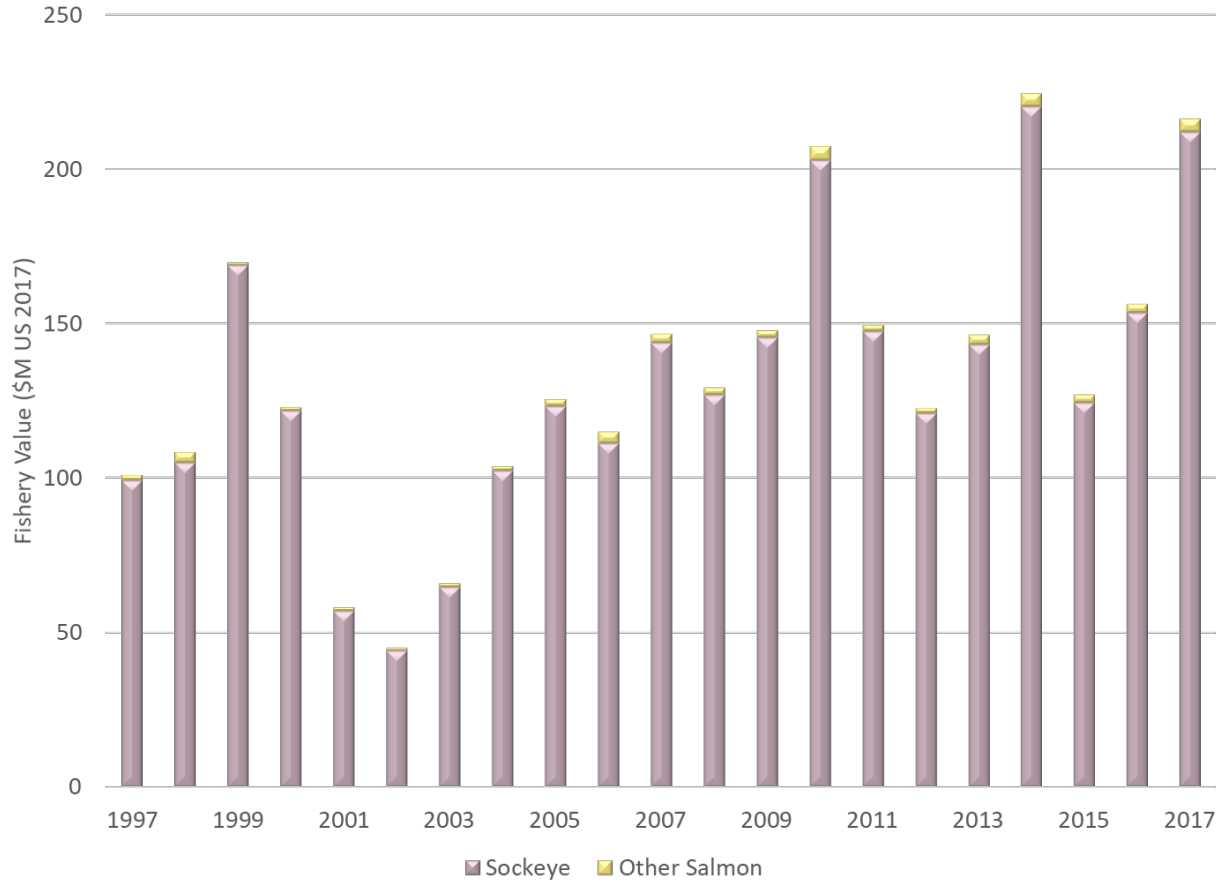
Table 3.6-3: Percentage Price Premium (Discount) for Other Alaska Sockeye Fisheries Relative to Bristol Bay

	Cook Inlet	Copper River	Prince William Sound	Southeast
20-Year Min. Price	-6	-2	-9	11
20-Year Max. Price	150	316	133	105
20-Year Median Price	53	159	61	55
20-Year Average	50	150	60	54
1998-2007 Average	35	143	56	56
2008-17 Average	63	156	64	52

Source: ADF&G 2018k

In 2017, the fishery generated $216.4 million in ex-vessel payments to all Area T permit holders, making that year the second-best year for permit holders collectively since 1997 (Figure 3.6-3). The 20-year inflation-adjusted ex-vessel value of the fishery is approximately $134.4 million, but over the last 10 years the ex-vessel value has averaged $162.8 million.

Figure 3.6-3: Total Ex-Vessel Fishery Value for Bristol Bay (Area T), $US 2017



Source: ADF&G 2018m

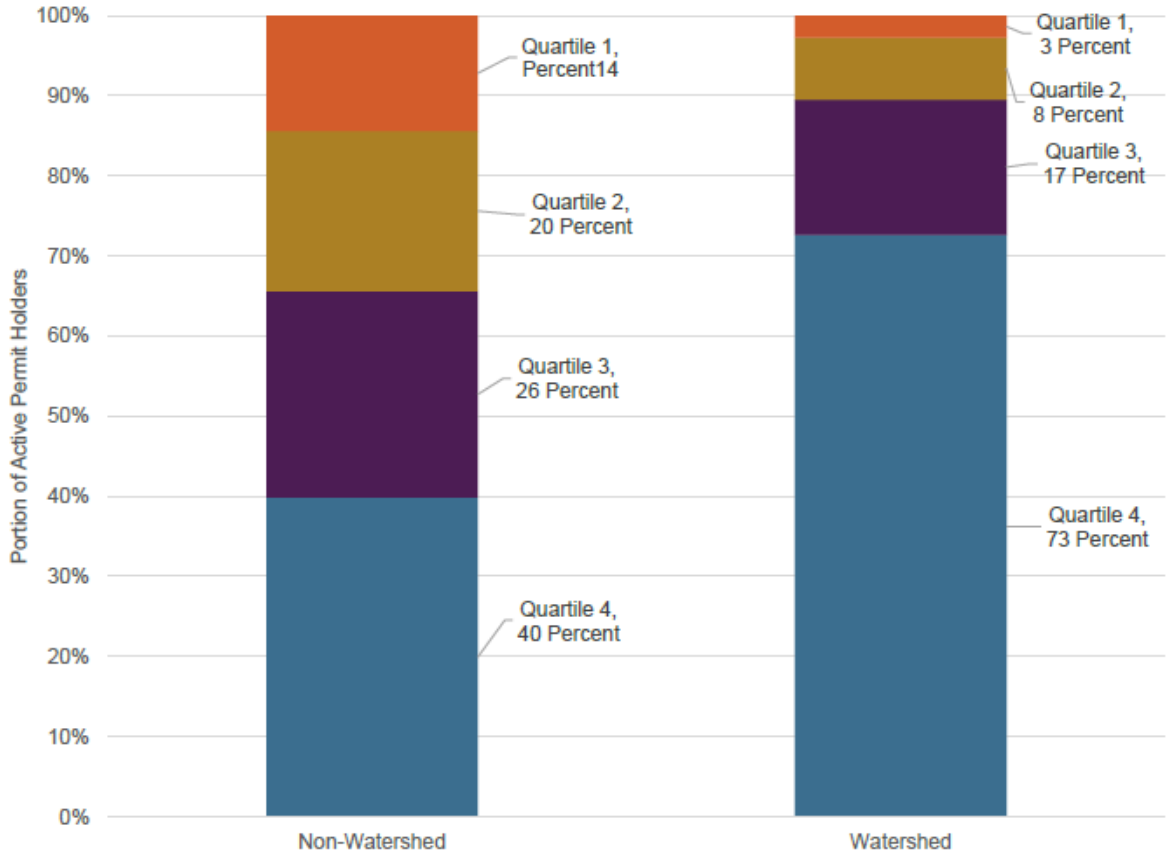
Average permit holder gross earnings vary from year to year with run and market strength, but increased substantially in both the set net and drift net fisheries since 2001 and 2002, when the fishery generated the lowest level of ex-vessel value in the modern era (Figure 3.6-4). In 2017, drift net permit values had an estimated value of over $103,000, while set net permits had an estimated value of roughly $40,000. The estimated values of both types of permits have risen substantially since 2001 and 2002, when smaller average run sizes and lower prices depressed the permits' expected earnings power.

Figure 3.6-4: Annual Average Permit Holder Earnings per Year, 2017

Source: CFEC 2018

Alaska Commercial Fisheries Entry Commission (CFEC) data divide permit holders into four earnings groups (i.e., quartiles). The aggregate amount of earnings in each group is the same, but the number of permit holders and the average earnings per permit holder is different. For example, in 2016 each quartile group earned roughly $35.5 million in aggregate, but the top group included just 170 permit holders earning an average of $232,837 each, while the bottom group included 759 permit holders earning an average of $52,044 each (CFEC 2018). Permit holders who are residents of District T are more likely to be in the bottom quartile compared to non-residents, and 80 percent less likely to be in the top quartile (Figure 3.6-5). Between 2002 and 2012, 73 percent of watershed residents were in the bottom earnings quartile, while 40 percent of non-watershed residents landed in the bottom quartile. In the same period for the top quartile, 3 percent of watershed resident permit holders landed in the top quartile, while 14 percent of non-watershed residents earned enough to be in that quartile (NEI 2014). These statistics may help explain permit ownership and participation trends discussed in the next section.

Figure 3.6-5: Distribution of Quartiles in the Drift Net Fishery by Area of Residence, 2002-2012

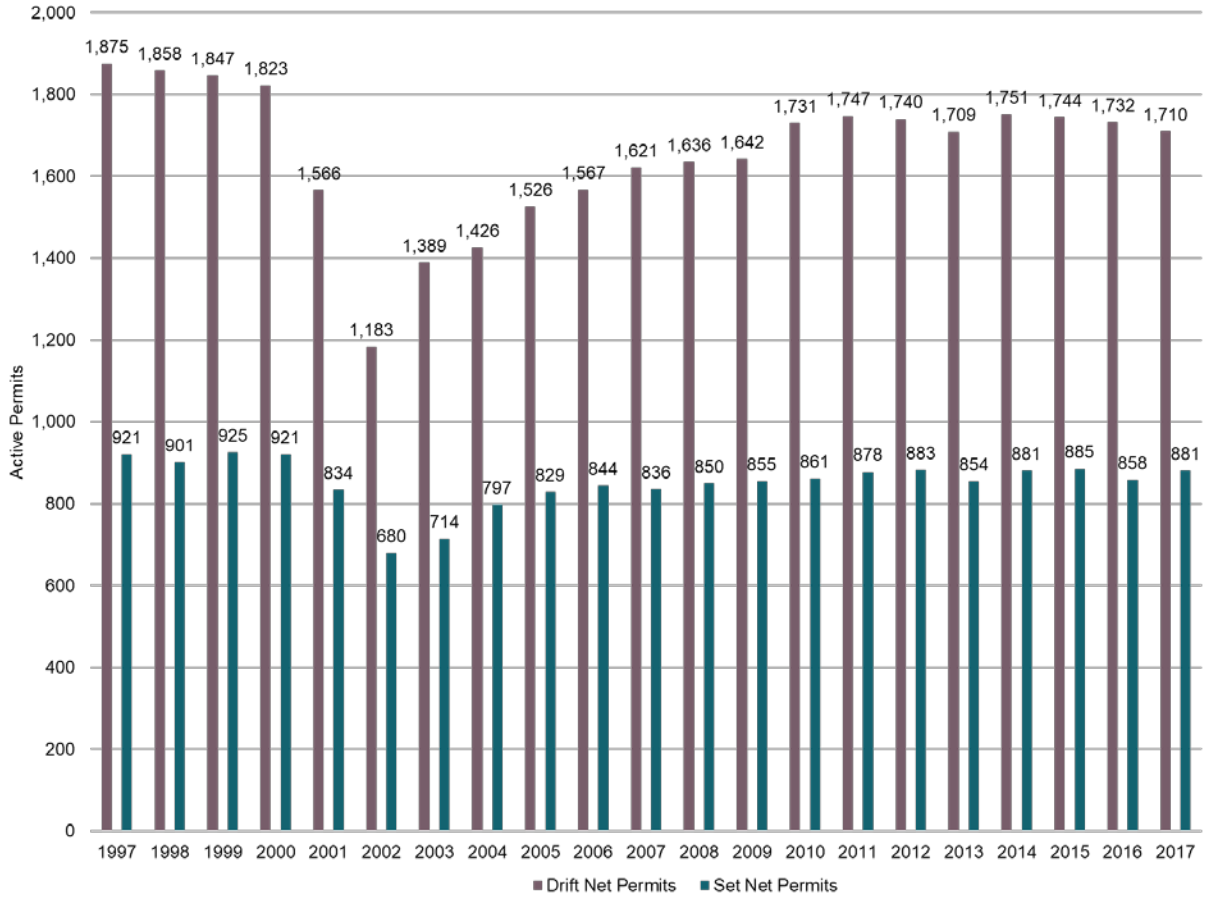


Source: NEI 2014

Participation in the Fishery and Permit Ownership

Permit holder participation in the fishery varies from year to year depending on permit holder expectations for both prices and the size of the overall Bristol Bay salmon run. Several distinct periods define permit holder participation over the past 20 years. Between 1997 and 2000, more than 97 percent of drift net permit holders and 90 percent of set net holders participated in the fishery. Fishery participation dropped substantially in 2001 and 2002 as low prices discouraged permit holders from fishing; only 63 percent of drift net permit holders and 67 percent of set net holders participated in the 2002 fishery. As ex-vessel prices have recovered, and the fishery has become better organized with the creation of the Bristol Bay Regional Seafood Development Association and combined permit holder/processor efforts to improve the value of the fishery, a greater percentage of permit holders are fishing their permits. Since 2010, at least 1,700 (91 percent) drift net permit holders have participated in the fishery each year, while at least 830 (85 percent) set net permit holders have participated since 2007 (Figure 3.6-6).

Figure 3.6-6: Annual Permit Holder Participation



Source: ADF&G 2018m

The fishery has experienced a gradual out-migration of permits from Alaskans to non-Alaskans; in particular from watershed residents (i.e., those who live in the watershed boundaries of Area T) to non-watershed Alaskans and non-Alaskans (ADF&G 2018m). Overall Alaskan permit ownership in the drift net fishery dropped from 55 percent to 45 percent between 1990 and 2017, while in the same period Alaskan ownership of set net permits fell from 76 percent to 65 percent (Table 3.6-4).

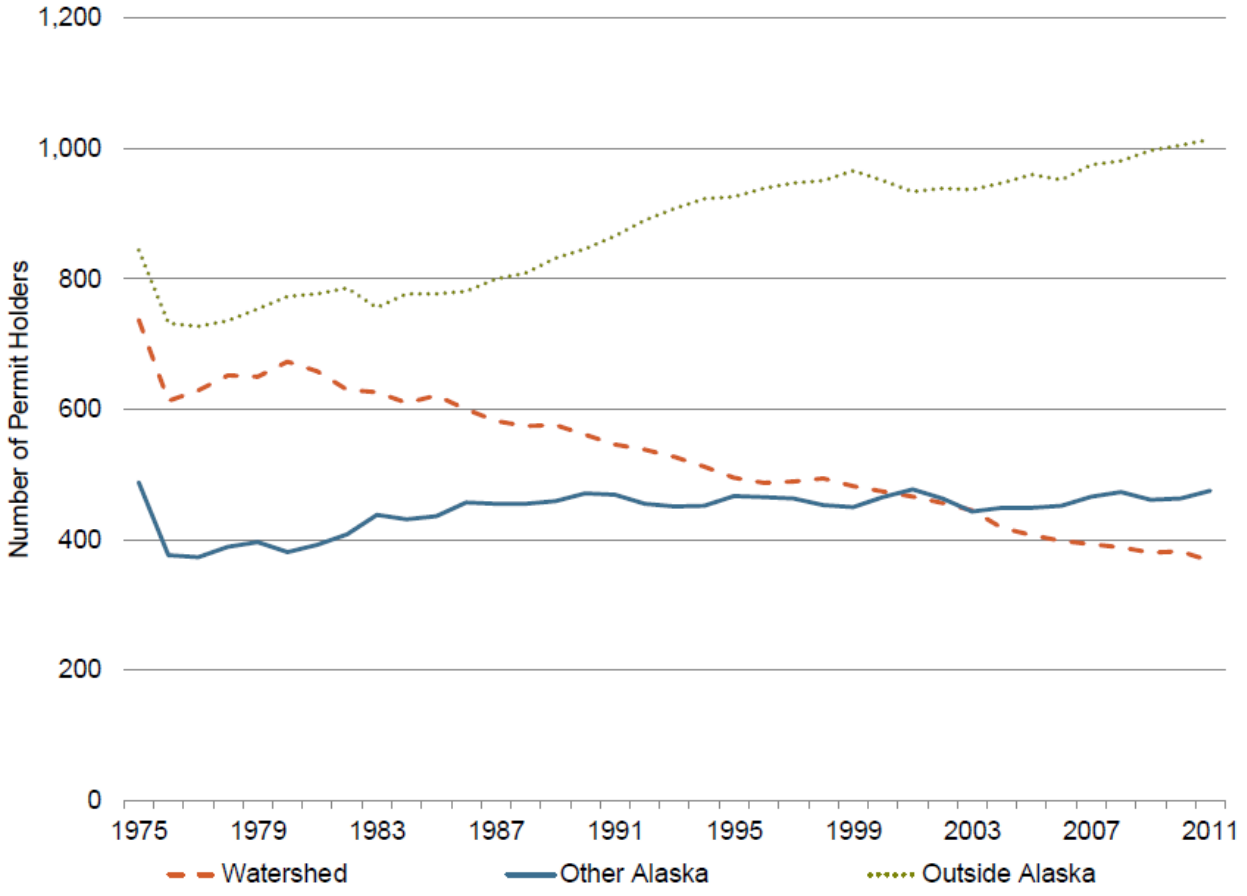
Table 3.6-4: Permits Owned by Alaskans and Non-Alaskans

Year	Drift Net			Set Net		
	Alaskan	Non-Alaskan	Percent Resident	Alaskan	Non-Alaskan	Percent Resident
1990	1,039	839	55	783	243	76
1995	967	921	51	762	257	75
2000	959	940	51	757	262	74
2005	895	967	48	688	300	70
2010	866	997	46	672	311	68
2015	834	1,030	45	639	336	66
2017	842	1,021	45	635	337	65

Source: ADF&G 2018m

The collective data show a loss in Alaska-owned permits, but more refined data show that out-migration of permits is really an issue specific to the Bristol Bay watershed residents, as ownership by Alaskans based outside of the watershed is stable or increasing (Figure 3.6-7). Between 1975 (when the limited-entry program started) and 2011, non-Alaskan ownership of the permits increased from roughly 850 permits to over 1,000 permits. Permit ownership by non-watershed Alaskans dipped after initial issuance as the CFEC adjudicated temporary permits but has risen from a low of less than 400 permits to nearly 500 permits in 2011. Permit ownership by residents of the watershed fell steadily between the late 1970s and 2011, from roughly 700 permits to fewer than 400 permits. As permits leave the region, so does the associated earnings-related spending. With average permit holder earnings of over $100,000 in 2017, the roughly 300 drift net permits that have out-migrated from the watershed represent approximately $30 million dollars in annual gross income that is not available to support the local economy.

Figure 3.6-7: Drift Net Participation in the Fishery by Permit Holder Region, 1975-2011



Source: NEI 2014

Theories as to why permit holders have left Bristol Bay include: lower access to, and higher cost of capital; the long-term effect of consistently earning less than non-watershed peers; financial hardship; and the relative desirability of the fishery to outsiders who want to join the fishery because of its potentially higher earning power compared to other Alaska salmon fisheries (Apgar-Kurtz 2012). Prior research shows that Bristol Bay resident vessels tend to be older, have less horsepower, smaller fuel and less refrigeration capacity (see Table K3.6-6 in Appendix K3.6) (NEI 2009).

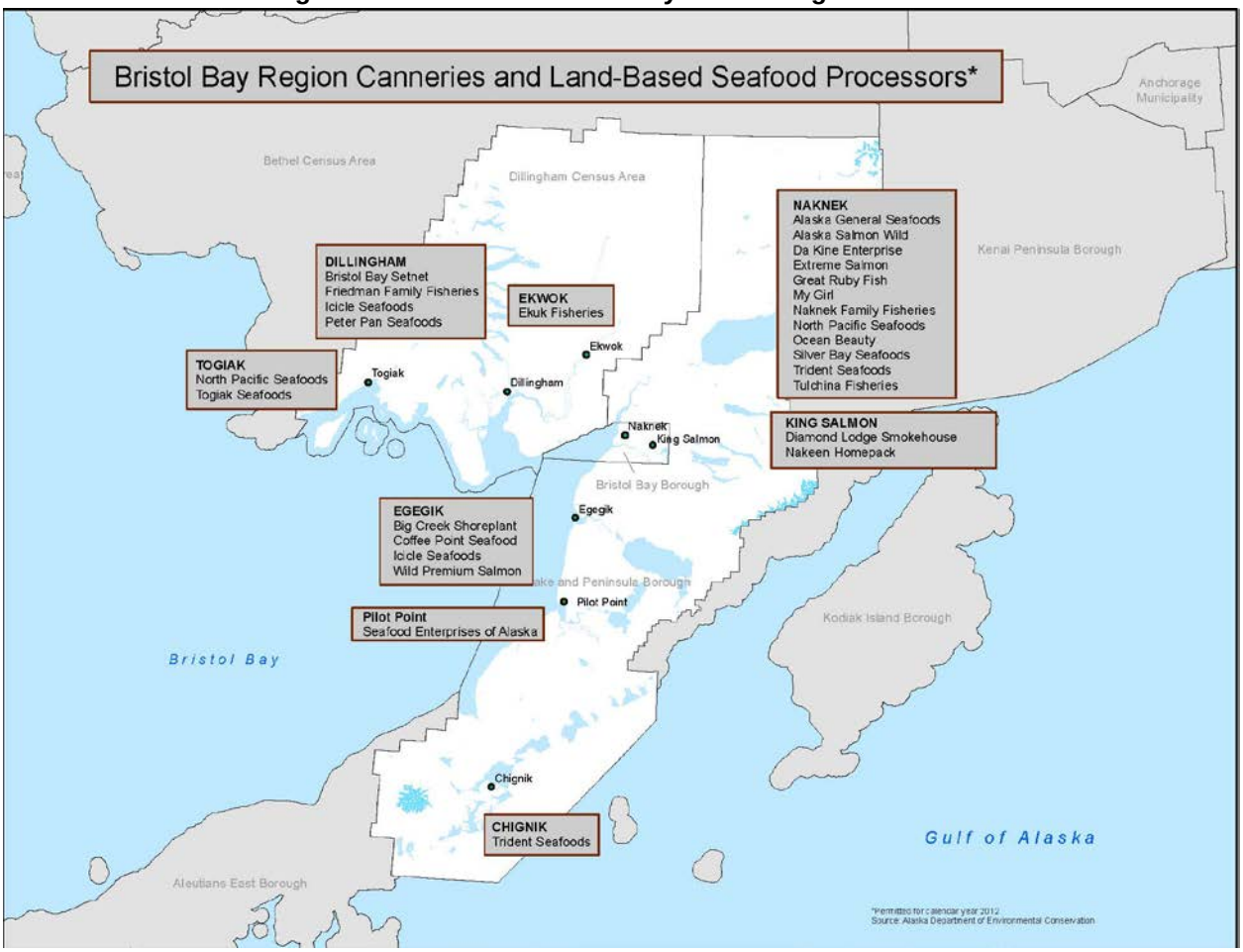
The rate of loss of permits is not equally spread across communities in the watershed. Apgar-Kurtz (2012) showed that the rate of permit loss was higher amongst communities who were not part of the Bristol Bay Economic Development Corporation (BBEDC) region and thus not eligible for BBEDC's permit loan program. The non-BBEDC watershed communities include those that are closest to the proposed project including Iliamna, Nondalton, Pedro Bay, Port Alsworth, and Newhalen. The group also includes communities further from the proposed project, but still in water systems hydrologically connected to the project, including Igiugig, Koliganek, Kokhanok, and New Stuyahok. When permit holders sell their permits, there are secondary effects on the community that lower earnings and the likelihood of community participation in the fishery:

1. There are now fewer opportunities for community members to obtain crew member jobs and bring a share of their earnings back to that community. Permit holders prefer to hire people that they know, and they are more likely to know people from their own community (Apgar-Kurtz 2012).
2. Family is the predominant way in which people learn to fish in the bay; if a family sells their permits the next generation is less likely to be commercial fishermen (Apgar-Kurtz 2012).

3.6.1.4 The Processing Sector

After harvest, permit holders deliver salmon to processors who pay them for their catch and prepare fish for distribution and sale into the broader seafood market. The processing sector in Bristol Bay ranges from small family owned operations to business units of multi-national corporations with operations across Alaska, the US, and the rest of the world. While the Alaska Department of Environmental Conservation (ADEC) documents processing facilities in seven Bristol Bay communities, the heart of processing in Bristol Bay is in the Bristol Bay Borough community of Naknek (Figure 3.6-8). In 2015, the last year for which data are available, the processing sector employed 3,087 people in the Bristol Bay Borough, 908 in the Dillingham Census Area, and 162 in the Lake and Peninsula Borough (LPB) (ADLWD 2018a).

Figure 3.6-8: Current Bristol Bay Processing Locations[3]



Source: ADLWD 2018b.

From 1998 to 2017, the processing sector in Bristol Bay produced $6.93 billion of first wholesale value seafood products; processors derived $6.2 billion of this value (89.5 percent) from sockeye salmon (Table 3.6-5)[4]. The next most valuable species was Pacific herring, which occur every May in the Togiak/Twin Hills region of the Bristol Bay. The remaining salmon species represented 3.6 percent, or $246.3 million, of wholesale value; other species generated $23.6 million in wholesale value.

Table 3.6-5: Bristol Bay Wholesale Values by Species and Year (millions of dollars)

Year	Sockeye Salmon	Herring	Chum Salmon	Chinook Salmon	Coho Salmon	Pink Salmon	Other Species	Total
1998	$197.0	$25.0	$2.4	$3.8	$2.1	$0.8	$4.0	$235.1
1999	$301.4	$41.1	$2.3	$0.7	$0.3	$0.0	$2.7	$348.6
2000	$257.7	$33.4	$3.1	$0.6	$2.1	$0.2	$0.2	$297.3
2001	$164.3	$28.4	$5.1	$0.6	$0.8	$0.0	$3.2	$202.5

[3] The Chignik processing facilities service the Chignik area salmon fisheries. These runs return to their spawning grounds via the Gulf of Alaska and not via Bristol Bay.
[4] All prices are in $US 2017.

Table 3.6-5: Bristol Bay Wholesale Values by Species and Year (millions of dollars)

Year	Sockeye Salmon	Herring	Chum Salmon	Chinook Salmon	Coho Salmon	Pink Salmon	Other Species	Total
2002	$140.4	$18.7	$2.9	$1.1	$0.4	$0.0	$2.2	$165.6
2003	$156.1	$23.8	$7.9	$1.1	$0.6	$0.0	$4.1	$193.7
2004	$232.6	$21.8	$2.9	$3.2	$4.9	$0.6	$0.3	$266.2
2005	$280.7	$26.7	$6.5	$2.6	$0.8	$2.2	$0.4	$319.9
2006	$293.9	$21.8	$11.5	$4.5	$1.2	$0.4	$0.4	$333.7
2007	$300.6	$16.0	$26.0	$2.1	$0.7	$0.0	$0.3	$345.6
2008	$309.3	$21.1	$10.8	$1.4	$1.4	$0.9	$0.1	$345.0
2009	$334.0	$25.3	$9.2	$1.2	$0.6	$0.1	$0.0	$370.4
2010	$437.1	$27.5	$8.2	$1.3	$1.4	$5.0	$0.0	$480.4
2011	$382.6	$21.6	$8.4	$3.3	$0.7	$0.0	$0.0	$416.6
2012	$302.2	$19.8	$7.3	$0.9	$1.3	$6.5	$0.0	$337.9
2013	$321.7	$23.1	$9.5	$0.7	$0.5	$0.4	$0.0	$355.9
2014	$402.1	$16.0	$4.6	$0.9	$3.0	$3.4	$0.0	$430.0
2015	$376.9	$16.9	$6.4	$1.6	$0.1	$0.0	$0.0	$401.9
2016	$469.2	$15.1	$9.3	$1.3	$1.1	$3.4	$5.7	$505.2
2017	$542.2	$13.6	$16.4	$1.7	$2.8	$0.2	$0.0	$576.9
Total	$6,201.9	$456.7	$160.9	$34.6	$26.7	$24.1	$23.6	$6,928.5

Source: ADF&G 2018d

Between 2004 and 2015, the processing sector provided jobs for an average of 4,106 workers; just 2.4 percent of those workers were residents from the Bristol Bay watershed, while another 12.2 percent were Alaska residents from outside the watershed. The remaining 85.4 percent were residents from regions outside of Alaska. Collective watershed resident wages averaged $1 million per year between 2004 and 2015, while total worker wages averaged $29.4 million (Table 3.6-6).

Table 3.6-6: Residency and Wages of Processing Workers

3.6-11 Year	Total Worker Count	Percent of All Processing Workers			Wages ($M Nominal)		
		Percent Nonresident Workers	Alaska Resident Ex-Watershed Workers	Watershed Resident Workers	Non-Resident Wages	Alaska Resident Wages, Ex-Watershed	Watershed Resident Wages
2004	3,594	83.0	13.5	3.5	$18.7	$2.2	$1.2
2005	3,357	81.6	14.9	3.5	$19.5	$2.3	$1.2
2006	3,090	84.2	12.3	3.5	$21.5	$2.4	$1.3
2007	3,655	84.1	12.4	3.5	$25.2	$3.2	$1.4
2008	3,987	83.8	13.5	2.7	$24.3	$3.1	$1.4

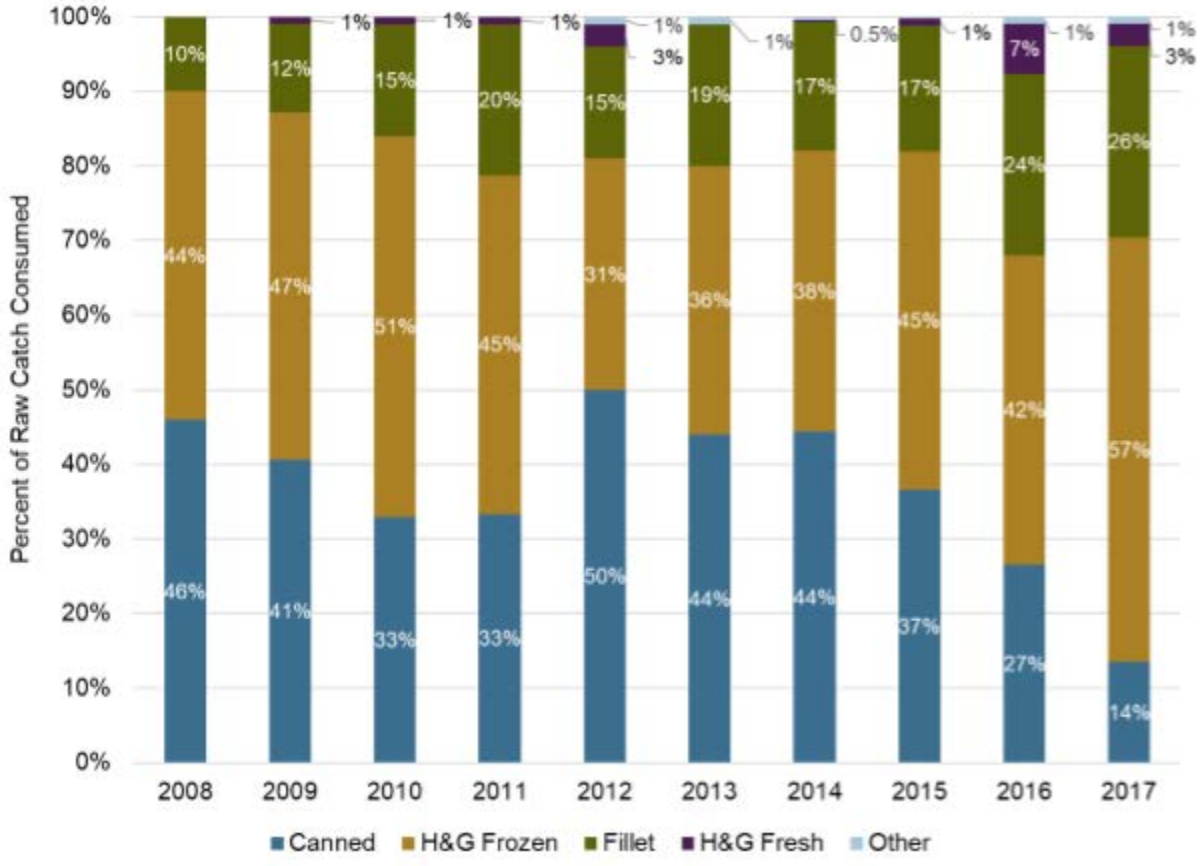
Table 3.6-6: Residency and Wages of Processing Workers

3.6-11 Year	Total Worker Count	Percent of All Processing Workers			Wages ($M Nominal)		
		Percent Nonresident Workers	Alaska Resident Ex-Watershed Workers	Watershed Resident Workers	Non-Resident Wages	Alaska Resident Wages, Ex-Watershed	Watershed Resident Wages
2009	4,855	87.0	11.8	1.2	$28.8	$2.9	$0.7
2010	4,886	87.0	11.3	1.7	$30.1	$3.2	$0.7
2011	4,574	87.8	10.5	1.7	$26.1	$2.7	$0.8
2012	4,026	85.6	12.0	2.4	$22.5	$2.6	$0.8
2013	4,328	84.7	13.3	2.0	$25.1	$4.2	$0.8
2014	4,791	87.6	10.5	1.9	$33.5	$3.7	$0.9
2015	4,134	85.9	12.0	2.1	$29.9	$3.5	$0.6

Source: ADF&G 2018d

Over the last decade, processors, the BBEDC, and the Bristol Bay Regional Seafood Development Association have focused several efforts on increasing raw product quality in the fishery. Processors consistently identify chilling fish at the point of harvest as the most important action that permit holders can take to increase product quality and they have offered bonuses to permit holders that chill their fish. Between 2008 and 2017, these bonuses have added between 12 percent and 28 percent to the base price paid to permit holders depending on the year. Permit holders responded to these incentives by increasing the portion of Bristol Bay salmon that is chilled immediately at harvest from 24 percent in 2008, to 73 percent in 2018 (Figure 3.6-9) (NEI 2018).

Figure 3.6-9: Raw Product Forms Processed in Bristol Bay, 2008-2017



Source: NEI 2018

3.6.1.5 Commercial Fishery Fiscal Contributions

The fiscal contributions of the Bristol Bay salmon fishery depend on the long-term health of the fishery. The harvest and processing of salmon in the Bristol Bay region provides millions of dollars in tax revenues to federal, state, and local governments. The federal government benefits through personal and corporate income taxes, and the State of Alaska benefits from Alaska Fisheries Business Tax (AFBT) (AS 43.75.015), while local governments benefit from general taxes such as sales taxes, real and personal property taxes, and raw fish taxes on the ex-vessel value of salmon processed within the jurisdiction (EPA 2014). Each municipality generates revenues in different ways: the Bristol Bay Borough, home to many processing plants, relies on real/personal property taxes and raw fish taxes; the city of Dillingham does not contain as many processing plants within the city limits, but it is home to lay-down and repair yards for boats, and a major provisioning center for fishing crews and so relies on sales taxes and property taxes; the LPB lacks a centralized population area that could provide it with sales and property tax revenues, but instead relies on raw fish taxes (Table 3.6-7). Overall, 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.

Table 3.6-7: Community Revenue Sources, 2017

Community	Sales Tax	Real Property Tax	Raw Fish Tax
Bristol Bay Borough	No	$4,918,466	$2,117,857
City of Dillingham	$2,528,395	$2,256,826	No
Lake and Peninsula Borough	No	No	$1,638,335
Egegik	No	No	$1,230,569
Nondalton	$0	No	No
Newhalen	$272	No	No

Source: ADCCED 2018

The State of Alaska shares revenues generated from the AFBT with local municipalities. As noted in EPA (2014), the State does not break out AFBT revenue by species or fishery. However, in 2010 when the ex-vessel value of the fishery topped $180 million in nominal terms, the Institute for Social and Economic Research estimated that the processors paid a minimum of $6.38 million in AFBT taxes (EPA 2014). In 2016 and 2017, the ex-vessel of the fishery was $156 and $216 million respectively (Table 3.6-8). Thus, one could expect that AFBT payment was slightly less than 2010 in 2016, and slightly more than 2010 in 2017.

Table 3.6-8: Estimates of Historic Fishing Related Revenues 2000-2010

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Simple lower-bound estimate of fisheries business tax obligations											
Ex-vessel value of Bristol Bay salmon harvests ($ 000)	$84,014	$40,359	$31,898	$46,684	$76,461	$94,556	$108,570	$115,763	$116,717	$144,200	$180,818
Canned Share (assumed tax rate = 5.0%)	37%	32%	49%	39%	34%	32%	34%	35%	28%	25%	27%
Non-canned share (assumed tax rate = 3%)	63%	68%	51%	61%	66%	68%	66%	65%	72%	75%	73%
Lower-bound estimate of fishers tax obligation ($ 000)	$3,145	$1,467	$1,270	$1,760	$2,818	$3,439	$3,998	$4,287	$4,163	$5,061	$6,383
State of Alaska Share Business Tax Payments to Bristol Bay Boroughs and Cities ($ 000)											
Bristol Bay Borough	$1,440	$918	$494	N/A	$451	$835	$1,178	$1,296	$1,564	$1,543	$1,797
Lake and Peninsula Borough	$357	$246	$162	N/A	$113	$71	$99	$134	$138	$152	$215
Dillingham	$203	$176	$49	N/A	$100	$154	$148	$184	$176	$187	$239
Egegik	$30	$176	$78	N/A	$36	$29	$29	$74	$63	$63	485
Total	$2,029	$1,517	$784	N/A	$700	$1,089	$1,454	$1,687	$1,941	$1,944	$2,335

Source: ADR 2018; EPA 2014

3.6.2 Upper and Lower Cook Inlet Commercial Fisheries

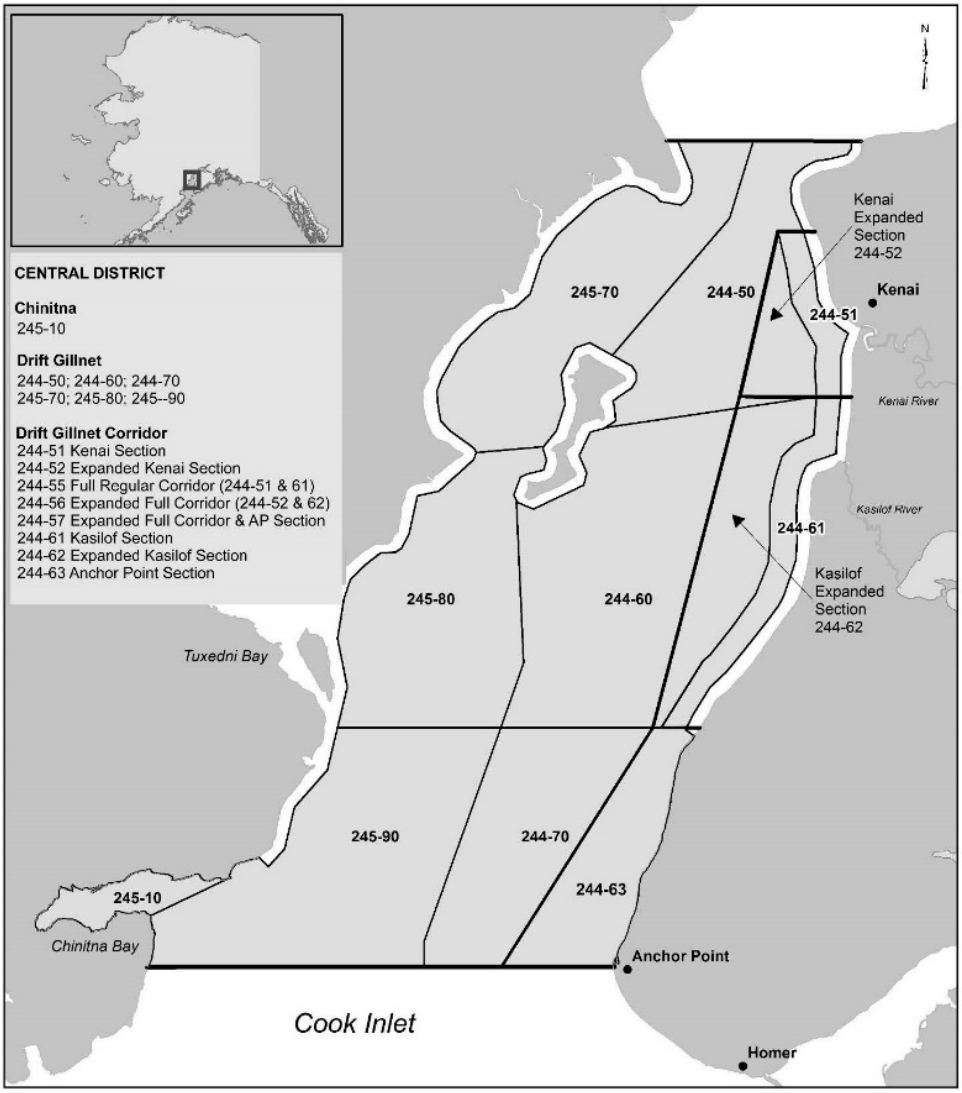
The project alternatives include a natural gas pipeline extending from north of Anchor Point on the Kenai Peninsula across Cook Inlet to Amakdedori port or Ursus Cove. This route crosses a complex set of fishing boundary areas including the southern edge of the Upper Cook Inlet (UCI) Management Area, the Lower Cook Inlet (LCI) Management Area, and federally managed waters more than 3 miles offshore. The UCI Management Area, which includes fisheries dependent on salmon headed to the Kasilof, Kenai, Susitna, Little Susitna, and Matanuska/Knik drainages, is home to extensive oil and gas pipeline infrastructure, which has operated since the 1960s. The LCI Management Area includes commercial salmon fisheries and has historically included a commercial Pacific herring fishery. Both the UCI and LCI host state-managed groundfish fisheries for Pacific cod, sablefish, walleye pollock, and rockfish species (i.e., black rockfish [*Sebastes melanops*], dark rockfish [*Sebastes cilatus*], and yelloweye rockfish [*Sebastes ruberrimus*]).

3.6.2.1 Upper Cook Inlet and Lower Cook Inlet Salmon

The UCI Management Area is one of the Alaska's most complex salmon management areas as management has to balance run escapement goals for multiple river systems and competing user groups including commercial set net permit holders, commercial drift net permit holders, fresh and saltwater recreational anglers and guides, and personal use fisheries. Between 2007 and 2016, commercial fisheries harvested an average of 3.48 million fish per year, generating $29.8 million in ex-vessel value on average. The 20-year average harvests for the fishery are 2.9 million sockeye salmon, 457,000 pink salmon, 288,000 coho salmon, 421,000 chum salmon, and 14,600 Chinook salmon (Shields and Frothingham 2018). While 20-year average harvests for sockeye salmon are representative of more recent trends, 10-year average harvests for the other species have been smaller than the 20-year harvests. The 10-year average harvests are 245,000 pink salmon, 167,000 coho salmon, 149,000 chum salmon, and 9,500 Chinook salmon (Shields and Frothingham 2018). These smaller harvests result from changes in abundance (e.g., Chinook salmon) and changes in commercial management to allow more late-season harvest opportunities for northern Cook Inlet recreational anglers fishing coho salmon. The project's proposed 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. While the UCI Management Area primarily encompasses salmon fisheries, the ADF&G also manages small commercial herring, smelt, and razor clam fisheries in the area boundaries.

The proposed project's pipeline would pass through ADF&G drift gillnet statistical areas 244-63 and 244-70 before passing into the LCI Management Area (Figure 3.6-10). The proposed pipeline would be located south of any set net fisheries contained in ADF&G statistical area 244-21 (encompassing the unnamed unshaded area located east of Area 244-61 in Figure 3.6-10). It is not possible to determine the amount of drift fleet harvest in areas 244-63 and 244-70 because the ADF&G does not collect harvest data or attempt to estimate harvest in these specific areas. Instead, harvest from areas 244-60, 245-80, 245-90, 244-70, and 244-63 are reported in aggregate as "Area 244-60" or "Area 1/District Wide." In 2016, the drift net fleet harvested 728,037 of the 1,266,696 sockeye salmon from this aggregate area; an amount equal to 57.5 percent of all UCI Management Area drift sockeye harvests. In the same year, the aggregate areas produced 70 percent of the coho salmon harvest and nearly two-thirds of the pink salmon harvest (Shields and Frothingham 2018). In spite of the uncertainty around the magnitude of the overlap between drift net fleet harvest activities and the project's proposed natural gas pipeline, the potential for conflict is low because of the depth of the pipeline on the sea floor, and the specifications of drift gillnet gear (ADF&G 2017c).

Figure 3.6-10: Upper Cook Inlet Drift Net Management Areas



Source: Shields and Frothingham 2018

The harvest in the LCI Management Area focuses primarily on pink and sockeye salmon from a combination of hatchery and wild sources, and is much smaller than UCI salmon harvests. Harvests in this area average $2.95 million per year in ex-vessel value between purse seine, set gillnet, and hatchery recovery operations. On average, 35 to 40 permit holders participate in salmon fisheries in these areas per year (Hollowell, Otis, and Ford 2017). Salmon harvests occur in most years in the Amakdedori and Chenik sub-district of the LCI. Between 1997 and 2018, fishing occurred from 2004 to 2014, and from 2016 to 2018. In the years when fishing occurred, permit holders harvested an average of 234,000 sockeye salmon, 616 coho salmon, 543 pink salmon, and 6 chum salmon. In these years, sockeye salmon harvest ranged from less than 25,000 fish to over 750,000 fish, with a median harvest of 171,000 sockeye salmon (ADF&G 2018q).

Commercial fishing activity near the Diamond Point port site differs from fishing activity at the Amakdedori port site. ADF&G LCI finfish management reports do not mention harvests in Iliamna Bay where the port would be located (Hollowel, Otis, and Ford 2017). The data provided by the ADF&G indicated that chum salmon were harvested near the port site in 15 of 32 years

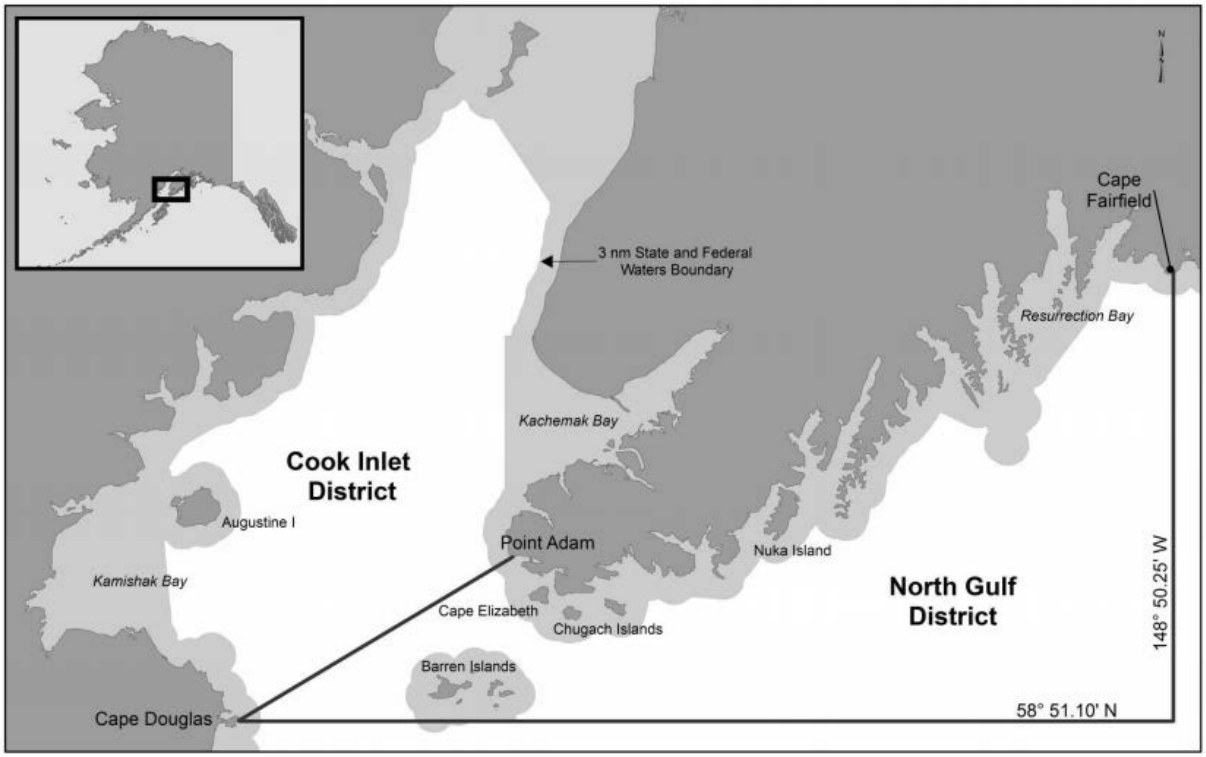
between 1986 and 2017, and pink salmon were harvested in 10 of 32 years during the same period. The average harvest in years where harvest was recorded was just over 27,000 chum salmon and approximately 3,600 pink salmon (ADF&G 2018q). The same ADF&G comments indicate that the escapement goal for Cottonwood Creek is approximately 5,000 to 12,000 chum salmon per year and that total district harvest has been as high as 160,000.

The ADF&G also manages a commercial Pacific herring fishery in the LCI Management Area, but since 2000 the spawning biomass has been too small to allow the opening of this fishery.

3.6.2.2 Upper Cook Inlet and Lower Cook Inlet Groundfish

The proposed pipeline would cross waters within the 3 nautical miles of shore managed by the State for groundfish fisheries for Pacific cod, sablefish, rockfish, and walleye pollock (Figure 3.6-11). These species are generally harvested by baited longlines or pots laid across the ocean floor, but can also be harvested using mechanical jigs or hand troll gear. ADF&G data indicate that Pacific cod is commercially the most important species of this group with Cook Inlet district harvests averaging between 1.7 and 3 million pounds annually; ex-vessel values average less than $2 million per year. Much of this harvest takes places in Kachemak Bay, south and east of the proposed pipeline (Rumble et al. 2016). The federally managed commercial Pacific halibut fishery in the Cook Inlet district had an average annual harvest of approximately 437,000 pounds of halibut over the past 10 years, with 66 percent of that harvest occurring in the federal waters between Kamishak and Kachemak bays. In 2017, 42 vessels participated in the halibut fishery. Other commercially important species harvested in the Cook Inlet district include lingcod, rockfish, sablefish, walleye pollock, spiny dogfish, and skate species.

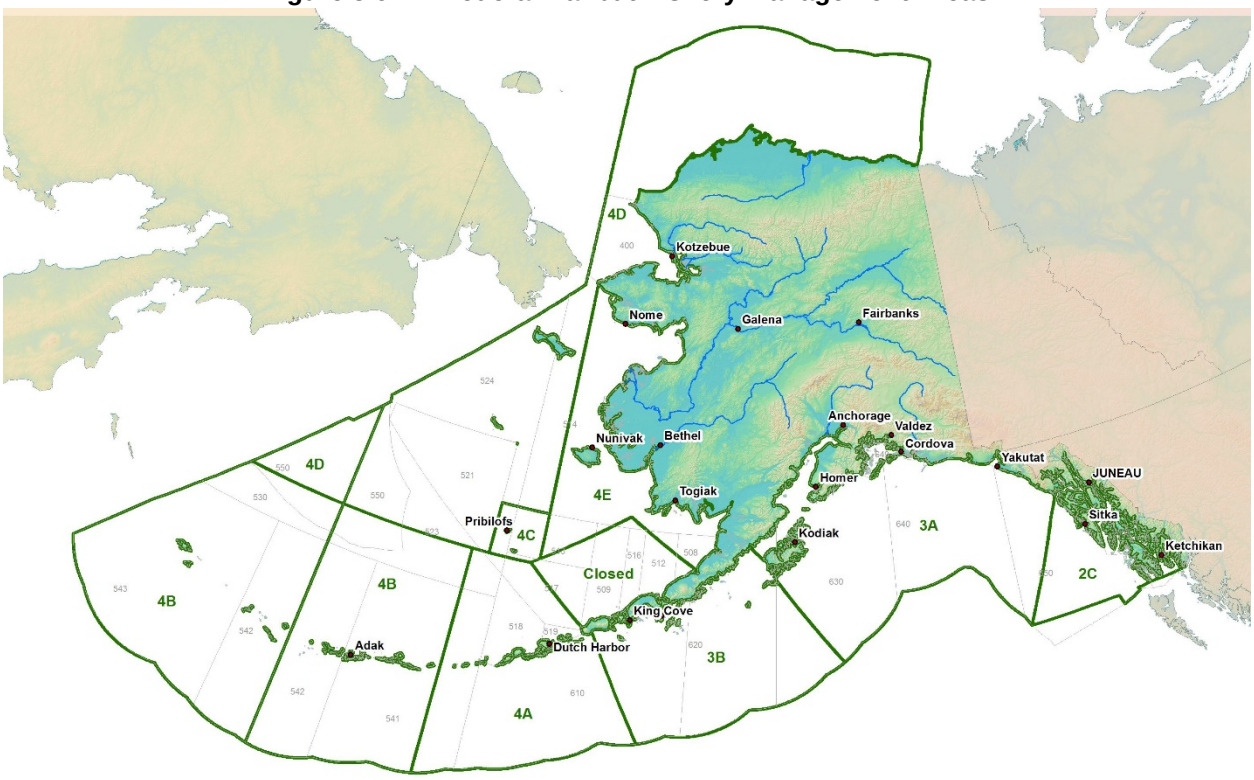
Figure 3.6-11: Cook Inlet Management Area Groundfish Areas and District Boundaries



Source: Rumble et al. 2016.

The proposed pipeline would cross the Cook Inlet district and federally managed waters in Cook Inlet beyond 3 nautical miles from shoreline. Commercial fisheries in these areas include fisheries for Pacific halibut, Pacific cod, and other groundfish (Figure 3.6-12). The halibut fishery is co-managed with the State of Alaska and the federal government, operating under limits established by the International Pacific Halibut Commission. The fishery for halibut uses longlines consisting of baited hooks laid on the ocean floor, while the cod fishery primarily uses longlines and pots. Federal management areas are much larger than state management areas; therefore, harvesters have greater flexibility to avoid fixed assets such as pipelines and undersea cables in federal waters. For example, halibut harvesters holding halibut quota for International Pacific Halibut Commission Area 3A, which includes Cook Inlet, can fish anywhere in the 3A management area. However, flexibility is not without cost; greater travel distance from home ports increases operating costs and increases uncertainty if commercial harvesters are forced to harvest from less familiar or less productive areas.

Figure 3.6-12: Federal Halibut Fishery Management Areas



Source: NOAA 2018d

The following sections describe current and historical fishing for each groundfish or shellfish species or species group.

Pacific Halibut

The fishery for Pacific halibut is Cook Inlet's most valuable groundfish fishery. In 2018, quota holders made over 300 landings of halibut, totalling 2.25 million pounds or 14 percent of all US landings of the species. The port of Homer had the second largest total of landed halibut weight in the country after Sitka in 2018, and Kodiak in 2017 and 2016. In these years, the port of Homer experienced a similar number of landings and total landed weight. The halibut season runs from March through November and operates on a quota system where quota owners pick

when and where to fish, subject to other regulations. Area 3A halibut quota can be fished anywhere from Kodiak to east of Yakutat.

Pacific Cod

The Pacific cod fishery is the largest commercial groundfish fishery in the Cook Inlet Area with about half of the total harvest occurring in the Cook Inlet District (waters of Cook Inlet north of a line from Cape Douglas to Point Adam). Fishermen catch Pacific cod using jig gear, pots, and longlines, and participate in two fishing seasons: the state waters fishery and the "parallel season" fishery, which runs concurrently with the federal fishing season. For combined federal and state waters of the Cook Inlet district over the recent 20 years, annual Pacific cod harvest has averaged approximately 2.7 million pounds, with a high of approximately 4.4 million pounds, about 40 percent of which typically occurs in the federal waters between Kamishak and Kachemak bays. Between 1997 and 2015, Pacific cod harvest in the Cook Inlet district state-waters fishery averaged 1.2 million pounds per year. The 10-year average is slightly higher at 1.4 million pounds, with the parallel season fishery adding another 350,000 to 500,000 pounds of harvest on average. The ex-vessel value of the fishery in the Cook Inlet district in 2017 was just under $1 million, with 37 vessels harvesting Pacific cod. ADF&G data indicate that nearly all of the Cook Inlet district harvest occurs south of Anchor Point in Kachemak Bay, with less than 50,000 pounds of total harvest occurring between 2012 and 2015 in the area encompassing Kamishak Bay (Rumble, Russ, and Russ 2016).

Walleye Pollock, Lingcod, Sablefish, and Other Species

The Cook Inlet Management Area does not host a walleye pollock directed fishery, but the species may be kept as bycatch. Total harvest in the entire management area, including the North Coast district and the Cook Inlet district ranges from less than 5,000 pounds per year, to less than 50,000 per year.

Lingcod harvests in the Cook Inlet Management Area including federal waters have varied dramatically in recent years from 6,700 pounds in 2015 to more than 52,000 pounds in 2018 (ADF&G 2019a). ADF&G management reports indicate that the majority of this harvest comes from state waters and that "virtually all" of the harvest comes from the North Gulf district outside of the EIS analysis area (Rumble, Russ, and Russ 2016).

In 2018, seven commercial harvests of nearly 25,000 pounds of sablefish came from Cook Inlet Management Area waters (ADF&G 2019a). This amount is less than half the historical harvest experienced between 2008 and 2014 and a more than two-thirds decline from the 83,000 harvested in 2005 (Rumble, Russ, and Russ 2016).

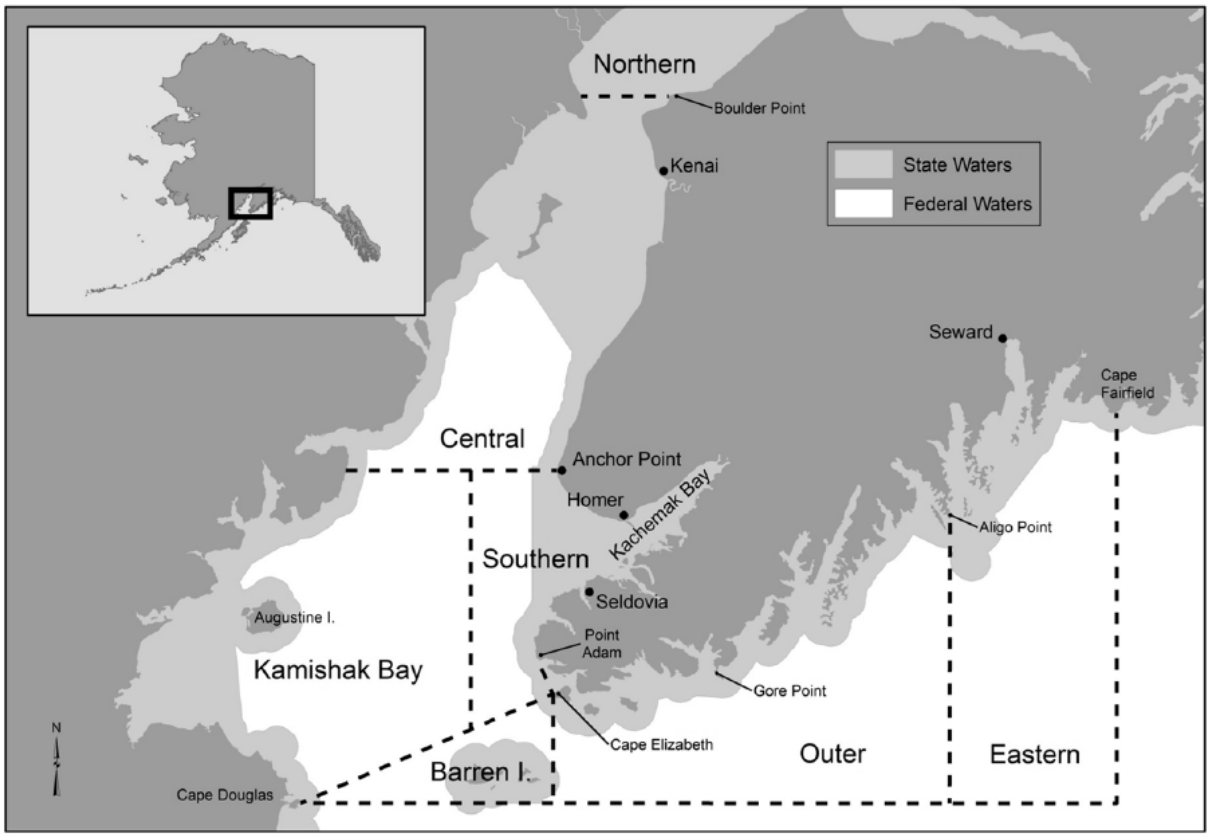
Rockfish Species

The rockfish complex includes dozens of species of the genus *Sebastes.* In the Cook Inlet Management Area, the majority of the rockfish harvest comes from pelagic shelf rockfish, such as black rockfish and dark rockfish. Demersal rockfish, primarily yelloweye rockfish, make up the second largest harvest group. According to ADF&G management reports, "Within the Cook Inlet Area, the [North Gulf District] historically yielded greater than 95 [percent] of the commercial rockfish harvest during any given year and also supported active sport and personal use rockfish fisheries, with the exception of a low of 85 [percent] in 2008. The rocky, high-relief habitat typical of the [North Gulf District] was more suitable to nearshore rockfish than the glacial-mud substrate of the [Cook Inlet District]" (Rumble, Russ, and Russ 2016). Thus, the vast majority of commercial rockfish effort and harvest is outside of the EIS analysis area of the Cook Inlet district.

3.6.2.3 Upper Cook Inlet and Lower Cook Inlet Shellfish and Miscellaneous Species

The Cook Inlet Management Area (i.e., ADF&G Registration Areas H and G) includes several active or historic shellfish fisheries. In these areas, the ADF&G manages all commercial shellfish within state and territorial waters, as well as delegated fisheries in the federal waters of the exclusive economic zone. Current and historic resources targeted in these management areas include weathervane scallops, octopus and squid, shrimp, hard shell clams and mussels, razor clams, Dungeness crab, sea cucumbers, and green sea urchins (Rumble et al. 2016b). The project would interact with this management area and associated fisheries through the positioning of the proposed natural gas pipeline, which would run from just north of Anchor Point in central shellfish district, through the northwestern corner of the Southern shellfish district through the Kamishak Bay shellfish district (Figure 3.6-13). The pipeline would pass through Kamishak Bay and Amakdedori port under Alternative 1 and through Ursus Cove before reaching the Diamond Point port area under Alternatives 2 and 3.

Figure 3.6-13: Cook Inlet Management Area and Shellfish Districts



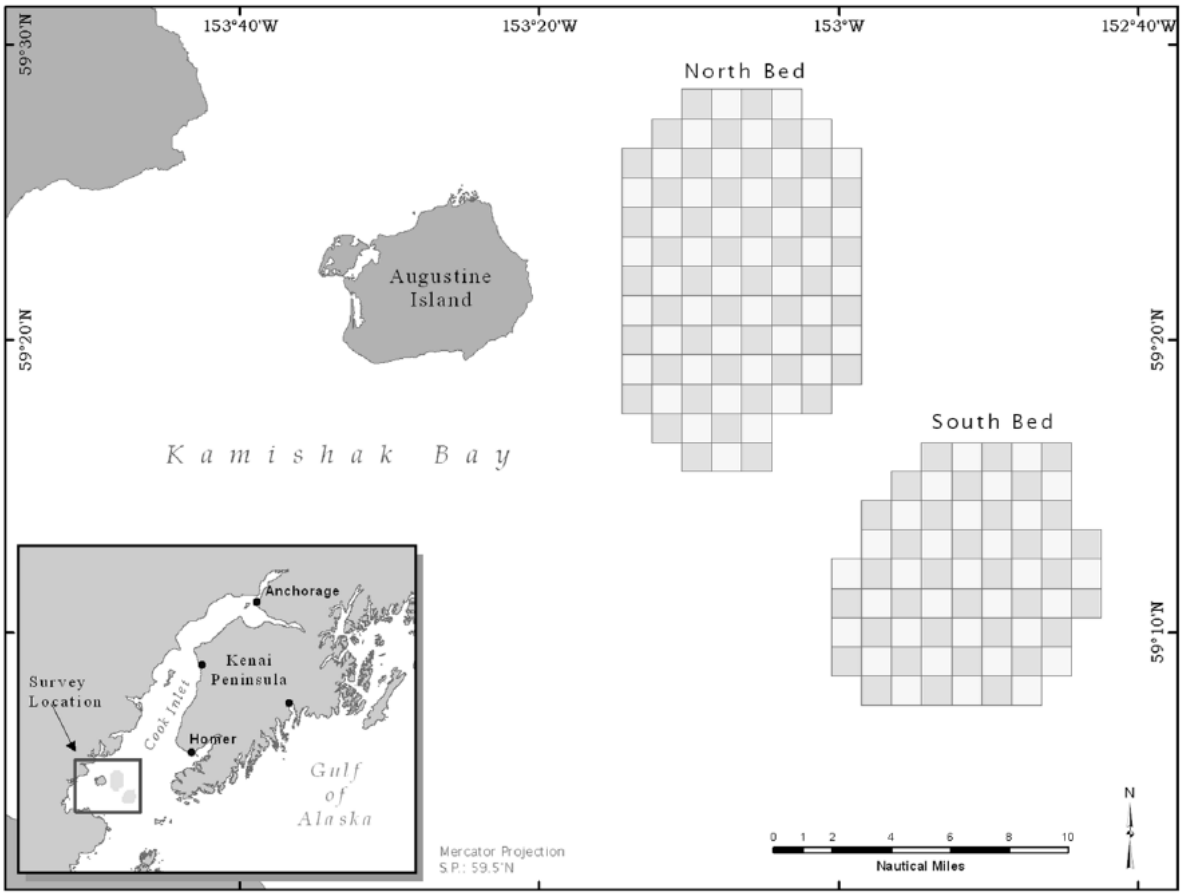
Source: Rumble et al. 2016b

The following sections provide a summary of current and historical fishing.

Weathervane Scallops

Kamishak Bay is home to a historic Weathervane scallop fishery composed of two scallop beds east of Augustine Island (Figure 3.6-14). This fishery is still actively managed by the ADF&G, but has closed due to low abundance since 2013. The northern bed is historically the more biologically and commercially productive of the two beds. Between 1993 and 2012 (i.e., the last 20 years that the fishery was open) an average of roughly two vessels per year harvested from the bed, with an average total harvest of 11,000 to 14,000 pounds. In 1995, 2003, 2007, 2008, and 2009 the fishery was either closed or had no vessels pursuing the fishery. The southern bed is the less productive of the two beds. ADF&G records show that between 1993 and 2012, harvest from the southern bed was only recorded in 2002, 2003, and 2004. The bed was closed in 1995, 2005, and 2006, and had no recoded effort in the other years (Rumble et al. 2016b).

Figure 3.6-14: Kamishak Bay Shellfish Beds



Source: Rumble et al. 2016b

Octopus

Octopus are a bycatch species harvested incidentally by other fisheries, particularly in the Pacific cod pot fishery. In every year since 2007, excepting 2010, ADF&G has issued an Emergency Order banning retention of incidentally harvest octopus when the harvest has approached the Guideline Harvest Level of 35,000 pounds. Over the past 20 years, an average

of 11 vessels per year have reported octopus landings totaling 30,000 pounds year (Rumble et al. 2016b; ADF&G 2019a).

Pacific Herring

The Kamishak Bay district of LCI hosts a historical Pacific herring fishery, which has been closed since the 2000 season. Between 1961 and 1999 the fishery harvested an average of 2,520 short tons of Pacific herring in the district (Rumble, Russ, and Russ 2016).

Shrimp, Dungeness Crab, and Hard Clams

Cook Inlet was home to a historical fishery for shrimp, which averaged 5 million harvested pounds per year between 1969 and 1983. The fishery closed in 1987 and 1997 because of low abundance (Rumble et al. 2016b).

While a Dungeness crab fishery existed in the southern district until the 1990s; there is currently no open fishing season for the species in the Cook Inlet Management Area. Similarly, hard shell clams were harvested in Kachemak Bay until 2006. There have been no recorded commercial harvests since that time (Rumble et al. 2016b).

3.6.3 Guided and Unguided Recreational Fishing

3.6.3.1 Freshwater Fishing

The EIS analysis area hosts numerous freshwater fishing resources that anglers use primarily to target Chinook salmon, sockeye salmon, rainbow trout, and other salmonid species. They value the area's low angler density, catch rates, and wilderness fishing conditions (EPA 2014). In turn, 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.

The ADF&G measures recreational fishing effort via the annual SWHS. The SWHS measures effort and catch (i.e., harvest plus catch and release) across a set of geographic statistical areas via a mail survey distributed to a sample of individuals who purchased an Alaska fishing license in the year being surveyed. Each year, the ADF&G mails 47,000 SWHSs to anglers who bought licenses; it divides anglers into four sample frames: Alaskans, non-Alaskan US citizens, Canadian residents, and all other anglers. In 2016, response rates across the frames varied between 26 percent and 50 percent; each year the ADF&G expects approximately 17,000 responses (ADF&G 2017m). Figure 3.6-15 shows ADF&G recreational fishing areas.

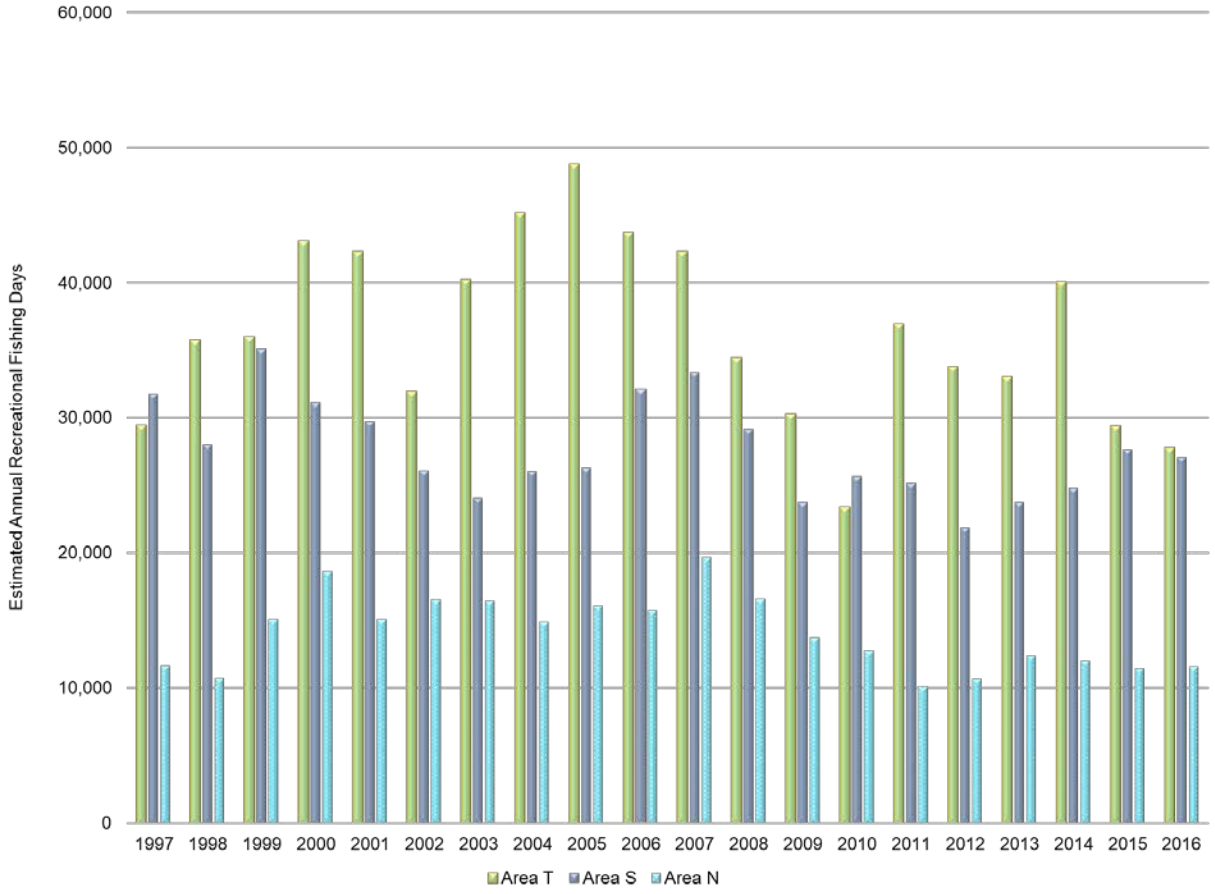
Figure 3.6-15: Map of ADF&G Recreational Fishing Areas

Source: ADF&G 2018d

The ADF&G SWHS statistical areas S, T, and N contain the waterbodies hydrologically connected to the project area; Area S contains the Kvichak River drainage while Area T contains the Nushagak, Wood, and Togiak river drainages (Figure 3.6-16). In 2016, the ADF&G estimated that anglers fished just over 27,000 days in Area S, nearly 28,000 days in Area T, and 11,600 days in Area N; the vast majority of these days were freshwater fishing days. The EIS analysis area also includes Area P which is not hydrologically connected to the project area[5].

[5] Area P includes the eastern terminus of the proposed natural gas pipeline, where the pipeline would connect with the existing natural gas supply system on the Kenai Peninsula. The primary facility would be a new compressor station north of Anchor Point and the Anchor River, which hosted an estimated 12,699 angler days in 2016. The facility would not be expected to affect angling in the area; thus, Area P is not discussed in further detail in this section.

Figure 3.6-16: Recreational Fishing Effort, 1997-2016



Source: ADF&G 2018d

Each year, the ADF&G publishes estimates of angler counts, fishing days, and harvest for those waterbodies that they have received enough completed surveys; this is in order to generate results of a certain statistical reliability. The SWHS combines all waterbodies for which there are not enough responses into an "other" category. Thus, busier waterbodies generate enough angler survey responses for ADF&G to create effort estimates every year, while some less busy waterbodies may only generate enough results a couple of times in a 10-year period. The absence of an estimate in a particular year for one of these waterbodies does not indicate the absence of effort in that year, but rather a lack of angler survey responses. Therefore, for these waterbodies it is particularly important to look at effort across time to get a truer sense.

In Area T, between 1997 and 2016, angler responses allowed the SWHS to estimate angling effort for eight distinct waterbodies, drainages, or systems. The survey identified the Nushagak River (excluding the Mulchatna drainage), the Wood River System, and the Togiak River System as the most frequently fished systems. These three systems accounted for 84 percent of estimated angling effort between 1997 and 2016, and each system received enough angler survey responses for the ADF&G to estimate effort on an annual basis. The Mulchatna River is the only system in Area S known to be connected to the project area via surface waters; the river accounted for 6.4 percent of estimated angling effort in the 20 years between 1997 and 2016. However, average annual angling effort on the Mulchatna River was 45 percent lower for the 2007 to 2016 period than it was during the 1997 to 2006 period (Table 3.6-9).

Table 3.6-9: Area T Waterbodies, Average Annual Angling Days and SWHS Appearances

Waterbody	1997-2006		2007-2016	
	Average Annual Days	Years as a Specified Waterbody	Average Annual Days	Years as a Specified Waterbody
Nushagak River	16,990	10	14,958	10
Wood River System	10,992	10	8,416	10
Togiak River System	4,601	10	4,984	10
Tikchik-Nuyakuk Lake System	2,053	10	1,950	6
Mulchatna River Drainage*	2,999	10	1,672	10
Nuyakuk River Drainage	--	0	1,327	6
Other Waterbodies	1,798	10	1,065	10
Kulukak River	--	0	758	1
Chilikadrotna River	1,031	2	--	0
Freshwater Total	**39,638**	**10**	**33,137**	**10**

Note: *This estimate includes any activity on the Koktuli River. Data from the ADF&G from 2007-2016 indicate that on average 2.3 anglers per year return harvest surveys indicating they fish the Koktuli; a number below the threshold for estimating effort on a specific waterbody (Borden 2018). In comparison, Lower Talarik Creek responses ranged from 2 responses to 17 responses and averaged 9.5 responses per year in same period. The department only estimated effort for Lower Talarik Creek when the number of responses in a single year reached the mid-teens at a minimum. Responses indicating effort on the Koktuli are typically a fraction of the ADF&G's minimum for estimating and publishing specific waterbody effort.
Source: ADF&G 2018d

Angler responses allowed the ADF&G to estimate angling effort for twice as many waterbodies in Area T as compared to Area S in the 1997 to 2016 period. However, Area S averages roughly one-quarter fewer angling days on average than Area T. The most popular waterbodies in Area S are the Alagnak/Branch River, the Kvichak River, the Copper River (tributary of Iliamna Lake), and the Lake Clark and Iliamna Lake drainages. Waterbodies that have been included in the SWHS annual report, which have the potential to be directly affected by the project, including transportation activity, are the Newhalen River, Lower Talarik Creek, Kvichak River, Gibraltar River, and Iliamna Lake (Table 3.6-10).

Table 3.6-10: Area S Waterbodies, Average Annual Angling Days, and SWHS Appearances

Waterbody	1997-2006		2007-2016	
	Average Annual Days	Years as a Specified Waterbody	Average Annual Days	Years as a Specified Waterbody
Alagnak (Branch) River drainage	9,394	10	6,320	10
Kvichak River	7,813	10	5,167	10
Copper River (tributary of Iliamna Lake)	2,118	7	2,396	10
Lake Clark drainage	2,133	10	2,371	10
Other Waterbodies	2,133	10	2,371	10
Iliamna Lake and tributaries	1,931	7	2,187	10

Table 3.6-10: Area S Waterbodies, Average Annual Angling Days, and SWHS Appearances

Waterbody	1997-2006		2007-2016	
	Average Annual Days	Years as a Specified Waterbody	Average Annual Days	Years as a Specified Waterbody
Newhalen River drainage	2,972	7	1,862	7
Kulik River	1,073	7	1,652	10
Moraine Creek	1,063	6	1,616	10
Iliamna River	--	0	990	6
Kukaklek River	--	0	724	6
Gibraltar River drainage	--	0	655	7
Funnel Creek	--	0	515	4
Lower Talarik Creek	576	6	441	3
Battle River	--	0	436	5
Tazimina River	589	1	--	0
Gibraltar Lake	630	1	--	0
Freshwater Total	**29,036**	**10**	**26,239**	**10**

Source: ADF&G 2018d

In Area N, the SWHS estimated an average of 15,102 fishing days between 1997 and 2006, and 13,113 days between 2007 and 2016. Angler effort is concentrated north of the project area for all the named sites, with the exception of the Kamishak River. The Kamishak River, which appears once as a named site in 20 years' worth of data, is located south of the project area near the McNeil River State Game Sanctuary and roughly 20 air miles from the potential Amakdedori port site (Table 3.6-11).

Table 3.6-11: Area N Waterbodies, Average Annual Angling Days and SWHS Appearances

Waterbody	1997-2006		2007-2016	
	Average Annual Days	Years as a Specified Waterbody	Average Annual Days	Years as a Specified Waterbody
Wolverine Creek mouth	3,783	3	2,393	10
Other Freshwater	2,693	10	2,249	10
Chuitna River	2,634	10	1,412	6
Kustatan River	2,557	7	0	0
Big River Lakes	1,615	8	2,168	10
Silver Salmon Creek	1,087	10	856	8
Theodore River	850	9	765	3
Crescent Lake	--	0	692	1
Kamishak River	--	0	276	1
Freshwater Total	**15,102**	**10**	**13,113**	**10**

Source: ADF&G 2018d

In addition to the SWHS, the ADF&G collects data on guided saltwater and freshwater fishing trips via the Alaska Guide Logbook Program. Under the program, Alaska guides record data on each day they spend guiding including data and location of the trip(s), the license numbers of guided anglers, harvest, and catch. While SWHS data is superior in its breadth, including both guided and unguided angler effort, logbook data is a census of guided trips as opposed to estimates based on a survey. Table K3.6-7 in Appendix K3.6 summarizes 2011 to 2014 program data for SWHS areas N, P, S, and T. Table 3.6-12 below shows the summarized data for "high interest" waterbodies, which would either be directly affected by the proposed project, have potential for cumulative or downstream effects, or have been mentioned in public scoping. The data provide insights into guided effort in the area including:

- The vast majority (i.e., 95+ percent) of all guided Nushagak/Mulchatna effort is on the Nushagak River.
- The Copper River, which is located on the eastern shores of Iliamna Lake south of alternative leading to Diamond Point port, and north of the alternative leading to Amakdedori port, hosts an average of nearly 1,500 guided fishing days per year.
- The Gibraltar River, which would be crossed by the port access road leading to Amakdedori port, hosts an average of fewer than 300 guided fishing days per year.
- The Newhalen River, which would be crossed by the Iliamna spur road or north route alternatives, hosts fewer than 200 guided days per year and only appeared in 3 years' worth of data out of a maximum of 4 years.
- Upper and Lower Talarik Creek host fewer than 200 guided angling days per year, combined. On average, Lower Talarik Creek is the more popular of the two waterbodies, hosting 75 percent of combined effort.
- The Koktuli River does not appear in the program data for these years.

3.6.3.2 Estimates of Economic Contribution

Sport fishing is a consistently significant economic activity in the Bristol Bay Region (EPA 2014). Anglers spend significant sums of money on transportation, lodging and meals, equipment, and guide services, amongst other expenditure categories. These expenditures help fuel local economies and generate local tax revenues for the City of Dillingham, the LPB, and the Bristol Bay Borough. Although annual estimates of sport fishing's economic contribution are not available, EPA (2014) and Duffield et al. (2007) provide estimates of annualized value based on 2005 sport fishing effort. The Duffield et al. (2007) estimates indicate that in 2005, per trip expenditures ranged from $426 for watershed residents to $7,933 for those staying at remote lodges. Watershed resident anglers averaged 11.54 trips per year, while ex-watershed Alaska residents and non-residents average 1.3 and 1.49 trips per year[6] (Table 3.6-13).

[6] Duffield et al. (2007) and EPA (2014) defined a trip as "a roundtrip visit from home and return." Given the region's remoteness, this definition means that most trips involve multiple days of activity. Remote fishing lodge packages typically range from 3 to 7 days.

Table 3.6-12: Comparative Estimates of Sport Fishing Effort, Days

Waterbody	Average of 2011-2014 Data			
	Appear-ances in Data (Max=4)	Business Operating	Trips	Days
Area N				
Kamishak River	4	8	133	356
Area P				
Anchor River	4	7	52	115
Area S				
Copper River (Iliamna Lake Area)	4	11	613	1,466
Kvichak River	4	19	548	1,288
Iliamna River	4	7	185	430
Gibraltar River	4	9	123	289
Iliamna Lake	4	8	76	223
Newhalen River	3	9	58	174
Lower Talarik Creek	4	8	55	148
Upper Talarik Creek	3	5	16	48
Chekok Creek	2	7	19	46
Area T				
Nushagak River – Sonar Site to Outlet of Mulchatna	4	28	1,153	3,577
Nushagak River – Black Point upstream to Sonar Site	4	21	847	2,513
Mulchatna River	4	6	135	342

Source: Sigurdsson and Powers 2012, 2013, 2014; Powers and Sigurdsson 2016.

Table 3.6-13: Inflation-Adjusted Estimates of per Trip Expenditures

Category	Watershed Residents	Alaska Ex-Watershed	Non-Residents	Remote Lodges
Estimated per Trip Expenditures	$426	$1,806	$4,560	$7,933
Average Trips per Year	11.54	1.30	1.49	N/A

Note: N/A = not applicable
Source: EPA 2014. Expenditures adjusted using Anchorage CPI.

The inflation-adjusted collective expenditures in Duffield et al. (2007) associated with recreational fishing in the Bristol Bay region equal $5.5 million by watershed residents, $6.9 million by Alaska residents living outside the region, and $54.1 million by non-residents, for a total of $66.58 million (Table 3.6-14). The inflation-adjusted estimate of statewide expenditures from Duffield et al. (2007) is $69.32 million; thus, most angler expenditures occur in-region.

Table 3.6-14: Inflation-Adjusted Estimates of In-Region Expenditures

Category	Watershed Residents	Alaska Ex-Watershed	Non-Residents	Total
Estimated Bristol Bay Expenditures	$5,564,568	$6,910,211	$54,108,115	$66,582,894

Source: EPA 2014. Expenditures adjusted using Anchorage CPI

In 2005, the year the Duffield et al. (2007) expenditure estimates are based on, the ADF&G SWHS estimated that anglers spent 75,083 days angling in SWHS areas S and T. In 2016, the same survey estimated that anglers spent 54,882 angling days in the region; a decline of 27 percent. For the 5-year periods of 2001 to 2005 and 2012 to 2016, effort was down 15 percent from the earlier period to the later period, as shown in Table 3.6-15. Presuming that angler expenditures have stayed the same adjusted for inflation, the decline in effort would result in a reduction in regional expenditures. A 27 percent adjustment applied to the Duffield et al. (2007) estimate of $66.58 million results in an estimate of $56.54 million in regional expenditures for 2016, presuming that the distribution of angler expenditures has remained constant.

Table 3.6-15: Comparative Estimates of Sport Fishing Effort, Days

SWHS Area	Annual Counts		Five-Year Averages	
	2005	2016	2001-2005	2012-2016
Nushagak	48,751	27,786	41,670	32,807
Kvichak	26,332	27,096	26,460	25,043
Total	75,083	54,882	68,130	57,851

Source: ADF&G 2018d

3.6.3.3 Local Recreational Fishery Fiscal Contribution

Anglers can contribute to the fiscal resources of local governments through taxes such as sales (City of Dillingham) and lodging (LPB, City of Dillingham, Bristol Bay Borough). The LPB also raises revenue through a direct tax on guide services where guides pay $3 per angler day to the borough.

In fiscal year 2018, the LPB generated $56,282 from 147 guides licensed to work in the borough, and $177,566 from 64 lodges in the borough. These amounts are equal to roughly 6.8 percent of all LPB tax revenue, and 4.6 percent of the all fiscal year 2018 revenue (Table 3.6-16) (LPB 2018b).

Table 3.6-16: Lake and Peninsula Borough Recreational Fishing Revenues

Fiscal Year	Annual Revenues	
	Guide Tax	Bed Tax
2015	39,716	262,831
2016	46,030	180,069
2017	30,948	108,895
2018	56,282	177, 566

Source: LPB 2018b

The Bristol Bay Borough, which does not have a guide tax, does have transient occupancy (i.e., bed) tax revenues and real property tax revenues associated with lodges. It is very likely that these revenues are a small subset of the borough's $4.9 million in annual property tax revenues given that fish processing facilities likely make up the bulk of the borough's tax base.

3.6.3.4 Saltwater Fishing in Cook Inlet

The EIS analysis area includes the saltwater fishing environment. ADF&G's SWHS estimates that, on average, anglers generate approximately 180,000 saltwater fishing days. A 2008 study by the ADF&G found that these anglers spend an average of approximately $245 per angling day (both fresh and saltwater). The study estimated total direct saltwater expenditures at just over $99 million in 2007 (ADF&G 2018d).[7]

Fishing effort SWHS data breaks down into three large groups and one smaller group of anglers. These are:

- *Boat anglers inside of Kachemak Bay as defined by a line running from Bluff Point to Seldovia*. Average efforts in this area equal just under 59,000 days per year based on 2008-2017 data or 33.2 percent of the area total. Effort in this area is predominantly by non-charter anglers with charter anglers accounting for just 28 percent of days between 2008 and 2017.
- *Boat anglers fishing north of a line which runs from Bluff Point between Homer and Anchor Point and Chinitna Point in West Cook Inlet.* This area includes popular saltwater launch and fishing locations such as Anchor Point, Happy Valley, Deep Creek, and Ninilchik. Efforts in this area average 58,000 days between 2008 and 2017, or 32.3 percent of the area total. The ADF&G estimates that just under half (i.e., 47 percent) of these days are by charter anglers.
- *Boat anglers south of the Bluff Point/Chinitna Point line and west of Gore Point on the outside of the Kenai Peninsula.* This area averages 44,600 days per year or 25 percent of the area total; 58.6 percent of the angling days in this area are charter angler days. This area includes Kamishak Bay and much of the natural gas pipeline transit zone.
- *Shore Anglers and Boat Day of Unspecified Location.* This category averaged 17,000 days per year between 2008 and 2017 or just under 9.5 percent of total effort. More than 95 percent of this effort is shore-based and nearly three-quarters of this category's effort occurs at the Homer Spit.

[7] The study did not estimate an expenditure per day figure for saltwater angling in Cook Inlet.

3.7 CULTURAL RESOURCES

This section describes the types of cultural resources in the affected environment. Historic properties are a subset of cultural resources which have been determined eligible for listing in the National Register of Historic Places (National Register) and are covered in Section 3.8, Historic Properties. This section focuses on the review of cultural resources and cultural values under National Environmental Policy Act (NEPA) in the Environmental Impact Statement (EIS) analysis area (described below).

The EIS analysis area for cultural resources is the project footprint for direct effects, and lands within 3 miles of the mine site and within 1 mile of the other project components (i.e., port sites, transportation corridors, and ferry terminals) for indirect impacts. This geographic area allows for the consideration of potential direct and indirect impacts on cultural resources from the project. Refer to Section 4.11, Aesthetics, for information on visual distance zones, and Appendix K4.11 for project viewshed figures.

The NEPA does not specifically define the term "cultural resources." The law requires that agencies consider the effects of their actions on all aspects of the "human environment," which NEPA interprets to include the natural and physical environment and the *relationship of people with that environment* (emphasis added) (40 Code of Federal Regulations [CFR] Part 1508.14). Humans relate to their environment through culture, requiring the consideration of effects on cultural aspects of the environment in NEPA analyses. NEPA defines effects as changes "on the quality of the human environment," which includes alterations to the "aesthetic, historic, cultural, economic, [and] social" aspects of the environment. The lead federal agency should consider "the degree to which the action may adversely affect districts, sites, highways and other structures, or objects listed in or eligible for listing in the National Register or may cause loss or destruction of significant scientific, cultural, or historical resources." In addition to NEPA, 33 CFR Part 320.4(e) also requires an evaluation of effects historical, cultural, scenic, and recreational values.

This analysis defines cultural resources as archaeological, historical, or architectural resources and locations of traditional cultural or religious importance to specific social and/or cultural groups. This may include, but is not limited to, Traditional Cultural Properties (TCPs); cultural landscapes (both historic and prehistoric); locations with indigenous place names; locations connected with an event(s) in oral histories; sacred and/or ceremonial sites; resource gathering and subsistence areas; or other sites of cultural importance that contribute to the continued identity, spirituality, and lifeways of communities in or near the project area.

Additional federal laws and Executive Orders also require the consideration of effects or impacts on cultural resources in coordination with NEPA and the National Historic Preservation Act (NHPA). These include:

- Antiquities Act of 1906 (16 US Code [USC] 431-433)
- Historic Sites Act of 1935 (16 USC 461-467)
- Archaeology and Historic Preservation Act of 1974 (16 USC 469-469c)
- Archaeological Resources Protection Act of 1979 (16 USC 470aa-47011)
- American Indian Religious Freedom Act of 1978 (42 USC 1996)
- Religious Freedom Restoration Act (42 USC 21b)
- Abandoned Shipwreck Act of 1987 (43 USC 2101-2106)
- Native American Graves Protection and Repatriation Act of 1995 (20 USC 3001 et seq.)

- Executive Orders 13006, 13007, and 13175

The Alaska Historic Preservation Act of 1971 addresses the consideration of cultural resources on State lands or lands potentially affected by public construction.

3.7.1 Data Gap Summary

Information presented herein is primarily based on a review of data on file at the Alaska Heritage Resources Survey (AHRS)[1], and the series of cultural resources survey reports prepared for the Pebble Limited Partnership (PLP) between 2004 and 2013 by Stephen R. Braund and Associates (SRB&A)[2]. The SRB&A reports also contain information about cultural resource features derived from interviews of local informants from the villages near the project area. Other reports have informed this document, including Boraas and Knott (2013) and data sets from subsistence harvest areas (SRB&A 2011b). Data and analytical gaps will be addressed through ongoing research, including input from public comments, and will allow for additional characterization of the affected environment for cultural resources in the Final EIS (FEIS). For example:

- SRB&A's field work scope was limited to investigating lands within the "claim block boundary," which was defined as mining claims owned or leased by PLP and Kaskanak, Inc., and represents an area larger than the current mine site footprint. The claim block analysis area covered lands from Iliamna Lake in the south, to the Nikabuna Lakes in the north, and west from the Newhalen River toward the Mulchatna River. Background and place names research covered the entirety of this area, whereas field work was targeted to where PLP had proposed ground-disturbing activities in support of geotechnical and mineral exploration activities.
- Field surveys did not cover the entire mine site or any of the project components outside of the mine lease area.
- SRB&A collected and consolidated place name data, and developed a place name database. The place name data cover the mine claim lease area and the Expanded Cook Inlet Baseline Study Area (ECIBSA). Public input and additional research may yield the identification of additional place names and contribute to better understanding the cultural significance of these places.
- The ECIBSA spans a large section of western lower Cook Inlet and extends from Kamishak Bay area in the south, to the Chinitna Bay area in the north. In addition to place name research, this area was also subject to literature reviews in 2011 and 2012; limited field surveys occurred at Knoll Head near Iniskin Bay, Williamsport at the head of Iliamna Bay, Y Valley, and Sunday Creek (SRB&A 2014). None of the areas surveyed fall in the project footprint or EIS analysis area for any of the alternatives or variants.
- SRB&A completed interviews and noted the location of approximately 1,600 interview-identified cultural resources based on informant knowledge, but only limited field work has been completed to determine if there are physical manifestations of these interview-identified sites (SRB&A 2011a; SRB&A 2018b). This analysis also acknowledges that not all cultural resources will have physical

[1] The AHRS is a database of identified cultural resource features in Alaska and is maintained by the Office of Historic and Archaeology. Site significance is not a consideration when assigning AHRS numbers. It is intended to be an inclusive data set, and not all sites have been field verified, nor are all sites in Alaska listed

[2] SRB&A is a consulting firm based in Anchorage, Alaska that specializes in the cultural and subsistence resources. SRB&A performed cultural resources investigations of the project as a consultant to PLP.

evidence. SRB&A conducted interviews in 2007 and again in 2013. The interview-identified cultural resources include historic structures or built features, travel routes (including traplines, trails, and portages), definable areas (e.g., burial grounds, battle sites, legend landscapes, and other areas of religious or traditional significance), and names or storied locations (place names). While field verification of these cultural resources has been limited, the geographical span of interview-identified cultural resources covers the entire project area, including alternatives and variants.

  - Interviews identified routes and trails, but field verification was limited to investigating if any of the reported routes and trails intersected the areas of ground disturbance for the geotechnical and mineral exploration activities in the mine claim lease area.
  - SRB&A collected and consolidated place name data, and developed a place name database The place name data cover the mine claim lease area and the ECIBSA as defined for the Environmental Baseline Document (EBD) and Supplemental Environmental Baseline Document (SEBD) reports, but data do not cover the Alternative 1 transportation corridor.

- PLP has not yet completed an assessment for off-shore cultural resources (and historic properties) for project components and alternatives. This will occur during the 2019 field season and be incorporated into the FEIS. Available data derived through side-scan sonar will be interpreted by an archaeologist to assess the potential for cultural resource features, and additional research may be undertaken to collect more information about off shore cultural resources.
- The transportation corridor for Alternatives 2 and 3, including the pipeline route, and the Diamond Point port components have not been surveyed or otherwise investigated for cultural resources.

The US Army Corps of Engineers (USACE) will be addressing data gaps throughout the NEPA process. The procedures detailing further work beyond the issuance of the FEIS (e.g., the process for additional identification research and surveys, evaluation, and mitigation measures) will be established through the Section 106 process, discussed in Section 3.8, Historic Properties. The NEPA and Section 106 processes may result in the identification of currently unknown cultural resources, which will be integrated into the analysis.

3.7.2 Cultural Context

The cultural resource EIS analysis area covers a broad and complex range of prehistoric traditions, ethnographic regions, land uses, and historic-era themes. The detailed cultural context and chronology for prehistoric archaeological traditions, ethnographic, and historic-era themes is presented in the archaeology survey summary reports prepared by SRB&A (SRB&A 2011a; 2015a; 2015b), and the reader is referred to those reports. Boraas and Knott (2013) also offer a detailed prehistoric cultural chronology based on known archaeological site data in the region (see Table 3.7-1). Archaeological artifacts analyzed from testing at known sites clearly demonstrate that the area has been continuously occupied as early as 10,000 years ago, with evidence of salmon fishing by Yup'ik or proto-Yup'ik people in the region for at least 4,000 years. A well-developed salmon-based culture emerged in the Norton tradition, dating from approximately 300 B.C. to A.D. 1000, as evidenced by the presence of sedentary villages and net fishing artifacts. The contexts cover prehistoric archaeology traditions, ethnographic studies of the Dena'ina, Yup'ik, and Alutiiq peoples that occupy the region, and offer a chronology of the regional history from contact through the Russian, and then American, periods. Boraas and Knott (2013) also illustrate how traditions established in the prehistoric, proto-historic, and

historic eras remain a central component of current lifeways and traditions of the subsistence-based cultural practices in the region.

Table 3.7-1: Chronology of Dena'ina Prehistory Identifying Ethnographic and Archaeological Cultures in the Iliamna and Cook Inlet Region.

	Nushagak River	Kvichak River	Illamna Lake	Mulchatna River	Lake Clark
AD 1800	Historic Yup'ik	Historic Yup'ik	Historic Yup'ik/Den.	Historic Yup'ik/Den.	Hist. Dena'ina
1000 BP	Pre-Contact Yup'ik	Pre-Contact Yup'ik	Pre-Contact Yup'ik & Dena'ina ■ ■	Sedentary Dena'ina	Sedentary ■ Dena'ina
(~A.D. 1000)	■ Norton Tradition (interior)	Norton Tradition (interior) ■ ■	■ Norton Tradition (interior)		Norton Tradition (interior)
2000 BP					
(~A.D. 0)					
3000 BP		Arctic Small	Arctic Small		Arctic Small
(~1000 B.C.)	←	Tool Tradition ■ ■	Tool Tradition	←	Tool Tradition
4000 BP					
(~2000 B.C.)			Ocean Bay ■ Tradition ■ (interior) ■		← Northern Archaic Tradition
5000 BP					
(~3000 B.C.)					
6000 BP					
(~4000 B.C.)		Paleoarctic Tradition	Paleoarctic Tradition		← Paleoarctic Tradition
	Putu PaleoIndian/ Paleoarctic	↓ To 10,000 B.C.	↓ To 10,000 B.C.		↓ To 10,000 B.C.

Notes: Salmon Cultures; Not Definitive or No Data; ■ Select Radiocarbon Dates; ← Probable
Source: Boraas and Knott 2013

3.7.2.1 Previous Cultural Resource Research

Prior to SRB&A's archaeological field surveys, only two archaeological field surveys occurred in the PLP mine claim lease area; no archaeological or historic-era sites were identified. SRB&A's report (2011a) details the results of the nearest cultural resources surveys in each direction from the claim boundary.

SRB&A's annual survey work commenced in 2004, and involved yearly surveys until 2012. Initial fieldwork focused on the mine claim lease area, and was limited to specific locations of expected ground disturbance in PLP's claim boundary with few exceptions, including several surveys in adjoining claim boundaries to the south of the mine site and a brief survey in 2006 along a section of the Newhalen River for a proposed bridge crossing. SRB&A's first surveys in the area that became the ECIBSA occurred in 2005, and focused on the then-proposed port site locations in the Knoll Head area (SRB&A 2011a). SRB&A returned in 2007 to survey two proposed meteorological station locations near Iliamna Bay, and again in 2012 to survey areas near Y Valley and Sunday Creek.

The transportation corridors for each alternative have not been surveyed for cultural resources. Literature reviews provided in SRB&A 2011a and 2015a include references and a narrative of previous studies throughout the general region. The SRB&A annual reports primarily discuss archaeological compliance surveys, but also offer a summary of historic and ethnographic sources, including historic documents, ethnographic and linguistic studies, and interview-identified cultural resources. Additionally, SRB&A 2011a contains information on the 2007 interview-identified cultural resources throughout the region, including both Bristol Bay and Cook Inlet drainages. SRB&A also completed reports providing the results of the 2013 interviews (SRB&A 2018b) that include tables and figures summarizing the results of these interview-identified cultural features. The geographic extent of the interview identified cultural features covers each alternative and provides data on the types of cultural resources features identified in the analysis area.

Ethnographic works about the Dena'ina, Yup'ik, and Alutiiq (see SRB&A 2011a for a list of select ethnographic and linguistic studies) contribute to understanding social structures, subsistence food storage practices, land use traditions, place names, and many other points of data with bearing on defining how humans have interacted with natural resources in the affected environment. For example, Boraas and Knott (2013) note that the Yup'ik and Dena'ina consider the land and waters to be their sacred homeland, and census data presented in their reports also note Alutiiq populations in Igiugig and Kokhanok, the latter village being near the proposed south ferry terminal and terminus of the port access road for Alternative 1. Salmon, and the waters that support them, are crucial elements of this homeland, and therefore may be considered as part of the cultural resource landscape. Interrelated to salmon are the wild foods and harvest areas (e.g., upland subsistence areas, fishing and hunting camps) (Boraas and Knott 2013). Boraas and Knott (2013) also detail Yup'ik and Dena'ina spirituality. Cultural relationships with the wild animals and fish are of primary importance, and some places have taken on special importance as sacred sites and landscapes, including known travel routes and traditional use areas. The Boraas and Knott (2013) report tells of one travel route, the Dena'ina trail connecting Old Iliamna and Kamishak Bay on Cook Inlet (and locations along the route), as being culturally and spiritually significant. The above reports, in conjunction with consultation, contribute more detail to the characterization of the affected environment beyond archaeological and historic-era sites. These reports indicate that the analysis area is in a region traditionally used for natural resource procurement, and that the analysis area may contain landscape features, place names, material sources, and harvest areas that are ascribed cultural value.

In July 2018, HDR completed an archaeological survey of the Amakdedori port site on behalf of PLP. One new archaeological site was identified (temporary site number HDR-AMK-01), and a National Register-evaluation report is pending; HDR also relocated the Amakdedori Village site (AHRS No. ILI-00044). No testing or investigation of reported human remains occurred, but HDR updated the site's geographic location information. The village site is not in the proposed port site footprint, but is directly south of the port site along Amakdedori Creek. The report does not mention cabins or other features in the area, and none were identified in the cultural resource survey area.

PLP retained ASRC Energy Services to complete a desktop study of the Alternative 1 transportation corridor (ASRC 2017). This desktop study was limited to a review of the AHRS database and did not investigate other types of cultural resources beyond sites and historic-era buildings already identified in the AHRS. The results of the ASRC study are discussed below.

3.7.3 Alternative 1 – Applicant's Proposed Alternative

3.7.3.1 Mine Site

Known AHRS Locations

Prior to SRB&A's archaeological surveys for PLP, the AHRS database included three sites in the mine claim lease area: ILI-00013, ILI-00031, and ILI-00106. The first two are prehistoric sites near the Newhalen River, and ILI-00106 is a number reserved for use by the National Park Service (NPS), which may not be associated with an actual site.

Of the AHRS locations previously identified by SRB&A in the larger mine claim lease area, 11 of them are located in the EIS analysis area for the mine site and two are in the footprint. These sites include small prehistoric sites comprised of lithic debitage, sites evidenced by cobble and/or rock features (e.g., tent or fire rings or stacks); and camping sites that include food wrappers, rifle cartridges, water/oil containers, antler, and bone, suggesting continued use as hunting locales. AHRS sites in the EIS analysis area for the mine site are listed in Appendix K3.7.

SRB&A surveys covered approximately 1,775 acres (approximately 22 percent) of the mine site footprint. When combined with the acres designated as having low potential for sites, approximately 3,880 acres (approximately 48 percent) have been surveyed or do not need to be surveyed, resulting in roughly 4,250 acres (approximately 52 percent) of high or medium potential for sites in the mine footprint that has not been surveyed for cultural resources. While much remains to be surveyed, the existing data does suggest a low density of cultural resource sites in the mine site area (i.e., 43 sites identified in 8,000 acres of survey, or 1 site per 200 acres).

Place Names

Indigenous place names can help define the value or cultural significance of locations to the local inhabitants and can help inform the identification of TCPs in the analysis area. Place names provide information about natural and social environments and the interaction of people with the landscape. They can provide insight into a culture's spirituality and world view, and identify culturally important features across the landscape. They are important in understanding territorial ranges and help with the identification and evaluation of cultural resources.

SRB&A reviewed place name data sources, and compiled a place name database and corresponding map of known place names for the Bristol Bay and Cook Inlet areas based on these sources and SRB&A interviews (Evanoff 2010; Krieg et al. 2005; Kari, Kari, and Balluta

1986; Kari and Kari 1982). Table 22-3 and Figure 22-20 through Figure 22-22 of the SRB&A 2011a report show the location of documented place names in the Bristol Bay drainages, mine study area, and the Cook Inlet drainages, which are also all listed in Appendix 22A of that report. Table 22-8 in the supplemental EBD (SRB&A 2015a) conveys related information about Dena'ina and Yup'ik place names in the PLP mine study area, and Figure 22-7 in that report shows Native place names in the vicinity of the claim block lease boundaries.

The place name database reveals five place names in the EIS analysis area for the mine site, and none of the five are in the project footprint. One additional place name was identified in the EIS analysis area for the mine site through interviews (PLA-041 Boys Mountain). Further analysis is in progress to investigate the location and significance of this place name.

Interview-Identified Cultural Resources

The approximately 1,200 cultural resource features identified by SRB&A based on informant interviews are presented in Table 22-9 (SRB&A 2011a), displayed on Figure 22-23 through Figure 22-25d, and listed in Appendix 22B of that report. Recent data provided by PLP in October 2018 (SRB&A 2018b) have tables and maps for an additional 537 cultural features identified during the 2013 interviews for a total of roughly 1,700 interview-identified cultural resources.

Interview-identified cultural resource features indicate a variety of cultural resources across the mine site EIS analysis area (and other project components). These features include camps, harvest locations, spiritually important places, routes, trails, and traplines. Subsistence maps demonstrate overlap with the mine site area, and harvest areas for resources such as, but not limited to, berries, upland game birds, waterfowl, caribou, and moose, supporting communities such as Newhalen, Nondalton, Iliamna, and Kokhanok. Additional information on subsistence harvests is presented in Section 3.9, Subsistence, and in Appendix K3.9.

In the mine site analysis area, SRB&A interviews resulted in the identification of 40 cultural resource features. Twenty-three of these features are classified as trails/routes, along with one trapline, five harvest locations/traditional use areas, nine camps, one spiritually important place, and one place name (see above). Of these features 14 are in the project footprint, and the remainder intersect the 3-mile buffer that constitutes the mine site EIS analysis area. No TCPs or cultural landscapes have been formally identified in the mine site area (or in other project components). However, informants noted that Groundhog Mountain as a potential TCP for its significance in local identity and subsistence (SRBA 2018b).

Specific to the routes and trails, Figure 22-17 and Figure 22-20 (SRB&A 2014) show interview-identified routes and trails investigated in 2011 and 2012, respectively. SRB&A did not find any physical evidence of these trails, but only investigated areas where trails intersected areas where ground-disturbing actions were proposed. Evanoff (2010) also documents access routes and seasonal travel locations for subsistence use that inform an examination of routes and trails and their cultural significance.

3.7.3.2 Transportation Corridor

The Alternative 1 transportation corridor includes the port access road from Amakdedori port to the south ferry terminal near Kokhanok and ferries across Iliamna Lake to a north ferry terminal, with the corridor continuing along the mine access road from the lake to the mine site with a spur road to Iliamna. The mine study area of analysis encompasses a portion of the transportation corridor north of Iliamna Lake as it enters into the mine site, and the discussion of cultural resources above for the mine site is applicable to this terminal section of the transportation corridor. Additional work may be necessary to identify other undiscovered cultural

resources along the mine access road, because the field efforts by SRB&A focused primarily on the mine site. However, the background research, including the ethnographic and traditional knowledge reports (Evanoff 2010; Boraas and Knott 2013), place name data, and interview-identified cultural features (SRB&A 2011a, 2015a, 2015b) cover the region through which the transportation corridor crosses.

Known AHRS Locations

A cultural resources desktop analysis completed by ASRC (2017) indicates that the transportation corridor from Amakdedori port to the mine site has not been subject to archaeology survey or broader cultural resources investigations. That report summarizes 13 known AHRS sites in the region that include archaeological sites, village sites, a cemetery, and historic buildings in Kokhanok.

Seven AHRS sites are known in the EIS analysis area for the Alternative 1 transportation corridor. These include three prehistoric/historic village sites: Old Kakhonak Village (ILI-00008), Amakdedori Village (ILI-00044), and Gibraltar Lake Village (ILI-00056), and four sites evidenced by small lithic debitage or cobble/rock features. AHRS sites in the EIS analysis area for the transportation corridor are listed in Appendix K3.7. None of the listed AHRS sites are in the footprint of the transportation corridor, although the Kokhanok spur road would lead to AHRS sites, such as ILI-00008, Old Kakhonak, and historic buildings in Kokhanok (ILI-00025 Saint Peter and Paul Chapel). These sites also include a cluster of sites in and around Kokhanok Village near the south ferry terminal, and along the southern shore of Iliamna Lake. The other sites are more isolated. Further work is required to identify potential cultural resources sites within the transportation corridor, including predictive modeling, more detailed literature review, field survey, and consultation, which may result in the identification of additional archaeology sites, historic buildings, and cultural resources. This work may be addressed in the Section 106 Programmatic Agreement (PA) as discussed in Section 3.8, Historic Properties, the PLP Cultural Resources Management Plan, and conditions of approval of state and federal permits associated with the project.

Place Names

The transportation corridor has not been subject to specific place names research or more detailed ethnographic or traditional ecological knowledge (TEK) investigations by PLP. This area largely falls outside the study areas used to guide previous PLP surveys. Public input and data from other sources, such as that completed by Yoko Kugo (2017) and other studies cited above in the mine site section, contribute to understanding the location of native place names in this project component. The place names are limited to the mine access road, as the port access road was not part of the cultural resource study area for PLP.

The place name database lists six locations in the transportation corridor; two of these intersect the project footprint. Interview-identified cultural features include two place names that intersect the transportation corridor (PLA-057 Kokhanok, Gibraltar River and PLA-078 Nondalton, Newhalen River). The Newhalen River (*Nughil Vetnu*) is duplicated in the database and the interview-identified cultural resources.

Interview-Identified Cultural Resources

This area remains in the homeland of the Dena'ina and Yup'ik, and the discussion above in the mine site section regarding the status of knowledge about cultural resources is applicable here. There are 190 interview-identified cultural resource features in the transportation corridor analysis area. This includes three battle sites, 38 grave/burials, 23 cabins, one cabin/place to

avoid, one cabin/village/grave/burial, 13 camps, two place names (see above), six harvest location/traditional use area/material sources, one material source/grave/burial, three observation/siting points, one place with legends or beings, three reindeer stations; seven sites, 69 trails/routes/traplines; 16 villages, one village/grave/burial, and one village/spiritually important place, and one categorized as "other." Of the 190 cultural features in the EIS analysis area, 69 are in the project footprint.

Traditional land use is further evidenced in this area by current subsistence use throughout the area. Community subsistence data show harvest areas for plants, moose, caribou, brown bear, and other resources supporting the nearby villages, such as Iliamna, Kokhanok, Igiugig, and Newhalen. This land use, coupled with the location of known AHRS sites in the vicinity, such as the Gibraltar Lake Village and Amakdedori Village (see below), and the interview-identified data, demonstrate a high likelihood of cultural resources located throughout the transportation corridor, including the possibility of places of traditional religious and cultural significance, cultural landscapes, and TCPs.

3.7.3.3 Amakdedori Port

The Amakdedori port falls within the ECIBSA used by SRB&A to frame the background research and characterize cultural resources in broader areas of interest in the lower Cook Inlet region (SRB&A 2015b). Much of the specific field work and research initially focused on the "original" Cook Inlet drainages study, which included the coast north of Ursus Cove to south of Tuxedni Bay, with an emphasis on the Knoll Head Offshore Area and Diamond Point Area. Field work was completed at Y Valley and along Sunday Creek in this region, and place name research also focused on this area, particularly along the existing overland route (Williamsport-Pile Bay Road) from the Diamond Point port site to Pile Bay. The result is that a more limited set of data is available for characterizing the affected environment at Amakdedori, and many of the data gaps discussed earlier apply to this area as well.

Known AHRS Locations

SRB&A's review of the AHRS database identified 58 previously documented AHRS sites within the entirety of the ECIBSA, two of which (ILI-00185 and ILI-00186) were documented by SRB&A during the 2005 field season. The 58 AHRS sites identified prior to SRB&A's 2012 surveys in the ECIBSA, as well as the three sites identified by SRB&A in 2012, total 61 documented sites across the ECIBSA. SRB&A crews surveyed a proposed weather station and separate repeater tower location near Amakdedori port, but did not identify any new archaeological sites (SRB&A 2014). Specifically related to offshore cultural resources, SRB&A reviewed two online databases of shipwrecks, including the NOAA, Automated Wreck and Obstruction Information System database, and the Bureau of Ocean Energy Management, Alaskan Shipwreck Database.

There are only three known AHRS sites reported in EIS analysis area for Amakdedori port (see Appendix K3.7). Archaeologist Douglas Reger (1980) reported Amakdedori Village (ILI-00044) as dating to the turn of the twentieth century, and composed of several house and cache pits at the mouth of Amakdedori Creek. Another site, (ILI-00291) is the reported location of the AGRAM shipwreck dating to 1923. In addition to these known sites, PLP retained HDR to complete a cultural resource survey of the proposed port location. The full report is still in progress, but the interim memorandum describes an additional prehistoric site (HDR-AMK-01), a lithic surface scatter near the northern end of the port facilities where the transportation corridor enters the port. The report also corrected GPS data for ILI-00044, moving the village farther north, but not in the footprint of the port facility.

Place Names

There are no listed indigenous place names in the Amakdedori port site in the place name database. Additional research and consultation will help identify indigenous place names in this area and contribute to understanding the cultural significance of these locations.

Interview-Identified Cultural Resources

Comments received during the EIS scoping period suggest that there are known grave locations at Amakdedori, although specific locational information has not yet been obtained. Five interview-identified sites were recorded in the port footprint. Residents of the Lake and Peninsula Borough (LPB) also refer to "old cabins, trails, and [the] village" as having personal meaning to many who reside in the borough." Amakdedori is also the location of current cultural learning camps and school field trips for students in Kokhanok. This feedback suggests that there are more cultural resources near Amakdedori port, and indicates that further consultation and field studies could result in the identification of more cultural resources in this area. Interview-identified sites also mention a village with graves/burials and house pits at Amakdedori, and one trail from the head of Sid Larson Bay to the Cook Inlet coast that crosses near Amakdedori (SRB&A 2018b).

The presence of graves, trails, cabins, and known prehistoric and historic resources indicates the potential for a broad range of resources to be located at Amakdedori port. Coastal modeling (SRB&A 2015b) demarks the coastline near Amakdedori as favorable beach lands for the harvest of coastal subsistence resources, which suggests a generally higher potential for identifying cultural resources in the area (Figure 50-5 and Figure 50-7; SRB&A 2015b). Additional research could result in the identification of more cultural resources, including routes and trails, and other land use areas significant to the local villages and others.

3.7.3.4 Natural Gas Pipeline Corridor

The affected environment description of Alternative 1 applies to the land-based portions of the natural gas pipeline corridor. Limited work has been done regarding marine archaeology or historic maritime archaeology for the Iliamna Lake or Cook Inlet crossings, therefore, little information is currently available regarding the affected environment for this portion of the natural gas pipeline route. Similarly, additional research and interdisciplinary research would characterize the affected cultural environment as it relates to coastal (Iliamna Lake and Cook Inlet) resource gathering and any associated traditional use areas or other marine cultural resources.

Aside from those identified under the transportation corridor, the AHRS lists one offshore location near the Amakdedori port, the site of the AGRAM Shipwreck dating to 1923 (ILI-00291). This shipwreck site is in the analysis area, but not in the footprint of the lightering facilities. More recently, PLP undertook side-scan sonar work for the project. This data has not yet been subjected to archaeological analysis.

The AHRS lists three locations on the Kenai side of Cook Inlet in the analysis area of the compressor station. These include a prehistoric midden site (SEL-00164: Clabo Midden Site); a prehistoric lithic site (SEL-00363: Whiskey Gulch Site 1), and the Sterling Highway (SEL-00379). AHRS sites in the EIS analysis area for the natural gas pipeline are listed in Appendix K3.7.

3.7.3.5 Alternative 1 – Kokhanok East Ferry Terminal Variant

The affected environment description for Alternative 1 applies to the Kokhanok East Ferry Terminal Variant. In addition to the cultural resources listed above, the analysis area for this variant does encompass four additional AHRS listed resources in the village of Kokhanok: Saint Peter and Paul Chapel (ILI-00025), The Henry Olympic Allotment Cemetery (ILI-00126), the Kokhanok BIA School (ILI-00262), and a site with pottery and beads (ILI-00127).

3.7.3.6 Alternative 1 – Summer-Only Ferry Operations Variant

This variant does not represent any changes from the affected environment as described for Alternative 1.

3.7.3.7 Alternative 1 – Pile-Supported Dock Variant

This variant does not represent any changes from the affected environment as described for Alternative 1.

3.7.4 Alternative 2 – North Road and Ferry with Downstream Dams

Cultural resources at the mine site would be the same as described for Alternative 1. This section covers the transportation corridor including the stand-alone segments of the natural gas pipeline corridor where it is not collocated within the transportation corridor, and Diamond Point port for Alternative 2. Neither of the proposed variants (summer-only ferry operations or the pile-supported dock) involve changes to the description of the affected environment for cultural resources under Alternative 2.

3.7.4.1 Transportation Corridor and Natural Gas Pipeline

This alternative falls in the northern portion of the ECIBSA, and as a result, represents an area that was subject to comparatively more background research for cultural resources by SRB&A than the Alternative 1 transportation corridor leading to Amakdedori port. SRB&A conducted limited field work in this area's transportation corridor or natural gas pipeline route analysis areas, which involved examinations of land along the western side of the Newhalen River between Nondalton and Iliamna, as well as a drilling-core storage area in Iliamna, both visited in October 2006 (SRB&A 2011a). SRB&A also completed field work along Sunday Creek and in Y Valley, near Knoll Head (SRB&A 2015b); however, this field work is not in the EIS analysis area, and is not directly applicable to the present analysis.

Alternative 2 would cross an area that is also closer to Lake Clark National Park and Preserve than Alternative 1; there have been ethnographic/place name studies and cultural landscape analyses completed for the park that are generally applicable to Alternative 2 in terms of understanding broader regional land use patterns. Initial research indicates that the existing Williamsport-Pile Bay Road, the new portion of the port access road, and the mine access road have not been researched or surveyed for cultural resources. The area does fall within the original transportation study area (SRB&A 2011a), so there is background data gathered for place names and interview-identified cultural features discussed below.

Known AHRS Locations

The AHRS lists 21 cultural resource sites in the EIS analysis area for the Alternative 2 transportation corridor. These include isolated lithic scatters, prehistoric/historic village remains, historic buildings, and historic roads and bridges. Historic-era AHRS sites include the Pile Bay Townsite Historic District (ILI-000198) and associated cultural resources at Pile Bay, such as

the O'Hara House (ILI-00197), The Vantrease Power Plant (ILI-00200), and the base of a radio antenna used by Carl Williams (ILI-00199). The Williamsport-Pile Bay Road itself is a historic linear feature (ILI-132), and there is an Alaska Road Commission camp adjacent to the road (ILI-00244). Near the Cook Inlet shore near the current barge landing area is the Williamsport Historical Occupation/Land Use Area (ILI-00247). Of these 21 AHRS locations, two are in the project footprint (ILI-00132 and ILI-00032). AHRS sites in the EIS analysis area are listed in Appendix K3.7. Five miles of the proposed road from Diamond Point to Pile Bay would overlap with the existing Williamsport-Pile Bay Road, resulting in essentially new construction (including features such as material sites and staging areas).

The pipeline corridor has a total of 20 AHRS known locations, many of which are also included in the transportation corridor. The Sterling Highway (SEL-0039) would cross the project footprint.

Place Names

Place name data consolidated from the SRB&A research includes 23 place names in the Alternative 2 transportation corridor (which includes the two ferry port locations and Diamond Point). Of these 23 place names, 12 intersect the project footprint and 11 are within the 1 mile buffer zone for indirect impacts.

Interview-Identified Cultural Resources

In addition to place names, the presence of archaeological sites coupled with subsistence data, suggest the potential for cultural resources throughout Alternatives 2 and 3. Iliamna Lake and the coastal areas are used for marine resource harvests (e.g., freshwater seals, salmon), and the upland areas are used for hunting upland game birds, waterfowl, caribou, moose, and other small mammals, as well as harvesting berries, wood, and other plant resources (see Section 3.9, Subsistence). Boraas and Knott (2013) tell of an important site, the Giant's Rock (Dzelggezh) along the Williamsport-Pile Bay Road, that held spiritual significance and was later dynamited in 1955 as part of road construction (Boraas and Knott 2013). That report also indicates that the Williamsport-Pile Bay Road follows an old Dena'ina trail.

There are 169 interview-identified cultural resource features in Alternative 2 EIS analysis area. These include: four battle sites, five cabins (two of which include graves/burials), 12 camps, 12 graves/burials (one of which is listed as a spiritually important place), 12 harvest locations/traditional use areas, 11 landscape features/place names, one observation point, four places to avoid (one of which includes graves and another, Roadhouse or Shaman's Mountain, which is spiritually important), three reindeer stations, one site, 86 trails/routes/traplines; and eight villages (two of which include graves/burials), and 10 categorized as "other." Of the 169 interview-identified cultural resource features, 84 are in the project footprint.

3.7.4.2 Diamond Point Port

There are no ARHS locations listed in the EIS analysis area for the Diamond Point port, and one interview-identified feature recorded in the port footprint. The discussion above regarding place names and other interview-identified cultural resource features for the transportation corridor applies here. PLP has gathered limited information regarding the potential for offshore marine archaeology near Diamond Point. In 2011, SRB&A reviewed two online databases of shipwrecks including the NOAA Automated Wreck and Obstruction Information System database and the Bureau of Ocean Energy Management Alaskan Shipwreck Database (SRB&A 2015b). The database review identified three (and possibly a fourth) shipwrecks in offshore vicinity of Knoll Head. These include the *Ferry Queen (1953),* the *Ema Marie (1964),* and the

Democrat (date not listed, exact location not known). The possible fourth shipwreck is the location of the *S.S. Farallon (1910).* As part of the 2012 literature review, SRB&A further researched the history and possible locations of the *S.S. Farallon's* shipwreck and the survivor's on-shore campsite. The campsite location was identified in 2012 and is listed in the AHRS (ILI-00267). These sites demonstrate the potential for offshore cultural features in the area, but none of the listed AHRS locations are in the EIS analysis area.

3.7.4.3 Alternative 2 – Summer-Only Ferry Operations Variant

This variant does not represent any changes from the affected environment as described for Alternative 1.

3.7.4.4 Alternative 2 – Pile-Supported Dock Variant

This variant does not represent any changes from the affected environment as described for Alternative 1.

3.7.5 Alternative 3 – North Road Only

The affected environment description for Alternative 2 applies to Alternative 3; however, the known AHRS locations for the Eagle Bay Ferry (ILI-00211: cabin depression) and the Pile Bay Port Site (ILI-00198) are not in the Alternative 3 analysis area as there is no ferry crossing for this alternative.

Similarly, there are 156 interview-identified cultural resources in Alternative 3, and 78 are in the footprint. This is 13 and 6 less than in Alternative 2 analysis area and footprint, respectively. However, the same types of cultural resources are present. The differences include seven fewer points, two fewer polygons, one less reindeer station, two less trails/routes, and one less village.

There is no change in the number of place names between Alternative 3 and 2.

3.7.5.1 Alternative 3 – Concentrate Pipeline Variant

This variant does not represent any changes from the affected environment as described for Alternative 1.

This page intentionally left blank.

3.8 HISTORIC PROPERTIES

The US Army Corps of Engineers (USACE) applies the Procedures for the Protection of Historic Properties (33 Code of Federal Regulations [CFR] Part 325, Appendix C) to guide its process of complying with Section 106 (54 US Code [USC] 306108) of the National Historic Preservation Act (NHPA) (54 USC 300101 et seq.) and its implementing regulations, "Protection of Historic Properties" (36 CFR Part 800). Appendix C offers characterizations of the term historic properties, which is formally defined in the statute itself (54 USC 300308) and in the Section 106 implementing regulations at 36 CFR Part 800.16(l) as, "a property which has historical importance to any person or group. This term includes the types of districts, sites, buildings, structures, or objects eligible for inclusion, but not necessarily listed, on the National Register" (33 CFR Part 325 (1)(b)). Appendix C also defines "Designated Historic Properties" as "historic propert[ies] listed in the National Register of Historic Places (National Register) or which have been determined eligible for listing in the National Register. A historic property that, in both the opinion of the State Historic Preservation Office (SHPO) and the USACE district engineer, appears to meet the criteria for inclusion in the National Register will be treated as a designated historic property" (33 CFR Part 325 (1)(a)). Federal agencies must consider impacts to all types of cultural resources, including those that do not meet the definition of historic properties as set forth in the NHPA, 36 CFR Part 800, and Appendix C and its implementing regulations. See Section 3.7, Cultural Resources, for National Environmental Policy Act (NEPA) based definitions and analyses. Permitting the construction, operations, and closure of the Pebble Project would require the USACE's compliance with Section 106, the Section 106 implementing regulations (36 CFR Part 800), and Appendix C.

Under 36 CFR Part 800, federal agencies must carry out all steps of the Section 106 review process in consultation with the SHPO and other consulting parties, including Alaska Native tribes, which—for purposes of Section 106—includes Alaska Native Regional or Village Corporations. The scope of the identification effort, determinations of eligibility and effect, and steps to resolve adverse effects must be informed by the traditional knowledge of Tribes who ascribe value to such properties. See below for a discussion and definitions of the Area of Potential Effects (APE) and permit area, which help define the geographic extent of the identification effort. The USACE continues to consult with the SHPO and consulting parties to clarify the APE and permit area definitions for this undertaking.

Meetings with consulting parties were initiated by the USACE on August 17, 2018 and to date, the USACE has hosted consulting party meetings on October 30, 2018, December 11, 2018, and January 15, 2019, to review the Section 106 process and gather input on historic properties. Additional consulting parties meetings are planned throughout the Section 106 process and development of the Programmatic Agreement (PA).

3.8.1 Data Gap Summary

Information in this section is currently based on data derived from the Alaska Heritage Resources Survey (AHRS) and the series of cultural resource reports prepared for the Pebble Limited Partnership (PLP) by Stephen R. Braund and Associates (SRB&A) between 2004 and 2013, particularly the summary reports included in the Environmental (and Supplemental) Baseline Documents (EBDs) for cultural resources covering the Bristol Bay and Cook Inlet Regions (SRB&A 2011a, 2015a, 2015b). Additional resources include indigenous place name data collected by SRB&A along with locations of interview-identified cultural resources gathered and mapped by SRB&A, and field surveys done by HDR in 2018; these are all assessed in Section 3.7, Cultural Resources. In addition to the information gaps and resultant status of

research and analysis discussed in Section 3.7, Cultural Resources, there are particular data gaps pertinent to the identification and evaluation of historic properties. These include:

- Preliminary review of the AHRS sites within the project footprint suggests that one AHRS location has been evaluated for inclusion in the National Register. This is the Williamsport-Pile Bay Road (AHRS No. ILI-00132) in the Alternatives 2 and 3 transportation corridor. The remaining known AHRS locations have not been evaluated for eligibility. The proposed transportation and pipeline corridors for each alternative and Diamond Point have not been systematically researched or surveyed for historic properties. These studies will be conducted in accordance with the NHPA Section 106 process, and the results will be incorporated into the ongoing analysis. Results reported herein are based on currently available information and will be revised as appropriate to incorporate additional findings. The need for and scope of additional research and survey work for the identification and evaluation of historic properties will be defined in a PA.
- Analysis of survey coverage for areas that have been surveyed remains in progress at this time. To date, approximately 22 percent of the mine site footprint has been surveyed.
- GIS modeling used to delineate areas of low potential (as developed and implemented by SRB&A) is being used to determine how many acres of high-potential lands exist versus low-potential lands in the project components, in order to help determine areas that should be surveyed.
- Meetings with consulting parties were initiated by the USACE via letters distributed to potentially involved entities on August 17, 2018. While underway, the Draft Environmental Impact Statement (DEIS) and Section 106 processes have not yet produced additional information regarding the identification and evaluation of historic properties in the analysis area. Guidance for ongoing identification and evaluation of historic properties will be incorporated into the PA.
- The APE has not yet been geographically defined. As previously discussed, the analysis in this section focuses on the cultural resources analysis area of the proposed facilities for each alternative. The APE will be determined during the NHPA Section 106 consultation process.

It is expected that the USACE will be addressing these data gaps throughout its Section 106 consultation process. The procedures detailing further work beyond the issuance of the Final EIS (FEIS) (e.g., the process for additional identification research and surveys, evaluation, and mitigation measures) will be established through the development of a PA.

3.8.2 Area of Potential Effects and Permit Area

The 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 area of potential effects is influenced by the scale and nature of an undertaking and may be different for different kinds of effects caused by the undertaking.”

Appendix C of 33 CFR Part 325 defines the term “permit area” as the geographic extent of the USACE’s responsibility for considering effects on historic properties. Permit area defines “those areas comprising the waters of the US that will be directly affected by the proposed work or structures and uplands directly affected as a result of authorizing the work or structures” (33 CFR Part 325 [1][g]). The permit area for the Pebble Project is preliminarily defined as the direct

footprint of all areas where fill or excavation would occur, where facilities or structures would be installed, and the areas used for construction of the project.

The APE for the project has not yet been formally adopted and will be finalized during the NHPA Section 106 consultation process and development of the PA. The analysis in this section, as well as the tables and information presented in Appendix K3.7, are based on known cultural resources listed in the AHRS database that are identified as being in the EIS analysis area for cultural resources (see Section 3.7, Cultural Resources). This EIS analysis area is the project footprint for direct impacts within 3 miles of the mine site or 1 mile of other project components for indirect impacts. This DEIS and initial 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.

Interview-identified routes and trails, areas with indigenous place names, and a multitude of other cultural resource features described in Section 3.7, Cultural Resources, allow for a comparison of those locations to the project footprint (as presented in SRB&A 2011a, 2015a, 2015b). As noted in Section 3.7, Cultural Resources, the mine site, transportation corridor, and Expanded Cook Inlet Baseline Study Area areas do contain interview-identified routes and trails, subsistence use areas, place names, and other cultural resources features that may be determined to be historic properties in the Section 106 review. It is expected that additional information gleaned through the Section 106 consultation process will further refine the extent and nature of other historic properties and the consideration of effects on historic properties.

As noted by SRB&A (2014) and until further National Register evaluations take place, it may be recommended that any cultural resources (including archaeological sites, trails and routes, traditional cultural properties, cultural landscapes, locations with indigenous place names, burial areas, resource-gathering areas, or other sites of religious or cultural significance) be considered as potentially eligible properties for the consideration of additional identification, evaluation, and effect assessments. Currently, there are no National Register eligible sites in the Alternative 1 project footprint and one historic property in the footprint of Alternatives 2 and 3. There are numerous cultural resource features spread across the landscape (See Section 3.7, Cultural Resources) 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.

3.8.3 Action Alternative 1 – Applicant's Proposed Alternative

No historic properties have been identified in the EIS analysis area for the mine site, transportation corridor, Amakdedori port, or natural gas pipeline corridor.

No historic properties have been identified in the EIS analysis area for the Summer-Only Ferry Operations Variant, the Kokhanok East Ferry Terminal Variant, or the Pile-Supported Dock Variant.

3.8.4 Action Alternatives 2 and 3 – North Road and Ferry with Downstream Dams and North Road Only

Both Alternatives 2 and 3 transportation corridors include construction of a road between Diamond Point and Pile Bay. This road intersects one historic property, the Williamsport-Pile Bay Road (ILI-00132). Per the description in the AHRS database, "This road follows a traditional portage that runs from Pile Bay on the NE end of Iliamna Lake SE across the Chigmit Mountains to Williamsport at the head of Iliamna Bay, Kamishak Bay." It is described as a "1

lane, 15.5 mi. seasonal road that provided the shortest surface route for six communities around Iliamna Lake."

No additional historic properties were identified in the EIS analysis area for the mine site, ferry terminals (Alternative 2), or the route that would be used for the pipeline ROW or the north access road under Alternatives 2 or 3, respectively.

No historic properties were identified in the EIS analysis area for the Summer-Only Ferry Operations Variant (Alternative 2), the Pile-Supported Dock Variant (Alternative 2), or the Concentrate Pipeline Variant (Alternative 3).

3.9 SUBSISTENCE

Subsistence is the way of life for many 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, plants, mushrooms, and firewood. These renewable resources provide food, fuel, and materials to make clothing, shelter, tools, and art.

The Environmental Impact Statement (EIS) analysis area for this section includes the subsistence resources that could be affected by the proposed mine site, port, transportation corridor, and natural gas pipeline corridor for each alternative. This includes habitat and migration routes for subsistence resources, community subsistence search and harvest areas, and areas used by harvesters to access resources.

For indigenous people, subsistence activities are rooted in traditional cultural values, spirituality, and a sense of community. Subsistence activities help transmit cultural knowledge between generations, maintain the connection of people to their land and environment, and are a source of pride and identity (Boraas and Knott 2013; SRB&A 2011b). In addition to its inextricable roots in traditional Alaska Native culture, subsistence is integral to the contemporary mixed economic system in rural Alaska. For many, subsistence is a chosen lifestyle, preferred over or in conjunction with a wage-earning lifestyle. Wage employment opportunities are scarce in rural Alaska, and residents face high prices for store-bought goods; some may have to travel to other communities to visit a store. Cash incomes typically supplement and support subsistence activities, which for generations have provided considerable nutritional and economic value for rural households. Part-time work or commercial fishing can provide enough income to purchase tools for support of subsistence activities: boats, all-terrain vehicles and gear; as well as providing fuel for home and engines. For additional information on cash incomes and socioeconomic conditions, see Section 3.3, Needs and Welfare of the People—Socioeconomics.

The sharing of resources is a fundamental characteristic of the subsistence way of life. Sharing of subsistence foods within and between communities reinforces social bonds and helps the recipients meet economic, material, and nutritional needs. The percentage of households giving and receiving subsistence resources is provided below for Iliamna, Newhalen, Pedro Bay, Nondalton, Igiugig, and Kokhanok, and for other communities in the EIS analysis area in Appendix K3.9. Sharing is an indicator of resilience of the culture to variations in household abilities to harvest and process wild foods (SRB&A 2011b).

A further indication of the importance of sharing practices in integrating communities is seen in the fact that some households are especially highly productive in their subsistence pursuits and provide a particularly large proportion of all subsistence harvest in a community. Studies conducted by the Alaska Department of Fish and Game (ADF&G) Division of Subsistence have documented a pattern in Alaska Native communities whereby 30 percent of a community's households produce 70 percent of the community's total subsistence harvest in terms of edible weight (known as the 30-70 rule) (Wolfe et al. 2010). This pattern is consistent, despite wide variation in community and household harvest profiles. The households that produce at a high level tend to be those with several older adult members who have access to cash and necessary equipment; these households are typically successful in both the subsistence and cash sectors of the mixed economy. The extra subsistence foods produced by high-harvesting households are usually shared with elders, single mothers with young children, young couples,

and other segments of the community (ADF&G no date). Resources are shared widely through kinship and friendship relationships, among households in the community, and in other communities in Alaska. The 30-70 rule also illustrates the specialization in production of wild foods in the subsistence sector; particular individuals or individual households may benefit from technological ability, financial resources, or traditional knowledge. For example, although nearly all households participate in the harvest of salmon in the study area communities, there are a smaller number of individuals who have the equipment, expertise, and time necessary to harvest certain resources, such as moose. Therefore, a relatively small group of hunters meet the community need for moose meat through long-established sharing patterns.

Subsistence activities in Alaska are regulated by both the federal and state governments. The Alaska National Interest Lands Conservation Act (ANILCA) passed by Congress in 1980, gives *rural* Alaskans priority for subsistence harvest of fish and wildlife on federal public lands and waters. The multi-agency Federal Subsistence Board is the decision-making body that regulates subsistence hunting and fishing on federal lands and waters, with technical support from the US Fish and Wildlife Service (USFWS) Office of Subsistence Management. There would be no project components proposed on federal lands where the subsistence management provisions of ANILCA would apply (see Section 3.2, Land Ownership, Management, and Use).

On state and private lands and waters, including those affected by the proposed project, since the 1989 Alaska Supreme Court *McDowell* decision, *all* Alaskans are qualified to harvest subsistence resources. With technical support of ADF&G, the Alaska Board of Fisheries and the Board of Game have ultimate decision-making responsibility for hunting and fishing on lands within the state jurisdiction.

Harvest of certain species is also regulated by additional laws such as the Marine Mammal Protection Act (MMPA) and the Migratory Bird Treaty Act (MBTA), and therefore these species are managed by different federal agencies. Pacific halibut and most marine mammals are managed by the National Marine Fisheries Service (NMFS). Sea otter and walrus are managed by the USFWS. Migratory birds are jointly managed by the state and federal governments and a co-management body representing eligible Alaska Native tribes.

3.9.1 Traditional Ecological Knowledge

The detailed results of a study done by Stephen R. Braund & Associates (SRB&A), in coordination with the ADF&G, are documented in SRB&A (2011b). Methods included conducting systematic household surveys and mapping interviews to update harvest data and subsistence use area maps. The study also documented traditional knowledge on “changes in resource use, abundance, quality, distribution, and migration,” as well as other factors like climate change and development projects (SRB&A 2011b). The data (tables, charts, and maps) used to determine the environmental baseline for this section reflect the findings of this study, and a subsequent data review of the six communities closest to the proposed project infrastructure, performed by SRB&A in 2018. Traditional ecological knowledge (TEK) and the culture value of subsistence as a chosen lifestyle, as described by Boraas and Knott (2013) were also reviewed during development of this section. Boraas and Knott concluded, based on elder and culture-bearer interviews, that this lifestyle has built strong networks of connected extended families in the Nushagak and Kvichak drainages based on sharing, traditional knowledge, and a respect for the environment, with salmon and clean water as the foundation of culture. A summary of specific TEK comments from Boraas and Knott (2013) is provided in Appendix K3.1. In this way, TEK regarding areas of subsistence use and harvest data, processing and sharing, and how information is transmitted over generations are incorporated into the analysis of Section 4.9, Subsistence. Scoping comments related to TEK were also considered in the analysis of impacts in Section 4.9, and are summarized in Appendix K3.1.

3.9.2 Seasonal Round

Subsistence users harvest a wide variety of resources throughout the year, and they often target specific species during certain seasons of the year, following a cyclical harvest pattern called the *seasonal round*. In general, communities in southwest Alaska share a similar seasonal round, with some variations depending on the area, available resources, and applicable hunting regulations. For example, coastal, lakeside, and riverside communities each rely on a somewhat different mixture of subsistence resources. Non-salmon fish and freshwater seals are harvested throughout the year, and many subsistence users prefer to harvest freshwater seals in the winter. In the spring, migratory birds, gull and waterfowl eggs, and Chinook salmon are harvested. Sockeye salmon are targeted in the spring or summer, depending on the run timing in different areas. Other salmon species, marine invertebrates, and green plants are harvested in summer. In late summer and into fall, spawning sockeye salmon and berries are harvested. During fall, subsistence users harvest migratory birds and upland game birds. In Dillingham, however, upland game birds are harvested year-round. Moose and caribou hunting typically occur in fall and/or winter, although hunters in Iliamna and Newhalen harvest caribou in spring. The coldest part of winter is the best time to harvest small, furbearing mammals (Fall et al. 2006; Krieg et al. 2009; Holen et al. 2011, 2012; Evans et al. 2013). The general gathering cycle of when harvests occur in the six communities closest to proposed project infrastructure is described in Table 3.9-1.

Table 3.9-1: Generalized Seasonal Round of Subsistence Activities, Project Area Communities

Resource	Winter										Spring				Summer						Fall			
	Nov		Dec		Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sep		Oct	
Sockeye (red) salmon																								
Chinook (King) salmon																								
Dolly Varden																								
Grayling																								
Lake trout																								
Whitefish																								
Northern pike																								
Seal																								
Moose																								
Caribou																								
Black bear																								
Brown bear																								
Dall sheep																								
Hare																								
Porcupine																								

Table 3.9-1: Generalized Seasonal Round of Subsistence Activities, Project Area Communities

Resource	Winter					Spring		Summer			Fall	
	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
River Otter	■	■	■	■	■	■						
Red fox	■	■	▒	▒	▒							
Lynx	■	■	▒	▒	▒	■	■	■				
Beaver	▒	▒	▒	▒	▒	▒	■	■	■	■	■	■
Ptarmigan	▒	▒	▒	▒	▒	▒	■	■	■	■	■	■
Spruce Grouse											■	■
Ducks/ Geese						■	■				▒	▒
Bird Eggs							■	■				
Clams						■						
Berries											■	▒
Other green plants								■				

Notes:
grey = occasional harvest; black = usual harvest.
Seasonal harvest is generalized for these communities, and patterns may differ slightly from community to community.
Source: SRB&A 2011b

Residents of Cook Inlet communities (i.e., Ninilchik and Seldovia) harvest many of the same resources at the same times of year as southwest Alaska communities, with some variations. In spring, green plants, mushrooms, and kelp are harvested. In summer, subsistence users gather berries, greens, marine invertebrates, and seaweed. The moose-hunting season occurs in late summer to early fall. During fall and winter, the residents hunt for upland game birds. Winter is the typical time for gathering firewood (Jones and Kostick 2016).

Subsistence hunters have observed that habitat change in southwest Alaska is affecting the Mulchatna caribou herd harvest in the Iliamna Lake and Bristol Bay areas (Van Lanen 2018). Many respondents said that the herd has moved away from these areas, and caribou hunting often requires traveling too far to make harvest worthwhile; moose are closer and more easily accessible. Hunters have adapted to changes in species availability by switching to greater reliance on increasing numbers of moose, rather than the more difficult-to-access caribou. Moose harvest data have verified local knowledge observations that habitat change, which is benefiting moose, is occurring. It was reported that since the late 1990s, the moose harvests by local residents have increased significantly in the southern portion of game management units (GMUs) 9B, 9C, and 17; and during the current decade, in the western portion of GMU 18. Increasing range expansion of moose in Alaska's tundra areas has been linked to warming, and has increased the shrub habitat (willows) that moose prefer (Tape et al. 2016). Changing winter conditions and more recent low snow and ice conditions are creating challenges in terms of access via snowmachine travel for winter caribou and moose hunting, and efforts focus on the fall season instead of the winter season.

3.9.3 Subsistence Harvest Patterns by Community

Construction and operations would primarily affect the subsistence areas of six Iliamna Lake communities near the mine site, transportation corridor, and port site locations. This section summarizes the most recent available comprehensive subsistence harvest surveys for the six communities near Iliamna Lake that would be most likely to be impacted by the project. Harvest area maps for each of the six Iliamna Lake communities are provided (see Figure 3.9-3, Figure 3.9-5, Figure 3.9-7, Figure 3.9-9, Figure 3.9-11, and Figure 3.9-13). Supplementary harvest area maps for these six communities by subsistence resource category (e.g., salmon, non-salmon fish, large land mammals) are provided in Appendix K3.9. A summary of the subsistence harvest surveys for other communities in the project area and nearby watersheds is provided in Appendix K3.9. The results are organized geographically from those communities closest to the proposed project around Iliamna Lake, followed by more distant communities down the Kvichak River drainage, across to the Nushagak River drainage, and includes a pair of Cook Inlet communities. Study years range from 1998 to 2014, depending on the community. Communities for which the comprehensive harvest data were older (e.g., Homer with a study year of 1982) or not available (e.g., Happy Valley, Anchor Point) were not included. Data available through ADF&G technical papers and of the ADF&G Community Subsistence Information System were reviewed and incorporated into this analysis.

Table 3.9-2 shows subsistence harvest amounts by community for eight subsistence resource categories. These eight categories (i.e., salmon, non-salmon fish, large land mammals, small land mammals, marine mammals, birds and eggs, marine invertebrates, and plants and fungi) are the same categories used by ADF&G in their comprehensive subsistence surveys reports. The six Iliamna Lake communities show a particularly high level of reliance on salmon. Annual per capita (per community member) harvests of salmon ranged from 205 pounds in Igiugig to 513 pounds in Kokhanok. In another indicator of high reliance, salmon represent 79 percent of total subsistence harvest for Iliamna and 73 percent for Newhalen, as examples. Additional information is shown on species diversity and proportions of total harvest in subsequent community accounts.

Sockeye salmon is the most important subsistence species for Kvichak watershed residents. Table 3.9-3 shows the subsistence harvest of sockeye salmon for communities in the Kvichak River drainage from 1997 to 2016. In that timeframe the largest subsistence harvest of sockeye salmon, in terms of the total number of fish, was in 1997, and the smallest harvest was in 2016. The subsistence harvest of sockeye salmon has decreased over the past 20 years. The most recent 10-year average (2007-2016) was lower than the previous 10-year average by 6 percent (ADF&G 2018m).

Compared to salmon, EIS analysis area communities have smaller harvest amounts for non-salmon fish; although, it is important to note that these fish are often taken throughout the year, providing a fresh food resource during winter months. Harvest levels of large land mammals, such as moose and caribou, are also smaller, although they too play an important role in subsistence food diversity.

Table 3.9-2: Estimated Per Capita Subsistence Harvests in Edible Weight (lbs.) by Community for the Most Recent Study Years

Community	Year	All Resources	Salmon	Non-Salmon Fish	Large Land Mammals	Small Land Mammals	Marine Mammals	Birds and Eggs	Marine Invertebrates	Plants and Fungi
Iliamna	2004	469.4	370.1	34.1	32.1	0.6	6.5	4.4	1.6	20.0
Newhalen	2004	691.5	502.2	31.8	101.3	3.1	4.4	16.2	2.5	30.0
Pedro Bay	2004	305.5	250.3	15.3	30.0	0.0	0.0	2.9	0.0	6.9
Nondalton	2004	357.7	219.4	33.9	74.4	7.4	0.0	3.8	0.4	18.4
Igiugig	2005	542.0	205.2	59.4	202.9	4.9	29.2	11.8	0.0	28.5
Kokhanok	2005	679.6	512.8	36.3	94.4	1.5	1.7	7.8	0.5	24.6
Port Alsworth	2004	132.8	89.0	12.0	23.4	1.3	0.0	1.6	1.1	4.4
Koliganek	2005	898.5	564.7	90.4	177.9	8.3	0.0	9.1	0.0	48.1
Levelock	2005	526.7	151.8	39.9	251.9	5.5	37.7	14.7	2.9	22.3
New Stuyahok	2005	389.2	188.3	28.0	138.8	4.6	0.0	6.2	0.2	23.0
King Salmon	2007	313.0	255.7	5.3	34.5	2.1	0.4	6.7	3.9	4.3
Naknek	2007	264.2	177.4	18.1	32.0	0.6	12.9	3.4	4.6	15.1
South Naknek	2007	267.5	200.8	8.1	7.1	0.6	21.1	1.2	3.6	25.0
Aleknagik	2008	296.0	143.4	25.6	63.5	2.6	9.5	12.6	0.3	38.5
Clark's Point	2008	1,210.1	637.2	33.8	209.1	15.4	127.1	53.0	2.3	132.1
Manokotak	2008	298.4	135.0	43.7	44.5	3.1	14.7	17.3	4.7	35.4
Dillingham	2010	212.1	130.6	7.3	49.4	2.2	4.4	5.7	1.1	11.4
Ninilchik	1998	163.8	42.5	38.3	65.6	0.5	0.0	1.43	11.0	1.0
Seldovia	2014	138.3	47.5	36.0	17.2	<0.1	1.1	0.9	5.5	30.0

Note: The first six communities listed are those closest to the proposed project. Small mammals harvested but not typically eaten are excluded from edible weight estimates. The marine mammals category includes saltwater and freshwater seals.
Sources: Fall et al. 2006; Krieg et al. 2009; Holen et al. 2011, 2012; Evans et al. 2013; Jones and Kostick 2016

Table 3.9-3: Subsistence harvest of sockeye salmon by community, in number of fish, Kvichak River Drainage, 1997-2016

Year	Levelock	Igiugig	Pedro Bay	Kokhanok	Iliamna-Newhalen[a]	Nondalton	Port Alsworth	Other[b]	Total
1997	1,062	2,067	5,501	8,722	19,513	17,194	2,348	3,101	59,508
1998	2,454	1,659	3,511	10,418	16,165	13,136	2,678	3,635	53,656
1999	1,276	1,608	5,005	10,725	14,129	17,864	4,282	2,834	57,723
2000	1,467	1,981	1,815	7,175	6,679	11,953	3,200	2,720	36,990
2001	908	779	2,118	9,447	8,132	7,566	1,958	1,901	32,808
2002	625	2,138	2,687	9,847	9,417	5,508	1,201	1,578	33,001
2003	737	1,081	2,135	9,771	13,824	8,016	1,370	1,591	38,495
2004	1,000	1,026	4,803	11,869	21,652	8,789	2,455	1,631	53,225
2005	914	1,017	4,162	16,801	12,010	8,824	2,457	2,078	48,263
2006	0	1,252	4,319	19,028	11,487	8,885	2,418	2,461	49,850
2007	102	1,803	5,487	15,105	11,453	7,902	3,211	2,410	47,473
2008	30	1,558	4,884	14,755	13,569	8,916	3,307	2,544	49,563
2009	759	1,457	7,802	15,759	9,871	5,709	3,155	2,260	46,772
2010	940	2,901	5,609	13,973	8,815	3,185	3,250	2,015	40,688
2011	933	1,931	3,898	9,895	15,433	7,947	4,026	1,163	45,226
2012	750	2,608	4,028	16,530	12,933	9,247	4,420	1,855	52,370
2013	984	345	3,971	13,392	7,632	10,550	3,377	2,305	42,556
2014	1,170	513	3,999	6,440	11,388	9,004	4,296	4,206	41,016
2015	398	1,153	2,519	8,098	9,691	8,722	6,588	2,207	39,377
2016	1,265	297	2,036	7,087	9,900	2,320	4,196	3,548	30,649
20-Year Average	881	1,459	4,014	11,742	12,185	9,062	3,210	2,402	44,960
1997-2006 Average	1,044	1,461	3,606	11,380	13,301	10,774	2,437	2,353	46,352
2007-2016 Average	733	1,457	4,423	12,103	11,069	7,350	3,983	2,451	43,569
2012-2016 Average	913	983	3,311	10,309	10,309	7,969	4,575	2,824	41,194

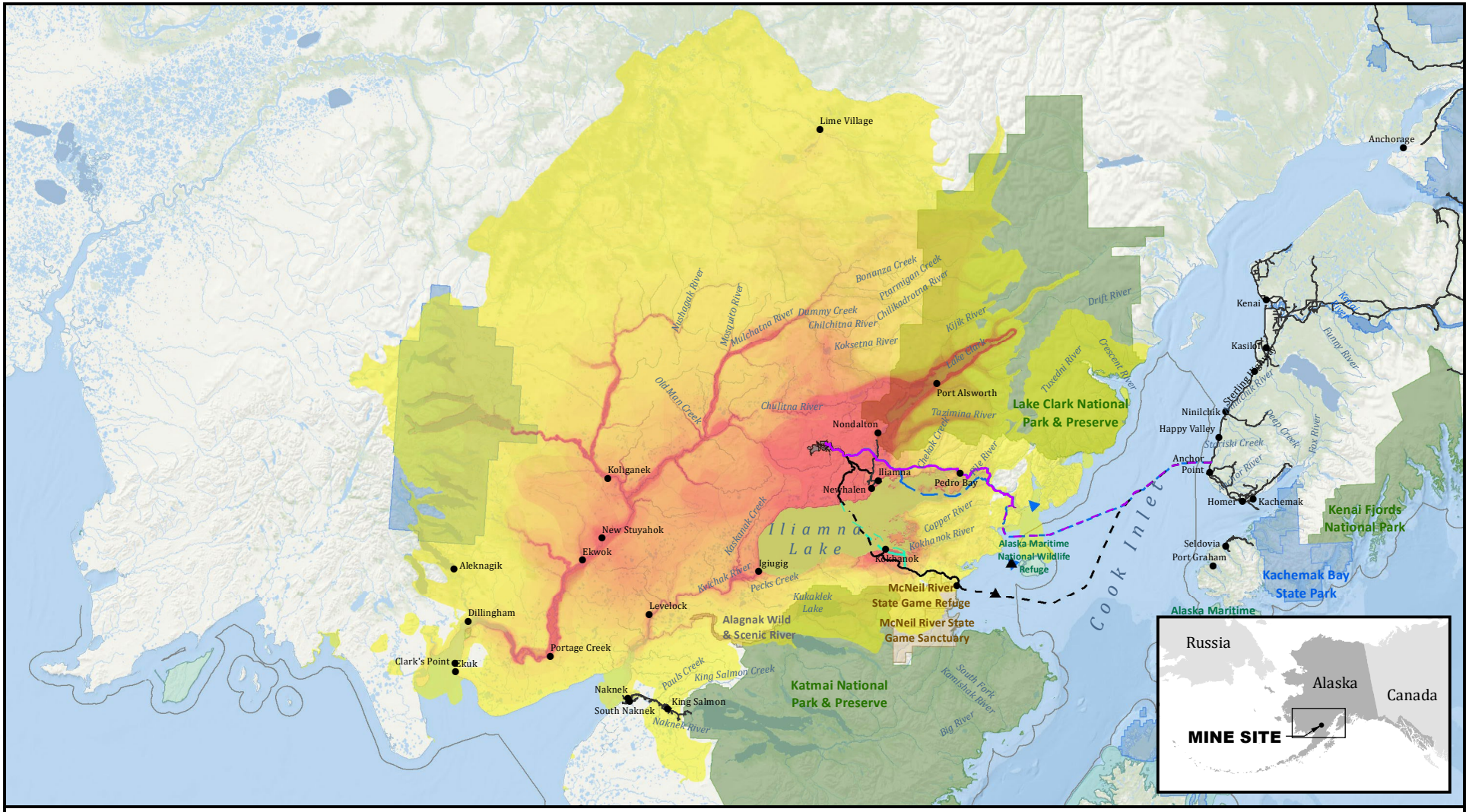
Note:
Harvests are extrapolated over areas for all permits issued, based on those returned. Harvest estimates based on community of residence and include fish caught only in the Naknek-Kvichak District.
[a] Includes Chekok.
[b] Subsistence harvests by non-Kvichak River watershed residents.
Source: ADF&G 2018m

Subsistence use areas represent another important dimension of subsistence activities. Communities have traditional use areas that represent a sophisticated cumulative body of knowledge about where animals in prime condition are likely to be available throughout the year. Subsistence search and harvest areas for some species are relatively constant, such as salmon fishing areas; while use areas for other species, such as moose, caribou, and fur-bearers, would vary with changes in abundance and distribution. Harvest patterns are dynamic and strategic, as subsistence users concentrate their efforts in areas likely to be productive, with current abundance and distribution of resources. These are being evaluated as cultural resources in Section 3.7, Cultural Resources. In addition, traditional place names identify significant locations in a traditional use area, and further indicate the long-term use patterns and are also discussed more in Section 3.7, Cultural Resources. Figure 3.9-1 shows the combined subsistence use areas from 1996/1997 through 2005/2006 for 12 communities in the EIS analysis area (i.e., Iliamna, Newhalen, Pedro Bay, Nondalton, Igiugig, Kokhanok, Port Alsworth, Koliganek, Levelock, New Stuyahok, Ekwok, and Portage Creek) in relation to proposed project infrastructure. Subsistence users search for and harvest resources over broad areas and may travel great distances via snowmachine, all-terrain vehicle, and boat.

3.9.3.1 Iliamna

Iliamna was established at its present location on the northern shore of Iliamna Lake when the Dena'ina Athabascan community of Old Iliamna moved from the mouth of Iliamna River in 1935. Today, this majority Alaska Native community is a cultural mosaic of Dena'ina, Yupik, Alutiiq, and Euro-American people. In 2004, Iliamna had an estimated year-round population of 73 people in 22 households. Fall et al. (2006) surveyed households about their 2004 subsistence activities and found that Iliamna residents harvested an estimated total of 34,160 pounds of wild foods (469 pounds per capita). Salmon dominated the subsistence production of Iliamna residents, as seen in Table 3.9-2, which displays per capita harvests by resource category. The top 10 resources harvested by Iliamna residents in 2004 in terms of edible weight are shown in Figure 3.9-2.

In addition to pounds harvested per capita, another measure of a resource's importance is the percentage of households in the community that used the resource. In 2004, salmon was the most widely used resource category (100 percent of households) followed by non-salmon fish (92 percent), plants and fungi (85 percent), large land mammals (77 percent), birds and eggs (69 percent), and marine invertebrates (46 percent) (Fall et al. 2006). Sharing and distribution of subsistence foods extend widely across households. In 2004, 77 percent of Iliamna households received wild resources, and 54 percent of households gave resources away (Fall et al. 2006). Table 3.9-4 describes the rates of households using, attempting to harvest, harvesting, giving away, and receiving different categories of resources during 2004. Most households try for and harvest salmon, non-salmon fish, and vegetation.



Sources: Pebble; USGS; ADNR
Subsistence use areas by
Stephen R. Braund & Associates

US Army Corps of Engineers

10 0 10 20
Miles

Administrative Boundaries

- Wild and Scenic River
- State Game Refuge/Sanctuary
- Alaska State Park
- National Wildlife Refuge
- National Park

- City/Town
- Roads
- Outer Continental Shelf
- River/Stream
- Lake/Pond

Overlapping Subsistence Use Areas
All Resources
12 Communities*
1996/97 - 2005/06
(SRB&A 2018)

*The 12 communities are Ekwok, Igiugig, Iliamna, Kokhanok, Koliganek, Levelock, New Stuyahok, Newhalen, Nondalton, Pedro Bay, Port Alsworth, and Portage Creek.

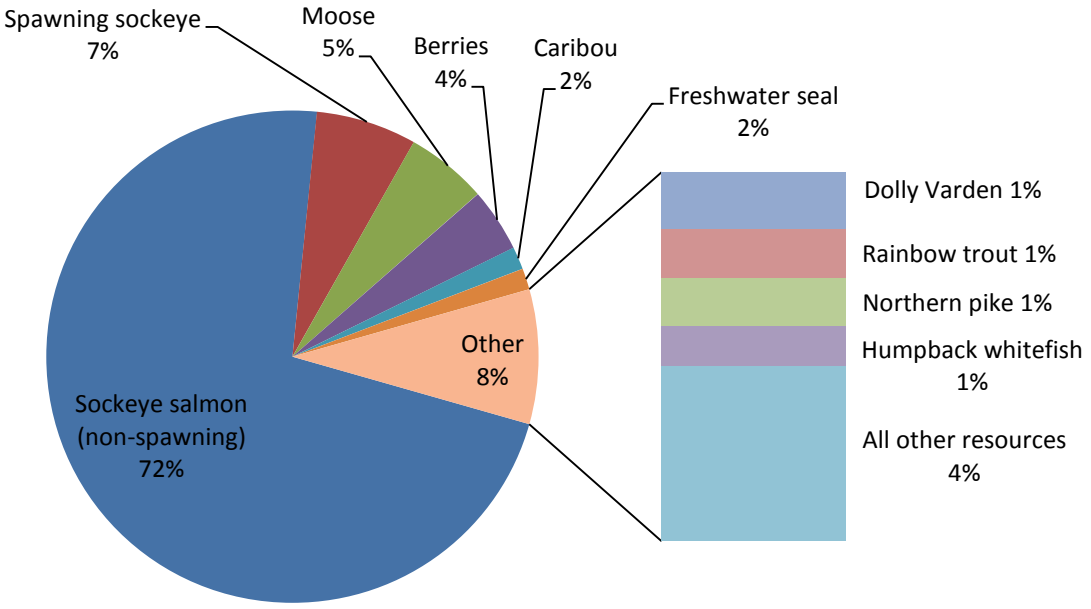
- Alternative 1
- Kokhanok East Ferry Terminal Variant
- Alternative 2
- Alternative 3

SUBSISTENCE USE AREAS

PEBBLE PROJECT EIS

FIGURE 3.9-1

Figure 3.9-2: Composition of Iliamna Subsistence Harvest by Estimated Edible Weight, 2004



Note: The term "spawning sockeye" refers to late-run sockeye salmon that have a distinctive red color and white meat, and are harvested in the fall.
Source: Fall et al. 2006

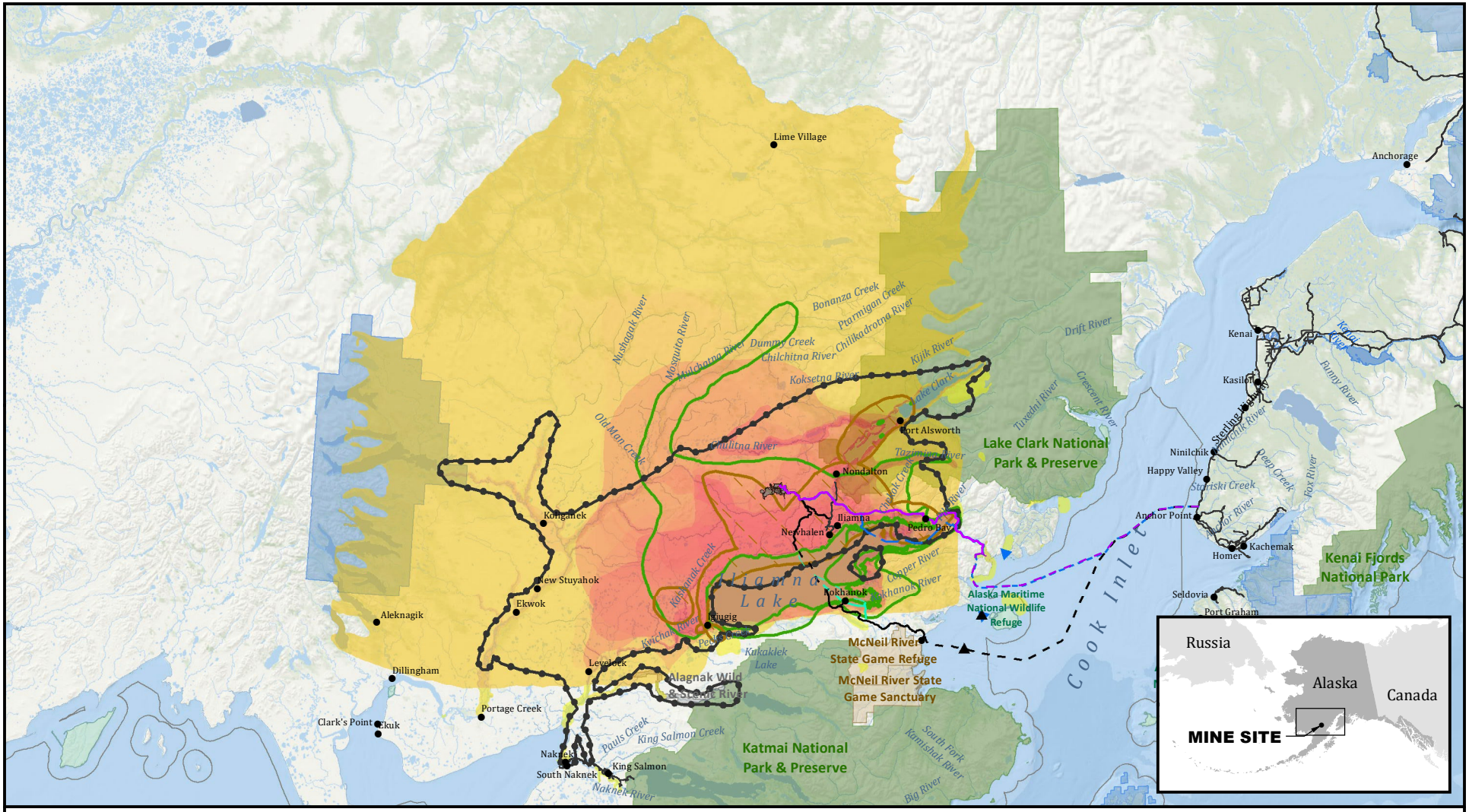
Table 3.9-4: Iliamna Subsistence Harvest Estimates by Resource Category, 2004

Resource	Percent of Households					Estimated Edible Harvest			Percent of Total Harvest
	Use	Attempt to Harvest	Harvest	Give Away	Receive	Total Pounds[1]	Average Pounds Per Household	Pounds Per Capita	
All Resources	100	100	100	54	77	34,160	1,553	469	100.0
Salmon	100	100	100	31	39	26,935	1,224	370	78.8
Non-Salmon Fish	92	77	77	31	39	2,477	146	34	7.3
Large Land Mammals	77	54	15	31	69	2,335	197	32	6.8
Small Land Mammals	31	31	23	8	15	44	2	1	0.1
Marine Mammals	31	31	23	23	8	473	22	7	1.4
Migratory Birds	39	31	31	23	15	103	15	1	0.3
Upland Game Birds	23	23	23	15	0	106	21	2	0.3
Bird Eggs	46	39	39	15	15	106	13	2	0.3
Marine Invertebrates	46	23	23	15	39	118	23	2	0.3
Vegetation	85	85	85	23	31	1,458	66	20	4.3

Notes:
[1]Estimated pounds include only edible pounds, and therefore do not include estimates for resources that are not typically eaten by community residents (e.g., furbearers).
Source: Fall et al. 2006

Trends in Iliamna subsistence harvest over time indicate that recent overall harvests and uses in 2004 were the same as the recent past, with some notable variations among uses of specific resources (Fall et al. 2006; SRB&A 2011b). Households reported changes in the uses of individual resources, with 46 percent reporting that their use of salmon had increased while another 46 percent of households said their use of salmon stayed the same. Forty two percent of households said they used less large land mammals in 2004 compared to recent years while 50 percent said they used about the same (Fall et al. 2006). Survey respondents noted competition, weather, animal population changes, and personal reasons as explanations for changes in their use of these resources (Fall et al. 2006; SRB&A 2011b). Iliamna residents expressed concern that non-local hunters were overharvesting caribou from the Mulchatna caribou herd. They also observed that lichen had become too thin to support the formerly large herd near the Mulchatna River, and it may be a decade before they can return to this area (Fall et al. 2006).

Figure 3.9-3 illustrates the 1996/1997 to 2005/2006 overlapping subsistence search and harvest area for Iliamna in relation to proposed project infrastructure. The figure also shows the search and harvest areas for large land mammals and all resources for other time periods. The primary areas used are north and west of Iliamna Lake, extending around to Lake Clark and to the Koktuli and Stuyahok rivers, and over the flats to the Kvichak River. High-use areas show in the Chulitna River (north of the mine site) and on the islands in Iliamna Lake (near and to the east of the ferry routes). Hunting and harvesting occurs along the Nushagak, Mulchatna, and Kvichak rivers. Iliamna residents travel along the lakeshore and rivers to harvest moose, caribou, waterfowl, and plants and berries. During the winter, inland use occurs for hunting and trapping small land mammals and furbearers, along with caribou, moose, and ptarmigan. Egg harvest, berry picking, and plant harvest occurs on the islands in Iliamna Lake. Boats, snowmachines and all-terrain vehicles (ATV) were the most common method of travel; there is a direct snowmachine route across Iliamna Lake between Iliamna and Kokhanok (PLP 2018-RFI 088).



Sources: Pebble; USGS; ADNR
Subsistence use areas by
Stephen R. Braund & Associates

US Army Corps of Engineers®

10 0 10 20
Miles

Administrative Boundaries
- Wild and Scenic River
- State Game Refuge/Sanctuary
- Alaska State Park
- National Wildlife Refuge
- National Park

- City/Town
- Roads
- Outer Continental Shelf
- River/Stream
- Lake/Pond

- Large Land Mammals, 1980-2002 (Holen et al., 2005)
- All Resources, 2004 (Fall et al., 2006)
- All Resources, 1960-82 (Wright, Morris, and Schroeder, 1985)
- Overlapping Subsistence Use Areas All Resources 1996/97 - 2005/06 (SRB&A 2018)

- Alternative 1
- Kokhanok East Ferry Terminal Variant
- Alternative 2
- Alternative 3

SUBSISTENCE USE AREAS, ALL RESOURCES - ILIAMNA

PEBBLE PROJECT EIS

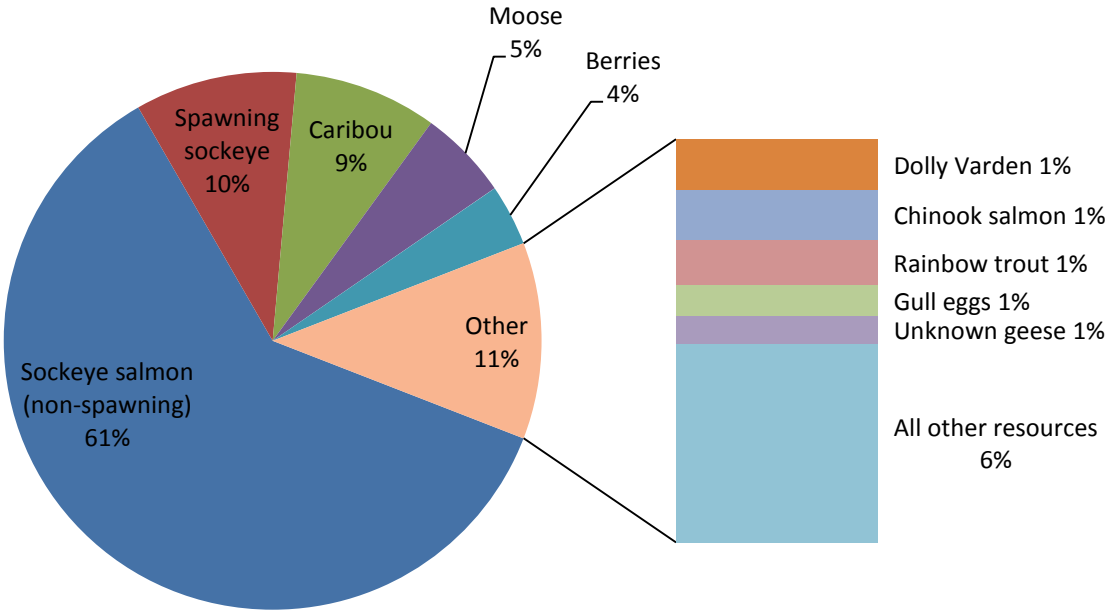
FIGURE 3.9-3

3.9.3.2 Newhalen

The Yup'ik village of Noghelingamiut was listed on the 1890 census in the location of present-day Newhalen at the mouth of Newhalen River on Iliamna Lake. Today, Newhalen is a predominantly Yup'ik community, but is also home to Alutiiq, Dena'ina, and Euro-American people. In 2004, Newhalen had an estimated year-round population of 125 people in 39 households. Newhalen residents were highly productive in subsistence activities, harvesting an estimated total of 86,607 pounds of wild foods (692 pounds per capita) in 2004. Salmon dominated the subsistence harvests, as seen in Table 3.9-2 which displays per capita harvests by resource category. The top 10 resources harvested by Newhalen residents in 2004 in terms of edible weight are shown in Figure 3.9-4.

Household participation in subsistence activities was very high. Salmon was the most widely used resource category (100 percent of households), followed by plants and fungi (92 percent), birds and eggs (92 percent), large land mammals (92 percent), non-salmon fish (88 percent), marine invertebrates (56 percent), and marine mammals (52 percent). Sharing and distribution of subsistence foods extend widely across households. In 2004, 96 percent of Newhalen households received wild resources, and 80 percent of households gave resources away (Fall et al. 2006). Table 3.9-5 describes the rates of households using, attempting to harvest, harvesting, giving away, and receiving different categories of resources during 2004. Most households try for and harvest salmon, non-salmon fish, large land mammals, small land mammals, bird eggs, and vegetation.

Figure 3.9-4: Composition of Newhalen Subsistence Harvest by Estimated Edible Weight, 2004



Note: The term "spawning sockeye" refers to late-run sockeye salmon that have a distinctive red color and white meat, and are harvested in the fall.
Source: Fall et al. 2006

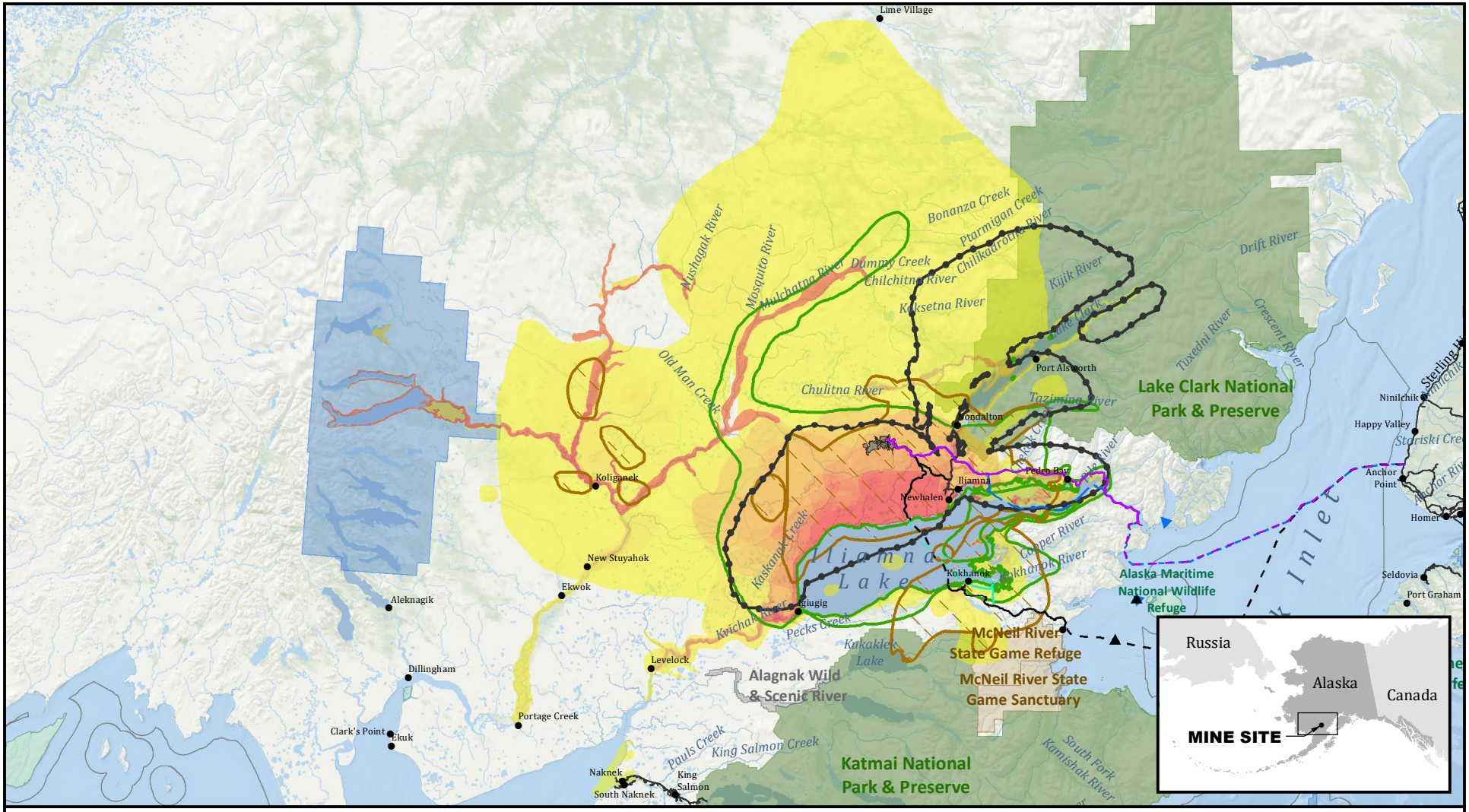
Table 3.9-5: Newhalen Subsistence Harvest Estimates by Resource Category, 2004

Resource	Percent of Households					Estimated Edible Harvest			Percent of Total Harvest
	Use	Attempt to Harvest	Harvest	Give Away	Receive	Total Pounds[1]	Average Pounds Per Household	Pounds Per Capita	
All Resources	100	100	100	80	96	86,606	2,794	692	100.0
Salmon	100	92	92	64	32	62,889	2,029	502	72.6
Non-Salmon Fish	88	88	88	52	56	3,980	146	32	4.6
Large Land Mammals	92	52	44	60	76	12,692	787	101	14.7
Small Land Mammals	32	28	28	20	20	392	13	3	0.5
Marine Mammals	52	32	24	36	32	555	18	4	0.6
Migratory Birds	60	48	48	40	32	1,088	73	9	1.3
Upland Game Birds	32	28	28	24	12	132	15	1	0.2
Bird Eggs	88	80	80	48	40	811	33	7	0.9
Marine Invertebrates	56	36	36	16	20	312	28	3	0.4
Vegetation	92	92	92	60	28	3,752	121	30	4.3

Note: [1]Estimated pounds include only edible pounds, and therefore do not include estimates for resources that are not typically eaten by community residents (e.g., furbearers).
Source: Fall et al. 2006

Trends in Newhalen subsistence harvest over time indicate that overall harvests were similar across all study years. Sockeye salmon, spawning sockeye salmon, and caribou were the top three harvested resources. Most Newhalen households reported that their harvest and use of wild resources in 2004 was about the same as in the preceding 5 years, though many households said they used less furbearers and large land mammals in recent years (Fall et al. 2006). Changes in resource populations have caused lower harvests in 2004, especially for large land mammals. A majority (61 percent) of respondents that reported reduced uses of at least one subsistence resource category cited personal reasons (such as having more cash employment reducing time to participate in subsistence activities) as the cause (Fall et al. 2006). Newhalen residents expressed similar concerns as Iliamna residents that overharvesting from non-local hunters and thinning lichen are reducing the Mulchatna caribou herd (Fall et al. 2006).

Figure 3.9-5 illustrates the 1996/1997 to 2005/2006 overlapping subsistence search and harvest area for Newhalen in relation to proposed project infrastructure. The figure also shows the search and harvest areas for large land mammals and all resources for other time periods. Harvest areas extend from Lime Village to Naknek, and from Tikchik Lakes to the eastern edges of Lake Clark and Iliamna Lake, with some use in Cook Inlet. The primary areas of overlapping use are near the Newhalen, Kvichak, Nushagak, and Mulchatna river drainages for hunting of caribou, moose, waterfowl, and other game; and also for fish, berries, and plants in the summer and fall. Overlapping use areas occur inland close to the community, along the northwestern shore of Iliamna Lake across the proposed mine access road and north ferry terminal, and toward Nondalton and the eastern shoreline. The primary means of travel are by snowmachine, boat, ATV, and truck. Travel routes to access resources were close to the Iliamna Lake shoreline, and there is a direct route across Iliamna between Newhalen and Big Mountain, and a similar direct route from Newhalen to Kokhanok (PLP 2018-RFI 088).



Sources: Pebble; USGS; ADNR
Subsistence use areas by
Stephen R. Braund & Associates

US Army Corps of Engineers®

10 0 10 20
Miles

Administrative Boundaries
- Wild and Scenic River
- State Game Refuge/Sanctuary
- Alaska State Park
- National Wildlife Refuge
- National Park

- City/Town
- Roads
- Outer Continental Shelf
- River/Stream
- Lake/Pond

- Large Land Mammals, 1980-2002 (Holen et al., 2005)
- All Resources, 2004 (Fall et al., 2006)
- All Resources, 1960-82 (Wright, Morris, and Schroeder, 1985)
- Overlapping Subsistence Use Areas All Resources 1996/97 - 2005/06 (SRB&A 2018)

- Alternative 1
- Kokhanok East Ferry Terminal Variant
- Alternative 2
- Alternative 3

SUBSISTENCE USE AREAS, ALL RESOURCES - NEWHALEN

PEBBLE PROJECT EIS

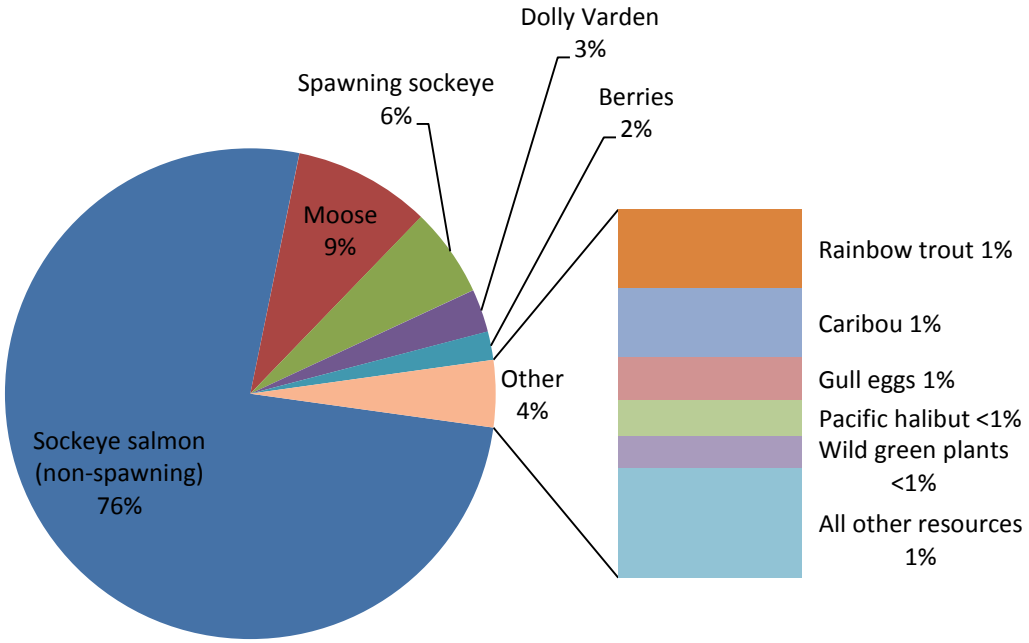
FIGURE 3.9-5

3.9.3.3 Pedro Bay

Pedro Bay is a Dena'ina Athabascan community at the eastern end of Iliamna Lake. In 2004, Pedro Bay had an estimated year-round population of 69 in 21 households. Pedro Bay residents harvested an estimated total of 21,026 pounds of wild food (306 pounds per capita) in 2004. Salmon dominated the subsistence production of Pedro Bay residents as shown in Table 3.9-2, which displays per capita harvests by resource category. The top 10 resources harvested by Pedro Bay residents in 2004 in terms of edible weight are shown in Figure 3.9-6.

Salmon, as well as plants and fungi, was the most widely used resource category (100 percent of households), followed by birds and eggs (94 percent), non-salmon fish (89 percent), and large land mammals (78 percent). Sharing and distribution of subsistence foods was widespread. In 2004, all Pedro Bay households received wild resources and almost all (89 percent) households gave resources away (Fall et al. 2006). Table 3.9-6 describes the rates of households using, attempting to harvest, harvesting, giving away, and receiving different categories of resources during 2004. Most households try for and harvest salmon, non-salmon fish, upland game birds, and vegetation.

Figure 3.9-6: Composition of Pedro Bay Subsistence Harvest by Estimated Edible Weight, 2004



Note: The term "spawning sockeye" refers to late-run sockeye salmon that have a distinctive red color and white meat, and are harvested in the fall.
Source: Fall et al. 2006

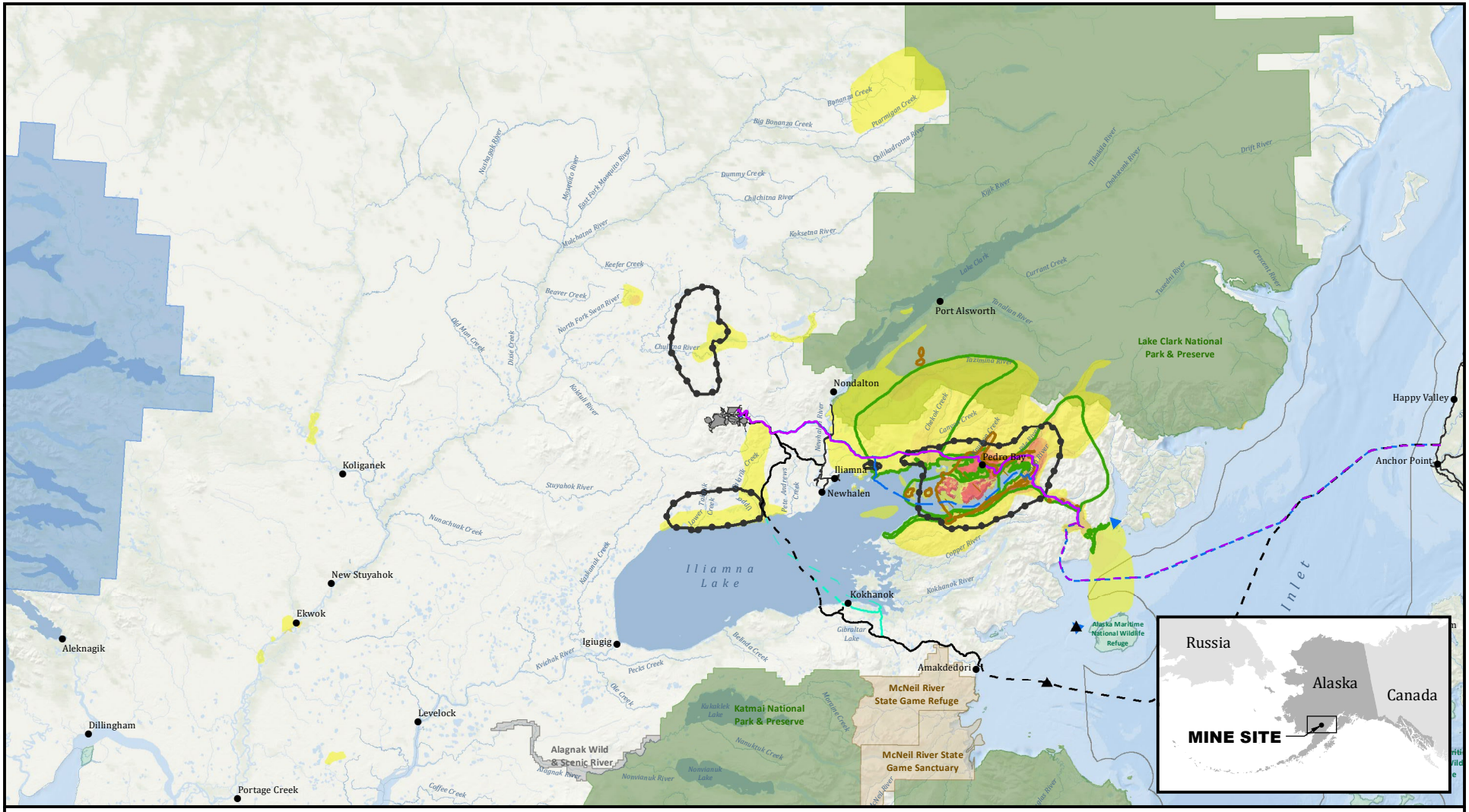
Table 3.9-6: Pedro Bay Subsistence Harvest Estimates by Resource Category, 2004

Resource	Percent of Households					Estimated Edible Harvest			Percent of Total Harvest
	Use	Attempt to Harvest	Harvest	Give Away	Receive	Total Pounds[1]	Average Pounds Per Household	Pounds Per Capita	
All Resources	100	100	100	89	100	21,026	1,001	306	100.0
Salmon	100	89	83	72	78	17,232	821	250	82.0
Non-Salmon Fish	89	61	61	39	83	1,053	82	15	5.0
Large Land Mammals	78	72	22	22	61	2,065	136	30	9.8
Small Land Mammals	11	6	6	6	6	0	0	0	0.0
Marine Mammals	0	11	0	0	0	0	0	0	0.0
Migratory Birds	11	11	11	0	0	8	4	<1	<0.1
Upland Game Birds	56	61	50	22	6	76	6	1	0.4
Bird Eggs	72	39	39	22	56	112	14	2	0.5
Marine Invertebrates	28	0	0	11	28	0	0	0	0.0
Vegetation	100	100	100	56	50	478	23	7	2.3

Note: [1]Estimated pounds include only edible pounds, and therefore do not include estimates for resources that are not typically eaten by community residents (e.g., furbearers).
Source: Fall et al. 2006

Trends in Pedro Bay overall subsistence harvest over time indicate that they remained relatively unchanged over the study years. Salmon accounted for the majority of the total harvest, and large land mammals and non-salmon fish contribute to the yearly subsistence harvest. Pedro Bay residents described sociocultural changes that were affecting harvest patterns. People had stopped harvesting smaller land mammals (beaver, snowshoe, and porcupine) as a food source as the community loses elders and there is less demand. Additionally, people were not spending as much time on subsistence activities because wage labor increased, and caused people to spend less time hunting and fishing for subsistence. Residents reported that Dolly Varden in the Iliamna River were being overharvested by the sport fishery, and that motorized boats were disturbing stream habitat. They observed that moose were being adversely affected by increased populations of wolves and bears (Fall et al. 2006).

Figure 3.9-7 illustrates the 1996 to 2005 overlapping subsistence search and harvest area for Pedro Bay in relation to proposed project infrastructure. The figure also shows the search and harvest areas for large land mammals and all resources for other time periods. Pedro Bay subsistence use areas are concentrated on the eastern end of Iliamna Lake and across the proposed transportation and pipeline corridors for Alternatives 2 and 3. Lower-use areas extended to near Upper and Lower Talarik creeks and along the Chulitna, Mulchatna and Nushagak rivers. Use areas extend toward Iliamna, near Tazimina Lakes, and east to Cook Inlet. The highest numbers of overlapping use areas are close to Pedro Bay, and along the coast to the Iliamna River for moose, other large land mammals, furbearers, small land mammals, waterfowl upland birds, berries, and plants. Flat and Porcupine islands were the prime harvesting locations for moose, seal, waterfowl, berries, and plants. Salmon and trout are taken in overlapping use areas near the community and near Pile Bay. Pedro Bay residents do not travel far to harvest sockeye salmon; they harvest “bright” or non-spawning sockeye in the bays of Iliamna Lake and spawning sockeye in the rivers, streams, and “fish ponds” above the lake (Fall et al. 2006). Travel routes to access subsistence areas were reported to extend west along the lake to Dillingham, and east to Pile Bay and to Williamsport (PLP 2018-RFI 088).



Sources: Pebble; USGS; ADNR
Subsistence use areas by
Stephen R. Braund & Associates

US Army Corps of Engineers®

10 0 10 20
Miles

Administrative Boundaries
- Wild and Scenic River
- State Game Refuge/Sanctuary
- Alaska State Park
- National Wildlife Refuge
- National Park

- City/Town
- Roads
- Outer Continental Shelf
- River/Stream
- Lake/Pond

- Large Land Mammals, 1980-2002 (Holen et al., 2005)
- All Resources, 2004 (Fall et al., 2006)
- All Resources, 1960-82 (Wright, Morris, and Schroeder, 1985)
- Overlapping Subsistence Use Areas All Resources 1996-2005 (SRB&A 2018)

- Alternative 1
- Kokhanok East Ferry Terminal Variant
- Alternative 2
- Alternative 3

SUBSISTENCE USE AREAS, ALL RESOURCES - PEDRO BAY

PEBBLE PROJECT EIS

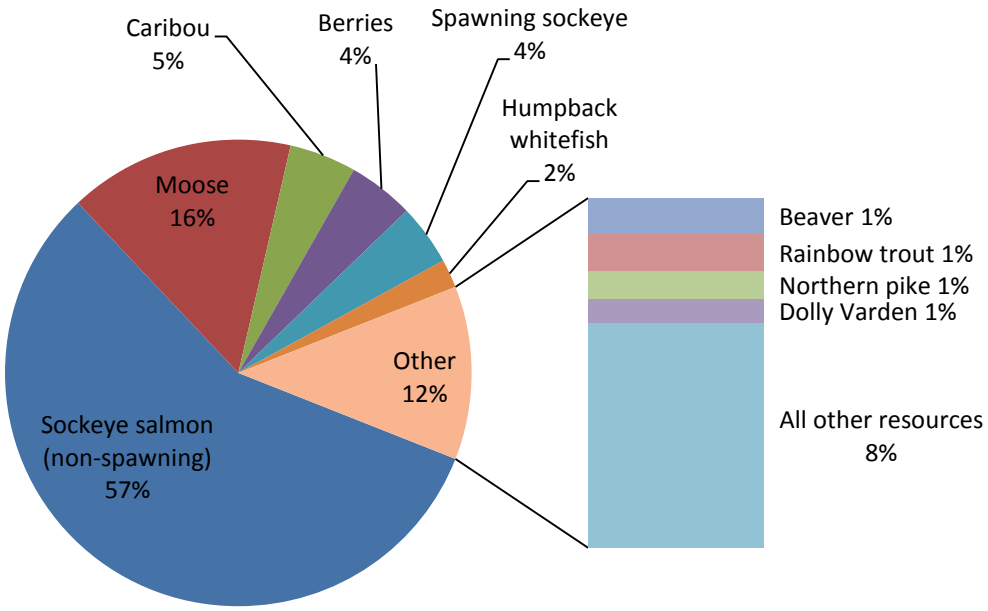
FIGURE 3.9-7

3.9.3.4 Nondalton

Nondalton is a primarily Dena'ina community on Sixmile Lake. In 2004, Nondalton had an estimated year-round population of 164 people in 43 households. Nondalton residents pursued a diverse range of productive subsistence activities, and harvested a total of 58,686 pounds of wild food (358 pounds per capita) in 2004 (Fall et al. 2006). Salmon dominated the subsistence production of Nondalton residents, as shown in Table 3.9-2, which displays per capita harvests by resource category. The top 10 resources harvested by Nondalton residents in 2004 in terms of edible weight are shown in Figure 3.9-8.

Plants and fungi was the most widely used resource category (97 percent of households) followed by salmon (92 percent), large land mammals (84 percent), non-salmon fish (82 percent), small land mammals (58 percent), and birds and eggs (50 percent). Sharing and distribution of subsistence foods was widespread. In 2004, 97 percent of Nondalton households received wild resources, and 92 percent of households gave resources away (Fall et al. 2006). Table 3.9-7 describes the rates of households using, attempting to harvest, harvesting, giving away, and receiving different categories of resources during 2004. Most households try for and harvest salmon, non-salmon fish, large land mammals, small land mammals, upland game birds, and vegetation.

Figure 3.9-8: Composition of Nondalton Subsistence Harvest by Estimated Edible Weight, 2004



Note: The term "spawning sockeye" refers to late-run sockeye salmon that have a distinctive red color and white meat, and are harvested in the fall.
Source: Fall et al. 2006

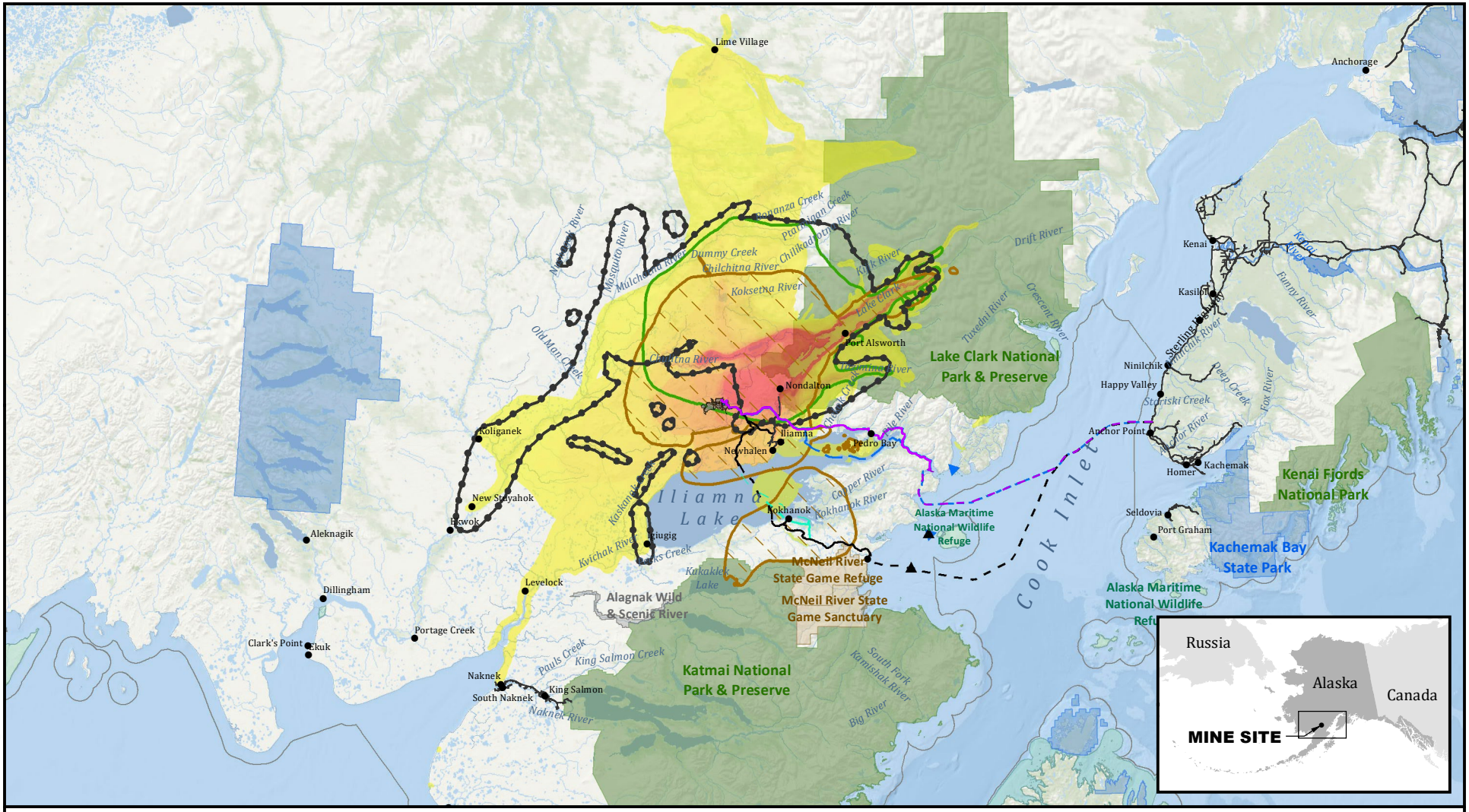
Table 3.9-7: Nondalton Subsistence Harvest Estimates by Resource Category, 2004

Resource	Percent of Households					Estimated Edible Harvest			Percent of Total Harvest
	Use	Try to Harvest	Harvest	Give	Receive	Total Pounds[1]	Average Household Pounds	Per Capita Pounds	
All Resources	100	97	97	92	97	58,685	1,365	358	100.0
Salmon	92	87	87	55	63	36,004	837	219	61.4
Non-Salmon Fish	82	76	76	53	45	5,561	170	34	9.5
Large Land Mammals	84	45	26	47	79	12,209	635	74	20.8
Small Land Mammals	58	50	50	45	21	1,206	28	7	2.1
Marine Mammals	8	3	0	0	8	0	0	0	<0.1
Migratory Birds	42	40	40	24	13	399	24	2	0.7
Upland Game Birds	45	42	42	26	8	224	12	1	0.4
Bird Eggs	13	0	0	5	13	0	0	0	<0.1
Marine Invertebrates	13	8	8	3	13	66	20	0	0.1
Vegetation	97	92	92	55	40	3,012	70	18	5.1

Note: [1]Estimated pounds include only edible pounds, and therefore do not include estimates for resources that are not typically eaten by community residents (e.g., furbearers).
Source: Fall et al. 2006

Trends in Nondalton subsistence harvest over time indicate that the estimated harvest in 2004 was lower than in previous study years. Nondalton residents cited changes in animal populations as the primary explanation for reduced harvests in at least one resource category. Other factors for harvesting less were personal reasons and poor or unusual weather. Survey participants commented that caribou numbers have declined, affecting subsistence resources, so that locals could not compete with non-local hunters. They also noticed that disturbance from helicopter traffic causes the caribou herd to move farther away, and they were seeing a trend of overharvest by non-locals for caribou and moose (Fall et al. 2006).

Figure 3.9-9 illustrates 1996/1997 to 2005/2006 overlapping subsistence search and harvest area for Nondalton in relation to proposed project infrastructure. The figure also shows the search and harvest areas for large land mammals and all resources for other time periods. Use areas for caribou, moose, black bear, and brown bear hunting were from the headwaters of the Mulchatna River and towards the Koktuli River system (Fall et al. 2006). Residents traveled south to Iliamna, to the headwaters of Upper Talarik Creek, and to the eastern end of Little Lake Clark (Fall et al. 2006). Fishing for salmon and freshwater fish occurred primarily at the outlet of Sixmile Lake north of the community. Small game and furbearers were trapped near Nondalton, close to the headwaters of Upper Talarik Creek, and in the Chulitna River valley. Waterfowl and upland bird hunting occurred in these same areas. Fishing also occurred in the Newhalen River near Petrof Falls, and on Lake Clark in Chulitna Bay. For berry picking, the area used was around the northern and southern shores of Iliamna Lake, and into the headwaters of the Koktuli River near Groundhog Mountain and Frying Pan Lake. Wild plant harvest occurred in the area immediately around Nondalton and on islands in Iliamna Lake, including Flat Island.



Sources: Pebble; USGS; ADNR
Subsistence use areas by
Stephen R. Braund & Associates

US Army Corps of Engineers

10 0 10 20
Miles

Administrative Boundaries
- Wild and Scenic River
- State Game Refuge/Sanctuary
- Alaska State Park
- National Wildlife Refuge
- National Park

- City/Town
- Roads
- Outer Continental Shelf
- River/Stream
- Lake/Pond

- Large Land Mammals, 1980-2002 (Holen et al., 2005)
- All Resources, 2004 (Fall et al., 2006)
- All Resources, 1960-82 (Wright, Morris, and Schroeder, 1985)
- Overlapping Subsistence Use Areas All Resources 1996/97 - 2005/06 (SRB&A 2018)

- Alternative 1
- Kokhanok East Ferry Terminal Variant
- Alternative 2
- Alternative 3

SUBSISTENCE USE AREAS, ALL RESOURCES - NONDALTON

PEBBLE PROJECT EIS

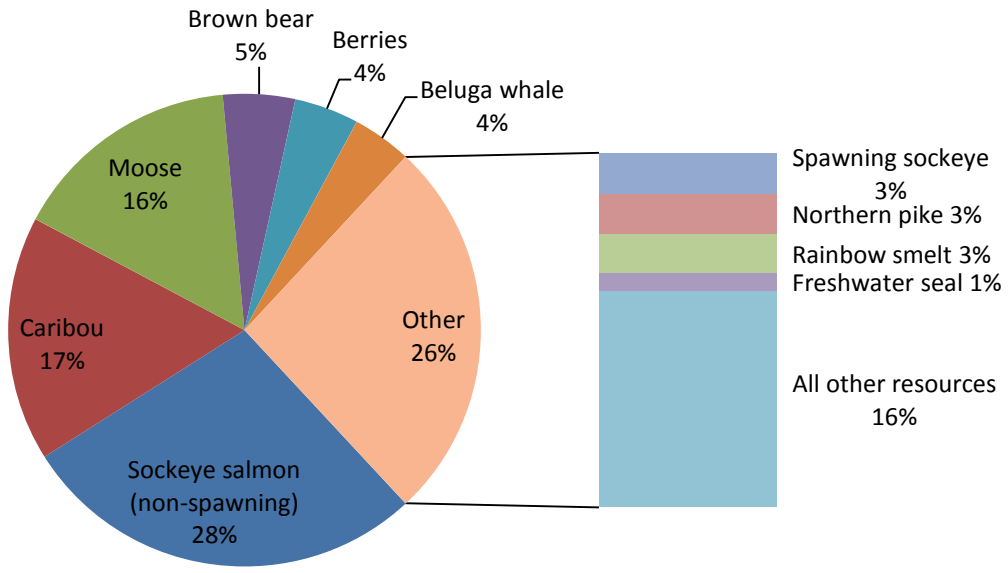
FIGURE 3.9-9

3.9.3.5 Igiugig

Igiugig is on the southeastern side of Iliamna Lake at the mouth of the Kvichak River, and was formerly a portage point for a reindeer station established at Kukaklek Lake in the early 1900s (Deur 2008). It was historically a Yup'ik village, and is now home to primarily Alutiiq, Yup'ik, and Dena'ina people. In 2005, Igiugig had an estimated year-round population of 41 people in 13 households. Residents pursue a wide array of productive subsistence activities. Krieg et al. (2009) surveyed residents about their 2005 subsistence activities, and found that Igiugig households harvested an estimated total of 22,310 pounds of wild foods (542 pounds per capita). Although salmon dominate the subsistence food production of residents, moose and caribou provide a larger portion of total subsistence food when compared to the other Iliamna Lake communities for per capita harvests, as shown in Table 3.9-2. The top 10 resources harvested in 2005 in terms of edible weight are shown in Figure 3.9-10.

In 2005, all households in Igiugig used salmon, non-salmon fish, plants and fungi, and large land mammals (Krieg et al. 2009). Other widely used resource categories included birds and eggs (92 percent of households), marine mammals (67 percent), and small land mammals (50 percent) (Krieg et al. 2009). Sharing and distribution of subsistence foods is widespread. All households received and gave away at least one subsistence resource in 2005 (Krieg et al. 2009). Table 3.9-8 describes the rates of households using, attempting to harvest, harvesting, giving away, and receiving different categories of resources during 2005. Most households try for and harvest salmon, non-salmon fish, large land mammals, small land mammals, migratory birds, upland game birds, bird eggs, and vegetation. In addition to relying heavily on subsistence hunting and fishing, the community relies on commercial fishing for cash income, with some families holding commercial fishing permits, and other working in the canneries (Deur 2008).

Figure 3.9-10: Composition of Igiugig Subsistence Harvest by Estimated Edible Weight, 2005



Note: The term "spawning sockeye" refers to late-run sockeye salmon that have a distinctive red color and white meat, and are harvested in the fall.
Source: Krieg et al. 2009

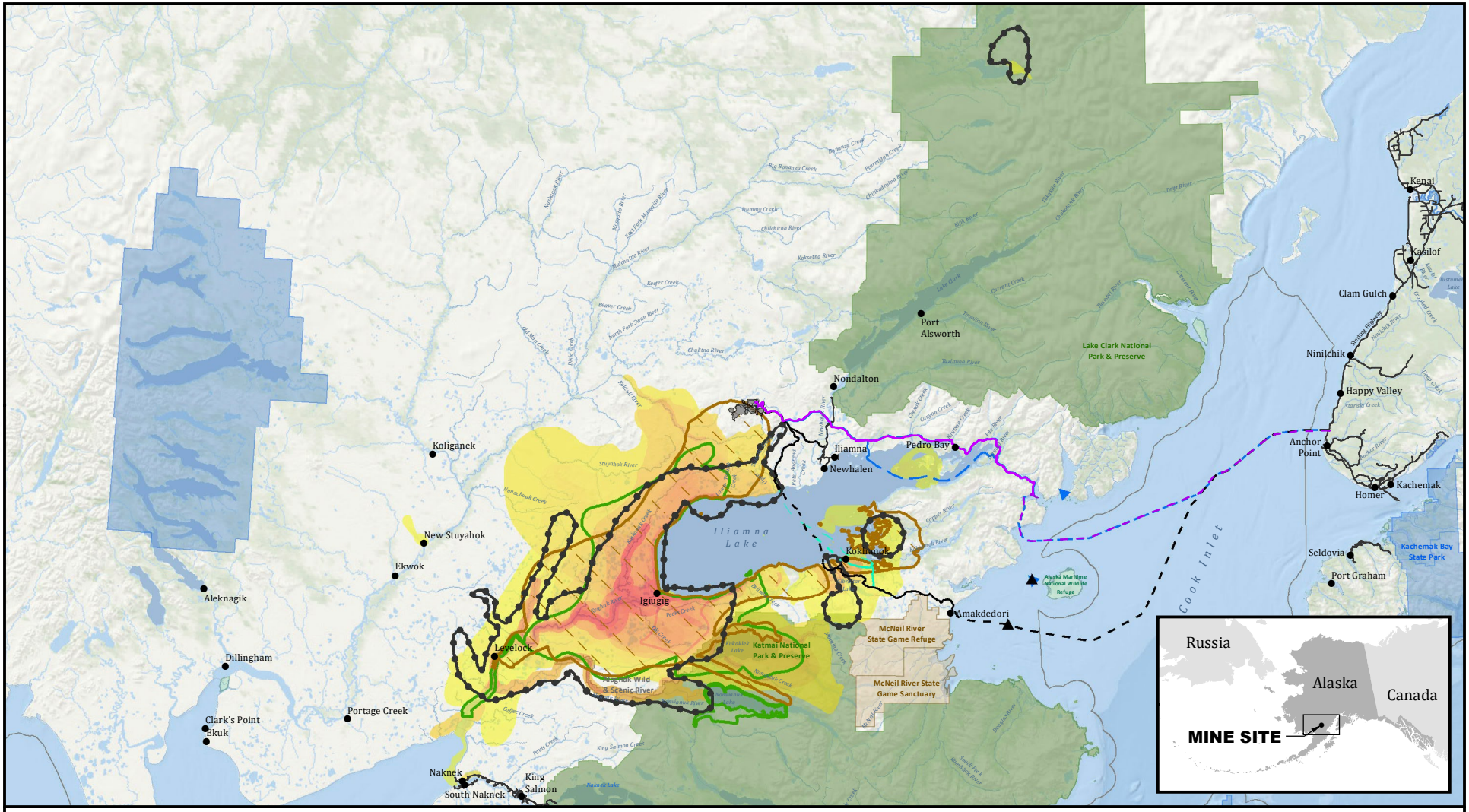
Table 3.9-8: Igiugig Subsistence Harvest Estimates by Resource Category, 2005

Resource	Percent of Households					Estimated Edible Harvest			Percent of Total Harvest
	Use	Attempt to Harvest	Harvest	Give Away	Receive	Total Pounds[1]	Average Pounds Per Household	Pounds Per Capita	
All Resources	100	100	100	100	100	22,310	1,716	542	100.0
Salmon	100	92	92	83	83	8,447	650	205	37.9
Non-Salmon Fish	100	83	83	58	92	2,445	188	59	11.0
Large Land Mammals	100	75	58	83	92	8,352	643	203	37.4
Small Land Mammals	50	42	33	42	17	202	16	5	0.9
Marine Mammals	67	33	33	42	58	1,203	93	29	5.4
Migratory Birds	83	58	58	42	42	233	18	6	1.0
Upland Game Birds	50	42	42	25	25	67	5	2	0.3
Bird Eggs	83	75	67	58	42	185	14	5	0.8
Marine Invertebrates	17	0	0	0	17	0	0	0	0.0
Vegetation	100	100	100	83	67	1,172	90	29	5.3

Note: [1]Estimated pounds include only edible pounds, and therefore do not include estimates for resources that are not typically eaten by community residents (e.g., furbearers).
Source: Krieg et al. 2009

Trends in Igiugig subsistence harvest over time indicate that overall harvests remained relatively unchanged over the study years. Salmon use decreased, and harvest of large land mammals increased (SRB&A 2011b). Reasons residents cited for changes were personal reasons and change in animal populations. It was noted that personal reasons accounted for 75 percent of households using less salmon, and 50 percent of households using fewer non-salmon fish, birds and eggs, and wild plants. Residents noted that these declines were from a need for fewer resources due to smaller families. All households reported that they were using fewer furbearers due to lower fur prices and higher costs of transportation (fuel) (Krieg et al. 2009).

Figure 3.9-11 illustrates the 1996/1997 to 2005/2006 overlapping subsistence search and harvest area for Igiugig in relation to proposed project infrastructure. The figure also shows the search and harvest areas for large land mammals and all resources for other time periods. The Igiugig subsistence use area encompasses a large area that extends around much of Iliamna Lake, and along the entire Kvichak River to Naknek. Travel for subsistence extends into Katmai National Park and Preserve and to the Mulchatna River. The majority of high-use areas for Igiugig are close to the community along the western shore of the lake, and along Kaskanak Creek, Kvichak, and Alagnak river corridors. Medium- to low-use areas for overlapping resources for waterfowl, upland birds, berries, and plants in the summer and fall are in the vicinity of the northern mine access roads and ferry terminals. Igiugig residents harvest beluga whales near the mouth of the Kvichak River near the community of Levelock and they harvest freshwater seals in the Kvichak River. Travel routes were across the same areas, with a lake route crossing occurring close to the shorelines (PLP 2018-RFI 088).



Sources: Pebble; USGS; ADNR
Subsistence use areas by
Stephen R. Braund & Associates

US Army Corps of Engineers

10 0 10 20
Miles

Administrative Boundaries
- Wild and Scenic River
- State Game Refuge/Sanctuary
- Alaska State Park
- National Wildlife Refuge
- National Park

- City/Town
- Roads
- Outer Continental Shelf
- River/Stream
- Lake/Pond

- Large Land Mammals, 1980-2002 (Holen et al., 2005)
- All Resources, 2005 (Krieg et al., 2009)
- All Resources, 1960-82 (Wright, Morris, and Schroeder, 1985)
- Overlapping Subsistence Use Areas All Resources 1996/97 - 2005/06 (SRB&A 2018)

- Alternative 1
- Kokhanok East Ferry Terminal Variant
- Alternative 2
- Alternative 3

SUBSISTENCE USE AREAS, ALL RESOURCES - IGIUGIG

PEBBLE PROJECT EIS

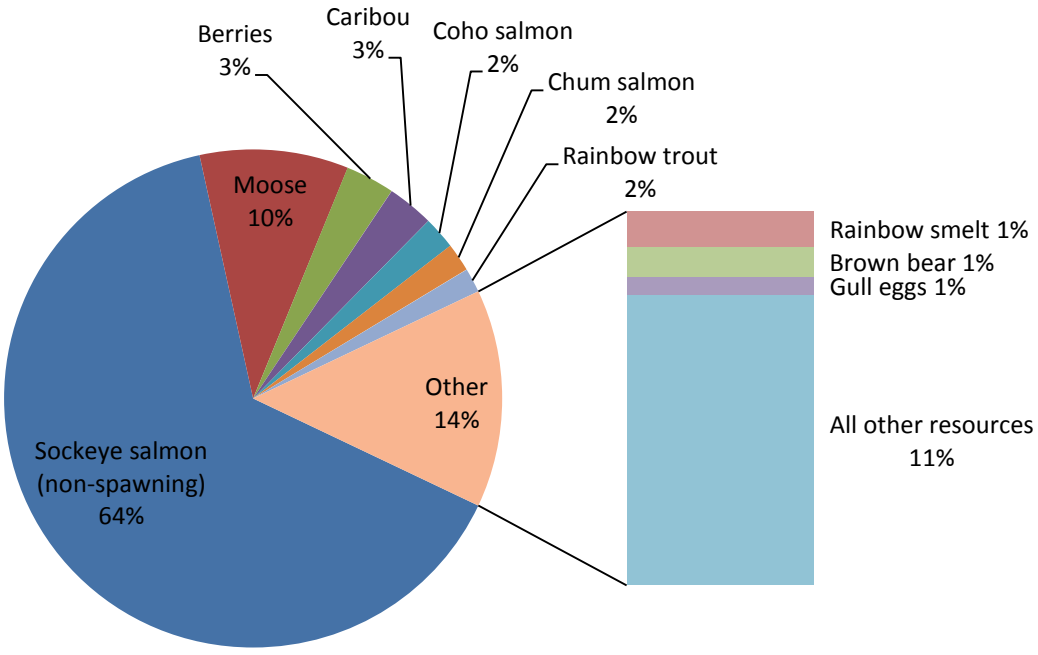
FIGURE 3.9-11

3.9.3.6 Kokhanok

Kokhanok is a predominantly Alaska Native community on the southern shore of Iliamna Lake. The Alaska Native population is a mix of Alutiiq, Yup'ik, and Dena'ina people. Economically, Kokhanok residents are highly dependent on subsistence fishing and hunting, with little industrial or tourist-based economic development; with subsistence hunting, fishing, and gathering representing a significant source of non-cash income (Deur 2008). In 2005, Kokhanok had an estimated year-round population of 158 people in 42 households. Kokhanok residents pursued a diverse range of productive subsistence activities, and harvested an estimated total of 107,645 pounds of wild foods (680 pounds per capita) in 2005. Salmon dominated the subsistence production of Kokhanok residents, as shown in Table 3.9-2, which displays per capita harvests by resource category. The top 10 resources harvested by Kokhanok residents in 2005 in terms of edible weight are shown in Figure 3.9-12.

Salmon, as well as plants and fungi, was the most widely used resource category (97 percent of households), followed by birds and eggs (91 percent), large land mammals (91 percent), non-salmon fish (74 percent), small land mammals (43 percent), and marine mammals (40 percent). Sharing and distribution of subsistence foods is widespread. In 2005, 94 percent of Kokhanok households received wild resources, and 83 percent of households gave resources away (Krieg et al. 2009). Table 3.9-9 describes the rates of households using, attempting to harvest, harvesting, giving away, and receiving different categories of resources during 2005. Most households try for and harvest salmon, non-salmon fish, small land mammals, upland game birds, birds eggs, and vegetation.

Figure 3.9-12: Composition of Kokhanok Subsistence Harvest by Estimated Edible Weight, 2005



Source: Krieg et al. 2009

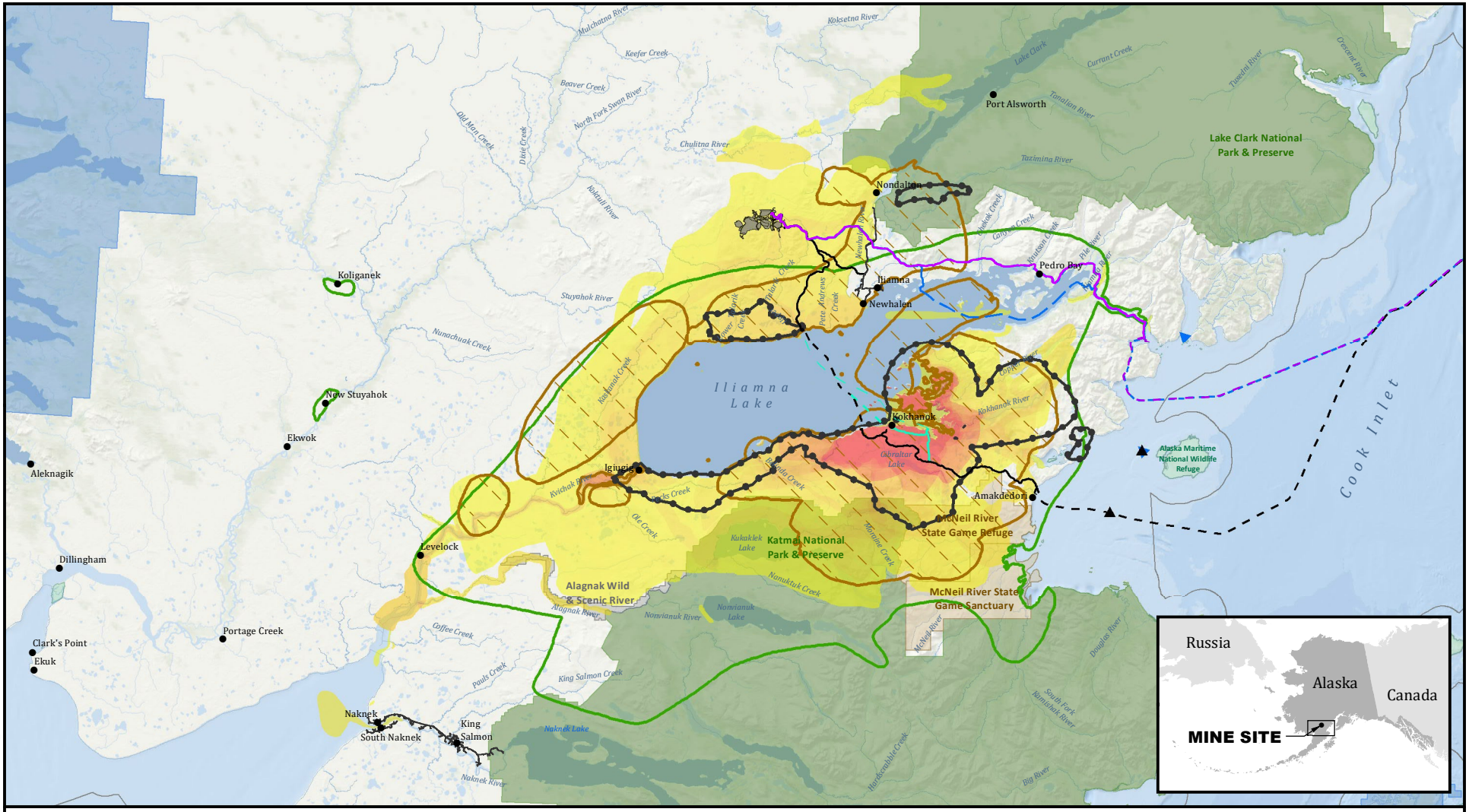
Table 3.9-9: Kokhanok Subsistence Harvest Estimates by Resource Category, 2005

Resource	Percent of Households					Estimated Edible Harvest			Percent of Total Harvest
	Use	Attempt to Harvest	Harvest	Give Away	Receive	Total Pounds[1]	Average Pounds Per Household	Pounds Per Capita	
All Resources	100	100	97	83	94	107,644	2,563	680	100.0
Salmon	97	89	83	63	60	81,222	1,934	513	75.5
Non-Salmon Fish	74	66	66	57	51	5,752	137	36	5.3
Large Land Mammals	89	63	46	40	71	14,956	356	94	13.9
Small Land Mammals	43	40	37	20	14	239	6	2	0.2
Marine Mammals	40	23	11	14	23	268	6	2	0.2
Migratory Birds	63	49	43	31	31	194	5	1	0.2
Upland Game Birds	66	57	54	49	17	273	7	2	0.3
Bird Eggs	83	77	77	51	31	769	18	5	0.7
Marine Invertebrates	9	9	9	6	3	74	2	1	0.1
Vegetation	97	97	97	34	34	3,894	93	25	3.6

Note: [1]Estimated pounds include only edible pounds, and therefore do not include estimates for resources that are not typically eaten by community residents (e.g., furbearers).
Source: Krieg et al. 2009

Trends in Kokhanok subsistence harvest over time indicate that the 2005 harvest was lower than in previous study years. This was due primarily to declines in large land mammal harvests. In 2005, Kokhanok residents most frequently cited animal population changes as the reason for changes in subsistence harvests and uses, particularly scarcity of moose and caribou. Weather was another reason cited for changes in resource harvests and uses. Weather can impact the abundance of resources as well as travel conditions (Krieg et al. 2009).

Figure 3.9-13 illustrates the 1996 to 2005 overlapping subsistence search and harvest area for Kokhanok in relation to proposed project infrastructure. The figure also shows the search and harvest areas for large land mammals and all resources for other time periods The highest-use areas for all resources was the area closest to the community along the Iliamna Lake shoreline towards Big Mountain, near the south ferry terminal, and along the south mine access road. The areas of use for all resources extend as far north as the Chulitna River, and west from Nondalton and Newhalen to the upper Koktuli River, Kaskanak Creek, and the Kvichak and Alagnak rivers. To the south of the community, use areas extend into Katmai National Park and Preserve, and east into Cook Inlet. Overlapping resource use areas are between Dennis Creek to the west near the southern ferry terminal, to the south along the south access mine road near Gibraltar Lake and east to Tommy Point, as well as the islands near Kokhanok and Intricate, Leon, and Kokhanok bays. The lands to the south of Kokhanok are overlapping use areas for caribou, moose, bear, fish, waterfowl, upland birds, berries, and plants. Travel routes occurred close to the Iliamna Lake shoreline and crossing the southern ferry terminal location, with a direct route to Igiugig along the shoreline and a route directly across Iliamna Lake between Iliamna and Kokhanok (PLP 2018-RFI 088).



Sources: Pebble; USGS; ADNR
Subsistence use areas by
Stephen R. Braund & Associates

US Army Corps of Engineers

10 0 10 20
Miles

Administrative Boundaries
- Wild and Scenic River
- State Game Refuge/Sanctuary
- Alaska State Park
- National Wildlife Refuge
- National Park

- City/Town
- Roads
- Outer Continental Shelf
- River/Stream
- Lake/Pond

- Large Land Mammals, 1980-2002 (Holen et al., 2005)
- All Resources, 2005 (Krieg et al., 2009)
- All Resources, 1960-82 (Wright, Morris, and Schroeder, 1985)
- Overlapping Subsistence Use Areas All Resources 1996-2005 (SRB&A 2018)

- Alternative 1
- Kokhanok East Ferry Terminal Variant
- Alternative 2
- Alternative 3

SUBSISTENCE USE AREAS, ALL RESOURCES - KOKHANOK

PEBBLE PROJECT EIS

FIGURE 3.9-13

This page intentionally left blank.

3.10 HEALTH AND SAFETY

The evaluation of impacts on human health and safety is a required component of the National Environmental Policy Act (NEPA) as it pertains to negative and beneficial consequences of a proposed project on potentially affected communities. There are federal and state laws and regulations, such as the Clean Air Act, Clean Water Act, and various Alaska statutes that have been enacted to ensure protection of human health. Compliance with these laws and regulations is taken into consideration in the evaluation of health and safety impacts in an integrated manner in this assessment and in a more singular, medium-specific manner in individual sections such as Section 3.20, Air Quality and Section 3.18, Water and Sediment Quality.

The Environmental Impact Statement (EIS) analysis area for this assessment corresponds 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, or through releases and discharges to the environment. Overall, as listed in Table 3.10-1, it includes eight communities in the Lake and Peninsula Borough (LPB), seven communities in the Dillingham Census Area, two communities in the Kenai Peninsula Borough (KPB), and three communities in Bristol Bay, as well as surrounding regions and the Municipality of Anchorage (it is likely that some project workers will come from this urban population). Not all communities are assessed for all health effects, as some effects may be more relevant to some communities than others. Although it is possible that additional communities may occasionally use the EIS analysis area, these communities capture those most likely to use the areas with the greatest magnitude of potential impacts from the project (e.g., potential impacts to air quality, water and sediment quality, soils, wildlife and fish, transportation) and are adequate to assess potential project impacts in this EIS with respect to health-related impacts.

This assessment is intended to document baseline health and safety status in the EIS analysis area so that project-related positive and negative health and safety consequences for the project and alternatives may be identified and assessed in Section 4.10, Health and Safety, as to their likelihood and degree, and mitigation measures may be recommended to minimize potential negative impacts that could occur as a result of the project. Human health data for the EIS analysis area are generally available at broad regional scales, but some data are available at the community level. Differences between the two scales are distinguished, where possible, to the extent relevant for this assessment.

Health and safety are related and complementary concepts. In the context of evaluating the impacts of a project, “health” is broadly considered to represent a state of physical and mental well-being of communities, while “safety” is more narrowly interpreted as engineering design, operation, and handling of project infrastructure, equipment, and materials in a manner that seeks to reduce hazards and prevent the occurrence of incidents and accidents (IFC 2007). It is also important to note that regulatory programs, agencies, and compliance procedures may be overlapping or very different for the health versus the safety aspects of a project. For example, the Occupational Safety and Health Administration (OSHA) regulations cover health and safety only for workers, and do not cover untrained workers or the general public.

In this section, health is described in a manner that is consistent with the State of Alaska’s guidelines for Health Impact Assessment (ADHSS 2015); safety is discussed in the context of relevant regulatory requirements under OSHA, Mine Safety and Health Act (MSHA), and other types of hazard assessment and prevention.

Table 3.10-1: Potentially Affected Communities

Potentially Affected Communities	HECs Assessed	Level of Assessment	
		Community[5] & Regional	Regional
Lake and Peninsula Borough			
Lake and Peninsula Borough	All, as needed[1]		X
Iliamna Lake/Lake Clark Region	All, as needed[1]		X
Nondalton	All	X	
Iliamna	All	X	
Newhalen	All	X	
Port Alsworth	All	X	
Pedro Bay	All	X	
Kokhanok	All	X	
Igiugig	All	X	
Levelock	All	X	
Dillingham Census Area			
Dillingham Census Area	All, as needed[1]		X
Nushagak/Bristol Bay Region	All, as needed[1]		X
Ekwok	All	X	
Koliganek	All	X	
New Stuyahok	All	X	
Dillingham	All, particularly HECs 1, 3 & 4 [2]	X	
Clark's Point	HECs 3 & 4 for Subsistence [3]	X	
Manokotak	HECs 3 & 4 for Subsistence [3]	X	
Aleknagik	HECs 3 & 4 for Subsistence [3]	X	
Bristol Bay Borough			
Bristol Bay Borough	All		X
King Salmon	HECs 3 & 4 for Subsistence [3]	X	
Naknek	HECs 3 & 4 for Subsistence [3]	X	
South Naknek	HECs 3 & 4 for Subsistence [3]	X	
Kenai Peninsula Borough			
Kenai Peninsula Borough	All		X
Ninilchik	HECs 3 & 4 for Subsistence [3]	X	
Seldovia	HECs 3 & 4 for Subsistence [3]	X	
City of Anchorage and Matanuska-Susitna Borough			
Anchorage Mat-Su Region	All, particularly HEC 1 [4]		X

Notes:
[1] Regions and boroughs are evaluated, as needed, based on the lack of or uncertainty with the community-level data.
[2] Dillingham is located farther from the project than the other 11 potentially affected communities, but it is likely that some project workers will come from this population and it is possible that subsistence users from this population could utilize the EIS analysis area. Therefore, the primary impacts would be expected to be socioeconomic in HEC 1 and subsistence impacts in HECs 3 and 4. Dillingham is represented in the information provided for the Dillingham Census Area.
[3] Potential subsistence impacts for these communities are assessed within HECs 3 and 4 and are represented in the information provided for the larger boroughs in which they reside (Dillingham Census Area, Bristol Bay Borough, and Kenai Peninsula Borough).
[4] Anchorage is located outside the Bristol Bay drainages and farther from the project, but it is likely that some project workers will come from this urban population and the primary impact would be expected to be socioeconomic (HEC 1).
[5] Community-level evaluations were performed as data permitted.

3.10.1 Health

For the purposes of this document and consistent with Alaska Department of Health and Social Services (ADHSS), health is defined not merely as the absence of disease, but as "the reduction in mortality, morbidity, and disability due to detectable disease or disorder, and an increase in the perceived level of health" (ADHSS 2015). Thus, it represents an integrated state of physical, social, and mental well-being. Health is affected by environmental, social, cultural, and genetic factors often called "determinants of health." Community health in Alaska, with its environmental and social setting and complex blend of health determinants, is in many ways different from national health trends in the US (ADHSS 2015). Resource development projects, such as mining activities, can often affect the health of nearby communities in complex ways; impacts may be both positive and negative.

Funding and completion of a health impact assessment (HIA) following Alaska guidelines is strictly voluntary in Alaska and is not required by either Alaska law or federal law (ADHSS 2015). Although voluntary, Alaska's HIA toolkit guidance helps project applicants and policy-makers understand both the negative and positive health impacts of a proposed project and create plans to enhance the positive and reduce the negative impacts. The toolkit provides a broad-based but tiered process that allows the scope of the HIA to be focused on a sub-set of finite, plausible health impacts (clearly defined causal connection between the project and the anticipated health impact) identified through a screening and scoping process. Therefore, although this assessment describes the broad health effects categories (HECs) and several typical health metrics for each category included in the ADHSS guidelines, emphasis is focused on assessing key issues and potential impacts identified during scoping (as required by NEPA) and those expressed by stakeholders.

There is generally overlap between the affected communities in relation to the project components and phases for all alternatives and variants (see Chapter 2, Alternatives, for a description of alternatives and variants); therefore, the functional classification of baseline information for the affected communities was at the scale of the EIS analysis area and through the end of the closure phase. Specific affected community distinctions by component, area, or phase are only denoted when relevant.

3.10.1.1 Assumptions and Limitations

Focus on Most Relevant Human Health Effects Categories and Diseases. An important goal of developing a HIA is that it should be useful in understanding project consequences and should help to inform project decisions. It should consider those health-related issues that are relevant to the project or of concern to the stakeholders and affected communities. The HIA toolkit outlines a broad set of eight types of HECs to be considered for a HIA in Alaska. However, not all effects categories are relevant or likely for every project. This assessment has been streamlined to focus on the HECs that could be directly impacted by the project or may be expressed as a primary stakeholder concern, based on the project description and review of concerns expressed by stakeholders and community members as summarized in the Pebble Project EIS Scoping Report (Appendix A). Among the range of concerns expressed by the communities and stakeholders during the scoping process, the highest health-related concerns included anxiety about possible social, psychological and behavioral health impacts, concerns about short-term economic gains versus potential long-term environmental devastation, fear of increased traffic-related accidents and injuries, potential exposure to toxic chemicals in air, water and other environmental media, chemical impacts on availability and quality of subsistence foods, particularly fishing resources, and potential overloading of existing infrastructure and services. The key issues for the health assessment were then identified by considering the stakeholder concerns in the context of the project description including the

design and operation features and the impact avoidance, mitigation, and monitoring measures already proposed by the Pebble Limited Partnership (PLP).

Therefore, the primary focus of this health assessment includes HEC 1: Social Determinants of Health, HEC 2: Accidents and Injuries, HEC 3: Exposure to Hazardous Materials, and HEC 4: Food, Nutrition, and Subsistence Activity. Baseline information for these HECs is discussed in this section and Appendix K3.10. These HECs are considered relevant since they assess social, financial and health impacts that may arise directly from project-related employment and economic activities (HEC 1), accidents and injuries related to a variety of new construction and transportation facilities required for the project (HEC 2), possible health effects related to chemicals that the public may be exposed to during project activities (HEC 3), and impacts on food availability and harvesting activities that may occur in the project footprint or affected areas (HEC 4).

The remaining health effects categories are less likely to have plausible, causal connections with or easily measurable impacts from the proposed project. The baseline status of these HECs is briefly summarized in this section but discussed in more detail in Appendix K3.10 for purposes of completeness.

Identifying Potentially Affected Communities: The communities included in this health assessment are consistent with the recommendations in the HIA guidance that potentially affected communities should be identified on the basis of multiple factors including, geographic proximity to the proposed project, potential for economic impact (e.g., work force recruitment areas, population influx areas), potential use areas in relation to project footprint (e.g., subsistence activity areas), and areas of health disparities. The project covers a relatively large geographical distance. The transportation corridor would extend approximately 96 miles and the natural gas pipeline would extend approximately 187 miles. The potentially affected communities, including children and adults, that were identified for the health assessment correspond to the EIS analysis area, which is the basis of Section 3.3, Needs and Welfare of the People–Socioeconomics, and the EIS analysis area, which is the basis of Section 3.9, Subsistence. The populations of the communities in the EIS analysis area for the health section range from very small, rural communities closer to the mine site to larger, more urban communities farther away. The locations of the selected areas are illustrated in figures for Section 3.4, Environmental Justice. These potentially affected communities, regional areas, and the HECs for which they are evaluated in this section are listed in Table 3.10-1.

The majority of the health assessment is focused on 11 individual communities that represent the five larger boroughs and census area of the EIS analysis area. This section focuses on the 11 potentially affected communities geographically closest to the project in the Bristol Bay drainage basins; those most likely to be potentially impacted by the project. These communities include eight Iliamna Lake/Lake Clark communities in the LPB, and three Nushagak/Bristol Bay communities in the Dillingham Census Area. The eight LPB communities are closest to the project and include: Nondalton, Newhalen, Kokhanok, Port Alsworth, Iliamna, Pedro Bay, Levelock, and Igiugig. In 2018, the LPB had a population of 1,663, while these small rural communities had approximate population ranges of 33 to 227 people. These eight communities may be more directly impacted, both positively and negatively, compared to communities farther away, due to their relative proximity to the project components and were evaluated for all HECs at the community-level when data permitted. Three Nushagak/Bristol Bay communities (i.e., New Stuyahok, Koliganek, and Ekwok) in the Dillingham Census Area (census area population 5,021 in 2018) were also identified as geographically close to the project and were evaluated at the community-level when data permitted. These three communities had populations ranging from 106 to 496 in 2018. This section also evaluates impacts to the nearby community of Dillingham (at a regional-level for health effects) and nearby boroughs and municipalities, as it is

likely that some project workers will come from these populations. The 2018 populations for these communities were 2,382 in Dillingham, 58,471 in the KPB, 879 in the Bristol Bay Borough, and 295,365 in Municipality of Anchorage (ADOL 2019; USCB 2018).

For subsistence-related health impacts, a total 19 individual communities distributed throughout the larger boroughs and census areas are evaluated. The communities evaluated for subsistence impacts in this section (in HECs 3 and 4) were slightly different from the communities evaluated for socioeconomic impacts. The local communities evaluated for subsistence effects include the eight affected communities in the LPB, and two of the three affected communities in the Nushagak/Bristol Bay area (data are insufficient to evaluate subsistence for Ekwok), as well as nine additional communities that are farther from the project but known to use the area for subsistence (see Section 3.9, Subsistence). The nine additional subsistence-related communities include four communities in the Dillingham Census Area (i.e., Dillingham, Clark's Point, Manokotak, and Aleknagik), three communities in the Bristol Bay Borough (i.e., Naknek, South Naknek, and King Salmon), and two communities in the KPB (i.e., Ninilchik and Seldovia). Section 3.9, Subsistence, focuses on six of the Iliamna Lake communities geographically closest to the project that show a particularly high level of subsistence activities in the EIS analysis area (i.e., Iliamna, Newhalen, Pedro Bay, Nondalton, Igiugig, and Kokhanok), but also presents baseline details on traditional ecological knowledge (TEK), seasonal rounds, and subsistence harvest patterns for all 19 communities. Although it is possible that additional communities may occasionally use the EIS analysis area, these 19 communities, particularly the six Iliamna Lake communities, capture those most likely to use the area and are adequate to assess potential project impacts in this EIS with respect to subsistence-related health impacts.

The limitation of evaluating health impacts to communities based on proximity to the project components is that some effects may not be directly related to the distance between the community and the project component, such as employment opportunities. The rural location of the mine and the planned on-site housing camps make traditional commute times irrelevant; therefore, the communities that would contribute to the workforce may include more than those closest to the site. Also not directly related to distance would be changes in a community from project features, such as communities that might want to use project components like the Amakdedori port during the operations phase. These factors that are not dependent on distance also warrant consideration.

Age and Scope of Available Information. This EIS relies upon previously compiled baseline information for most of the HECs, which date from about 2002 to 2017, with the majority from 2008 to 2017. More current data were accessed, when available, with a focus on the effects categories and diseases most relevant to human health effects.

For five categories (i.e., Social Determinants of Health; Accidents and Injuries; Food, Nutrition, and Subsistence Activity; Water and Sanitation; and Health Services Infrastructure), this health section primarily relies on the data and conclusions from Section 4.3, Needs and Welfare of the People–Socioeconomics; Section 4.12, Transportation and Navigation; and Section 4.9, Subsistence, and supplements those sections as appropriate. For infectious diseases and non-communicable and chronic diseases, the baseline description focuses on the top several diseases in each category based on their public health significance and occurrence frequency. The sources of data cited also provide information on less prevalent diseases and conditions.

Health data are not always available at the community level for these potentially affected communities, due to privacy concerns and very small community sizes. To address these limitations, regional data sources in and near the EIS analysis area, including the LPB, Bristol Bay Borough, Dillingham Census Area, KPB, and Municipality of Anchorage, were included in

the evaluation. Of these, only Anchorage is considered an urbanized area, and while it is neither located geographically close to the project nor in the Bristol Bay drainages, it is likely that some project workers will come from this population. The other boroughs are considered remote, rural areas and are in or close to the EIS analysis area.

3.10.1.2 Demographic Summary of Potentially Affected Communities

The eight Iliamna Lake/Lake Clark communities and three Nushagak/Bristol Bay communities in or geographically closest to the project are generally comparable in median age and high school-level education rates to state averages, but lower in rates of college-level education and median income levels. With the exception of Port Alsworth, the individual communities in LPB and Dillingham Census Area are majority Alaska Native populations. Bristol Bay Borough, Kenai Peninsula, and Anchorage have closer correspondences with state-level trends, particularly Anchorage, with its much larger population. To provide context for the health assessment, a brief summary of the demographic data is presented in Table 3.10-2 for the 11 communities geographically closest to the project, as well as regional data. More detailed demographic information for these 11 communities, including seasonal impact on employment, top employment sectors, population changes, age range percentages, gender percentages, and housing, is presented in Section 3.3, Needs and Welfare of the People–Socioeconomics. The nine additional communities that were evaluated only for subsistence impacts are represented in the information provided for the larger areas in which they reside (Dillingham Census Area, Bristol Bay Borough, and KPB).

Table 3.10-2: Demographic Summary

Subject	Alaska Native[2] Population (2017)	White[1] Population (2017)	Median Age (2018)	High School Graduate or Higher (2018)	Earned College Degrees (2018)	Median Household Income (2018)	Unemploy-ment Rate (2018)
Lake and Peninsula Borough	67.6%	22.4%	32.3	88%	16%	$45,208	13.2%
Nondalton	73.6%	13.6%	31.8	85%	11%	$38,750	25.0%
Iliamna	75.4%	16.9%	34.8	97%	19%	$93,750	6.1%
Newhalen	82.5%	9.6%	25.3	90%	17%	$36,250	8.0%
Port Alsworth	10.2%	68.8%	18.9	99%	49%	$86,667	1.3%
Pedro Bay	50.0%	16.7%	57.3	100%	11%	$53,750	18.2%
Kokhanok	91.9%	8.1%	28.1	81%	8%	$41,250	30.8%
Igiugig	89.1%	10.9%	29.0	86%	21%	$48,750	0.0%
Levelock	97.9%	2.1%	24.5	83%	2%	$25,000	16.3%
Dillingham Census Area	72.9%	17.5%	30.1	86%	17%	$58,708	11.4%
Ekwok	100.0%	0.0%	28.3	69%	0%	$28,750	39.5%
Koliganek	82.9%	9.4%	26.6	83%	20%	$53,750	11.1%
New Stuyahok	97.3%	0.4%	24.8	78%	3%	$43,750	23.8%
Dillingham	56.5%	28.0%	31.6	91%	22%	$75,764	5.1%

Table 3.10-2: Demographic Summary

Subject	Alaska Native[2] Population (2017)	White[1] Population (2017)	Median Age (2018)	High School Graduate or Higher (2018)	Earned College Degrees (2018)	Median Household Income (2018)	Unemploy-ment Rate (2018)
Bristol Bay Borough	34.6%	52.0%	41.8	93%	20%	$79,500	6.8%
Kenai Peninsula Borough	7.3%	83.6%	40.6	93%	24%	$65,279	8.6%
Anchorage	7.3%	63.7%	33.1	93%	35%	$82,271	5.8%
State of Alaska	14.2%	65.3%	33.9	92%	29%	$76,114	7.7%

Notes:
-- = Not Available
[1] Alone, non-Hispanic.
[2] Alone or in combination with one or more other races.
See Section 3.3, Needs and Welfare of the People–Socioeconomics, for additional discussion and details.
Demographic and socioeconomic profiles of the affected communities are presented in McDowell 2011a; McDowell 2018a; in Section 3.3, Needs and Welfare of the People–Socioeconomics; and Section 3.4, Environmental Justice. The Alaska Native Health Status Report (ANTHC 2017a) presents recent state and regional overviews of sociodemographic highlights (e.g., demographics, education attainment, unemployment, poverty, and household income), as well as mortality highlights, morbidity highlights, and maternal, infant, and child health highlights.
Sources: USCB 2018

3.10.1.3 Baseline Community Health Conditions

Baseline conditions are defined as the current health status of the potentially affected communities, in the absence of or prior to the proposed project. Information for the 11 potentially affected communities geographically closest to the project and evaluated for all HECs is presented and compared to other local and regional data as warranted, and also compared to state or US data. Primary data sources include government, regional, community, and academic sources.[1] As noted earlier, the individual communities in the Dillingham Census Area, KPB, and Bristol Bay Borough that were evaluated only for subsistence impacts are not included here but are included in the respective borough-level data.

Although statewide data offers some context, the HEC discussions in this section are limited to health endpoints that have relevant and recent regional and local data available (older data are presented as warranted or if current data were not available). When available, local community data are representative of very small populations. Comparisons of statewide rates with local small population community rates should be interpreted with caution due to the statistical uncertainty associated with small populations and also because the statewide rates represent a mix of large and small population data. For regional rates based on fewer than 20 cases, they should also be viewed with caution because they may not be statistically reliable.

[1] Primary data sources include the Alaska Department of Commerce, Community, and Economic Development, Alaska Department of Environmental Conservation, Alaska Department of Fish and Game, ADHSS, Alaska Department of Labor and Workforce Department, Alaska Native Tribal Health Consortium, Alaska State Troopers, Bristol Bay Area Health Corporation, Bristol Bay Native Association, Cook Inlet Region, Inc. Foundation, Commercial Fisheries Entry Commission, US Department of Commerce, Bureau of Economic Analysis, US Census Bureau, US Centers for Disease Control and Prevention, US Department of Health and Human Services, World Health Organization, and other government, regional, community, and academic sources.

It is also important to recognize that communities and populations are composed of many sub-groups with different levels of health status, access to healthcare, and susceptibility to health impacts leading to disparities in health status. Age, gender, ethnicity, income level, education, and other factors greatly affect the health status of individuals and households.

3.10.1.4 Health Effects Categories

HEC 1: Social Determinants of Health

It is widely recognized that social and economic factors and access to healthcare have a strong causal relationship with health status (WHO 2018; ODPHP 2018). Factors such as income, education, isolation, and early access to healthcare are termed social determinants of health (SDH) because any changes in these factors, positive or negative, can lead to corresponding changes in the physical, mental, and social health of the population. Outcomes of SDH such as infant mortality, suicide rates, or dental health, serve as indicators of overall community health status and health needs. Any project-related impacts to the SDH of the affected communities, especially the small communities, may result in immediate and substantial impacts on key aspects of community health (e.g., increased income levels as a project benefit may make preventive healthcare more affordable and result in a drop in avoidable, serious health issues). Oral health is an important and commonly used health indicator by public health agencies such as the Centers for Disease Control and the ADHSS, as it represents both behavioral and structural risk factors.

The ADHSS Technical Guide (ADHSS 2015) suggests a broad list of SDH for consideration. For the purposes of this assessment, a limited subset of SDH representing a range of physical, mental, and social factors was selected, which covers a range of population sectors from infants to adults and has the most value as overall indicators of community health status. Physical metrics of SDH include life expectancy, adequate prenatal care, infant mortality, and oral health. Psychosocial metrics of SDH include teen pregnancy rates, adult mental health, suicide (overlaps with HEC 2), alcohol use, and binge drinking. Many of these SDH for the affected communities are evaluated in this EIS in Section 3.3, Needs and Welfare of the People–Socioeconomics. SDHs, such as isolation and cultural change, lack meaningful available data at the community level of health, but are addressed in a larger context in Section 3.7, Cultural Resources, and Section 3.9, Subsistence.

For those SDH not covered in Section 3.3, Needs and Welfare of the People–Socioeconomics, Table K3.10-1 in Appendix K3.10 summarizes the additional relevant SDH and important indicators for this HEC since they may potentially be impacted by the project. The Bristol Bay, Kenai Peninsula, and Anchorage regions have similar Alaska Native life expectancies to the state, but these rates are approximately 7 to 8 years lower than state and national life expectancies for whites (ANTHC 2017b). The Iliamna Lake/Lake Clark communities had rates of adequate prenatal care comparable to the urban Anchorage region. In comparison to these rates, the Nushagak/Bristol Bay communities, LPB, Dillingham Census Area, and Bristol Bay Borough all had higher rates of inadequate prenatal care, particularly the Nushagak/Bristol Bay communities (ANTHC 2016a; McDowell 2018b). The Nushagak/Bristol Bay communities and the Bristol Bay region had higher teen pregnancy rates than the Dillingham Census Area, the Kenai Peninsula, and Anchorage (ANTHC 2016c). With regard to oral health, the Bristol Bay, Kenai Peninsula, Anchorage, and state rates were all fairly similar for Alaska Natives, but they all had higher rates of tooth loss compared to Alaska Whites (ANTHC 2017c, 2017d).

Mental health is measured as self-reported stress, depression, and problems with emotions in the past 30 days (ANTHC 2017e; McDowell 2018b). Although the average statewide number of poor mental health days was 20 percent higher for Alaska Natives than Alaska Whites (ANTHC

2017e), the LPB, Dillingham Census Area, and Bristol Bay Borough all self-reported lower rates of poor mental health (all races) than state rates reported for all races, whites, and Alaska Natives (McDowell 2018b). Binge drinking is measured as self-reported adults aged 18 years of older who have had five or more drinks (men) or four or more drinks (women) on one or more occasions in the past 30 days (ANTHC 2017g) or in one sitting (McDowell 2018b). The LPB and Dillingham Census Area self-reported lower rates of binge drinking (all races) compared to state rates, while Bristol Bay Borough reported rates higher than the state (McDowell 2018b). While not exhaustive, these metrics indicate that some areas of health status where the rural communities are comparable to or better off than urban areas and some health needs where rural areas fare worse, and project-related activities may lead to improvement or further worsening, as discussed in Section 4.10, Health and Safety.

Overall, the affected communities whose health may be most impacted by the project in EIS analysis area (or may use the area for residence, subsistence, or recreation) are the remote, rural communities in the Bristol Bay Region (which includes the LPB, Bristol Bay Borough, and Dillingham Census Area) and Kenai Peninsula Region. The remote communities generally have lower levels of employment, income, formal educational attainment, and access to amenities than urban communities. While they are comparable to the larger urban areas in some areas of health, there are other areas such as alcohol consumption, where the rural areas may have higher health needs.

HEC 2: Accidents and Injuries

Accidents and injuries include both fatal and non-fatal incidents that are primarily unintentional and affect the mortality and morbidity rates of a community. Unintentional injury (e.g., falls, poisoning, drowning, and motor vehicle crashes) is the third leading cause of death in the state and a leading cause of death in most regions (ADHSS 2017a; ANTHC 2017i), including the Iliamna Lake/Lake Clark Communities, Dillingham Census Area, and Bristol Bay Borough (McDowell 2018b). Intentional incidents include homicide and suicide (note: suicide overlaps with HEC 1, psychosocial stress). An understanding of baseline rates of accidents and injuries is important in order to understand whether any aspects of the project could lead to changes in these parameters. For example, surface transportation elements of the project could alter the rates of motor vehicle and other land transport accidents.

Information regarding unintentional deaths and injuries, leading causes of hospitalization, and suicide rates was available for most of the regions in the EIS analysis area (see Table K3.10-2 in Appendix K3.10). In comparison to national and state rates, the levels of unintentional deaths and injuries in the potentially affected communities were higher. Overall, falls were the number one cause of hospitalizations in Alaska as well as the EIS analysis area regions, with the exception of Bristol Bay.

Vehicle incidents and causes related to land transport were ranked as the number one cause of hospitalization in Bristol Bay (other land transport), as number two (other land transport) in the LPB, and number two (other land transport) and number three (motor vehicle) in Dillingham Census Area. These rankings are similar to one another and to the State of Alaska overall, where vehicle accident hospitalizations are ranked as the number two (motor vehicle) and number four (other land transport) causes of hospitalization for the State of Alaska overall (ANTHC 2015, 2017c, 2017j; McDowell Group 2018b). Baseline data for other transportation accident types (e.g., ferry, barge, air) were not readily available, which may be due to low number of occurrences as none are listed as leading causes of hospitalizations. Numeric data on rates or numbers of accidents by cause or type of transportation were not readily available.

Suicide mortality rates varied by region, but was the fourth leading cause of death among Alaska Native people during the period from 2012 to 2015 (ANTHC 2017f). Suicide mortality rates for the Dillingham Census area, Anchorage, and state are similar. In comparison to the Dillingham Census Area, Anchorage, and the state, Bristol Bay regional rates are higher, and Kenai Peninsula regional rates are lower (ANTHC 2017f; McDowell 2018b). However, due to the low number of documented suicide mortality cases in the Dillingham Census Area, Bristol Bay region, and Kenai Peninsula region, these rates may not be statistically reliable and should be viewed with caution.

HEC 3: Exposure to Potentially Hazardous Materials

Environmental exposure to hazardous chemicals through the air, land, or water is also considered a health determinant. Baseline data may be qualitative in terms of proximity to known contamination sources, or quantitative through analytical data collection (e.g., water quality data, soil analytical data). Overall, baseline conditions of exposure to potentially hazardous chemicals may include the occurrence of localized poor air quality in some areas due to outdoor dust or indoor air pollution, as well as elevated levels of a few naturally occurring metals in soils, surface waters, groundwater, and some food sources.

Air Quality. The role of poor air quality on community health, particularly with regard to respiratory disorders, has been well-documented (WHO 2016). Air pollutant concentrations that are lower than the Alaska Ambient Air Quality Standards (AAAQS) provide public health protection, including protecting the health of sensitive populations such as asthmatics, children, and the elderly. Section 3.20, Air Quality, presents background concentrations for criteria pollutants for each project component that are representative of the ambient environment and include the contributions from nearby and other background sources. This background air quality data is sufficient for establishing baseline EIS analysis area conditions for NEPA purposes. All measured criteria air pollutants in the region containing the project are below AAAQS. The project is far from any potential sources of lead (e.g., airfields), and, absent large regional anthropogenic sources, there is no reason to expect measureable concentrations of hazardous air pollutants in the project area except for what is biogenic in nature (see Section 3.20, Air Quality).

Burning trash, generating power using diesel generators, and heating homes using wood stoves are possible practices within the potentially affected communities in the EIS analysis area that could contribute to localized poor air quality indoors and outdoors. Unpaved roads are a major source of dust and may circulate pollutants in dust, which affects air quality and may also settle on food sources. There are also indoor air quality issues with the use of old wood and fuel oil burning stoves, which may be made worse by spending a lot of time indoors in winter.

Water Quality. The baseline water quality data is provided in Section 3.18, Water and Sediment Quality. The baseline surface water data were obtained from the waterbodies in the EIS analysis area that would be most affected by project activities including: North Fork Koktuli, South Fork Koktuli, Upper Talarik Creek, Frying Pan Lake, Iliamna Lake, and surface water data along the western and eastern parts of the north access route of the transportation corridor. Baseline surface water resources in the vicinity of the mine site and Alternatives 2 and 3 transportation corridors had numerous detections of naturally occurring trace elements/metals, but only a few mean concentrations exceeded the selected applicable State of Alaska water quality standards (WQS) protective for all designated water uses (most stringent of human health and ecological criteria, including drinking water supply and household use): aluminum in the west portion of the north access road, and aluminum and copper in the east portion of the north access road. While cyanide was only occasionally present in detectable concentrations,

none of the mean concentrations were above the WQS. See Section 3.18, Water and Sediment Quality and Appendix K3.18, for further details on water quality criteria.

The baseline groundwater data were obtained from individual wells along the watershed within each lithologic group located in and outside the Pebble deposit area. Baseline groundwater had numerous detections of naturally occurring trace elements/metals, with mean concentrations of aluminum, copper, iron, lead, manganese, molybdenum, and zinc exceeding the most stringent of either drinking water standards or WQS for aquatic life criteria, since groundwater could discharge to surface waterbodies. For further details see Section 3.18, Water and Sediment Quality. Several community drinking water wells are located along the transportation corridors: Nondalton City Well, Newhalen Public Well #2, Iliamna Weathered Inn Well, and the Pedro Bay Tribal Council Well. Arsenic was reported as above drinking water standards in the Nondalton, Newhalen, and Pedro Bay wells, while pH was reported above drinking water standards in the Newhalen, Pedro Bay, and Iliamna wells. Arsenic is a naturally occurring element in rock and soil, and often present in trace amounts in groundwater. Concentrations of arsenic in groundwater are generally associated with volcanic deposits and gold-mining areas, and high concentrations of arsenic in groundwater are largely the result of arsenic-containing minerals (e.g., iron-sulfide and copper-sulfide minerals) dissolving naturally over time from weathered rock and soils.

Existing Potentially Hazardous Materials Sites. There are numerous known contaminated sites in the EIS analysis area that are under federal or state agency oversight. The following summarizes the number of open Alaska Department of Environmental Conservation (ADEC) regulated contaminated sites listed for each of the boroughs in and within the vicinity of the EIS analysis area on ADEC's contaminated sites database, as of March 2018 (ADEC 2018d):

- Lake and Peninsula Borough – 30 open sites
- Bristol Bay Borough – 60 open sites
- Dillingham Census Area – 25 open sites
- Kenai Peninsula – 130 open sites

In addition, there are four US Environmental Protection Agency (EPA) Comprehensive Environmental Response, Compensation, and Liability Act sites in Anchorage (EPA 2018a), as well as US Army Corps of Engineers (USACE) formerly used defense sites in the LPB (four sites) and the KPB (10 sites). Contaminants of concern from these sites include, but are not limited to: metals, asbestos, polychlorinated biphenyls, petroleum hydrocarbons (e.g., fuel, lubricants), pesticides, and solvents. All these sites are under active oversight by government agencies, and agency directives are expected to control or prevent exposure to the general public. Therefore, the proximity of these sites is not expected to contribute to the baseline exposure to hazardous materials.

Potentially Hazardous Materials Exposure through Subsistence. People may be exposed to chemicals in food sources through food-web transfer (i.e., chemicals accumulated by fish, wildlife or edible plants). The accumulation of chemicals in biological tissues is called bioaccumulation; increasingly higher concentrations of chemicals at higher levels of the food-web is called biomagnification. However, not all chemicals have the propensity to bioaccumulate or biomagnify. Examples of metals that may bioaccumulate to some degree include arsenic, lead, and mercury, while mercury also can biomagnify.

In the EIS analysis area, baseline trace element (metal) data were collected for soil, vegetation, and fish tissue, as well as sediment and surface water, and are provided and discussed in Section 3.14, Soils; Section 3.26, Vegetation; Section 3.24, Fish Values; and Section 3.18, Water and Sediment Quality. Exposure to these trace elements/metals from these media,

resources, and from ambient air may have the potential to impact human health from direct exposure, including inhalation, or through dietary exposure, including the potential for some of these trace metals to bioaccumulate in tissue. Bioaccumulation can occur either from the direct exposure pathway (i.e., inhalation of metals in air or dust) or from the dietary pathway (e.g., metals may bioaccumulate and biomagnify in wildlife and fish, which may then be consumed by subsistence users). In addition, exposure to infants can occur through maternal transfer of dietary metals. Exposure to these trace elements through direct and dietary exposure represents baseline hazardous exposure potential for the potentially affected communities in the EIS analysis area.

HEC 4: Food, Nutrition, and Subsistence Activity

The role of adequate and high-quality food and nutrition is of paramount importance to health. In Alaska, subsistence activities greatly contribute to community nutrition to provide dietary items such as fish, game, and berries that are highly nutritious, and also support cultural and social cohesion (ANHB 2004). The level of physical activity involved in harvesting subsistence foods also contributes to a more active lifestyle and confers additional health benefits (overlaps with HEC 7 as low physical activity is considered a chronic disease contributing factor). Thus, subsistence activities and nutrition play a large role in the physical and social health of communities; changes to these dietary habits and food security may lead to changes in health. For example, if the footprint of a project has a substantial overlap with traditional hunting or fishing areas such that people's access to these resources is reduced or subsistence users avoid harvesting resources near regional extractive industrial developments due to concerns (whether real or perceived), this may lead to changes in subsistence harvesting patterns and dietary composition, such as reduced fishing or hunting activity and the purchase of lower-quality, processed foods. The health consequences may include a more sedentary lifestyle along with lower nutritional health status. Conversely, positive impacts may also occur if increased income from increased employment allows food-insecure households to purchase more equipment for subsistence harvesting or to purchase more nutritious food.

As discussed in Section 3.3, Needs and Welfare of the People–Socioeconomics, the cost of living in Alaska is higher than the national average, with Alaska ranked as the third most expensive state nationally, based on costs of living in the four largest Alaskan cities, including Anchorage. However, the price of food in Alaska is even higher in small rural communities that are not connected to the Alaska main road system. In some communities, staple goods, such as food and fuel, cost over twice as much as they do in Anchorage because the items need to be transported by barge or air. For example, during an August 2018 visit to Iliamna, the price of a half-gallon of whole milk was $13.49, which is equivalent to $27 a gallon, and is nearly nine times the 2017 national average price of $3.16 (Statistica 2018). For additional discussion, see Section 3.3, Needs and Welfare of the People–Socioeconomics.

While the cost of living can be high in rural communities, it can be offset by subsistence hunting and fishing to supplement the needs of families and communities. Subsistence activities are a central feature of Alaska Native history and society, support healthy diet and nutrition, and are an important aspect of preserving cultural heritage and mental health. Subsistence foods are vital in small rural communities, often the basis of many local economies. These foods are important for food security due to high cost of living/food in the region, and are widely recognized as healthier than market food options. Subsistence foods include salmon, shellfish, game and wildlife (e.g., moose and caribou), and plants and berries. Section 3.9, Subsistence, provides subsistence harvest activity details for each of the potentially affected communities. A large proportion of households in the EIS analysis area participates in subsistence activities and depend on the wild food resources procured by hunting and fishing (see Section 3.9,

Subsistence). As shown in Table K3.10-3 in Appendix K3.10, the LPB, Dillingham Census Area, and Bristol Bay Borough report a higher subsistence lifestyle (approximately 2.5 times) than Alaska's population overall (McDowell 2018b). These subsistence lifestyle rates corresponds with LPB and Bristol Bay Borough self-reporting higher percentages of physical activity compared to Alaska overall, but does not correlate with the Dillingham Census Area, which was only slightly above Alaska overall (McDowell 2018b; see Table K3.10-5 in Appendix K3.10). However, this may be due to how the baseline data for the communities was measured, since subsistence lifestyle and physical activity were both self-reported beliefs defined by the respondent.

Percentages of nutritional intake and weight are similar between LPB, the Dillingham Census Area, Bristol Bay Borough, and Alaska, with some noted differences (McDowell 2018b). Table K3.10-3 in Appendix K3.10 presents nutritional baseline data, while overweight/obese baseline data is presented in Table K3.10-5 in Appendix K3.10 (weight overlaps with HEC 7, as it is considered a chronic disease contributing factor). Bristol Bay Borough is, self-reported, more likely to be overweight/obese according to body mass index and eat less than five daily servings of fruits and vegetables compared to Alaska overall; while Dillingham Census Area self-reports a higher percentage of adults who consume one or more sugar-sweetened beverage or soda per day (not including 100 percent juice or artificially sweetened drinks) compared to Alaska overall (McDowell 2018b).

Poverty levels and rates of malnutrition, as well as cost of living/food and access to, quantity and quality of subsistence resources have the potential to impact food security. Food security is defined by the US Department of Agriculture (USDA) as, "access by all people at all times to enough food for an active, healthy life" (ADF&G 2018r). Food security data, as collected by the Alaska Department of Fish and Game (ADF&G), include subsistence foods as well as store-bought foods. As shown in Table K3.10-3 in Appendix K3.10, the potentially affected communities in the LPB had percentages of families with incomes below the federal poverty level threshold[2] (2012-2016) ranging from 28.6 percent (Kokhanok) to 0 percent (Igiugig and Pedro Bay); while those in the Dillingham Census Area ranged from 28.1 percent (New Stuyahok) to 5.7 percent (Koliganek). Overall, approximately 15 percent of both LPB families and Dillingham Census Area and just 4 percent of Bristol Bay Borough families fell below the federal poverty level threshold (McDowell 2018a). These borough/census area rates are lower than those living below the poverty level threshold for Alaska Natives statewide and fairly similar to national whites (2011-2015) (ANTHC 2017a).

Subsistence activities remain an important food source for a large proportion of households in the EIS analysis area reporting using and harvesting (Section 3.9, Subsistence), although it is difficult to quantify how variability in subsistence activities would influence food security. Although subsistence frequently involves no monetary exchange, the contribution of food procured by hunting and fishing can be a significant contributor to household and community welfare (see Section 3.3, Needs and Welfare of the People–Socioeconomics).

HECs of Low Relevance

As noted earlier, the relevance to the project of the remaining HECs outlined in the HIA toolkit is expected to be low. These include Infectious Diseases (HEC 5), Water and Sanitation (HEC 6), Non-communicable and Chronic Diseases (HEC 7), and Healthcare Services and Infrastructure (HEC 8). These issues may be addressed by planned project programs and measures or fall

[2] The federal poverty threshold is updated for inflation, but does not vary geographically, and is based on pre-tax income (ANTHC 2017a).

outside the project activity footprint. Therefore, they are briefly summarized; details are included in Appendix K3.10.

HEC 5: Infectious Diseases

HEC 5 evaluates the role of infectious diseases in the health, mortality, and morbidity of populations. Appendix K3.10 and Table K3.10-4 provide details on leading infectious disease rates for the EIS analysis area community regions, when available, and the state of Alaska, as well as childhood immunization rates. Overall, reportable infectious diseases (influenza and pneumonia) were the tenth leading cause of death to all races in Alaska (ADHSS 2017a), but regional rates were not readily available. Regional Alaska Native rates of sexually transmitted infections (as represented by chlamydia and gonorrhea) are comparable to or lower than state Alaska Native rates, while the more urban Anchorage region has rates higher than the state average (ANTHC 2017k, 2017l).

HEC 6: Water and Sanitation

HEC 6 evaluates water and sanitation for the potentially affected communities because the lack of safe water supply (i.e., running water) and suitable sewage disposal can represent a major public health and community development problem. Appendix K3.10 provides details on water and sanitation for the EIS analysis area community regions. In the Bristol Bay Region (which includes Bristol Bay Borough, the Dillingham Census Area, and LPB), 99 percent of households had water and sewer services; while in the Kenai Peninsula, service was 100 percent (ANTHC 2017n).

HEC 7: Non-Communicable and Chronic Disease

Since non-communicable and chronic diseases can consume a large part of healthcare resources and affect the overall health status of a population, HEC 7 evaluates the incidence of such diseases but in the context of evaluating an individual project, it may be difficult to attribute a single project-related cause to changes in disease incidence. Appendix K3.10 and Table K3.10-5 provide details on non-communicable and chronic diseases for the EIS analysis area communities and regions, as well as chronic disease contributing factors. Overall, Iliamna Lake/Lake Clark, Nushagak/Bristol Bay communities, Anchorage, and the state have similar leading causes of death (cancer and heart disease) and similar cancer death rates, with the exception of higher rates in Iliamna Lake/Lake Clark communities (McDowell 2018b; ADHSS 2017a; ANTHC 2017a, 2017i, 2017o). Heart disease rates in the Iliamna Lake/Lake Clark communities and Nushagak/Bristol Bay communities were higher than both Anchorage and state rates (McDowell 2018b; ADHSS 2017a; ANTHC 2017a, 2017i, 2017p).

HEC 8: Health Services Infrastructure and Capacity

An important measure of the health-related resilience and support structure of a community is the quality and quantity of healthcare that is available to the residents. HEC 8 evaluates potential impacts to the capacity of existing healthcare services. Appendix K3.10 and Table K3.10-6 provide details on health services, hospitalizations, and adequacy of health services in the EIS analysis area. Overall, LPB, Bristol Bay Borough, and the Dillingham Census Area report lower or similar access to health services (McDowell 2018b). Although there are some variations in the top three leading causes of hospitalizations by year and region, pregnancy/childbirth and newborn/neonate complications of pregnancy and childbirth or newborn/neonate conditions are consistently leading causes. The LPB, the Dillingham Census Area, Bristol Bay Borough, Kenai Peninsula, and Anchorage are all designated as Medically Underserved Area/Population.

3.10.2 Safety

Safety, as defined by compliance with OSHA and MSHA regulations, or other types of design, structural, operational, and accident or hazard prevention programs cannot be described for the EIS analysis area under baseline conditions, as there is no project activity. Safety is discussed with reference to the project, in Section 4.10, Health and Safety.

This page intentionally left blank.

3.11 AESTHETICS RESOURCES

This section describes the existing conditions against which the potential effects of a project will be assessed, pertinent regulatory and management framework, and information about the regional and project landscape. Aesthetics can refer to the perception of beauty by one or a combination of the senses, and can apply to the quality of life enjoyed by the general public and property owners (40 Code of Federal Regulation [CFR] Part 230.53). As such, aesthetic attributes addressed in this assessment focus on perceptual elements of visual environment (including the night sky), soundscape, and olfactory elements (i.e., smell). Because visual and olfactory attributes are difficult to measure, they are addressed qualitatively.

3.11.1 Environmental Impact Statement Analysis Area

The Environmental Impact Statement (EIS) analysis area for aesthetic resources extends westward from Happy Valley on the Kenai Peninsula and the Bristol Bay and Cook Inlet drainages to the eastern side of the Iniskin Peninsula, encompassing Iliamna Lake and the surrounding communities. For each alternative, the EIS analysis area includes a:

- 50-mile radius from the mine site (70-mile radius for night sky impacts)
- 10-mile radius from the ferry terminals (25-mile radius for night sky impacts)
- 20-mile buffer from the transportation corridor and natural gas pipeline (night sky impacts not assessed)
- 25-mile radius around the ports, including night sky impacts, considered in each action alternative

For visual impacts, these distances (radii) were selected based on the relationship between distance, scale, and anticipated visibility. Visual contrast created by the project is directly related to its size and scale as compared to the surroundings in which it is placed; as such, larger scale actions (such as the mine site) would be more visible. Likewise, visual contrast decreases as viewing distance increases (BLM 1986). These radii (distances) thus represent the maximum distance at which these actions are expected to be detectable to the viewer, based on the scale of each specific project component.

The visibility of night lighting may extend beyond that which is visible under daylight conditions and is estimated at a maximum of 70 miles for the mine site (similar to the skyglow effects from Anchorage) and 25 miles for the ferry terminals and ports (similar to skyglow effects from Valdez). These distances are the maximum distance that changes to night sky due to skyglow are assumed to begin to occur for the purposes of this analysis. These distances were estimated using data from the New World Atlas of Artificial Night Sky Brightness (Falchi et al. 2016a, 2016b), which provides artificial sky brightness for the entire world using high-resolution satellite data. The city of Valdez is larger than the ports and ferry terminals and includes more night time lighting (large ferry terminal and harbor, lighting associated with the town) than would be expected for the project ports and ferry terminals. Therefore; night sky impacts from the ports and ferry terminals are considered conservative and would likely be of lesser magnitude than those estimated using city of Valdez data. However; based on data from the New World Atlas of Artificial Night Sky Brightness, data from the city of Valdez was the best available to represent similar geographic conditions to the ports ferry terminals without underestimating impacts. Night sky impacts are not evaluated from the transportation corridor and natural gas pipeline as no night lighting would be anticipated.

3.11.2 Methods for Establishing Baseline Conditions

Baseline visual resource conditions were established by: 1) implementing a viewshed analysis to determine locations where the project could be visible (i.e., seen areas); 2) completing a regulatory and management review; 3) assessing landscape character attributes, viewer groups and related visual sensitivity, and visual distance zones (visibility) in the EIS analysis area; 4) estimating night sky conditions based on data available from the New World Atlas of Artificial Night Sky Brightness (Falchi et al. 2016a, 2016b) and National Park Service (NPS) monitoring data for one location in Lake Clark National Park and Preserve (NPS 2013b); and 5) assessing baseline soundscape. These methods are consistent with procedures identified in the "Guide To Evaluating Visual Impact Assessments for Renewable Energy Projects" (NPS 2014b).

3.11.2.1 Viewshed Analysis

Locations from which the project could be seen in the EIS analysis area were determined by implementing a viewshed analysis using geographic information system (GIS) viewshed modeling. This analysis determines potential project visibility based on the relationship between topography, height of project components, average eye height of the viewer, and height of vegetation. The resulting "seen area" represents an area, or locations on the landscape, where proposed project features may be visible. However, it does not represent any measure of detectability of these features, or level of impact to aesthetic quality. This information informed the analysis of project visibility, including scale dominance and contrast described in Section 4.11, Aesthetics.

Viewshed analyses were developed for Alternatives 1, 2, and 3 by the Pebble Limited Partnership (PLP) (PLP 2018-RFI 034a, PLP 2018-RFI 034c) and used to form the basis of analysis in Section 4.11, Aesthetics (Figure 3.11-1). Models were developed using assumptions of bare earth and vegetation (i.e., considering the potential screening effects of vegetation) for Alternative 1, and bare earth only for Alternatives 2 and 3, at a viewer height of 5 feet 5 inches. Bare earth was used for Alternatives 2 and 3 as a conservative approach, with screening attributes of vegetation considered qualitatively based on results of Alternative 1 viewsheds.

The resulting viewshed was clipped to buffer distances for each component specified by the EIS analysis area. The completed viewshed analyses can be found in Appendix K4.11.

3.11.2.2 Landscape Character

Landscape Character: Landscape character attributes were assessed by first dividing the EIS analysis area into geographic units defined by prevailing physiography (Wahrhaftig 1965), then assessing landscape character in each geographic unit. Landscape character attributes were described in terms of landscape character typology; the basic elements of form, line, color, and texture of prevailing landform, water, vegetation, and cultural modification. This approach was applied across the analysis area to ensure that baseline data in visual resources were collected consistently across the EIS analysis area.

Viewer Groups: Viewer groups were identified through coordination with recreation, cultural, and subsistence resources, as well as review of scoping comments. These sources were used to understand how specific locations in the EIS analysis area are used, and the types of viewer groups that may be associated with those uses. Characteristics of identified viewer groups, such as seasonality, amount of use, and predominant viewer activity were included in this inventory.

There is seasonal variation in the number and type of viewers in the EIS analysis area. According to Section 3.5, Recreation, a majority of visitors come to experience the "naturalness," and "abundance of resources," from May through October. This seasonal access

corresponds with fishing and hunting activities and is the high season for recreation, tourism, and subsistence activities. Access to fishing and hunting grounds for recreation and subsistence use is from air travel, boat, and all-terrain vehicles (ATVs).

Although the majority of recreation and tourism occurs in the summer, ongoing subsistence activity and inter-village travel occur in the winter. As the wet grounds and waters freeze, travel via snowmachine provides access to areas not available in the warmer seasons. Commercial activities consist of fisheries, recreation, and tourism.

Commercial recreation fishing lodges and camps are located on the Kvichak and Alagnak rivers. Several lodges on the main stem of the Alagnak, at the outlet of Nonvianuk Lake, and one on the Kulik River, provide guided fishing services. Together these lodges support the majority of the visitation for fishing in the area. Access to the fishing lodges and camps is through aircraft or motorized boat. The elevated position from an aircraft provides a contextual experience, allowing the viewer to see broad expanses of the landscape.

Viewer Platforms: Viewer platforms are considered those locations where individuals are likely to experience views of the landscape in EIS analysis area. Viewers in the EIS analysis area include local residents and communities, as well as those engaging in subsistence activities, recreationists, and travellers.

- **Local Communities.** Local communities are located throughout the EIS analysis area. Communities along the shoreline of Iliamna Lake consist of Iliamna, Newhalen, Pedro Bay, Kokhanok, and Igiugig. To the north, at the edge of Lake Clark National Park and Preserve, is the community of Nondalton. The landscape is dominated by vast panoramic views of Iliamna Lake, with a backdrop of the mountains of the Big River Hills.
- **Subsistence Areas.** See Section 3.9, Subsistence, for subsistence activity locations. Summer access to these areas is primarily by boat, aircraft, and ATV, while in winter travel predominantly follows the frozen rivers and landscapes by snowmachine. Air travel is also prevalent throughout the year.
- **Recreation Areas.** Recreation extends from the fishing camps along Iliamna Lake into Lake Clark National Park and Preserve, Katmai National Park and Preserve, and up the Koktuli River Watershed and into the tundra of the Big River Hills. Outfitters provide guide service from fishing and hunting camps to remote locations in the Big River Hills and fishing areas on Iliamna Lake and Kamishak Bay in the Cook Inlet. The McNeil River State Game Sanctuary and Refuge receive annual visitors as well.
- **Transportation Routes.** Several transportation routes used by industry, local communities, and subsistence and recreation users are limited to air travel, boat, ATV, and snowmachine. Short unimproved roads connect the communities of Newhalen and Iliamna to Nondalton in the winter, although in the summer that route involves an impassable river crossing. In the winter, there are transportation routes across Iliamna Lake or along its shores between the lake communities. See Section 3.12, Transportation and Navigation, for information on existing land, air and water transportation routes.
- **Air Travel**. Low-altitude local aircraft may fly over the project area during scheduled air service or in route to remote communities or hunting/fishing destinations.

Distance Zone: Project visibility, or distance zones, was assessed by subdividing into three zones based on relative distance from travel routes (land or water-based) or observation points. Common travel routes included common commercial flight paths and common local flight paths. Distance zones were classified as:

- Foreground (i.e., 0 to 0.5 mile from view point)
- Middleground (i.e., 0.5 mile to 5 miles)
- Background (i.e., over 5 miles)

3.11.2.3 Key Observation Points

Key Observation Points (KOPs) representing common and/or sensitive viewer locations were established in the EIS analysis area. These locations represent point-based (e.g., vistas and residential areas), linear (e.g., roadways), and area-based (e.g., subsistence or recreation use areas) viewer locations. The KOPs were used as standard locations from which to describe existing visual resources at a localized scale, and to assess potential effects that may result from the project. A total of 12 KOPs were identified for use in the analysis as described in Table 3.11-1 and shown in Figure 3.11-1.

3.11.2.4 Night Sky

The night sky is a combination of both natural and human-caused sources of light. Natural light sources include moonlight, starlight from individual stars and planets, the Milky Way, zodiacal light (i.e., sunlight reflected off dust particles in the solar system), the aurora borealis, fire, lightning, meteors, and airglow. Airglow is caused by radiation striking air molecules in the upper atmosphere and appears similar to a faint aurora (NPS 2016f). Artificial lighting increases the night sky's brightness, an effect known as artificial skyglow. Artificial skyglow can affect the night sky for large distances and for that reason is the most visible effect of light pollution (Falchi et al. 2016a).

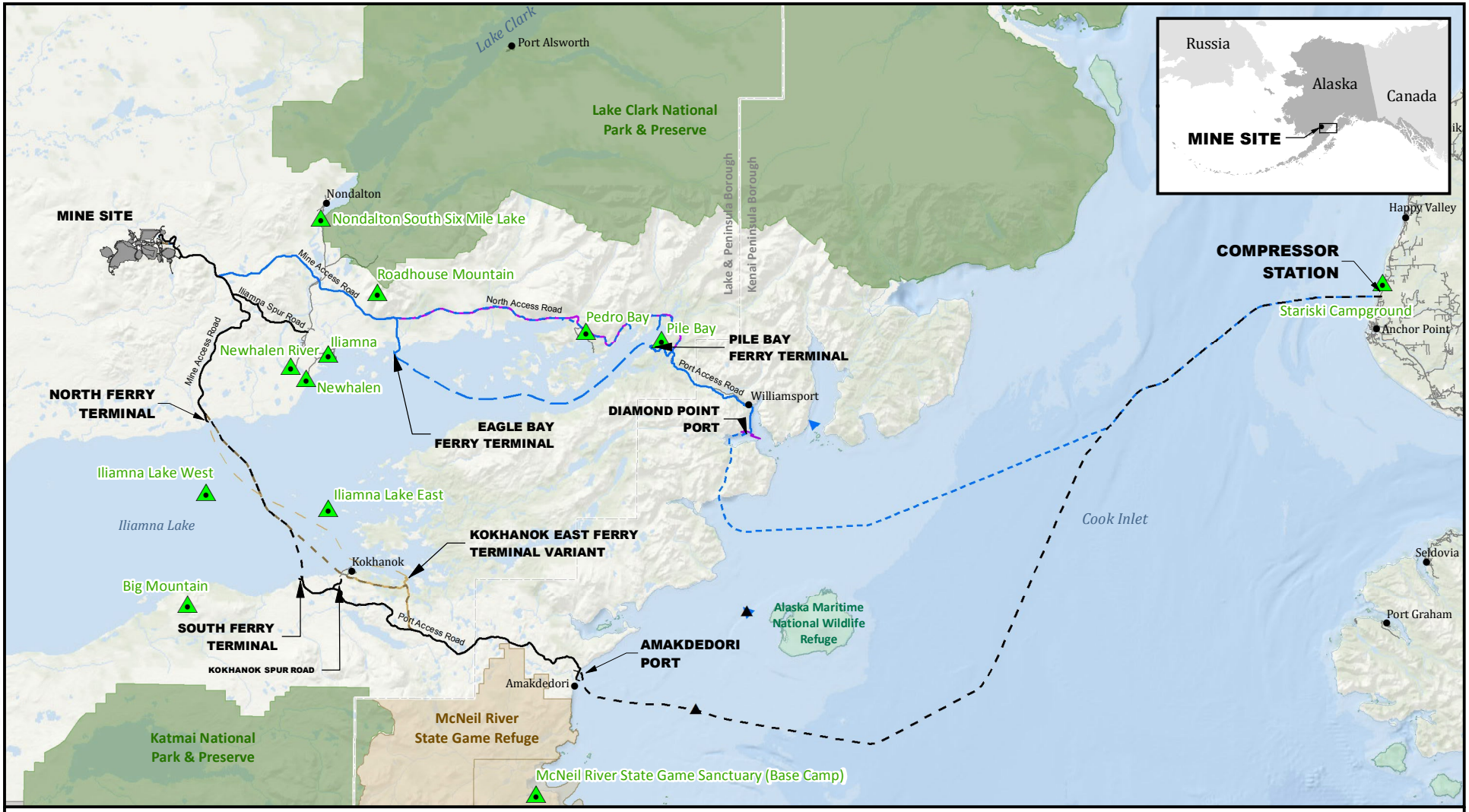
The existing quality of the night sky for the EIS analysis area is estimated based on data from the New World Atlas of Artificial Night Sky Brightness (Falchi et al. 2016a, 2016b) and NPS night sky monitoring report at Keyes Point near the northern shore of Lake Clark in Lake Clark National Park and Preserve (NPS 2013b). The New World Atlas of Artificial Night Sky Brightness shows light pollution as the ratio of artificial sky brightness to natural brightness. For areas protected for scenic or wilderness character, a ratio of 1 to 2 percent indicates areas where attention should be given to protect a site from future increases in light pollution (Falchi et al. 2016a). A ratio of 8 to 16 percent is considered polluted on an astronomical point of view, meaning observations of astronomical features begin to be affected. The NPS (2013b) monitoring report includes photographs, which depict artificial night glow as well as monitoring data and narrative including the Bortle Class based on the Bortle Dark-Sky Scale as reported by the NPS observers. The Bortle Dark-Sky Scale is a nine-step scale used to rate sky conditions at an observation site with Class 1 indicating an excellent dark-sky site and Class 9 indicating an inner-city sky (Bortle 2001). Data from these two sources was used to estimate existing night sky quality in the EIS analysis area.

Table 3.11-1. Key Observation Points

KOP Number	Location	KOP Type	Viewer Group	Viewer Sensitivity	Project Component	Distance Zone	Viewer Geometry	Viewer Activity
1	Stariski Campground	Point	Recreationists; Tourists	High	compressor station; Amakdedori port	Foreground/ Middle ground	At Grade	Stationary
2	McNeil River State Game Sanctuary (Base Camp)	Area	Recreationists; Tourists	High	Amakdedori port; transportation corridor	Middleground	At Grade	Stationary - Transient
3	Iliamna Lake West	Area	Residents; Subsistence Users; Tourists	Moderate-High	north ferry terminal; transportation corridor	Foreground to Background	At Grade; Inferior	Stationary - Transient
4	Iliamna Lake East	Area	Residents; Subsistence Users	Moderate-High	south ferry terminal; transportation corridor	Foreground to Background	At Grade; Inferior	Stationary - Transient
5	Newhalen River	Linear	Residents; Subsistence Users; Recreationists; Tourists	High	mine site; transportation corridor	Background	At Grade	Transient
6	Roadhouse Mountain	Point	Recreationists; Subsistence Users	Moderate	mine site; transportation corridor	Middleground; Background	Superior	Stationary
7	Big Mountain	Point	Recreationists; Subsistence Users	Moderate	mine site; transportation corridor	Middleground; Background	Superior	Stationary
8	Nondalton South	Point	Residents	High	mine site; transportation corridor	Background	At Grade; Inferior	Stationary - Transient
9	Iliamna	Point	Residents	High	transportation corridor	Middle ground	At Grade	Stationary
10	Newhalen	Point	Residents	High	transportation corridor[1]	Background	At Grade	Stationary
11	Pedro Bay	Point	Residents	High	transportation corridor[1]	Foreground	At Grade	Stationary
12	Pile Bay	Point	Residents	High	transportation corridor[1]	Foreground	At Grade	Stationary

Notes:

KOP pertains specifically to Alternative 2 and 3



Sources: PLP 2018; ADNR

US Army Corps of Engineers

5 0 5 10
Miles

Alternative 1
- Key Observation Points
- Lightering Locations
- Mine Site
- Transportation Corridor
- Natural Gas Pipeline
- Ferry/Port Site
- Ferry Terminal

Kokhanok East Ferry Terminal Variant
- Transportation Corridor
- Ferry Route
- Natural Gas Pipeline

Alternative 2
- Transportation Corridor
- Ferry Route
- Ferry Site

Alternative 2/3
- Lightering Location
- Natural Gas Pipeline
- Port Site

Alternative 3
- Transportation Corridor

Other Features
- Local Roads
- Borough Boundary
- National Park
- National Wildlife Refuge
- State Game Refuge/Sanctuary

KEY OBSERVATION POINTS

PEBBLE PROJECT EIS

FIGURE 3.11-1

3.11.2.5 Soundscape

Information on soundscape was derived from applicable noise and vibration concepts and methodologies used in characterizing noise of the affected environment (AECOM 2018c) (see Section 3.19, Noise). The ambient sound level, or soundscape, is a composite of sound from all sources, including the natural background and anthropogenic sources. Existing ambient sound levels are often the starting point for analyzing project-associated noise impacts, because such environmental noise analysis typically compares project-associated noise to either existing ambient or natural background sound, based on applicable adverse effect or impact assessment criteria. Existing ambient sound was evaluated for the EIS analysis area, including the mine, port, transportation corridor, and natural gas pipeline corridor for each alternative and variants, as well as the surrounding area where project-associated noise could have a direct effect on human receptors.

3.11.3 Regulatory and Management Framework

The regulatory and management framework review included federal, state, and local planning documents for planning areas with geographic nexus to the project area. The review focused on identifying specific regulations or planning objectives pertaining to visual resources or scenery management.

3.11.3.1 Federal

Per 33 CFR Part 320.4, applications for Department of the Army permits may involve areas that possess recognized scenic, conservation, or recreational values. Full evaluation of the general public interest requires that due consideration be given to the effect which the proposed activity may have on values such as those associated with wild and scenic rivers, national rivers, national parks, estuarine and marine sanctuaries, and such other areas that may be established under federal or state law for similar and related purposes. Recognition of those values is often reflected by state, regional, or local land use classifications, or by similar federal controls or policies. Action on permit applications should, be consistent with and avoid adverse effects on the values or purposes for which those classifications, controls, or policies were established. Additional policies specifically applicable to certain types of activities are identified in 33 CFR Parts 321 through 324.

3.11.3.2 State

The project area is located in the Alaska Department of Natural Resources (ADNR) Bristol Bay and Kenai planning units. These areas are managed per the Bristol Bay Area Plan (ADNR 2013a) and the Kenai Area Plan (ADNR 2001), respectively, to “maintain the quality and diversity of the natural environment and protect heritage resources and the character and lifestyle of the community.”

The EIS analysis area also takes into account lands owned by seven Alaska Native Claims Settlement Act (ANSCA) corporations. ANSCA does not provide provisions for the protection or management of visual resources; however, individual landowners may implement such management policies.

3.11.4 Landscape Character

The landscape setting in the visual resources EIS analysis area includes mountain ranges surrounded by river valleys, rivers, shrub tundra, marshy lowlands, wetlands, coastal shoreline, estuaries, and ocean inlet environments. Primary river drainages intersecting the EIS analysis area include the Mulchatna, the Nushagak, and Koktuli rivers. The waterways provide access to

remote recreation and subsistence use areas. Human development in the EIS analysis area is generally limited to areas in and around geographically isolated communities and small fishing and hunting lodges. Development includes roads, airstrips, docks, houses, schools, community centers, and other structures in the communities.

3.11.4.1 Regional

The visual resources EIS analysis area falls within portions of four different physiographic units: Nushagak-Big Hills, Nushagak-Bristol Bay Lowland, Aleutian Range, and Alaska Range (Wahrhaftig 1965). The landscape character of each physiographic unit is influenced by the fluvial geomorphologic, hydrologic, vegetation cover, elevation, and landforms.

The **Nushagak-Big River Hills** are characterized by flat-topped ridges ranging in elevation from 1,500 feet to the west, 2,500 feet to the east, and 4,200 feet to the north. The Big River Hills unit drains to the Kuskokwim River from primary tributaries. The southern section of the physiographic unit drains to the Mulchatna and Nushagak rivers. Vegetation communities consist of spruce, birch, and cottonwoods along riparian corridors (Shacklette et al. 1969; ADNR 2005).

The **Nushagak-Bristol Bay Lowland** is dotted with moraine lakes rising from sea-level to an altitude of 300 to 500 feet at its high point. Linear narrow belts of elevated topography enclose large glacial lakes fed by upland hydrology. The lowland is drained by the Nushagak River and other rivers flowing to the estuaries of Bristol Bay. This physiographic unit is of the marine phase of the tundra climate with mild winters and short, cool summers. Dominant vegetation includes moist wet tundra plant communities. Standing water, mosses, sedges, and low-growing shrubs cover the landscape with clumping stands of alder, willow, and patches of stunted spruce and birch growing along the riparian edges of major streams and rivers (Shacklette et al. 1969; Bailey 1995).

The **Aleutian Range** consists of heavily glaciated U-shaped valleys, rugged ridges, and mountain peaks anchored between the Pacific Ocean and the Bering Sea. It runs west to Aleutian Island with an elevation ranging from 1,000 to 4,000 feet. The Aleutian Range is flanked by large volcanic peaks elevating upward to 8,500 feet. Steep rivers drain south to the Pacific Ocean, while braided meandering rivers run slowly to the Bering Sea. The west end of the Aleutian Range drains into the Bristol Bay Lowland, feeding hundreds of small lakes and ponds. Vegetation is sparse and consists of spruce, birch, and cottonwoods along riparian corridors and a spattering of open low-shrub tundra as the elevation increases (Shacklette et al. 1969; Kevin Waring & Associates 2015a).

To the east, the **Alaska Range** connects with the Aleutian Range between Iliamna Lake and Mount Spurr. The mountain range extends over 600 miles to the Canadian border. The heavily glaciated mountain ranges average between 7,000 and 10,000 feet in elevation with a number of peaks exceeding 10,000 feet. The Alaska Mountain range is the divide for rivers flowing from the Yukon Territory south to the Gulf of Alaska. The southern section drains through glacial streams to the Kuskokwim River and to the Nushagak or Kvichak rivers, eventually flowing into Bristol Bay (Shacklette et al. 1969; Kevin Waring & Associates 2015a).

3.11.4.2 EIS Analysis Area

Mine Site

The mine site would be located in the southern section of the Nushagak-Big River Hills physiographic unit. The landscape is characterized by the rugged Sharp, Pig, Kaskanak, and

Groundhog Mountains that appear prominent and distinct from the surrounding lowlands and Iliamna Lake.

Views from ridgetops are largely panoramic; however, there is more enclosure in drainages and low elevation areas. Topography is dominated by numerous rounded hills that appear consistent and well-defined by the converging lines of drainages. As elevation increases, trees become stunted and vegetation becomes intermixed with short alpine tundra and exposed rock outcrops.

The upper sections of Talarik Creek and the Koktuli rivers meander through eroded, braided wetlands and tundra flowing into Iliamna Lake to the Kvichak River, before draining into Bristol Bay. The Talarik Creek floodplain is characterized by exposed flat grasslands and low sand dunes created from strong winds with little diversity of vegetation. These river systems not only provide habitat for salmon, but also provide important travel routes to remote areas for subsistence use in the summer and winter.

Single day tours are almost exclusively accessed via aircraft. Visitors are flown into surrounding parks and other destinations over the proposed project area to access bear viewing locations along the coastline, in the estuaries and up the stream corridors and over the glaciers of Four Peaks Mountain. Multi-day commercial tours either stage outside the park on large boats in Kamishak Bay, or at lodges in the park.

Viewer groups in this area include individuals engaged in subsistence or recreation activities. These individuals experience the landscape from fixed points while fishing or viewing wildlife and can be transient as they move through the landscape on foot, snowmachine, boat, or aircraft. Small aircraft are used to provide access for fishing and hunting areas, and to a lesser extent, provide tours for nature viewing. Areas on the flight paths provide an expansive view of the landscape settings. During winter months, overland travel (via snowmachine) is common as the ground is frozen.

Transportation Corridors

The transportation corridor would be a linear system that cuts through the Nushagak-Big River Hills and Nushagak-Bristol Bay Lowland physiographic units.

Under Alternative 1, the transportation corridor would include crossing Iliamna Lake, which is located in the Bristol Bay Lowlands, southwest of Lake Clark National Park and Preserve and the northwestern edge of the Alaska Range. The lake is approximately 100 miles long by 30 miles wide and is the largest fresh water lake in Alaska. The shallow shoreline is made up of long, fine edges, meandering inlets, and checkered islands. The low topographic relief provides extensive panoramic views extending across the tundra to Iliamna Lake. In the immediate foreground, the wet shrub tundra presents limited obstruction to vast views of the surrounding landscape. To the west is the Bristol Bay lowlands made of wet shrub tundra, marsh lands, and hundreds of small lakes. Northern views feature the rounded mountains of the Nushagak–Big River Hills.

Viewer positions along Iliamna Lake are either from the shoreline or from a boat on the water. Access to the surrounding landscape for commercial, subsistence, and recreation uses are through the main airport and community of Iliamna. Air transportation is a prominent form of travel in the area. From the elevated position in an aircraft, the viewer can relate to the expansive, undisturbed landscape setting. There is minimal lighting visible from the existing communities, which is primarily seen in the winter months when there is limited daylight. Lower Talarik Creek flows into Iliamna Lake from the north. The State of Alaska established the Lower Talarik Creek Special Use Area in 1999 as a high value resource for fish and wildlife habitat and subsistence harvest, as well as local and commercial recreation (ADNR 2005). Viewer groups in

this area include individuals engaged in subsistence or recreation activities, as well as travellers.

Alternatives 2 and 3 include transportation corridors located on the north end of Iliamna Lake. This portion of the lake is characterized by the broad floodplains of the Chekuk Creek, Knutson Creek, and the Pile River. The ridgelines of Three Sisters Mountain, Knutson Mountain, and Roadhouse Mountain rise prominently from the river valleys. Lake Clark National Park and Preserve is located to the north and east of the transportation corridor access roads, at the northwestern edge of the Alaska Range. The features are viewed by aircraft while traveling in and out of the park, and local communities.

Roadhouse Mountain is a popular summer ATV route that is located southwest of the mine site along the border of Lake Clark National Park and Preserve and the north end of Iliamna Lake. Expansive 360 degree panoramic views dominate the viewer experience from the top of Roadhouse Mountain. Significant visual features include Iliamna Lake and its distinct shoreline. The marshy wet lowlands and the river valleys of the Nushagak-Big River Hills dominate the foreground view while Sharp, Groundhog, and Kaskanak mountains frame the background views.

The Alagnak River is designated as a Wild River in the Wild and Scenic River System. The Alagnak River is located about 45 miles west of the proposed mine site, 30 miles from Iliamna Lake, and more than 20 miles from the Alternative 1 transportation corridor (outside of the EIS analysis area considered under Alternative 2 and 3). The Alagnak River provides opportunities for exemplary Alaska recreation due to remoteness, scenery, and sport fisheries. The Alagnak River is accessed by aircraft and from the west side of Katmai National Park and Preserve. The river has a reputation of being a world-class fishery and is considered to be one of the most popular fly-in fishing destinations in southwest Alaska.

The McNeil River State Game Refuge is located in the EIS analysis area for the Alternative 1 port access road and Amakdedori port. As described in Section 3.5, Recreation, the McNeil State Game Refuge and Sanctuary is a premier destination for bear viewing and is home to one of the largest congregations of brown bears in Alaska. Large numbers of brown bears come to McNeil River to feed on sockeye, chum, and coho salmon. Brown bears are present in the McNeil State Game Refuge and Sanctuary throughout the year, and congregate at McNeil River late May through the end of August. The Alaska Department of Fish and Game (ADF&G) operates a visitor bear viewing program at McNeil River from early June through late August. Smaller numbers of brown bears congregate at Chenik Creek in Chenik Lagoon during late June through late July, depending on the timing of the sockeye run. Guided bear viewing and private visitor bear viewing occurs during the month of July (ADF&G 2018b).

Soundscape

Noise receptors in the analysis area for the transportation corridors generally include subsistence users, recreationists, and residents. The existing ambient noise level is estimated to be comparable to “wilderness ambient,” as described for the mine site and port analysis areas (see Section 3.19, Noise) with a 35 decibel day-night average noise level (L_{dn}).

For additional information on baseline noise conditions in the EIS analysis area, see Section 3.19, Noise.

Amakdedori Port

The proposed Amakdedori port site (Alternative 1) is located on state lands designated for habitat use in the Kenai Peninsula Borough (KPB) area boundary. The area located to the

northern end of the Aleutian Range is considered wet shrub tundra, collecting runoff forming wet meadows, bogs, and hundreds of small lakes.

Viewer groups include private outfitters who operate single and multi-day commercial tours to Katmai National Park and Preserve from May through September. Single day adventure tours are offered from as far away as Anchorage, and as close as Dillingham.

Diamond Point Port

The Diamond Point port site (Alternatives 2 and 3) is located in Iliamna Bay, on the west side of Cook Inlet. The bay is characterized by the rugged topography of the Chigmit Mountains, which descend precipitously to the water. An existing road is located at the northern tip of the bay, connecting the village of Williamsport to Pile Bay Village on Iliamna Lake. Viewer groups include local residents and recreationists traveling to/from Lake Iliamna.

Natural Gas Pipeline

The landscape character of the pipeline rights-of-way (ROWs) are is the same as those described for the transportation corridors, as the pipelines would be co-located with the transportation corridor of either Alternative 1 or Alternative 3; the discussion for the transportation corridor under Alternative 2 and 3 is relevant to the Alternative 2 pipeline route, with the exception of the portion located between Diamond Point port and Ursus Cove. The pipeline would terminate on the Kenai Peninsula near Anchor Point and Anchor Point Recreation Area. Views form this area include the broad Cook Inlet and distant peaks of the Aleutian Range. The area is populated with residents, recreationists, tourists, and commercial operators using the Cook Inlet and Kenai Peninsula as a base to access the natural and remote setting of Bristol Bay, Iliamna Lake, and the national parks and preserves.

3.11.5 Night Sky

Night sky conditions in the EIS analysis area are almost entirely pristine, with a ratio of artificial night brightness to natural night brightness of less than 1 percent. There is one exception surrounding the Iliamna Airport where artificial night lighting affects the quality of the night sky. Artificial brightness is between 8 to 16 percent of the natural background within an approximate 5-mile radius around the airport, which is considered polluted on an astronomical point of view (Falchi et al. 2016a). The ratio of artificial brightness to natural brightness is 1 percent or greater within an approximate 6-mile radius around the airport. Night sky monitoring at Keyes Point near the northern shore of Lake Clark performed by the NPS did not identify any visible lights or domes anywhere along the horizon with the naked eye and assigned the location Bortle Class 2 (NPS 2013b). A Bortle Class 2 indicates a “typical truly dark site” where airglow may be weakly apparent along the horizon and the Milky Way appears highly structured to the unaided eye, indicating high-quality night sky (Bortle 2001).

3.11.6 Soundscape

Baseline noise levels of the EIS analysis area are compatible with outdoor ambient sound levels consistent with a “wilderness ambient,” classification (baseline noise level of 35 dBA Ldn) (see Section 3.19, Noise).

This page intentionally left blank.

3.12 TRANSPORTATION AND NAVIGATION

The Environmental Impact Statement (EIS) analysis area for this section includes the transportation and navigation resources that could be affected by the proposed mine site, port, transportation corridor, and natural gas pipeline corridor for each alternative. This includes surface transportation from the mine site to Cook Inlet and a small section of the Sterling Highway, air transportation from airports across the region (Dillingham to Anchorage), and water transportation on Cook Inlet, Iliamna Lake, and navigable rivers from the mine site east to the inlet. Navigation also includes deep water port construction and usage from local to global users, and constitutes the EIS analysis area. Local and regional land, air, and water transportation systems and activities in the EIS analysis area are included. Navigability of each project component is discussed.

The major mode of transportation between communities in this region and outside of the region is by air and water. Surface transportation is most often used for travel within communities, and can include on-road and off-road transport via automobiles, trucks, snowmachines, all-terrain vehicles (ATVs), dog sleds, and horses (DOWL 2016).

3.12.1 Surface Transportation

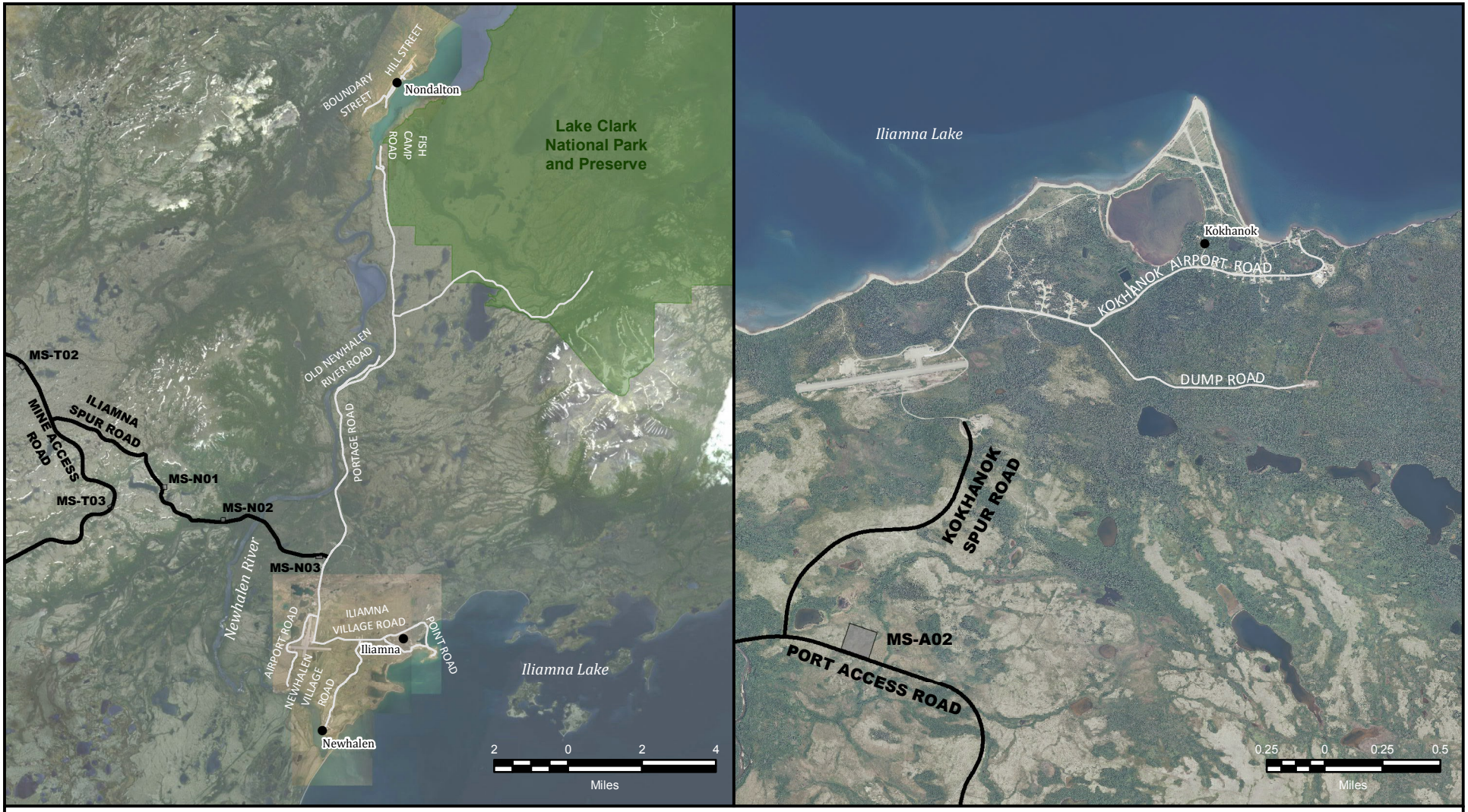
No existing roads access the current mine site or the Amakdedori port site directly. Surface transportation in the area consists of off-road transport via ATVs and snowmachines between villages and to subsistence areas (Fall et al. 2006). Using off-road vehicles with a curb weight of less than 1,500 pounds does not require a permit from Alaska Department of Natural Resources (ADNR 2011).

There is potential for overland traffic through the EIS analysis area to access native allotments and private lands close to the mine site. The closest native allotments to the mine site include one area approximately 25 miles to the west, and land in the community of Nondalton to the east. Privately owned land approximately 15 miles to the north exists at Nikabuna Lakes (HDR 2015). Native allotments and other private lands are shown in Figure 3.2-1a-e.

The road systems in the transportation corridors for all alternatives are primarily undeveloped, with the exception of local community roads, the Iliamna-Nondalton River Road (14 miles), and the Williamsport-Pile Bay Road (15 miles) with limitations. The annual average daily traffic count for the busiest road in the Iliamna/Newhalen road system in 2017 was 424 cars per day. Nondalton roads experienced 50 to 60 cars per day, and Kokhanok local roads had an average of 75 cars per day (ADOT&PF 2018b). Existing roads in and near communities are provided in Table 3.12-1 and shown in Figure 3.12-1.

Table 3.12-1: Community Roads

Community	Miles of Local Roads
Iliamna/Newhalen	12
Nondalton	3
Iliamna-Nondalton River Road	15
Kokhanok	3
Pedro Bay	5
Williamsport-Pile Bay Road	15



Sources: PLP 2018; ADOT&PF

US Army Corps of Engineers®

Alternative 1

- Transportation Corridor
- Transportation Footprint

Other Features

- Existing Road Infrastructure
- National Park

EXISTING ROADS: ILIAMNA, NEWHALEN, NONDALTON, AND KOKHANOK

PEBBLE PROJECT EIS

FIGURE 3.12-1

Iliamna, Newhalen, and Nondalton are connected to one another, but the 15-mile road from Iliamna to Nondalton is only passable when the Newhalen River is frozen (ADCCED 2018).

The Williamsport-Pile Bay Road is a state-maintained, approximately 15-mile-long road that connects Williamsport on the Cook Inlet to Pile Bay on Iliamna Lake (NOAA 2018c). This road had an average annual daily traffic count of 19 cars per day in 2017 (ADOT&PF 2018b); it is assumed that the average would be doubled (i.e., 38 cars per day) for the summer months and would be zero for the winter months, as the road is only used between June and October (NOAA 2018c). Its current use is for transporting fishing vessels and heavy freight. Vessels less than 12 feet wide, 32 feet long, and 9.5 feet high may be hauled on the road. Approximately 50 fishing boats are transferred on the road annually, and approximately 22 barge loads of fuel and cargo were transported in 2009 (Kevin Waring and Associates 2011c). Tidal fluctuations in Cook Inlet and the potential for wet and flooding road conditions determine the accessibility and degree of drivability (i.e., Williamsport is very shallow and boats can only be hauled out at a 17-foot or higher tide, after navigating through a channel) (Fast 2018; NOAA 2018c). When the tide allows, one landing craft can deliver freight to Williamsport at a frequency of eight times per month. However, delivering fuel to communities by air is more economical than this method. Fuel is also transported by barge up the Kvichak River from Bristol Bay, which takes more than a week, and involves lightering (i.e., the process of transferring cargo between vessels of different sizes) through shallow areas. The Pile Bay port is undeveloped (DOWL 2016). Airport Road in Pedro Bay experienced an average annual daily traffic count of 45 cars per day in 2017 (ADOT&PF 2018b). The Williamsport-Pile Bay Road and Pedro Bay local roads are shown on Figure 3.12-2.

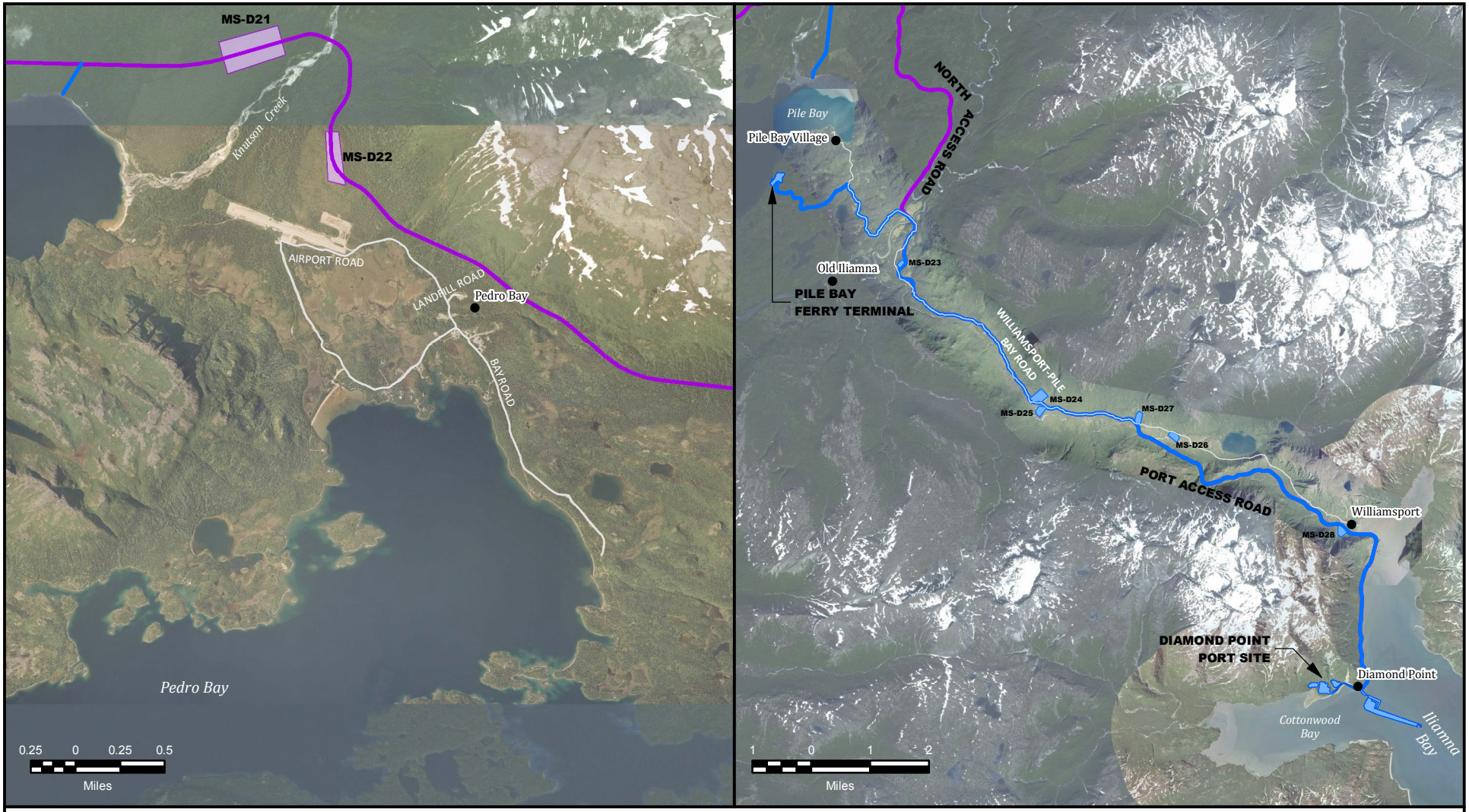
The Diamond Point quarry port is approximately 3 miles from Williamsport, in Iliamna Bay, but is not currently connected by road (DP 2018).

Current off-road surface transportation in the EIS analysis area for all alternatives includes travel to and from subsistence harvest areas and neighboring villages via ATV and snowmachine. This type of travel is easiest in the colder months, when the tundra, rivers, and lakes are frozen (Fall et al. 2006; Krieg et al. 2009). Additionally, snowmachines are used to access hunting areas for freshwater seals on Iliamna Lake (Lanen 2012). Known community subsistence harvest areas are discussed in Section 3.9, Subsistence.

No existing roads provide access to the proposed Amakdedori port. Subsistence activities occur in the area, via surface and water transportation. For more information on subsistence activities near Amakdedori, see Section 3.9, Subsistence.

The proposed natural gas pipeline would connect to the Kenai Compressor Station near Anchor Point, following Bourbon Avenue west until crossing the Sterling Highway. This stretch of the Sterling Highway had annual average daily traffic volume of just fewer than 3,000 vehicles in 2017 (ADOT&PF 2018b). The Sterling Highway is the only major roadway connecting the city of Homer to the rest of the Kenai Peninsula and the Alaska road system (DCRA 2017). According to the Alaska Highway Safety Office, the Sterling Highway had three fatal motor vehicle accidents that each resulted in one death in 2016, all occurring in Soldotna. There was one fatal accident that resulted in one death in 2017, in Clam Gulch (AHSO 2018).

There were no fatal motor vehicle accidents reported for 2016 and 2017 on any existing internal community roads that would be connected to the mine site or transportation corridor (AHSO 2018). Statewide, the Alaska Highway Safety Office reported that in 2017, there were 75 fatal crashes in Alaska, totaling 79 fatalities. From 2016 to 2017, fatalities and fatal crashes decreased by 6 percent and 4 percent, respectively. In addition, fatal crashes related to alcohol dropped by 54 percent.



Sources: PLP 2018; ADOT&PF

US Army Corps of Engineers

Alternative 2

- Transportation Corridor
- Transportation Footprint

Alternative 3

- Transportation Corridor
- Transportation Footprint

Other Features

- Existing Road Infrastructure

EXISTING ROADS: WILLIAMSPORT-PILE BAY ROAD AND PEDRO BAY

PEBBLE PROJECT EIS

FIGURE 3.12-2

3.12.2 Air Transportation

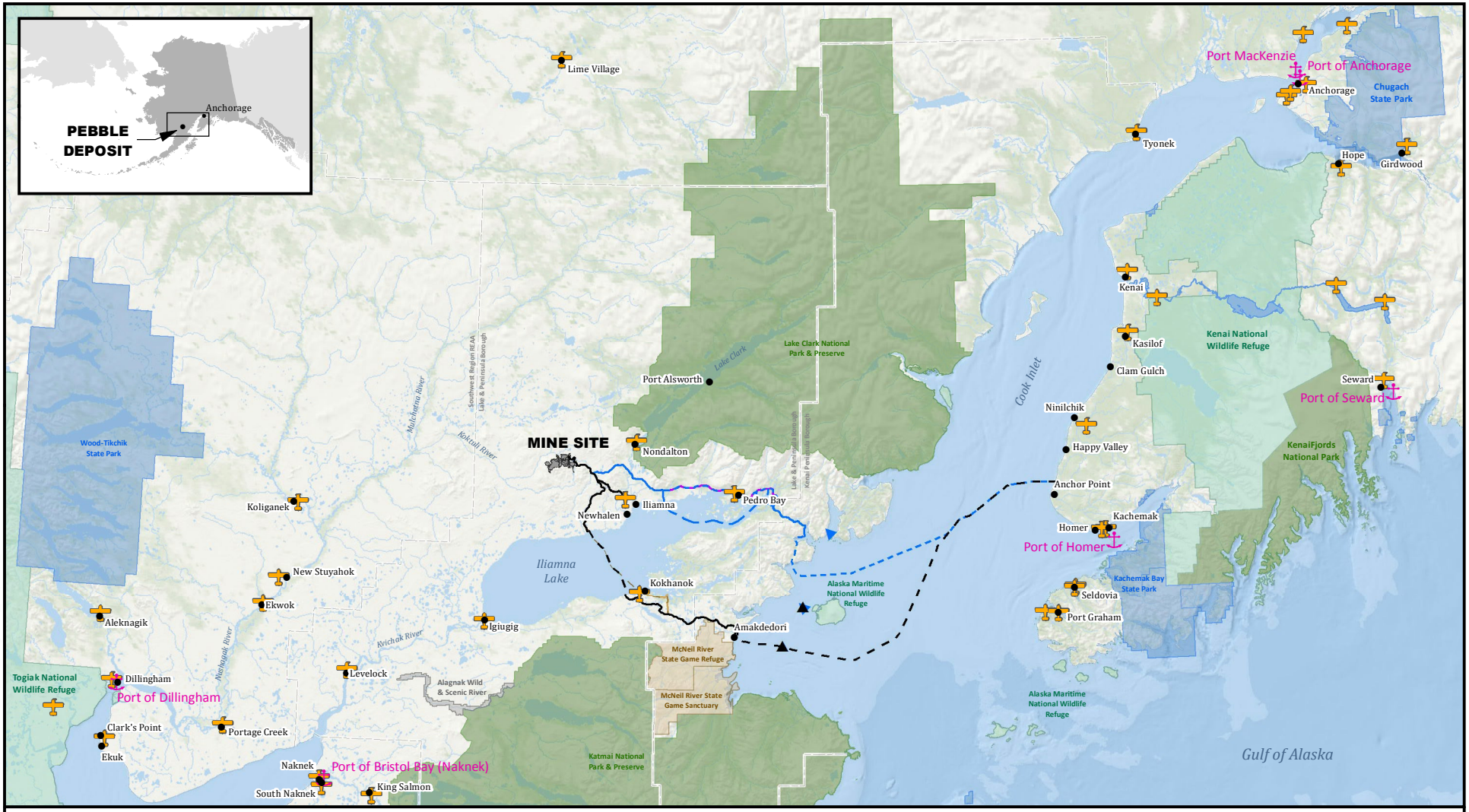
Passenger and cargo transport by aircraft is common for residents, visitors, and goods in the Bristol Bay region, on a regularly scheduled and charter basis. Small charter planes, run by private guide companies, also transport sport fishermen and hunters to lodges around the Iliamna Lake and Lake Clark areas (Travel Alaska 2018). General flight paths from Anchorage to Bristol Bay and the Alaska Peninsula communities go over Iliamna, or fly over the project area if there is inclement weather over Iliamna Lake (FAA 2018; Ravn 2018).

Table 3.12-2 provides a summary of airports in the EIS analysis area that may be affected by a change in air traffic related to the Pebble Project. Included in the table are eight airports west of Cook Inlet, and three east of Cook Inlet. Regional airports are shown in Figure 3.12-3.

Table 3.12-2: Summary of Potentially Affected Airports

Airport	Owner	Use	Average Annual Operations*	Runway Surface	Runway Lighting	Based Aircraft
Dillingham Airport (DLG)	ADOT&PF Central Region	Public	50,735	Asphalt/grooved	HIRL	59
Iliamna Airport (ILI)	ADOT&PF Southcoast Region	Public	15,330	Asphalt/grooved Water	MIRL -	29
King Salmon Airport (AKN)	ADOT&PF Southcoast Region	Public	15,330	Asphalt/grooved, in poor condition Asphalt/grooved Water	HIRL MIRL -	39
Kokhanok Airport (9K2)	ADOT&PF SR Region	Public	-	Gravel	MIRL	-
Nondalton Airport (5NN)	ADOT&PF Southcoast Region	Public	1,248	Gravel	MIRL	-
Pedro Bay Airport (4K0)	ADOT&PF Southcoast Region	Public	1,040	Gravel	MIRL	-
Igiugig Airport (IGG)	ADOT&PF Southcoast Region	Public	8,030	Gravel	MIRL	-
Port Alsworth Airport (TPO)	Glen Alsworth, SR	Private	1,300	Dirt/gravel	-	19
Ted Stevens Anchorage International Airport (ANC)	ADOT&PF	Public	261,705	Asphalt/concrete/grooved Asphalt/grooved Asphalt/grooved	HIRL HIRL HIRL	109
Kenai Municipal Airport (ENA)	City of Kenai	Public	39,055	Asphalt/grooved Gravel Water	HIRL None -	61
Homer Airport (HOM)	ADOT&PF Central Region	Public	48,180	Asphalt/aggregate friction Seal coat Water	HIRL -	93

Notes:
*One operation is a takeoff or a landing
HIRL=High-Intensity Runway Lighting; MIRL=Medium-Intensity Runway Lighting
Source: AirNav 2018



Sources: PLP 2018; ADNR

US Army Corps of Engineers

10 0 10 20
Miles

Alternative 1
- Lightering Locations
- Mine Site
- Transportation Corridor
- Natural Gas Pipeline

Kokhanok East Ferry Terminal Variant
- Transportation Corridor
- Natural Gas Pipeline

Alternative 2
- Transportation Corridor
- Ferry Route

Alternative 2/3
- Lightering Location
- Natural Gas Pipeline

Alternative 3
- Transportation Corridor

Other Features
- Airport or Sea Plane Base
- Ports
- City/Town
- Borough Boundary

- National Park
- National Wildlife Refuge
- Alaska State Park
- Wild and Scenic River
- State Game Refuge/Sanctuary

REGIONAL AIRPORTS AND PORTS

PEBBLE PROJECT EIS

FIGURE 3.12-3

3.12.3 Navigation

Federal jurisdiction of navigation includes those waters that are subject to tidal influence, are used presently, were used in the past, or could be used in the future to transport interstate or foreign commerce (e.g., transportation of goods and fuel, guided fishing or rafting, oil and gas production) (33 Code of Federal Regulations [CFR] Part 329.4). Section 10 of the Rivers and Harbors Act of 1899 requires authorization from the US Army Corps of Engineers (USACE) for the construction of any structure in or over any navigable waters of the US (NWUS). Structures or work outside the limits defined for NWUS require a Section 10 permit if the structure or work affects the course, location, or condition of the waterbody and applies to any dredging or disposal of dredged materials, excavation, filling, rechannelization, or any other modification of a NWUS. The General Bridge Act of 1946, as amended, and the Rivers and Harbors Act of 1899, as amended, require the location and plans of bridges and causeways across the NWUS be submitted to and approved by the Secretary of Homeland Security (delegated to the US Coast Guard [USCG]) prior to construction.

Streams or lakes are referred to as "navigable in fact" when they are used, or are susceptible of being used, in their ordinary condition as highways for commerce over which trade and travel are or may be conducted (77 US Code [USC] 557, 563). Examples of commerce in the vicinity of the project include goods lightered from Iliamna to Nondalton by boat in the summer, fuel transported across Iliamna Lake to Kokhanok and Igiugig, and goods transported to Anchorage and Homer up Cook Inlet, in addition to commercial fishing and guided hunting, fishing, rafting, or sightseeing.

Table 3.12-3 lists the navigable waters in the EIS analysis area.

Table 3.12-3: Navigable Waters of the US

Waterway	Agencies with Authority	Limit of Navigability	Existing Structures/ Facililities
Cook Inlet	USACE/USCG	All waters subject to tidal influence	Communication cables Oil and gas infrastructure – platforms, pipelines, exploration drilling Municipal and commercial docks Navigation aids
Iliamna Lake	USACE/USCG	Entire waterway	Public dock in Iliamna Small boat ramp in Igiugig Boat landing in Pedro Bay Several private docks
Kvichak River	USACE/USCG	Mouth to and including Iliamna Lake	Beach landing and riverfront dock in Levelock
Newhalen River	USCG	Entire waterway	Beach landing in Newhalen, small-boat launch along Newhalen River Road
Nushagak River	USACE/USCG	USACE – from mouth of Wood River USCG - Mouth to the Village of Koliganek	N/A

Source: USCG 2012; USACE 2018b; Kevin Waring & Associates 2010b, 2011b

There are limited facilities for delivery of cargo and fuel and similar purposes in the EIS analysis area. Nondalton is not accessible by barge (Kevin Waring & Associates 2010b).

Figure 3.12-4 illustrates the navigable waterways in the EIS analysis area. The Gibraltar River, Iliamna River, and Pile River are considered navigable by the State of Alaska (ADNR 2018b); the ADNR Division of Mining, Land, and Water determines navigable waters for the State.

3.12.3.1 Mine Site

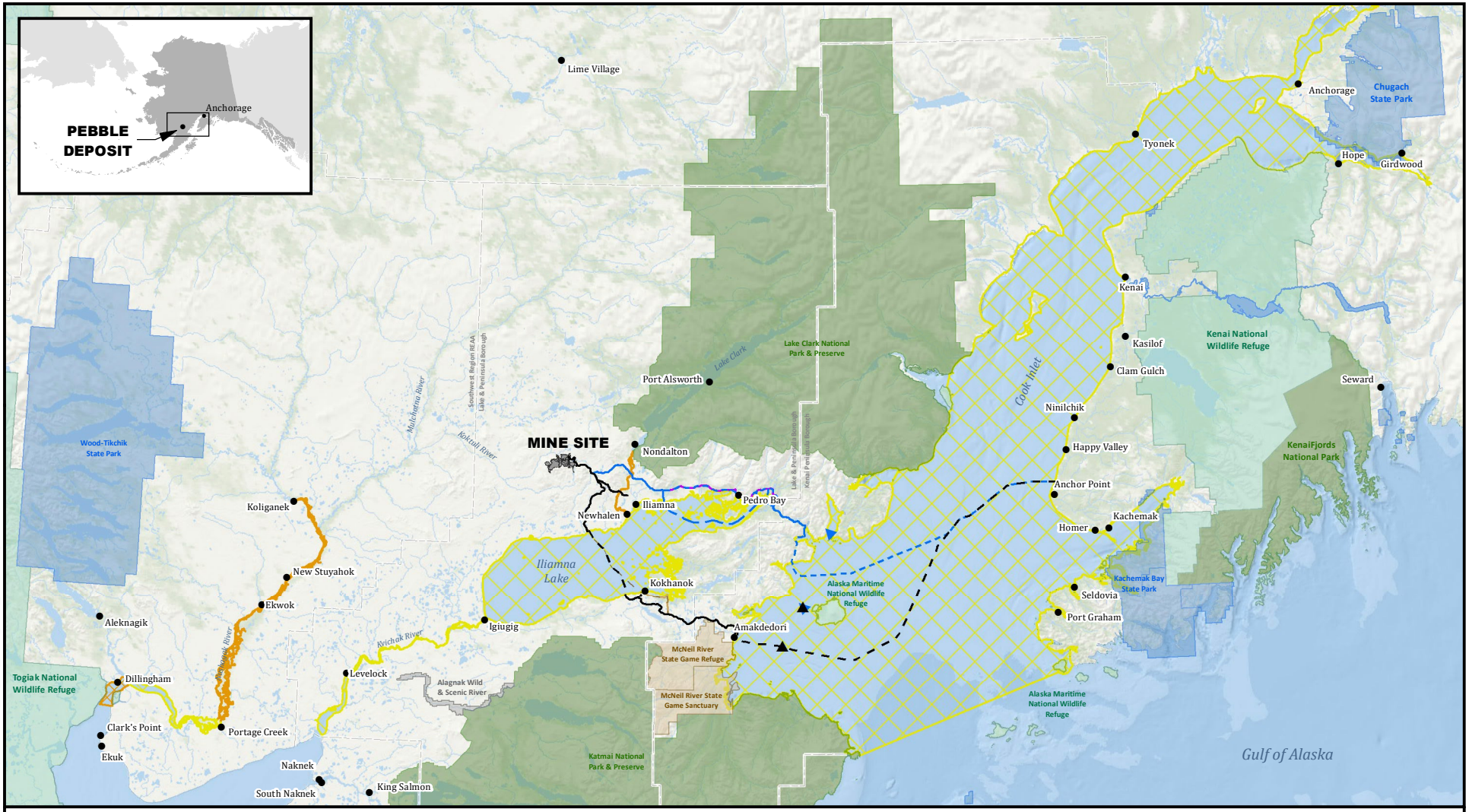
The mine site is not accessible by navigable waters, although some navigable waters are hydrologically connected to the area, such as the Kvichak and Nushagak rivers. Some small watercraft use associated with recreational activities occurs on the Koktuli River downstream of the mine site. The closest navigable water with facilities to accommodate vessel traffic is Iliamna Lake, and the closest "navigable in fact" river is the South Fork Koktuli River.

3.12.3.2 Transportation Corridor

Alternatives 1 and 2 transportation corridors would connect the mine site with the Amakdedori or Diamond Point port overland, with one section relying on a ferry crossing of Iliamna Lake.

Iliamna Lake is used year-round by community members to access subsistence harvest areas and resources in and surrounding the lake, traveling via watercraft in open water and by snowmachine when ice permits. For example, people from Kokhanok cross the lake to access resources near the community of Iliamna and near Lake Clark National Park and Preserve (Fall et al. 2006). See Section 3.9, Subsistence, for more information on subsistence practices. There is a heavily used snowmachine route between the communities of Kokhanok and Iliamna across the lake. The communities of Pedro Bay and Igiugig also traverse the length of the lake on snowmachine, hugging the shoreline (PLP 2018 RFI-088). The local sport fishing, hunting, and tourism industries also rely on the use of Iliamna Lake for transportation and natural resources (Fall et al. 2006). Refer to Section 3.5, Recreation, for information on recreational use of Iliamna Lake; and Section 3.6, Commercial and Recreational Fisheries, for information on recreation and commercial fisheries pertaining to Iliamna Lake. Iliamna Lake is also used for inter-village travel, via boat during the open water season or by snowmachine, once ice has formed on the lake.

Fuel and other supplies are delivered to Iliamna Lake communities via barge. Barges also use the Williamsport-Pile Bay Road for portage from Cook Inlet (Kevin Waring & Associates 2010b). Historically, barges have traveled from Bristol Bay up the Kvichak River and into Iliamna Lake, depositing goods at the Iliamna barge landing for the communities of the area. However, low water levels and river shoals in some years make this route limited to shallow draft vessels, or infeasible (Kevin Waring & Associates 2010b). No other navigable waterways in the EIS analysis area are used to transport goods commercially, although several smaller rivers and streams are used for recreation and subsistence. The Newhalen River is used for transportation but cannot accommodate barge traffic to transport goods to Nondalton (Kevin Waring and Associates 2010b).



Sources: PLP 2018; ADNR

US Army Corps of Engineers®

10 0 10 20

Miles

Navigable Waterway Jurisdiction
- USCG
- USCG and USACE

Alternative 1
- Lightering Locations
- Mine Site
- Transportation Corridor

Natural Gas Pipeline

Kokhanok East Ferry Terminal Variant
- Transportation Corridor
- Natural Gas Pipeline

Alternative 2
- Transportation Corridor
- Ferry Route

Alternative 2/3
- Lightering Location
- Natural Gas Pipeline

Alternative 3
- Transportation Corridor

Other Features
- City/Town

- Borough Boundary
- National Park
- National Wildlife Refuge
- Alaska State Park
- Wild and Scenic River
- State Game Refuge/Sanctuary

NAVIGABLE WATERWAYS

PEBBLE PROJECT EIS

FIGURE 3.12-4

Ice coverage can vary across Iliamna Lake, which contributes to transportation access. An aerial image analysis of lake ice coverage on Iliamna Lake from 1999 to 2018 revealed that 15 out of 19 winters had ice cover on the majority or the entire lake surface for prolonged periods. Four winters had little or no ice cover. Prevailing wind direction pushes ice to the west, creating a variance in the length of ice duration depending on location. The easternmost, narrower portion of Iliamna Lake, near Pile Bay, Pedro Bay, and Eagle Bay, had median ice duration of 88 to 100 days. Near Iliamna and Newhalen, the median ice duration was 101 to 105 days. The middle portion between east and west, north of the village of Kokhanok and south of Eagle Bay, had median ice duration of 101 to 120 days, although the portion of lake east of Kokhanok and south of Eagle Bay had median ice duration from 121 to 140 days. The longest median ice duration was observed on the western half of Iliamna Lake, topping at 140 days and gradually decreasing to 111 days at about 2 miles west of Newhalen (PLP 2018-RFI 013).

3.12.3.3 Cook Inlet

Cook Inlet is home to commercial, subsistence, sport, and personal-use fisheries. Aquatic farming, research, and hatcheries are also permitted (ADF&G 2018h). See Section 3.9, Subsistence, for more information on subsistence uses of Cook Inlet.

Types of vessels that are present in Cook Inlet range up to 840 feet long and include various cargo vessels, tank ships carrying petroleum products, tugs, passenger vessels, fishing vessels, fish processing vessels, mobile drilling rigs, government vessels, and dredges, which can have typical speeds of up to 20 knots. The weather and conditions of Cook Inlet can create difficulty for vessels, because seasonal sea ice and sudden weather changes occur (Eley 2012).

The Cook Inlet Vessel Traffic Study (Eley 2012) found that in 2010, 80 percent of ship transits were made by 15 ships (to Homer, Nikiski, and Anchorage), and there were 480 ship port calls or transits total. The ships include state, national, and international owners (Eley 2012). Area ports are shown on Figure 3.12-3. Further summary of this study is presented below:

> *Each region of Cook Inlet (upper, middle and lower) experienced varying levels of activity based on the primary port and the types of vessels operating there. Kachemak Bay in lower Cook Inlet experienced the highest levels of activity in Cook Inlet, primarily due to ferry operations, or vessels awaiting a marine pilot, more favorable weather, or Coast Guard inspection. Middle Cook Inlet reflected tank ship movements in and around the Nikiski and Drift River oil terminals. Upper Cook Inlet activity was dominated by movement in and out of the Port of Anchorage. AIS [Automatic Identification System] data showed that the busiest times of year were the third quarter (July through September) followed by the second quarter (April through June).*

Pilotage (i.e., the process of directing the movement of a ship by visual or electronic observations of recognizable landmarks) is required for all vessels traveling in Cook Inlet (unless exempt[1]), because navigation is affected by large tidal fluctuations, currents, winds, mud flats, ice flows, boulders, reefs and shoals that are not always detectable by echo sounder, lead lines, or by observing turbulence in the water (NOAA 2018c). Potential hazardous obstacles may also include shipwrecks, unconsolidated sediments, glacial deposits, and volcanic debris (BSEE 2018b). Navigating Cook Inlet in the winter months requires a separate set of guidelines set by the USCG, and vessels are subject to inspection by the USCG to ensure proper conditions (NOAA 2018c).

[1] Examples of vessels exempt from pilot requirements in Cook Inlet include fishing vessels, most vessels under 65 feet, and US registered pleasure craft.

The Alternative 1 Amakdedori port site is not currently developed for water transportation. The location of the proposed port is in Kamishak Bay, Cook Inlet, approximately 33 miles southwest of Williamsport (ADCCED 2018). The water depth at the proposed port site is considered deep enough for barges to load and off-load supplies, and travel to and from lightering locations.

Western Cook Inlet has more debris than eastern Cook Inlet, and experiences larger ice pans in the winter. In Kamishak Bay, there are scattered reefs within a few feet of the water surface, many of which are visible at low tide. Local knowledge is recommended for navigation of this area, especially for lower Kamishak Bay, known as the Kamishak Gap, near the Douglas River, where tide rips, currents, and strong west winds combine with the underwater obstructions of reefs, ledges, and mudflats.

Amakdedori can be approached safely just north of Amakdedori Creek, although rocky outcroppings exist near shore, and large reefs offshore. Winds in this area can pick up after mid-August to produce larger swells (NOAA 2018c). Wave height can depend on wind direction and storms, and the mean wave heights in the vicinity of Amakdedori were 1.67 and 2.36 feet, based on data from two Acoustic Doppler Current Profilers, which started collecting data in March of 2018, and will continue through March 2019. Satellite imagery was reviewed of Kamishak Bay for the years 2006 through 2013 to conclude that ice coverage in the bay can form as early as early November, and can melt as late as late April (PLP 2018-RFI 039).

A bathymetry study of Amakdedori showed that the ocean bed slopes gently over 5.6 miles to a depth of 60 feet, with Amakdedori Creek's alluvial fan reaching almost 1,000 feet offshore. Rocky outcroppings were found about 2 miles north of the river outflow (PLP 2018-RFI 039). Preliminary results from additional wave height data collected March 2018 to June 2018 indicate that breaking may be occurring near the Amakdedori location. Numerical models were also run to evaluate swell and potential maximum wave heights at Amakdedori. Results confirm that a long-period swell from the Gulf of Alaska can penetrate Kamishak Bay and reach the Amakdedori site; and waves from the northeast have a slightly smaller wave height than waves coming from the southeast (PLP 2018-RFI 039).

The Diamond Point port site for Alternatives 2 and 3 would be located in Iliamna Bay, north of the entrance to Cottonwood Bay. The site is currently being developed as a quarry. The bay shoals gradually from 36 feet in the entrance north of White Gull Island to 6 feet in the entrance to Cottonwood Bay. It can be approached between North Head and White Gull Island, although care must be taken to avoid a reef. Iliamna Bay has several suitable temporary anchorages (NOAA 2018c).

At the end of the eastern arm of Iliamna Bay is Williamsport, the eastern portage point for passage to Iliamna Lake. The depth of Iliamna Bay is 36 to 48 feet although Williamsport is shallow and usable only at higher stages of the tide. Upper Cook Inlet ice drifts to this area in the winter (NOAA 2018c). The NOAA acoustic wave profiler recorded wave height data from 2010 to 2012 outside of Iliamna Bay.

The lightering location for Alternatives 2 and 3 would be in Iniskin Bay. Safe anchorages in this area can be dependent on season and wind. Although sometimes windy, Iniskin Bay is considered secure for anchorage of medium-sized vessels on the west side of Cook Inlet in any weather. Fishing vessels 4,000 tons or less currently use this bay for anchorage. Reefs and shoals near the water surface exist in this bay (NOAA 2018c).

The *Pebble Project Ice Database 1997-2016* examined ice data at Amakdedori, Diamond Point, and Lightering Location A, and concluded that Amakdedori experienced thinner ice for a shorter duration than Diamond Point in Iliamna Bay. Diamond Point averaged 5 to 6 weeks per year surrounded by significant ice (often thick, compact, stable ice), and Amakdedori averaged 3

weeks per year of significant ice, but generally thinner. Lightering Location A showed brief irregular bursts of ice cover or no ice cover, with most (17 out of 19 seasons observed) seasons having ice cover for 2 or fewer weeks (PLP 2018-RFI 039).

Based on the available data for geography, wave, bathymetry, and ice coverage, access to Amakdedori or Diamond Point may be limited due to high wave activity and periods of ice coverage in Kamishak and Iliamna bays.

3.13 GEOLOGY

3.13.1 Introduction

This section describes the baseline geology of the project area. Information provided here is based on field and office studies conducted by the applicant and others in the project area between 1985 and the present, as described in Appendix K3.13. Paleontological resources are also addressed in Appendix K3.13. Other sections that directly correspond to the geology discussion are Section 3.14, Soils and Section 3.15, Geohazards.

The Environmental Impact Statement (EIS) analysis area for geology includes the footprints for the mine (including material sites), port and ferry terminals, and transportation and pipeline corridors. The EIS analysis area is the same as the project area for this resource.

A definition for many technical terms applied in this section can be found on the online project website technical glossary (https://pebbleprojecteis.com/overview/glossary).

3.13.2 Regional Setting

The project area lies approximately 250 miles northwest of the Alaska-Aleutian megathrust, where the Pacific tectonic plate subducts (i.e., sinks), beneath the North American plate. Section 3.15, Geohazards, describes the tectonic setting, seismicity, faults, and volcanic activity. Tectonic activity at the plate boundary is the cause of the region's seismicity and volcanic activity, and has promoted the growth of the Alaskan landmass through the accretion of crustal blocks called terranes. Tectonic plate boundaries shifted throughout the Mesozoic era (245 to 65 million years ago). These shifts produced igneous intrusives (magma) of Late Cretaceous (about 90 million years old) responsible for the mineralization of the Pebble deposit (PLP 2011a).

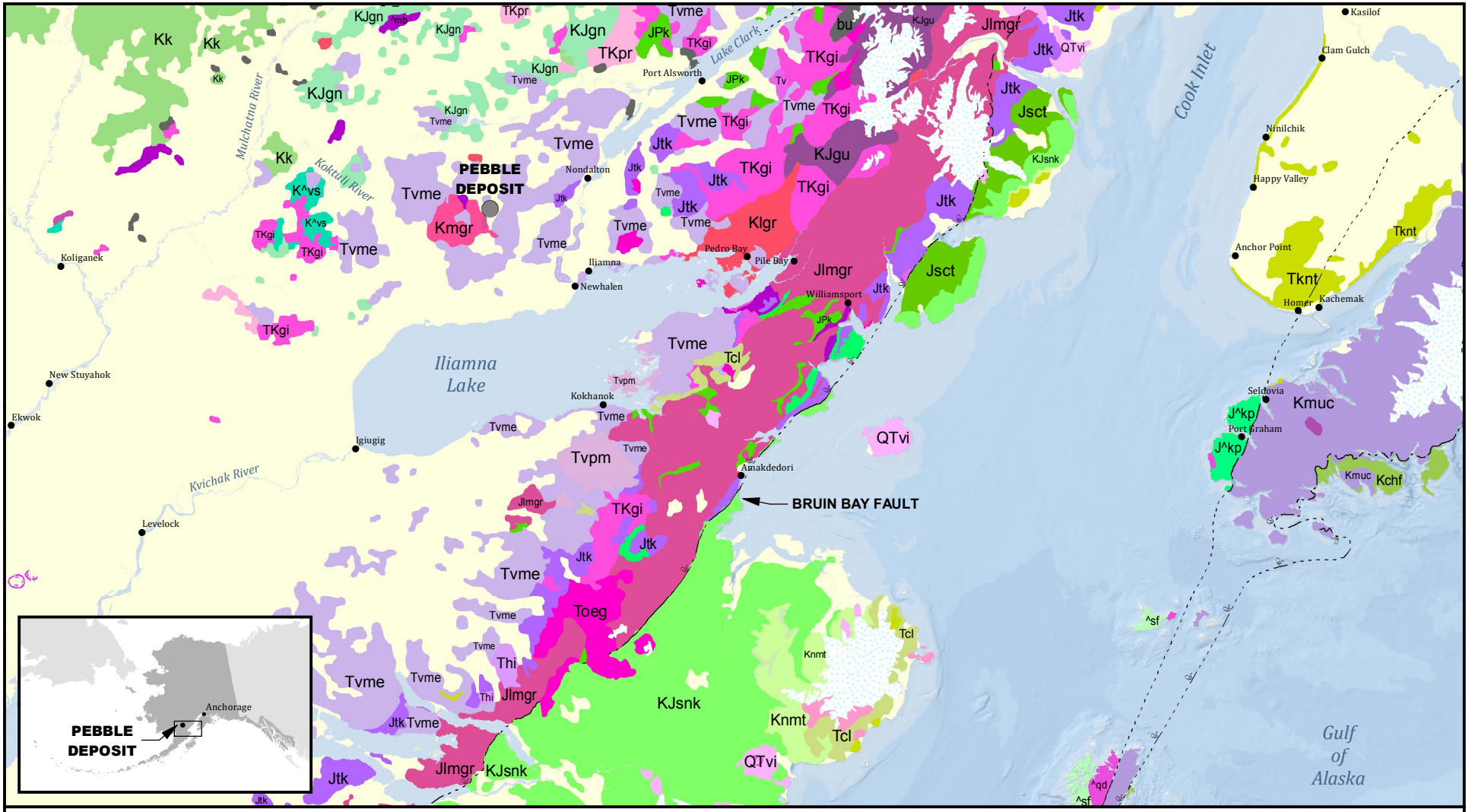
Over the last 2.6 million years (i.e., Quaternary age), glaciers have repeatedly advanced over the landscape, causing erosion of glacial valleys, rounding landforms of hills and mountains, and depositing reworked materials throughout the region. The unconsolidated sediments occur in the valleys between bedrock hills and mountains. No glaciers exist in the project area.

3.13.3 Geologic Overview of the EIS Analysis Area

The geology of the mine site is generally comprised of bedrock hills with thin or no unconsolidated sediment with overburden in the wide valleys (Hamilton and Klieforth 2010). Overburden in this area is comprised of glacial, glaciofluvial, and alluvial sediments. Iliamna Lake lies within a basin generally filled with glacial sediments of Quaternary age that are exposed southwest, west, and north of the lake, with occasional bedrock outcrops. The area between Iliamna Lake and Cook Inlet generally consists of exposed or near-surface bedrock, with limited sediments overlying the bedrock at the lower elevations (Wilson et al. 2015; Figure 3.13-1).

The geologic structure of the project area is broadly defined by the northeast- to southwest-trending Bruin Bay Fault (Figure 3.13-1) (see Section 3.15, Geohazards).

Extensive surficial glacial deposits similar to those near Iliamna Lake overlie the southwestern portion of the Kenai Peninsula (Detterman and Reed 1973). There is no known permafrost in the project area, including the areas of all alternatives and variants. See Section 3.14, Soils, for a discussion of permafrost.



Sources: PLP; ADNR

Note: The complete legend describing the map units is provided in Wilson et al. 2015.

US Army Corps of Engineers

10 0 10 20

Miles

PEBBLE PROJECT AREA GEOLOGY

PEBBLE PROJECT EIS **FIGURE 3.13-1**

3.13.4 Alternative 1 – Applicant's Proposed Alternative

This section describes the geology relevant to Alternative 1 and variants.

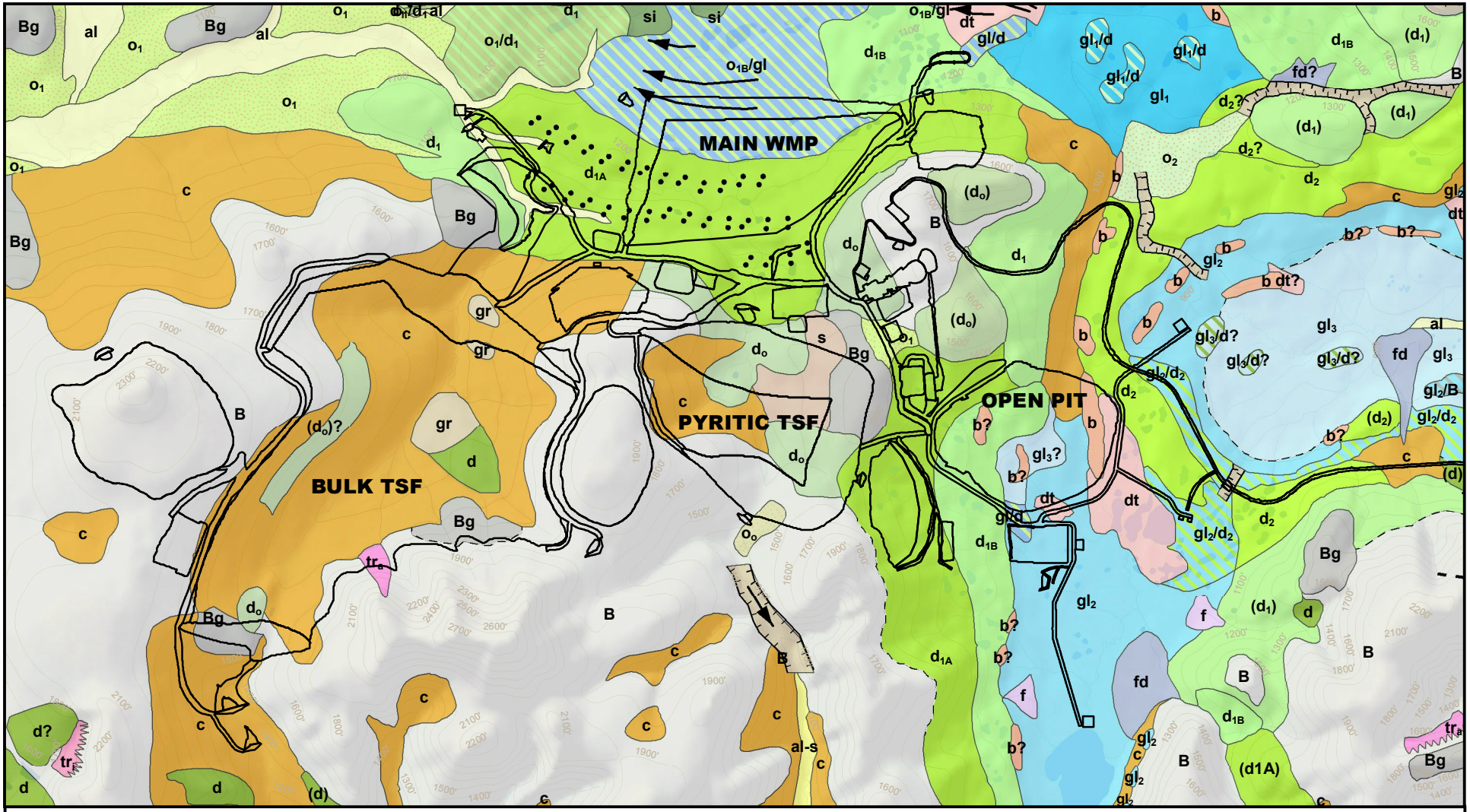
3.13.4.1 Mine Site

Unconsolidated sediments (overburden) cover a large portion of the mine site. These sediments consist of glacial till, outwash, alluvium, alluvial fan and deltaic deposits, and glaciolacustrine (glacial lake) deposits (Figure 3.13-2). Sediment grain sizes vary from silt, sands, and gravels to boulders. Overburden ranges in thickness from a few feet to about 165 feet (Detterman and Reed 1973; Knight Piésold et al. 2011a).

When glaciers were present, lakes formed where glacial ice blocked the major drainage basins (Hamilton and Klieforth 2010), resulting in deposition of lacustrine deposits. Glacial lake deposits are mapped in the eastern half of the open pit area, extending south of Frying Pan Lake, and in the area of the proposed water treatment plant (WTP) #1 discharge-south (Figure 3.13-2). The lake deposits are composed of stratified (layered) to weakly stratified silts, sands, and fine gravels, and display poorly drained surface morphology (Hamilton and Klieforth 2010). Glacial meltwater channels and a moraine ridges are also present (Figure 3.13-2).

Colluvium and felsenmeer occur along the flanks of Kaskanak Mountain, including within the footprint of the bulk tailings storage facility (TSF) and on slopes surrounding the mine site. Solifluction lobes composed mostly of silt are present on isolated lower slopes in the mine site, including the footprint of the pyritic TSF (Knight Piésold et al. 2011a). Thin, organic soils less than 1 foot thick cover the mine site, and are often intermixed with sands and gravels (Hamilton and Klieforth 2010) (see Section 3.14, Soils).

Bedrock occurs at the higher elevations (above about 1,400 feet above mean sea level [amsl]) in the mine site area (Figure 3.13-2). The bedrock geologic map (Figure 3.13-3) shows details of the mine site's complex bedrock geology, which are also addressed below.



Sources: PLP 2018d; Hamilton and Klieforth 2010

US Army Corps of Engineers

0.5 0 0.5 1
Miles

Project Features

Surficial Geology Linear Features
- Contact
- Crest of moraine ridge
- Drainage Channel
- Fault
- Meltwater channel

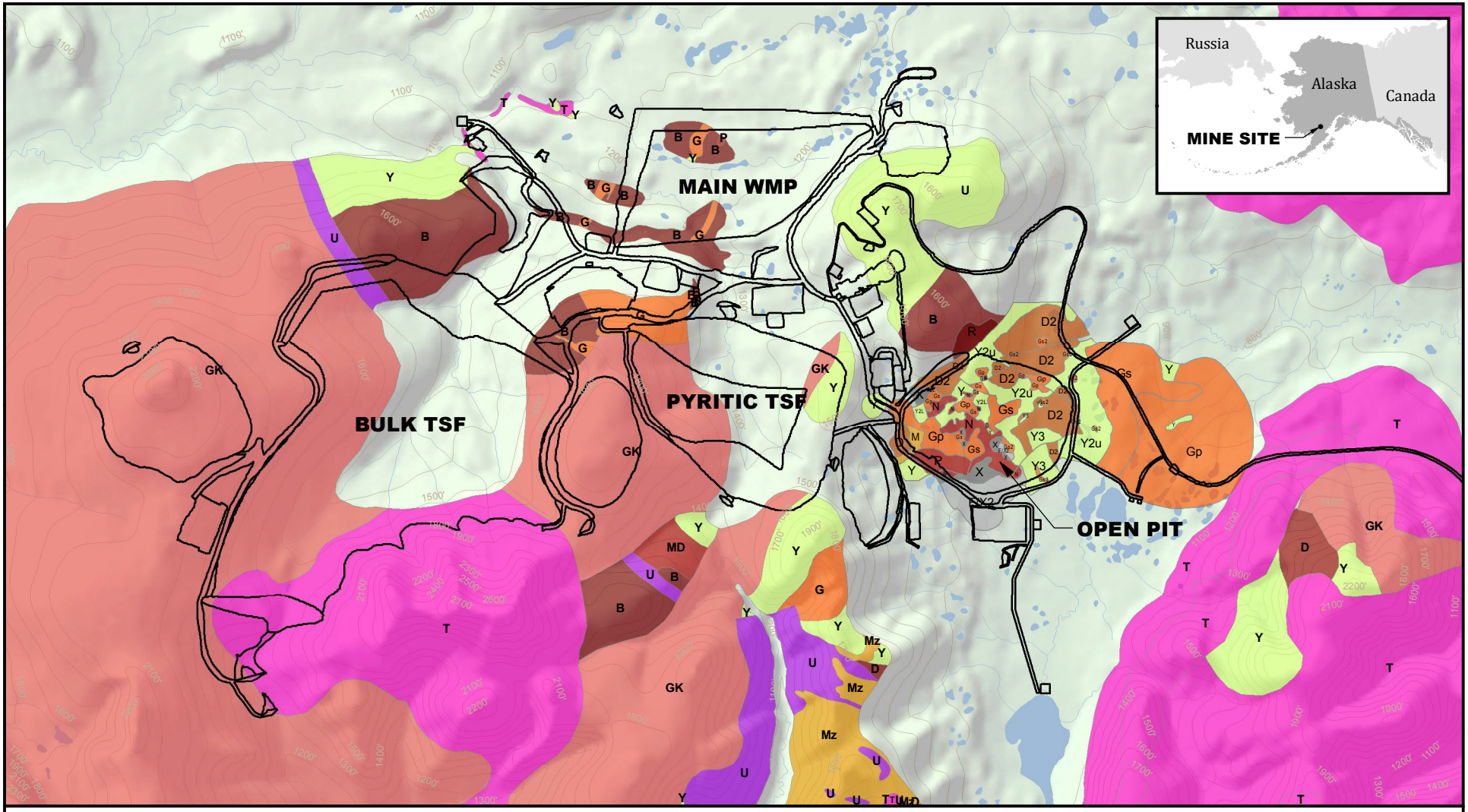
Surficial Geology Map Units

Alluvian: al, al-s
Bedrock, undifferentiated: B
Bedrock, glaciated: Bg
Beach deposits: b, b?
Colluvium: c
Glacial drift: d, d?, d1, d1A, d1B, d2, d2?, do, (d), (d1), (d1A), (d2), (do), (do)?
Deltaic deposits: dt, dt?
Fan deposits: f
Fan-delta deposits: fd, fd?
Glacial-lake deposits: gl/d, gl1, gl1/d, gl2, gl2/B, gl2/d2, gl3, gl3/d?, gl3?
Gravel: gr
Glacial outwash: o1, o1/d1, o1B/gl, o2, oo
Solifluction deposits: s
Silt, ice-rich: si
Talus rubble: tra, tri

MINE SITE SURFICIAL GEOLOGY

PEBBLE PROJECT EIS

FIGURE 3.13-2



Sources: PLP 2018d; Knight Piesold 2011d

US Army Corps of Engineers

0.5 0 0.5 1
Miles

Project Features

Bedrock Geology

- F/X2; Fault breccia
- X; Intrusion breccia
- Y, Y2L, Y2u, Y3; Mesozoic andesitic sedimentary flysch
- C; Mesozoic conglomerate
- M, Mz; Cretaceous monzonite
- G, Gp, Gs2, Gs3, Gs; Cretaceous quartz monzodiorite, granodiorite sill
- D, D2; Diorite sill
- GK; Cretaceous granodiorite (Kaskanask batholith)
- MD, N, P; Cretaceous monzodiorite
- D; Cretaceous diorite
- B; Mesozoic basalt and gabbro
- R; Gabbro
- U; Cretaceous pyroxenite
- T; Tertiary volcanic and sedimentary rocks

MINE SITE BEDROCK GEOLOGY

PEBBLE PROJECT EIS

FIGURE 3.13-3

Mine Site Bedrock Geology and Mineralization of the Pebble Deposit

The mine site bedrock geology is complex (Figure 3.13-3). Much of the bedrock in and around the open pit is a type of Mesozoic sedimentary rock derived from eroded andesitic volcanic rock (Kahiltna flysch). Tertiary (Paleogene and Neogene, about 65 to 2.6 million years old) volcanic and sedimentary rocks outcrop at higher elevations on the southern end of the bulk TSF and in the southeastern corner of the mine site area. A variety of Cretaceous (about 145 to 65 million years old) intrusive rocks outcrop in the mine site, including the granodiorite of the Kaskanak batholith, which outcrops in the western portion of the mine site (Knight Piésold et al. 2011a) (Figure 3.13-3).

Other diverse magmas intruded in the flysch in a north-northeast–trending belt throughout the Cretaceous, and were then folded by tectonic forces (Nokleberg et al. 1994). The mineralization that formed the Pebble deposit was likely caused by these diverse magma intrusions that comprise the rock in the open pit area (Knight Piésold et al. 2011a).

Offshoots of the magma injected into joints and fractures in the surrounding sedimentary bedrock, heating the rock, and causing hot fluids to circulate in a large magmatic-hydrothermal system. The hot fluids carried dissolved metals from the magma, including copper, gold, and molybdenum. As the fluids cooled, the metals and associated sulfide minerals (such as iron sulfide [pyrite]) precipitated in the surrounding rock, concentrated in metal-rich quartz veins. These rocks make up the Pebble deposit, a copper, gold, molybdenum porphyry system.

Table 3.13-1 presents the estimated deposit resource for copper, gold, and molybdenum; and compares the total deposit to the amount that would be mined over the 20-year lifespan of the project (PLP 2018d). The proposed project would mine approximately 10 percent of the total estimated Pebble deposit resource.

Table 3.13-1: Estimated Pebble Deposit Resource (Measured, Indicated, and Inferred)

	Total Deposit		20-Year Open Pit	
	Weight	**Grade**	**Weight**	**Grade**
Copper	81.5 Blb	0.34%	7.4 Blb	0.29%
Molybdenum	5.64 Blb	234 ppm	398 MMlb	154 ppm
Gold	107.3 MMoz	0.31 g/t	12.1 MMoz	0.27 g/t

Notes:
Blb: billion pounds
g/t: grams per ton
MMlb: million pounds
MMoz: million ounces
ppm: parts per million
Source: PLP 2018d

Construction Materials

Material to construct the embankments would be sourced from quarries A, B, and C, with granodiorite rock at these locations. Granodiorite is a competent (e.g., strong and resistant) rock that is suitable for use as rockfill. Construction would also use overburden removed from the open pit area that is determined suitable as rockfill (Figure 3.13-3).

3.13.4.2 Transportation Corridor

Roads

Bedrock and surficial geology varies somewhat across the transportation corridor (Chapter 2, Alternatives, Figure 2-13 through Figure 2-15), but is generally comprised of the same rock types and overburden present at the mine site. Few bedrock exposures exist north of Iliamna Lake, and glacial sediments cover most of the terrain (Detterman and Reed 1973, 1980).

Along the mine access road, the buried bedrock is mostly the same Tertiary volcanic rock present in the mine site. South of Iliamna Lake, the port access road traverses Tertiary volcanic rocks similar to north of the lake, and Jurassic intrusive bedrock outcrops at higher elevations with sparse surficial deposits (Figure 3.13-4) (Detterman and Reed 1973, 1980; Wilson et al. 2015).

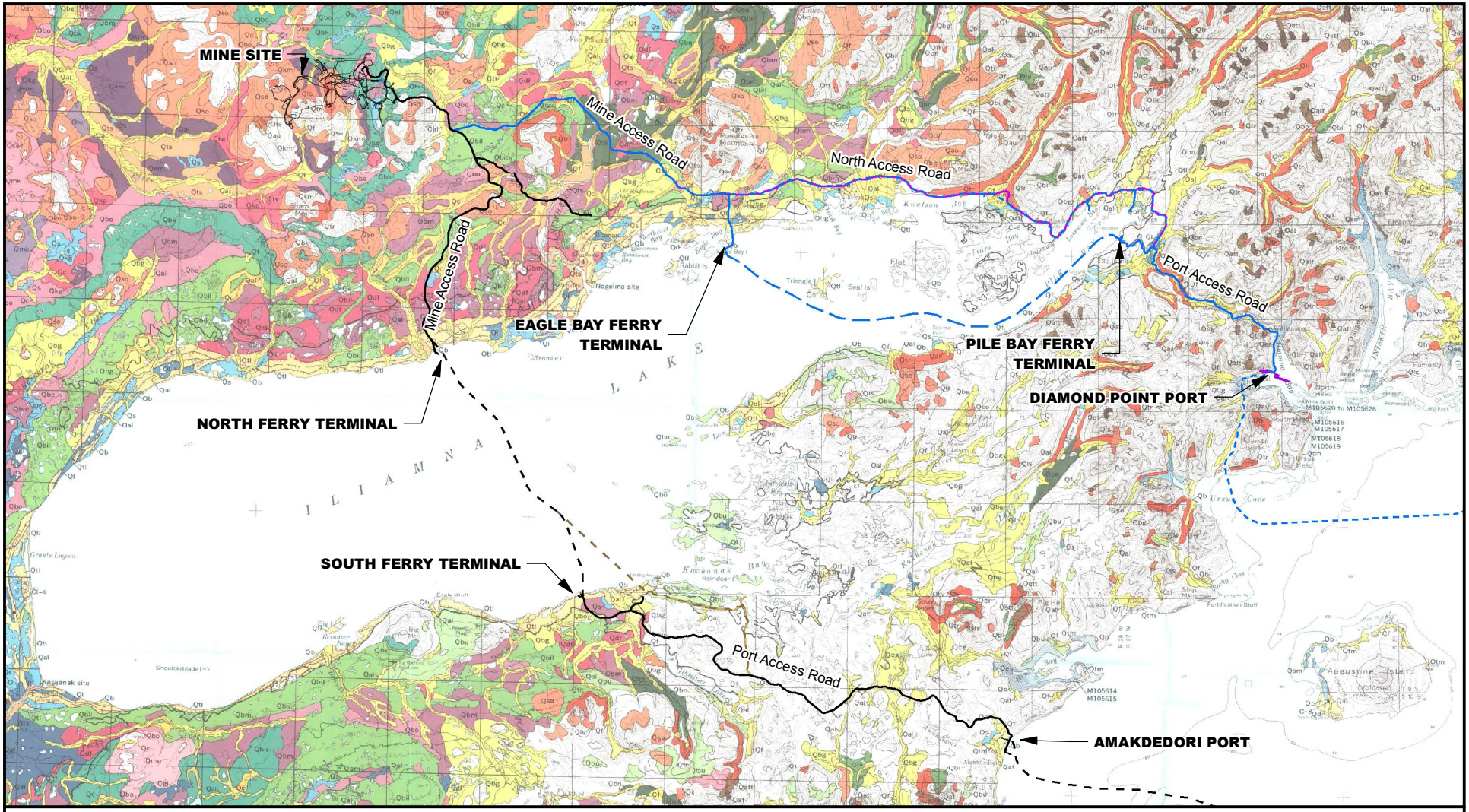
Near the port site, the transportation corridor would cross outcrops of Jurassic metamorphic rock and marine sedimentary rock that are locally abundant in marine invertebrate fossils (Detterman and Reed 1980; Wilson et al. 2015). The entire Iliamna spur road would be underlain by Quaternary glacial deposits, with no apparent exposed bedrock (Detterman and Reed 1973, 1980).

Ferry Terminals

The north ferry terminal would be underlain by Pleistocene glacial deposits consisting mostly of sand. The south ferry terminal would be underlain by Tertiary volcanic rock near the shoreline, and by Pleistocene terrace deposits farther upslope (Detterman and Reed 1973, 1980).

Construction Material Sources

Material sites along the transportation corridor would supply earthen materials (e.g., rock, gravel) for construction and maintenance of the transportation corridor. Material sites underlain by bedrock would likely require blasting (Figure 3.13-5). The remaining material sites would likely be developed in surficial glacial deposits and could be excavated without blasting (Detterman and Reed 1973; Hamilton and Klieforth 2010).



Sources: PLP 2018d; Detterman and Reed 1973

US Army Corps of Engineers®

5 0 5 10
Miles

Alternative 1
- Mine Site
- Transportation Corridor
- Natural Gas Pipeline
- Ferry/Port Site

Kokhanok East Ferry Terminal Variant
- Transportation Corridor
- Natural Gas Pipeline

Alternative 2
- Transportation Corridor
- Ferry Route
- Ferry Site

Alternative 2/3
- Natural Gas Pipeline
- Port Site

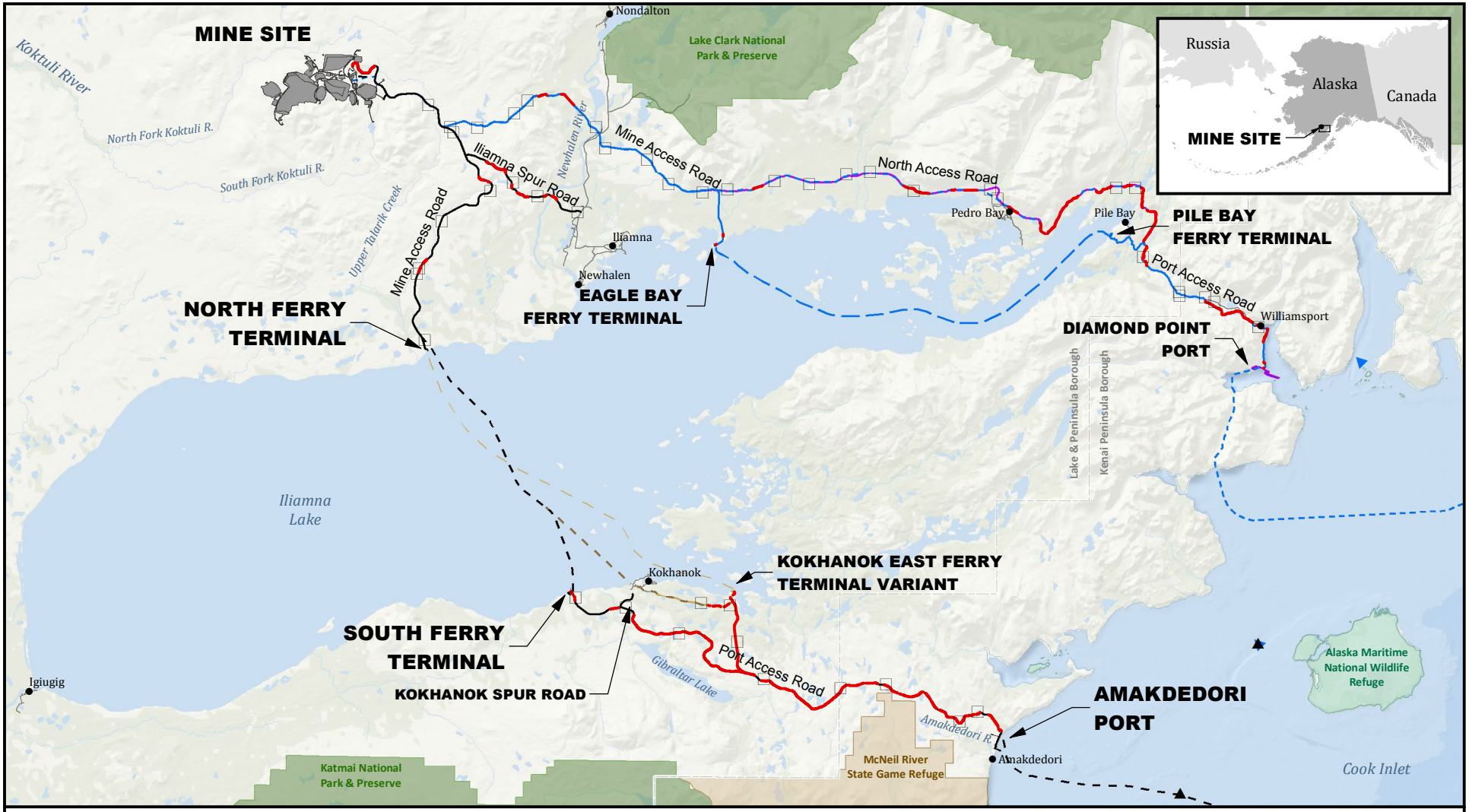
Alternative 3
- Transportation Corridor

Geology
- Bedrock
- Holocene Glacial Moraine and Drift
- Outwash
- Beach and Eolian Deposits
- Mass Wasting Deposits
- Alluvium
- Estuary and Lake Deposits
- Pleistocene Glacial Moraine and Drift

SURFICIAL GEOLOGY OF TRANSPORTATION CORRIDORS

PEBBLE PROJECT EIS

FIGURE 3.13-4



Sources: PLP 2018d; ADNR

US Army Corps of Engineers

5 0 5 10
Miles

- Material Site
- Blasting Intervals

Alternative 1
- Mine Site
- Transportation Corridor
- Natural Gas Pipeline
- Port Site

Kokhanok East Ferry Terminal Variant
- Transportation Corridor
- Ferry Route
- Natural Gas Pipeline

Alternative 2
- Transportation Corridor
- Ferry Route

Alternative 2/3
- Natural Gas Pipeline
- Port Site

Alternative 3
- Transportation Corridor

Other Features
- Local Roads
- Borough Boundary
- National Park
- National Wildlife Refuge
- State Game Refuge/Sanctuary

BEDROCK BLASTING INTERVALS

PEBBLE PROJECT EIS

FIGURE 3.13-5

3.13.4.3 Amakdedori Port

The footprint of the Amakdedori port would be on marine terrace and beach deposits consisting of sand, pebbles, and cobbles (Detterman and Reed 1973). Alluvial fan-delta deposits from Amakdedori Creek extend about 1,000 feet offshore into Kamishak Bay (PLP 2018-RFI 039). Seafloor sediment at and around the Amakdedori port site is composed of primarily subtidal gravel and beach complex, with sub-bottom sediments consisting primarily of fine silty sand, occasional coarse gravel and shell fragments, and a fines content ranging from 14 to 19 percent (GeoEngineers 2018a).

Bedrock is not exposed in the port footprint, but is exposed in the bluffs to the northeast, and consists of Jurassic igneous and metamorphic rock, and fossiliferous marine sedimentary rocks (Detterman and Reed 1973, 1980; Wilson et al. 2015).

Rock to be used in construction of the port would be supplied from material site MS-A08 (PLP 2018-RFI 035) (Appendix K2, Alternatives, Figure K2-1b). MS-A08 is in an area of thin or absent surficial deposits underlain by bedrock (Detterman and Reed 1973).

3.13.4.4 Natural Gas Pipeline Corridor

The surficial and bedrock geology of the natural gas pipeline corridor is the same as that addressed above for the transportation corridor, except for the Cook Inlet crossing and the segment of the corridor on the Kenai Peninsula.

Cook Inlet is a relatively shallow sedimentary basin filled with actively migrating, sand- to boulder-sized material. Cook Inlet seafloor deposits are described in further detail in Section 3.18, Water and Sediment Quality.

Surficial deposits along the Kenai Peninsula segment include Quaternary glacial outwash sediments and minor alluvial deposits (Wilson et al. 2015). Bedrock on the Kenai Peninsula segment is almost entirely buried by deep glacial deposits, but limited outcrops to the east reveal late-Tertiary estuarine and non-marine sedimentary bedrock (Wilson et al. 2015).

Construction material sources for the natural gas pipeline corridor would be the same as those identified for the transportation corridor between the mine site and Amakdedori port. No material sites would be required on the Kenai Peninsula portion of the pipeline route (PLP 2018-RFI 035).

3.13.4.5 Action Alternative 1 – Summer-Only Ferry Operations Variant

The Summer-Only Ferry Operations Variant is not relevant to geology affected environment, and is therefore not addressed in this section.

3.13.4.6 Action Alternative 1 – Kokhanok East Ferry Terminal Variant

The Kokhanok east ferry terminal is underlain by Quaternary beach deposits near the Iliamna Lake shoreline, and by Tertiary volcanic bedrock farther upslope (Detterman and Reed 1973, 1980).

3.13.4.7 Action Alternative 1 – Pile-Supported Dock Variant

Marine sediments at the Amakdedori port site that are relevant to the dock variant are the same as those addressed above for the port.

3.13.5 Action Alternative 2 – North Road and Ferry with Downstream Dams

3.13.5.1 Mine Site

The geology and material sites at the mine site would be the same as for Alternative 1.

3.13.5.2 Transportation Corridor

Roads

Geology of the transportation corridor between the mine site and the Eagle Bay ferry terminal is similar to the geology described for the Iliamna spur road in Alternative 1. Bedrock is overlain by glacial moraine, beach deposits, solifluction, stream channels, and terrace deposits (Figure 3.13-4) (Detterman and Reed 1973).

From the Pile Bay ferry terminal to Williamsport, the transportation corridor would largely follow the existing road underlain by Jurassic (200 to 145 million years old) igneous rock, Quaternary alluvium, talus, and rubble deposits (Detterman and Reed 1980; Wilson et al. 2015).

From Williamsport to the Diamond Point port, the road would cross a slope underlain by Jurassic to Triassic (251 to 200 million years old) igneous volcanic rock and intrusive granodiorite and quartz monzonite, and slightly metamorphosed basaltic flows and sedimentary rocks (Detterman and Reed 1980; Wilson et al. 2015).

Ferry Terminals

The Eagle Bay ferry terminal would be underlain by glacial deposits (Detterman and Reed 1973, 1980). The Pile Bay ferry terminal area is likely Jurassic igneous rocks, and possibly isolated glacial beach deposits (Detterman and Reed 1973, 1980).

Construction Material Sources

Material sources for construction of the transportation corridor from the mine site to Iliamna Lake would be supplied by the material sites in mostly glacial deposits (Detterman and Reed 1973). Construction of the transportation corridor between Williamsport and Diamond Point might also use bedrock that would be removed (excavated or drilled/blasted) to support construction of the roadbed (Detterman and Reed 1980; Wilson et al. 2015).

3.13.5.3 Diamond Point Port

The geology of the Diamond Point port is mapped as Jurassic igneous intrusive rocks (Detterman and Reed 1980; Wilson et al. 2015). Construction of a port facility at Diamond Point would likely require drilling and blasting.

3.13.5.4 Natural Gas Pipeline Corridor

The pipeline would cross beneath Cook Inlet and make landfall on the shore of Ursus Cove. The corridor would then follow a possible geological bedding and/or linear structural feature that is largely overlain by glacial deposits. Cretaceous to Jurassic igneous and volcanic rocks are mapped in the feature (Detterman and Reed 1973, 1980).

Between the Cottonwood Bay and Pile Bay road intersection, the geology of the pipeline corridor is the same as the geology of the transportation corridor. From the Pile Bay road intersection to near Pedro Bay, the corridor is underlain by mostly Cretaceous to Jurassic igneous rocks (Detterman and Reed 1973, 1980).

From Pedro Bay to the western portion of Knutson Bay, the geology consists mostly of surficial glacial deposits and bedrock similar to those found near Pedro Bay. From Knutson Bay to the mine site, the geology consists of surficial glacial deposits, similar to the geology of the Alternative 2 transportation corridor to the Eagle Bay ferry terminal (Detterman and Reed 1973, 1980).

3.13.5.5 Action Alternative 1 – Summer-Only Ferry Operations Variant

The Summer-Only Ferry Operations Variant is not relevant to geology affected environment, and is therefore not addressed in this section.

3.13.5.6 Action Alternative 2 – Pile-Supported Dock Variant

Marine sediments at the Amakdedori port site that are relevant to the dock variant are addressed above under Alternative 1, Amakdedori port.

3.13.6 Action Alternative 3 – North Road Only

3.13.6.1 Mine Site

The geology and construction materials would be the same as those for Alternative 2.

3.13.6.2 Transportation Corridor

The geology of the road from the mine site to near the western portion of Knutson Bay consists of surficial glacial deposits, similar to the geology of the Alternative 2 transportation corridor to the Eagle Bay ferry terminal (Figure 3.13-4). From Knutson Bay to Pedro Bay, the geology consists mostly of surficial glacial deposits and then bedrock, including Cretaceous and Jurassic igneous rocks.

From Pedro Bay to the intersection with the road to Pile Bay, the geology consists of Cretaceous and Jurassic intrusive igneous rocks. From the Pile Bay road intersection to the Diamond Point port site, the transportation corridor would largely follow the existing road, as under Alternative 2 (Detterman and Reed 1973, 1980).

3.13.6.3 Diamond Point Port

The geology and construction material sources for the Diamond Point port site would be the same as for Alternative 2.

3.13.6.4 Natural Gas Pipeline Corridor

The geology and construction material sources would be the same as for Alternative 2.

3.13.6.5 Alternative 3 – Concentrate Pipeline Variant

The concentrate pipeline corridor would follow the same alignment as the transportation and natural gas pipeline corridors for Alternative 2. The geologic environment would therefore be the same.

3.14 SOILS

This section describes the soil types in the project area, and evaluates project disturbance/removal, susceptibility to erosion, and soil chemical quality. In addition, soil conditions such as permafrost and soil impairment from contaminated sites are briefly addressed in this section. Descriptions of unconsolidated overburden at the mine site and other project components are provided in Section 3.13, Geology, and Section 3.15, Geohazards. The Environmental Impact Statement (EIS) analysis area for soils includes all areas that would be disturbed as a result of the project, and addresses all alternatives, components, and variants. Disturbed areas would include locations of removal or subsequent placement of soil.

3.14.1 De Minimis / Insignificant Soil Conditions

Some soil conditions that may be important in other areas of Alaska have minimal presence in the project area, as described below.

3.14.1.1 Permafrost

Permafrost is soil that is permanently frozen. This condition can cause problems during development, because changes to the overlying vegetation can cause a thermal disturbance to this condition, resulting in melting and erosion.

To date, investigations in the project area (including all project components) have not reported widespread permafrost. Small patches of permafrost may occur in the project area; however, occurrence is presumed to be relict permafrost from prior glacial periods (Knight Piésold 2011b). Recorded variations in ground temperature at depth in the mine site study area do not support the presence of permafrost, based on measured mean annual ground temperatures above freezing (39.1 degrees Fahrenheit [°F]). Recorded groundwater temperatures from the deposit area were also above freezing throughout the year. Although such conditions do not preclude the occurrence of small localized areas of permafrost, current conditions do not support permafrost development or wide-spread occurrence. Additional technical discussion regarding potential permafrost occurrence in the study area is provided in Appendix K3.14.

3.14.1.2 Soil Impairments

A review was conducted of the Alaska Department of Environmental Conservation (ADEC) Contaminated Sites Program database (ADEC 2018d). The database lists known contaminated sites and leaking underground storage tanks throughout Alaska. The database provides information regarding the type of contaminant released to the environment; the type(s) of media (air, water, soil, and rock) affected by the contaminant; the potential responsible party for the documented release; and the location where the release occurred. No contaminated site records coincided with or were in proximity to the project footprint.

3.14.2 Alternative 1 – Applicant's Proposed Alternative

3.14.2.1 Mine Site

Soil Types

Available literature directly associated with the mine site and transportation corridor components is limited to the Exploratory Soil Survey of Alaska (ESS), which was completed by the US Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS;

formerly known as the Soil Conservation Service) (Rieger et al. 1979). Literature provided by the National Resource Conservation Service (NRCS) generally covers a variety of baseline soil data intended to assist in land resource planning and management, including classifications based on soil taxonomy, drainage, slopes, vegetative growth potential, and suitability for various land uses and development.

The ESS is not sufficient for site-specific interpretations, but is useful as a general soils map. Although some soils information provided in the ESS does not translate directly to current classification system standards, comparative equivalent soil type estimates can be made. Technical information regarding soil types within the project footprint is provided in Appendix K3.14.

Soils at the mine site are generally well-drained, acidic, gravelly, and formed from volcanic source rocks. Most of the mine site area (approximately 71 percent) is associated with hilly to steep terrain that supports vegetation such as alder, grasses, or low shrubs in a thin surface cover of decomposed plant material. The remaining area (29 percent) is relatively level, with surface features consisting of rolling topography, small lakes, and sedge peat muskegs. More detailed descriptions of soil types and distribution present at the mine site are provided in Appendix K3.14.

Erosion

Erosion resulting from surface and subsurface soil disturbances would be attributed to both wind and hydraulic processes. Numerous conditions can influence a soil's susceptibility to wind and hydraulic erosion. Such conditions include weather (e.g., wind, precipitation), season (e.g., ground freeze), soil type (e.g., texture and cohesion), slope angle and length, vegetative cover, and severity of disturbance. In most circumstances, soil disturbances and subsequent exposure would accelerate erosion by wind and water. Finer-grained soil types such as silt and sand are generally more susceptible to erosion than gravels and coarser material. Flowing water over ground surfaces results in hydraulic erosion that also removes and transports soils. Possible consequences of erosion include sediment loading in surface water runoff, and alteration of soil profile characteristics and ecological communities. Downslope movement of surface materials from other slope instability processes (e.g., landslides, solifluction) is addressed in Section 3.15, Geohazards.

Soil Chemistry

A baseline soil chemistry description is provided for the mine site to compare anticipated effects resulting from the deposition of fugitive dust from sources of concern. Fugitive dust sources of concern at the mine site include mining operations; material (e.g., rock) storage, processing, and handling (including concentrate); tailings storage; and repurposing materials derived from the mine site (e.g., aggregates).

The baseline soil chemistry evaluation is exclusive to the mine site. Further evaluation of limited upland soil chemistry baseline data for the transportation corridor and natural gas pipeline corridor was not conducted because neither of these components is considered to have mechanisms or chemical sources that could result in adverse impacts to soil (Section 4.14, Soils). Furthermore, the limited upland soil chemistry data for the transportation corridor and natural gas pipeline corridor are chemically consistent with those described for the mine site study area (SLR et al. 2011a).

To establish baseline soil chemistry conditions at the mine site, more than 200 shallow surface soil samples (i.e., less than 0.5 foot below ground surface) were collected from a total of 117 locations (SLR et al. 2011a). The samples were analyzed to determine the variability in naturally

occurring constituents (NOCs), which included trace elements, hydrocarbons, total carbon, cyanide, sodium, and ions. Sample results and more detailed discussion are provided in Appendix K3.14.

All trace elements (mostly metals) evaluated were detected in some of the surface samples. Although reported concentrations of most NOCs were generally low and consistent with undeveloped areas of Bristol Bay drainages, analytical results of some sample locations reported elevated NOCs at levels considered elevated in literature. Variations across up to 16 different landform types and 7 different habitat types reportedly influence the ranges of elemental concentrations throughout the study area (SLR et al. 2011a).

Iron and aluminum are the most abundant elements reported throughout the mine site study area surface soils, followed by calcium and magnesium. Concentrations of other trace elements are substantially lower. Trace elements with the lowest average concentrations include mercury and silver. The relative distribution of trace elements in the mine site study area surface soils is generally consistent with those reported across the US, based on published US Geological Survey (USGS) evaluations. Comparison of co-located shallow subsurface soil sample results (18 inches in depth) reported similar relative and mean concentrations of trace elements; however, less variability among sample locations was observed (where present). Notable deviations include those associated with bismuth and mercury. The mean concentration of bismuth and mercury in surface soil is 13; and two times greater, respectively, than shallow subsurface soil (SLR et al. 2011a).

Because arsenic, copper, and lead are considered key trace elements associated with the deposit, additional depth-based and temporal (i.e., yearly) statistical tests were performed to identify differences. The statistical tests identified no significant[1] differences in depth-based or temporal variables (SLR et al. 2011a).

3.14.2.2 Transportation Corridor and Amakdedori Port

Soil Types

Because land-based portions of the natural gas pipeline corridor on the western side of Cook Inlet would be buried in the road bed of the transportation corridor, soil types for both the transportation and natural gas pipeline corridors are collectively described in this section, in addition to those present at the Amakdedori port site.

Based on soil type descriptions provided in the ESS, approximately 60 percent of the soil types (547 acres) associated with the transportation corridor footprint are the same as those described for the mine site. Most of the remaining acreage (328 acres) consists of varying sand, silt, and clay mixtures (i.e., loam) over shallow bedrock or gravel till materials. The soils are generally well-drained, and occur in steep to hilly terrain. A limited occurrence (13.5 acres) of poorly drained organic-rich muskeg soils also coincides with the transportation corridor. Soil type distribution and additional details are provided in Appendix K3.14.

The Amakdedori port site is generally level, and includes upland (shore-based) soil types that transition seaward to intertidal dunes and a gravel-lined shoreline. ESS soil types associated with the Amakdedori port site and immediate area are limited to loamy upland soils with hilly to steep associations.

[1] The term “significant” is used correctly as it applies to statistical testing, p-value.

Erosion

The ESS does not provide wind and water erosion descriptors (i.e., suitability ratings) for all soil types; and where present, are limited to unique physical conditions or soil types. None were listed for map units corresponding to the transportation corridor; however, generalized inferences regarding susceptibility to erosion can be made assuming surface cover would be removed or disturbed. Finer-grained loamy soils over shallow bedrock in hilly or steep terrain are considered to be conditions that would be most susceptible to erosional processes in the transportation corridor (including Amakdedori port site). This is attributed to the erosional susceptibility of finer-grained materials that overlie bedrock conditions that are generally resistant to erosional processes, and potentially facilitate overland flow. Comparatively increased surface water flow velocities associated with hilly to steep terrain would likely increase the susceptibility of soils to erosion. Soils associated with nearly level terrain are likely the least susceptible to hydraulic erosion in the transportation corridor. However, information provided in the ESS is broadly based, and is not intended to be used for site-specific applications.

3.14.2.3 Natural Gas Pipeline Corridor

Soil Types

Because the natural gas pipeline on the eastern side of Cook Inlet would predominantly incorporate existing infrastructure, potential soil disturbances directly associated with the project would be limited to the horizontal directional drilling (HDD) work area and compressor station area. The most detailed resource for soil data in this area is the USDA NRCS Soil Survey of Western Kenai Peninsula Area, Alaska. Available NRCS data for the area include a land capability classification. This classification provides a general suitability index for agriculture or farming (USDA 2005). Soils in the footprint are considered to have severe limitations for these purposes.

Two detailed soil map units coincide with approximately 6 acres of proposed pipeline footprint ground disturbance on the eastern side of Cook Inlet. The soils consist of silt and sand mixtures (i.e., silt loam). Additional details for soils associated with the pipeline infrastructure on the eastern side of Cook Inlet are provided in Appendix K3.14.

Erosion

Soils in the pipeline infrastructure footprint on the eastern side of Cook Inlet predominantly consist of silt and sand mixtures (i.e., silt loam) along slope angles ranging from 0 to 4 percent. The soil is poorly to well-drained, with no flooding or ponding. The soils have a severe susceptibility to wind erosion, assuming disturbance and removal of surface cover, and a “slight” water erosion hazard.

3.14.2.4 Alternative 1 – Summer-Only Ferry Operations Variant

The Summer-Only Ferry Operations Variant would necessitate additional project footprint to store and manage concentrate (see Chapter 2, Alternatives). The soils descriptions provided in this section address the proposed locations where surface soils may be affected by increased project footprint.

3.14.2.5 Alternative 1 – Kokhanok East Ferry Terminal Variant

This area is east of the proposed south ferry terminal site. Soil conditions at the south ferry terminal include soils common to the transportation corridor, but are exclusive to (13.5 acres) varying sand, silt, and clay mixtures (i.e., loam) over shallow bedrock or gravel till materials.

3.14.2.6 Alternative 1 – Pile-Supported Dock Variant

This variant would not cause change in the land footprint of Alternative 1; therefore, soils are the same as those described under Alternative 1.

3.14.3 Alternative 2 – North Road and Ferry with Downstream Dams

3.14.3.1 Mine Site

The downstream dams would necessitate increased project footprint. Soils in the mine site area, described above under Alternative 1, address the proposed locations where surface soils may be affected by increased project footprint.

3.14.3.2 Transportation Corridor and Diamond Point Port

This section addresses the road and pipeline corridor from the mine site to Diamond Point port site.

Soil Types

Approximately one-half of the transportation corridor footprint and Eagle Bay ferry terminal under Alternative 2 consist of the same soil types as those described for the mine site. Approximately one-third of the transportation corridor footprint and Pile Bay ferry terminal footprint consist of well-drained soils on foot slopes associated with hilly to steep terrain. The shallow soils are formed in silty volcanic ash (10 to 24 inches thick) overlying very gravelly glacial till. Based on generalized ESS descriptions, the remaining area in the transportation corridor consists of rough mountainous land along steep rocky slopes overlying shallow bedrock and boulder-sized rock fragments. Less than 1 percent of the total footprint consists of silty loess (20 to 40 inches) over gravelly glacial till to fibrous organic soils in depressions. These soils are associated with level or nearly level terrain, and range from well-drained to very poorly drained soils. Additional soil type details are provided in Appendix K3.14.

Erosion

Soils associated with nearly level terrain are likely the least susceptible to hydraulic erosion in the transportation corridor. Soils considered most susceptible to erosion include those with finer-grained textures (e.g., volcanic ash) that are associated with hilly to steep terrain. This is attributed to the erosional susceptibility of finer-grained materials and comparatively increased surface water flow velocities associated with hilly to steep terrain.

Coarse-grained soil textures or shallow bedrock in rough mountainous terrain should not preclude the potential for erosion susceptibility or location-specific conditions where erosion may be comparatively greater. Enhanced design or stabilization measures may be required on a case-by-case basis to mitigate steep side slopes, cross-slope toe-cuts, or slope failure. Erosion associated with potential high-energy environments in mountainous terrain includes, but is not limited to, increased surface water runoff flow velocities, up- or down-slope failure (e.g., slumping, washout), or impacts to infrastructure from natural process (e.g., landslides).

Because the ESS is broadly based and is not intended to be used for site-specific information, general terrain conditions (e.g., topography) are considered in Section 4.14, Soils.

3.14.3.3 Natural Gas Pipeline Corridor

This section addresses the overland portion of the natural gas pipeline corridor (Diamond Point to Ursus Cove). The pipeline would be constructed below grade along a valley floor, and eventually resurface at the Diamond Point port site after a short marine crossing of Cottonwood Bay. The 5.5 miles of uplands pipeline along this segment coincide with shallow bedrock and coarse soil textures (e.g., boulder and cobble) in rough mountainous terrain; however, it is likely that appreciable gravel/sand-bearing colluvium is present along the valley floor. The pipeline from the port would follow a shared road corridor towards the Pile Bay ferry terminal.

3.14.3.4 Alternative 2 – Summer-Only Ferry Operations Variant

Baseline soil characteristics are the same as described under this variant in Alternative 1.

3.14.3.5 Alternative 2 – Pile-Supported Dock Variant

This variant would not cause change in the land footprint of Alternative 2; therefore, soils are the same described under Alternative 2.

3.14.4 Alternative 3 – North Road Only

The occurrence and distribution of soil types and terrain under Alternative 3 are generally the same as Alternative 2. The primary difference between Alternative 2 and Alternative 3 is a shared overland transportation and pipeline infrastructure under Alternative 3, and absence of ferry terminal infrastructure.

3.14.4.1 Alternative 3 – Concentrate Pipeline Variant

The concentrate pipeline under this variant would follow the same corridor as the north road and natural gas pipeline corridor. The soil characteristics are the same as described for the north access road corridor for Alternative 3.