4.23 WILDLIFE VALUES

The following section provides a description of the potential environmental consequences from the project to non-federally listed birds, terrestrial wildlife, and marine mammals and their habitats. Impacts to federally listed wildlife species are discussed in Section 4.25, Threatened and Endangered Species. Direct and indirect impacts from the project may include the following:

- Behavioral disturbance, including:
  - Noise
  - Presence of humans, vehicles and equipment, vessels, and aircraft
- Injury and mortality, including:
  - Collision with vehicles and equipment, vessels, aircraft, facilities/structures (including disorientation from lighting)
  - Exposure to contamination from pit lake or other project attractants
  - Defense of life and property
  - Spills (see Section 4.27, Spill Risk)
- Habitat changes, including:
  - Habitat loss (including vegetation removal and fill of wetlands)
  - Avoidance of nearby habitat
  - Fragmentation
  - Spills (see Section 4.27, Spill Risk)
  - Fugitive dust impacts (see Section 4.14, Soils; Section 4.22, Wetlands and Other Waters/Special Aquatic Sites; Section 4.26, Vegetation; and Appendix K4.24, Fish Values)
  - Invasive species introduction or spread (see Section 4.26, Vegetation)
  - Changes in water quality and air quality (see Section 4.18, Water and Sediment Quality; and Section 4.20, Air Quality)

Potential direct and indirect impacts are assessed according to four distinct factors: magnitude, duration, extent, and likelihood of occurrence. For wildlife resources, the magnitude of impacts depends on the specific species' sensitivity to the disturbance or change, and the type of disturbance or change. The magnitude for direct impacts to species habitat is presented as the acreage of habitat impacts from the project (the combined acreage of the project footprint for all mine components). The duration of potential impacts is how long the impact persists, which may be for the life of the project or beyond, and may depend on the season in which the impact occurs. Habitat impacts from the project would be temporary and permanent. If habitat impacts would last for the life of the project, they were considered permanent. Temporary habitat impacts would occur throughout the life of the project, such as during the installation of the natural gas pipeline. The extent of impacts varies depending on the specific area of impact in relation to the species' range that may be affected. The Environmental Impact Statement (EIS) analysis area was designed to encompass the full extent of impacts that species may experience from the project while present in the EIS analysis area. The likelihood of impacts is the potential that the impact would occur to the species or habitat if the alternative or variant were to be constructed and operated. Generally, impacts were considered likely to occur, if the project were to be constructed.

Impacts to vegetation, wetlands, and waterbodies are not detailed herein, but described where appropriate as they relate to impacts to wildlife habitat. Impacts to vegetation communities are detailed in Section 4.26, Vegetation; and impacts to wetlands are detailed in Section 4.22, Wetlands and Other

Waters/Special Aquatic Sites. Some impacts to vegetation and wetlands that may indirectly impact wildlife species, such as impacts from fugitive dust and invasive species, are discussed below.

Additionally, several potential spill scenarios were evaluated for their impacts on biological resources. Spill risk was evaluated for the following substances: diesel fuel, natural gas, copper-gold ore concentrate, chemical reagents, bulk and pyritic tailings, and untreated contact water. The substances analyzed do not include all of the hazardous materials that would be used for the project. The substances selected were based on their spill potential and potential spill consequences. Potential impacts to wildlife resources (including the interrelated impacts to prey resources) from various spill scenarios are not discussed in this impact analysis, but are detailed in Section 4.27, Spill Risk.

Impacts to fish are not detailed herein, but described where appropriate as they relate to impacts to fish habitat. Impacts to fish and habitat are detailed in Section 4.24, Fish Values. These impacts to fish would directly impact wildlife species that rely on them.

4.23.1 Analysis Area

The EIS analysis area for wildlife includes the project footprint for each alternative and the extended geographic area where impacts to wildlife are considered for the life of the project. The analysis area generally encompassed the extent of potential project impacts apart from those related to spills, which are discussed in Section 4.27, Spill Risk. Potential impacts from various spill scenarios have a different analysis area that is detailed in Section 4.27, Spill Risk.

The EIS analysis area for wildlife varied depending on the species and project component due to differences in species biology and potential impacts from different project components. Table 4.23-1 details the analysis area per species group and project component. Various buffers that have been placed around the project components are defined as the radial distances of the outermost extent of the project component footprint, and encompass both permanent and temporary impacts. It is understood that large terrestrial wildlife and marine mammals have large home ranges. The analysis area is not meant to encompass the home range of all species. Rather, wildlife that occur in and transit through the analysis area may be exposed to a variety of impacts from the project, and then move beyond/outside of the analysis area. All project components and alternatives in the marine environment of Cook Inlet have the same analysis area.

Table 4.23-1: Analysis Area per Species/Group and Project Component

Species Group	Mine Site	Transportation and Natural Gas Pipeline Corridor	Port	Lightering Locations
Raptors	10-mile radius	3-mile radius	3-mile radius	1-mile radius
Waterbirds[1]	10-mile radius	1-mile radius	1-mile radius	1-mile radius
Landbirds and Shorebirds	10-mile radius	1-mile radius	1-mile radius	1-mile radius
Terrestrial Mammals	10-mile radius	3-mile radius	3-mile radius	None
Marine Mammals	None	The western portion of lower Cook Inlet south to Cape Douglas plus three shipping routes (6.4 nautical miles [7.4 miles] in width) from the mouth of lower Cook Inlet south and west out to the edge of the exclusive economic zone. For harbor seals in Iliamna Lake, a 1-mile buffer around the ferry and natural gas pipeline routes was selected as the analysis area.		

Note:

[1] Because waterbirds occur both in the terrestrial environment and the marine environment, the analysis area for waterbirds in Cook Inlet encompasses the same area as marine mammals: Kamishak Bay south to Cape Douglas.

For the mine site, a 10-mile-radius buffer was applied as the analysis area to encompass impacts such as noise from project activities (including blasting), light pollution, fugitive dust, loss and alteration of habitat, and other impacts. For the transportation and natural gas pipeline corridor and port, a 3-mile-radius buffer was applied for raptors and terrestrial mammals due to their large home ranges and potential impacts from noise, and loss of nesting, denning, migrating, and foraging locations. Waterbirds, landbirds, and shorebirds had a 1-mile-radius buffer in the transportation and natural gas pipeline corridor analysis area due to their smaller home range sizes.

All project components and alternatives in the marine environment of Cook Inlet and beyond have the same analysis area. The analysis area includes all activities associated with pipeline construction, operation, maintenance/repair, and monitoring, as well as potential project-related vessel and aircraft routes. Specifically for marine mammals, the analysis area includes marine waters crossed by concentrate bulk carriers traveling from Cook Inlet through Shelikof Strait and the Aleutian Islands, and marine line haul barges from Cook Inlet to West Coast ports traveling either through the Pacific Ocean, or near the coast through the Gulf of Alaska and southeast Alaska. The shipping lanes are approximately 6.4 nautical miles wide (7.4 miles), and include the area of ensonification from vessels during all project activities. The shipping lanes are defined in PLP 2020-RFI-163 and buffered to include an area of ensonification. The analysis area for non-Threatened and Endangered Species (TES) of marine mammal is the same for TES of marine mammal; specific details for how the analysis area in the marine environment was determined are provided in Section 4.25, Threatened and Endangered Species. The analysis area for waterbirds in Cook Inlet encompasses the same area as marine mammals: Kamishak Bay south to Cape Douglas.

The analysis area in Cook Inlet includes a vessel corridor from Nikiski south to Kamishak Bay, and most of the western portion of lower Cook Inlet. The analysis area encompasses Kamishak Bay and includes all marine components during all phases of the project (construction, operations, and closure). This includes installation of the natural gas pipeline, projected flight paths in and out of the airstrip at Amakdedori, and project-related vessel traffic between the port and lightering locations. The analysis area excludes eastern lower Cook Inlet, where there are well-established shipping lanes for non-project-related vessel traffic (Nuka and Pearson 2015). The analysis area does not change regardless of the alternative or variants considered, and encompasses the extent of potential project-related impacts that are reasonably expected to occur. Many wildlife species have a much larger range than the analysis area; however, this section focuses on species that have the potential to be present in the area during project construction, operations, and closure.

The analysis area for wildlife species varies slightly depending on the geographic extent of the alternative variants considered. That is, the radius buffer area was expanded slightly to accommodate each variant, thereby increasing the analysis area. A figure of the variants is provided in Chapter 2, Alternatives, and the variants are shown on figures in Section 3.23, Wildlife Values. There are no variants considered for Alternative 1a. For Alternative 1, there are three variants (Summer-Only Ferry Operations Variant, Kokhanok East Ferry Terminal Variant, and Pile-Supported Dock Variant); for Alternative 2—North Road and Ferry with Downstream Dams, there are three variants (Summer-Only Ferry Operations Variant, Newhalen River North Crossing Variant, and Pile-Supported Dock Variant); and for Alternative 3 —North Road Only, there is one variant (Concentrate Pipeline Variant). Potential direct and indirect impacts to wildlife species from the specific variants are discussed at the end of each alternative section. Impacts to all wildlife species from each variant are discussed collectively, and not subdivided based on species grouping (birds, terrestrial wildlife, and marine mammals), because many of the impacts from the variants would be similar across species groups.

Scoping comments were received related to potential impacts to wildlife (including terrestrial and marine mammals), and on potential impacts to migratory birds and waterfowl populations; abundance, diversity, migratory patterns, and potential for displacement; and attraction of birds to tailing ponds. Specific comments related to bears included concerns for human safety from bears that move between Amakdedori port and McNeil River State Game Refuge and Sanctuary; that the road and Amakdedori port and the mine access roads could change brown bear (*Ursus arctos*) migration and result in brown bear habitat fragmentation and mortalities; and bears could become food conditioned, resulting in bear mortality. Regarding marine mammals, comments expressed concerns that the ferry could strike harbor seals (*Phoca vitulina*) in Iliamna Lake; the EIS should incorporate traditional knowledge on harbor seals in the lake; and that the transportation of mining materials across Cook Inlet and Iliamna Lake could affect local marine mammals due to increased underwater noise. Specific concerns regarding birds were that birds could be exposed to contaminants in tailing ponds, and that bald eagles (*Haliaeetus leucocephalus*) and golden eagles (*Aquila chrysaetos*) would be impacted by the project, along with seabird colonies in Kamishak Bay. Caribou (*Rangifer tarandus*) were also a concern for commenters; specifically, traditional calving grounds for the Mulchatna caribou herd, which are in the analysis area. Comments also expressed concern that exploration activities at the site have caused caribou to avoid the area.

4.23.2 Summary of Key Issues

Table 4.23-2 summarizes the key issues for wildlife resources from each alternative and their variants. The direct loss of habitat acreages from all project components is provided in Table 2-2 of Chapter 2, Alternatives, and summarized at the end of the table below. Impacts to marine mammals and waterbirds would be similar to those detailed for federally listed marine mammals and birds described in Section 4.25, Threatened and Endangered Species.

Table 4.23-2: Summary of Key Issues for Wildlife Resources

Impact From Project Component	Alternative 1a	Alternative 1 and Variants	Alternative 2 and Variants	Alternative 3 and Variant
Mine Site				
Behavioral changes	Avoidance of the mine site by terrestrial wildlife and bird species during construction, operations, and closure. Some species may return to formerly used and newly created habitats during and after various components have been reclaimed. There would be no behavioral changes from any of the variants at the mine site. This impact does not apply to marine mammal species because they do not occur in the mine site.			
Injury and mortality	During construction, operations, and closure, direct mortality to some terrestrial wildlife and bird species may occur through vegetation clearing and collisions with vehicles, equipment, and structures. Potential exists for bears to be killed in defense of life and property. Additional mortality may occur due to altered predator and prey relationships. There would be no additional injury or mortality from any of the variants at the mine site. This impact does not apply to marine mammal species because they do not occur in the mine site.			
Habitat changes	Direct loss of 8,390 acres of habitat. Indirect loss of additional habitat surrounding the mine site. project-related noise, lighting, fugitive dust (estimated as a	Loss of 8,390 acres of habitat. *Summer-Only Ferry Operations Variant* would result in loss of 8,424 acres. *Kokhanok East Ferry Terminal Variant* and *Pile-Supported Dock*	Loss of 8,497 acres of habitat. *Summer-Only Ferry Operations Variant* would result in loss of 8,530 acres. *Newhalen River North Crossing Variant* and *Pile-Supported Dock*	Loss of 8,390 acres of habitat. *Concentrate Pipeline Variant* would result in loss of 8,392 acres. Indirect loss of additional habitat surrounding the mine site due to behavioral

Table 4.23-2: Summary of Key Issues for Wildlife Resources

Impact From Project Component	Alternative 1a	Alternative 1 and Variants	Alternative 2 and Variants	Alternative 3 and Variant
	330-foot buffer around the mine site), etc.	*Variant* would not result in additional changes at the mine site. Indirect loss of additional habitat surrounding the mine site due to behavioral avoidance from project-related noise, lighting, fugitive dust (estimated as a 330-foot buffer around the mine site), etc.	*Variant* would not result in additional changes at the mine site. Indirect loss of additional habitat surrounding the mine site due to behavioral avoidance from project-related noise, lighting, fugitive dust (estimated as a 330-foot buffer around the mine site), etc.	avoidance from project-related noise, lighting, fugitive dust (estimated as a 330-foot buffer around the mine site), etc.
Transportation Corridor				
Behavioral changes	Traffic volumes, at 35 round-trip truck trips per 24-hour day (approximately one vehicle passing in one direction every 21 minutes if evenly spaced running 24 hours) would be anticipated to disturb wildlife while vehicles are passing. Vehicles may travel in groups, therefore, intervals between vehicles may be greater. There would be additional light vehicle traffic (i.e., vehicles other than large trucks transporting concentrate, fuel, and consumables) along the transportation corridor, which would add an unknown number of additional daily vehicle trips. Terrestrial wildlife would avoid the project components due to increased noise, vehicle, fugitive dust, and human presence. In particular, brown bears may den farther away from the transportation corridor, especially the port access road.	Similar to Alternative 1a with a slightly longer road. Physical presence of vessels over 18 miles of travel, and aircraft, may displace harbor seals that inhabit Iliamna Lake. *Summer-Only Ferry Operations Variant* would result in traffic volumes at 70 round-trip truck trips per 24-hour day (one vehicle every 10 minutes) plus an unknown amount of additional light vehicle traffic. *Kokhanok East Ferry Terminal Variant* would not result in additional behavioral changes; however, due to the difference in geographical area covered by this variant, behavioral changes would be shifted north around Kokhanok. Physical presence of vessels over 27 miles of travel, and aircraft, may displace harbor seals that inhabit Iliamna Lake.	Similar to Alternative 1a but with a shorter road. Physical presence of vessels over 29 miles of travel, and aircraft, may displace harbor seals that inhabit Iliamna Lake. *Summer-Only Ferry Operations Variant* would result in traffic volumes at 70 round-trip truck trips per 24-hour day (one vehicle every 10 minutes). *Newhalen River North Crossing Variant* would not result in additional behavioral changes, although any impacts to wildlife would be shifted slightly north.	Similar to Alternative 1a, but no impacts to Iliamna Lake seals due to lack of ferry in Iliamna Lake but a longer road. *Concentration Pipeline Variant* would result in a reduction of truck trips to 18 per 24-hour day, which equates to one vehicle per 40 minutes, plus an unknown amount of additional light vehicle traffic.

Table 4.23-2: Summary of Key Issues for Wildlife Resources

Impact From Project Component	Alternative 1a	Alternative 1 and Variants	Alternative 2 and Variants	Alternative 3 and Variant
	Physical presence of vessels has the potential to cause disturbances to mother and pup pairs of harbor seals which can lead to pup abandonment and death of the pup. Physical presence of vessels over 28 miles of travel, and aircraft, may displace harbor seals that inhabit Iliamna Lake.			
Injury and mortality	Underwater noise from vessels may exceed disturbance thresholds as defined by regulatory agencies.			
	Potential for terrestrial wildlife collisions with vehicles across 74 miles of road. Potential for harbor seals that inhabit Iliamna Lake to collide with vessels during construction and operation over 28 miles of travel across Iliamna Lake.	Potential for terrestrial wildlife collisions with vehicles across 77 miles of road. Potential for harbor seals that inhabit Iliamna Lake to collide with vessels during construction and operations over 18 miles of travel across Iliamna Lake. *Summer-Only Ferry Operations Variant* may increase collisions for wildlife species (such as brown bears) because traffic would be doubled, but may reduce injury and mortality for species such as moose, which are easier to see during the summer (because there would be no truck traffic in winter). Either one large ferry making two round-trips; or two ferries making one round-trip per day. *Kokhanok East Ferry Terminal Variant* would reduce total length of road to 70 miles, and therefore reduce the potential for collisions. However, it would increase the length of	Potential for terrestrial wildlife collisions with vehicles across 54 miles of road. Potential for harbor seals that inhabit Iliamna Lake to collide with vessels during construction and operations over 29 miles of travel across Iliamna Lake. *Summer-Only Ferry Operations Variant* may increase collisions for wildlife species (such as brown bears) because traffic would be doubled, but may reduce injury and mortality for species such as moose, which are easier to see during the summer (because there would be no truck traffic in winter). There would be no change in the ferry route; however, there would be either one large ferry making two round-trips per day on average; or two ferries making one round-trip each per day. This may increase the potential for harbor seal impacts during summer months.	Potential terrestrial wildlife collisions with vehicles across 83 miles of road. There would be no impact to harbor seals that inhabit Iliamna Lake due to lack of a ferry. *Concentrate Pipeline Variant* would reduce the number of truck-trips, and therefore reduce the potential for injury and mortality for all terrestrial species.

Table 4.23-2: Summary of Key Issues for Wildlife Resources

Impact From Project Component	Alternative 1a	Alternative 1 and Variants	Alternative 2 and Variants	Alternative 3 and Variant
		the ferry crossing to 27 miles, and would be closer to harbor seal locations in Iliamna Lake.	There would be no impact to harbor seals from an ice-breaking ferry during the winter because it would not operate during the winter. *Newhalen River North Crossing Variant* would not result in additional injury and mortality.	
Habitat changes	Loss of 1,193 acres (inclusive of 380 acres from material sites and 30 acres from the ferry terminals) of terrestrial wildlife and bird habitat. Additional terrestrial wildlife avoidance of surrounding habitat. Small amount of habitat loss along the shore of Iliamna Lake from ferry terminals for harbor seals. Potential impacts to prey species as a result of turbidity from construction and routine operations of the ferry terminals.	Loss of 1,171 acres (inclusive of 251 acres from material sites and 27 acres from the ferry terminals) of terrestrial wildlife and bird habitat. Additional terrestrial wildlife avoidance of surrounding habitat. Small amount of habitat loss along the shore of Iliamna Lake from ferry terminals for harbor seals. Potential impacts to prey species as a result of turbidity from construction and routine operations of the ferry terminals. *Summer-Only Ferry Operations Variant* and *Pile-Supported Dock Variant* would not change the amount of habitat impacted. *Kokhanok East Ferry Terminal Variant* would result in 1,205 acres (inclusive of 358 acres from material sites and 19 acres from the ferry terminals) of habitat loss.	Loss of 912 acres (inclusive of 321 acres from material sites and 25 acres from the ferry terminals) of terrestrial wildlife and bird habitat. Additional terrestrial wildlife avoidance of surrounding habitat. Small amount of habitat loss along the shore of Iliamna Lake from ferry terminals for harbor seals. Potential impacts to prey species as a result of turbidity from construction and routine operations of the ferry terminals. *Summer-Only Ferry Operations Variant* would increase habitat loss to 934 acres (inclusive of 321 acres from material sites and 25 acres from ferry terminals). *Pile-Supported Dock Variant* would not change the amount of habitat impacted. *Newhalen River North Crossing Variant* would result in 932 acres of impacts (inclusive of 338 acres from material sites and 25 acres from ferry terminals).	Loss of 1,641 acres (inclusive of 604 acres from material sites) of terrestrial wildlife and bird habitat. Additional terrestrial wildlife avoidance of surrounding habitat. *Concentrate Pipeline Variant* would result in additional habitat loss from increasing width of the access road by 3 feet.

Table 4.23-2: Summary of Key Issues for Wildlife Resources

Impact From Project Component	Alternative 1a	Alternative 1 and Variants	Alternative 2 and Variants	Alternative 3 and Variant
Port				
Behavioral changes	Terrestrial wildlife avoidance of area. Underwater noise from construction, operations, and closure may exceed disturbance thresholds for marine mammals as defined by the USFWS and NMFS. Physical presence of vessels and aircraft (mainly during construction) may displace marine species, including disturbances to harbor seal mother and pup pairs.	Same as Alternative 1a. *Pile-Supported Dock Variant* would not result in additional behavioral changes.	Same as Alternative 1a. Maintenance dredging of the navigation channel would cause disturbance to nearby marine mammals during dredging activities. *Pile-Supported Dock Variant* would not result in additional behavioral changes.	Same as Alternative 1a. Maintenance dredging of the navigation channel would cause disturbance to nearby marine mammals during dredging activities. *Concentrate Pipeline Variant* would not result in additional behavioral changes.
Injury and mortality	Potential for terrestrial wildlife to be killed in defense of life and property at the port. Potential for bird species to collide with port infrastructure (including the lighted navigation buoys and the communications tower), and vessels. Potential for vessels to collide with marine mammals. Potential for disturbance to harbor seal mother and pup pairs, which can lead to pup abandonment and death of the pup.	Similar to Alternative 1a. The underwater noise from construction (sheet pile-driving) may exceed injury thresholds for marine mammals as defined by the USFWS and NMFS. *Pile-Supported Dock Variant* construction would have a potential to result in injury and mortality to marine mammals.	Similar to Alternative 1a, except there would be no lighted navigation buoys at Diamond Point port, and therefore no collision hazard. The underwater noise from construction (sheet pile-driving) may exceed injury thresholds for marine mammals as defined by the USFWS and NMFS. *Pile-Supported Dock Variant* construction would have a potential to result in injury and mortality to marine mammals.	Similar to Alternative 1a, except there would be no lighted navigation buoys thereby reducing the collision hazard for birds. *Concentrate Pipeline Variant* would not result in changes to injury and mortality.
Habitat changes	Loss of 22 acres of terrestrial wildlife habitat (including the port facilities and airstrip) and 2 acres of benthic marine habitat.	Loss of 22 acres of terrestrial wildlife habitat (port facilities and airstrip) and 11 acres of benthic marine habitat. *Summer-Only Ferry Operations Variant* would result in 49 acres of habitat loss to the terrestrial environment	Loss of 41 acres of terrestrial wildlife habitat and 70 acres of benthic marine foraging habitat. Maintenance dredging approximately every 5 years of the navigation channel would cause habitat disturbance. *Summer-Only Ferry Operations Variant*	Loss of 32 acres of terrestrial wildlife habitat and 79 acres of benthic marine foraging habitat. Maintenance dredging approximately every 5 years of the navigation channel would cause habitat disturbance. *Concentrate Pipeline*

Table 4.23-2: Summary of Key Issues for Wildlife Resources

Impact From Project Component	Alternative 1a	Alternative 1 and Variants	Alternative 2 and Variants	Alternative 3 and Variant
		and 11 acres of benthic marine habitat. *Kokhanok East Ferry Terminal Variant* would not cause any habitat changes. *Pile-Supported Dock Variant* would result in less than 0.1 acre of benthic marine habitat loss in addition to the 22 acres of terrestrial wildlife habitat loss.	would not cause any habitat changes. *Pile-Supported Dock Variant* would result in 102 acres of impact.	*Variant* would result <1 acre larger port footprint.
Lightering Locations and Lighted Navigation Buoys				
Behavioral changes	Avoidance of lightering locations and the immediate vicinity while vessels are moored and loading concentrate. There would be no changes from any of the variants.			*Concentrate Pipeline Variant* would be similar to the other Alternatives, except there would be fewer lightering barge trips, and therefore a reduced potential for behavioral changes.
Injury and mortality	Potential for entanglement with anchor mooring buoy cables at lightering locations. Potential for injury or mortality during all project phases while vessels transit to and from the lightering locations. During operations, 27 concentrate vessel shipments would depart the lightering locations annually. Each concentrate vessel would be moored for 4 to 5 days and require 10 lightering trips to fill each concentrate vessel. An additional 33 supply barges (inclusive of 4 fuel barges) would be required annually to supply consumables, fuel, reagent, etc. This equates to 330 annual project-related vessel trips in the analysis area. There would also be oceanic tugboats to pull the supply barges and port-based tugboats to assist the bulk carrier with mooring and to move the lightering barges. There would be no changes from any of the variants.			Potential for entanglement with anchor mooring buoy cables at the lightering location in Iniskin Bay. The likelihood of entanglement would be less compared to other alternatives due to one less lightering location. Potential for injury or mortality during all project phases while vessels transit to and from the lightering location in Iniskin Bay. The same number of concentrate vessels, supply barges, lightering trips, and tugboats as the other alternatives. *Concentrate Pipeline Variant* Each concentrate vessel requires between 5 and 6 lightering trips to fill each concentrate vessel. An additional 33 supply barges (inclusive

Table 4.23-2: Summary of Key Issues for Wildlife Resources

Impact From Project Component	Alternative 1a	Alternative 1 and Variants	Alternative 2 and Variants	Alternative 3 and Variant
				of 4 fuel barges) would be required annually to supply consumables, fuel, reagent, etc. This equates to approximately 222 annual project-related vessel trips during operations in the analysis area, which is a reduction compared to the other alternatives.
Habitat changes	Loss of 0.15 acre of benthic marine habitat from the two lightering location mooring buoy anchors and minor loss of habitat from lighted navigation buoy anchors. There would be no changes from any of the variants.			Loss of 0.07 acre of benthic marine habitat from the single lightering location mooring buoy anchors. No lighted navigation buoys are necessary for the Diamond Point port. There would be no changes from the variant.
Natural Gas Pipeline and Fiber-Optic Cable				
Behavioral changes	Avoidance of 193 miles during construction for wildlife species. Physical presence of vessels and aircraft may displace marine species.	Similar to Alternative 1a with avoidance of 187 miles during construction for wildlife species. *Summer-Only Ferry Operations* and *Pile-Supported Dock Variants* would not result in additional behavioral changes. *Kokhanok East Ferry Terminal Variant* would be 185 miles long.	Similar to Alternative 1a with avoidance of 164 miles during construction for wildlife species. *Summer-Only Ferry Operations*, *Newhalen River North Crossing Variant*, and *Pile-Supported Dock Variants* would not result in additional behavioral changes.	Similar to Alternative 1a with avoidance of 164 miles during construction for wildlife species. *Concentrate Pipeline Variant* would not result in additional behavioral changes.
Injury and mortality	Potential for wildlife to collide with vessels and equipment during construction and pipeline installation. During construction, underwater noise levels (which would vary with different dredging technologies) may exceed the disturbance thresholds as defined by USFWS and NMFS.	Same as Alternative 1a with the same pipeline and fiber-optic cable installation techniques. *Summer-Only Ferry Operations*, *Kokhanok East Ferry Terminal*, and *Pile-Supported Dock Variants* would not result in additional injury and mortality.	Similar to Alternative 1a, but to a lesser extent because the pipeline and fiber-optic cable are shorter. *Summer-Only Ferry Operations*, *Newhalen River North Crossing Variant*, and *Pile-Supported Dock Variants* would not result in additional injury and mortality.	Same as Alternative 2. *Concentrate Pipeline Variant* would not result in additional injury and mortality.

Table 4.23-2: Summary of Key Issues for Wildlife Resources

Impact From Project Component	Alternative 1a	Alternative 1 and Variants	Alternative 2 and Variants	Alternative 3 and Variant
Habitat changes	Loss of 3 acres of permanent habitat (from compressor station and Iliamna Lake crossing) plus temporary impacts during pipeline trenching.	Loss of 7 acres of permanent habitat (from compressor station and Iliamna Lake crossing) plus temporary impacts during pipeline trenching. *Summer-Only Ferry Operations* and *Pile-Supported Dock Variants* would not result in additional habitat changes. *Kokhanok East Ferry Terminal Variant* would have a slightly different pipeline alignment, but acreage of impacts would be similar.	Loss of 308 acres of permanent habitat (from compressor station and material sites) plus temporary impacts during pipeline trenching. *Summer-Only Ferry Operations*, *Newhalen River North Crossing Variant*, and *Pile-Supported Dock Variants* would not result in additional habitat changes.	Loss of 13 acres of permanent habitat (from compressor station and material sites) plus temporary impacts during pipeline trenching. *Concentrate Pipeline Variant* would not result in additional habitat loss.
Total Direct Impacts				
Total Direct Impact Footprint	***Alternative 1a*** 9,611 acres	***Alternative 1*** 9,600 acres ***Alternative 1—Kokhanok East Variant*** 9,635 acres ***Alternative 1—Summer-Only Ferry Operations Variant*** 9,661 acres ***Alternative 1—Pile-Supported Dock Variant*** 9,589 acres	***Alternative 2*** 9,763 acres ***Newhalen River North Crossing Variant*** 9,783 acres ***Alternative 2—Summer-Only Operations Variant*** 9,819 acres ***Alternative 2—Pile-Supported Dock Variant*** 9,753 acres	***Alternative 3*** 10,130 acres ***Alternative 3—Concentrate Pipeline Variant*** 10,132 acres

Notes:

NMFS = National Marine Fisheries Service
USFWS = US Fish and Wildlife Service

4.23.2.1 Mitigation

Potential project impacts were evaluated based on Pebble Limited Partnership (PLP)'s committed measures, which are detailed in Chapter 5, Mitigation, in Table 5-2. Mitigation measures related to wildlife include the following:

General Wildlife Measures:

- A Wildlife Interaction Plan (WIP) would be developed and implemented to minimize human-wildlife interactions and resolve any potential conflicts. The goal of the plan would be to prevent problems resulting from human-wildlife interactions to a manageable and acceptable level, and to ensure that wildlife can continue to thrive in the project area. This plan would be managed through an adaptive management approach. Wildlife report sightings and interactions reported would be used to assess the effectiveness of mitigation measures, or guide project personnel in the establishment of additional mitigation measures as required. This plan would describe education and training for project personnel and contractors, control measures to avoid and minimize human-wildlife interactions deterrence and hazing procedures for reporting wildlife sightings and interactions, and an adaptive management approach. Measures from RFI 122 would be incorporated into the project's WIP (PLP 2019-RFI 122).

  Amakdedori Port Wildlife Safety (specific to Alternative 1a and Alternative 1):

  - The port facility would be fenced-in using chain-link fences and possibly electrical fences. The road entrance would have a gate, and the fence would extend onto the causeway as needed to limit access from the intertidal zone.

  Transportation Corridor Wildlife Safety:

  - Wildlife present on the road would be given the right-of-way. Traffic would stop, if necessary, to allow the safe passage of wildlife (e.g., a bear or moose crossing, or walking along, the road).
  - The maximum speed limit for the road system would be set at 35 miles per hour (mph). Speed limits would be reduced as required in areas of high seasonal wildlife use and at known crossing points. Vehicle speeds would be posted along the road, and all drivers would be monitored using mobile global positioning system (GPS) fleet tracking technology to ensure compliance.
  - As practical, snowbank height during the winter would be minimized to increase driver visibility.
  - Any wildlife injuries or mortalities would be immediately reported as appropriate. The carcasses of any road-killed animals would be removed and disposed of in a timely manner so that they do not serve as an attractant to bears or other wildlife. PLP would coordinate with the Alaska Department of Fish and Game (ADF&G) on the salvage of fresh, useable game species for community food.

  Food and Garbage Management:

  - Feeding and attracting of wildlife by project personnel would be prohibited.
  - Food would be kept inside buildings and only permitted inside vehicles for short periods, when workers are unable to use the dining facilities. Food and garbage would be disposed of in dedicated trash containers at each site, and routinely emptied to limit buildup of odors that could attract wildlife.
  - Trash containers inside fenced areas would be located away from the fence line to minimize wildlife attraction.

  - Any food wastes that could attract wildlife would be temporarily stored in enclosed containers, and periodically backhauled to the mine site for incineration and disposal.

- Employees and contractors would be instructed on relevant rules and regulations that protect wildlife. See the US Fish and Wildlife Service (USFWS) webpage on regulations and policies (https://www.fws.gov/birds/policies-and-regulations.php).
- Specific wildlife awareness training would be required for drivers operating in the area.
- Winter management of snow berms along roadways would include periodic breaks or cleared areas in snow berms to allow wildlife to get off the road during the approach of oncoming vehicles.
- PLP would evaluate the use of wildlife detection systems at identified high-traffic animal crossings. Animal detection systems use sensors to detect large animals that approach the road. Once a large animal is detected, warning signals are activated to inform the drivers that a large animal may be on or near the road at that time.
- PLP prepared an Invasive Species Management Plan (ISMP) (PLP 2019-RFI 133). PLP would implement the ISMP through training and communicating with project personnel and contractors throughout the life of the project, including during planning, construction, operations, reclamation, and closure. The goal of the ISMP is to prevent, minimize, and control the spread of invasive species. It includes training requirements, development of a Hazard Analysis and Critical Control Point plan prior to construction, prevention measures, early detection and rapid response, and control treatment options.
- A conceptual Fugitive Dust Control Plan (FDCP) has been prepared to identify project design features and best management practices (BMPs) that would be implemented to minimize fugitive dust emissions (PLP 2019-RFI 134).
- The project would have a no hunting, fishing, or gathering policy for non-local employees.
- To detect changes to water quality and its effects to fish and wildlife, water quality would continue to be monitored on a regular basis until the mine reclamation is complete. Results would be reported to the State of Alaska in compliance with permit requirements and management plans.
- The project would provide for controlled use of the road corridor and ferry for local residents, improving the supply of goods and reducing the cost of importing goods. Controlled use could include scheduled convoys for the transport of private vehicles and supplies, qualification and limited-use authorization of third-party vehicles and drivers using the access infrastructure, or other similar arrangements.

Measures Specific to Brown Bears:

- A detailed bear interaction plan designed to minimize conflicts between bear and humans would be incorporated into the WIP. PLP would coordinate with ADF&G on development of this plan.
- Bear-proof containers and bear-proof trash receptacles would be used for food and garbage. Food would only be left inside vehicles or other unsecured locations when staff are present and can remove the food source in response to wildlife attracted to the food source.
- PLP would consult with ADF&G on additional wildlife surveys that may be required prior to construction. Bear denning surveys would be updated prior to construction.
- Encounters with an occupied brown bear den that has not previously been identified by ADF&G would be reported to the Division of Wildlife Conservation, ADF&G, within 24 hours. Mobile activities would avoid such discovered occupied dens by 0.5 mile unless

alternative mitigation measures are approved with concurrence from ADF&G. Non-mobile facilities would not be required to relocate. Before commencement of any activities, PLP would consult with ADF&G to identify locations of brown bear den sites. Additional surveys may be required pre- and post-construction to determine denning areas and changes in denning use due to project impacts.

- Mandatory training would be required for mine workers on ethical behavior around brown bear populations (e.g., strict use of bear-safe trash cans; strict prohibition of bear feeding and harassing).

Measures Specific to Aircraft and Helicopter Use:

- PLP would employ protocols to ensure that helicopters and fixed-wing planes do not harass wildlife. These protocols, listed below, would remain in place throughout construction and the life of the mine.
    - Do not harass or pursue wildlife.
    - Fly 500 feet above ground level, or higher when possible and safe to do so.
    - When wildlife (especially bears, caribou, moose, wolves, raptor nests, flocks of waterfowl, seabirds, or marine mammals) are observed, avoid flying directly overhead and maximize lateral distance.
    - Appropriate flight restrictions (e.g., elevation restrictions) would be established to reduce caribou hunting impacts.

Measures Specific to Avian Species:

- BMPs and design guidelines would incorporate avian protection for all powerlines.
- PLP would follow BMPs with respect to powerline design and placement to minimize the potential for bird collisions. This could include the use of flight diverters and other deterrent devices.
- The 100- to 150-foot-tall monopole communications tower at the port would be marked with high-visibility paint bands and may include flashing red lights at the top (if required), in accordance with Federal Aviation Administration (FAA) and USFWS guidance.
- PLP would follow USFWS Land Clearing Timing Guidance for Alaska to avoid destruction of active bird nests.
    - https://www.fws.gov/alaska/pages/nesting-birds-timing-recommendations-avoid-land-disturbance-vegetation-clearing

Measures Specific to Marine Mammals:

- All project-related vessel traffic would be restricted to 10 knots or less when west of the vertical line 153°15′0″ W (Kamishak Bay) to minimize the potential for impacts with marine wildlife.
- Additional measures would be developed through the consultation process with the USFWS and the National Marine Fisheries Service (NMFS) (for threatened and endangered species), which would also benefit non-listed wildlife species, especially marine mammals. The measures detailed in the draft biological assessments for USFWS and NMFS are included in Appendix G and Appendix H, respectively. The measures in the draft biological assessments are not final until the conclusion of the consultation process, and additional reasonable and prudent measures may be added.
- Additional measures would be developed during the application process for marine mammals protected by the Marine Mammal Protection Act (MMPA).

4.23.3 No Action Alternative

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

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

4.23.4 Alternative 1a

4.23.4.1 Birds

The project has the potential to directly and indirectly impact breeding, wintering, migrating, and staging bird populations through behavioral disturbance, injury and mortality, and habitat changes as detailed in the following sections. The magnitude, duration, extent, and likelihood of impacts to raptors, waterbirds, landbirds, and shorebirds would be anticipated to differ among individual species; however, impacts are discussed collectively herein for the majority of avian groups. Additionally, potential impacts at the mine site, transportation and natural gas pipeline corridors, and the Amakdedori port are discussed collectively under each project component. In terms of likelihood, impacts as described in the following sections would be expected to occur if the project is permitted and constructed.

Behavioral Disturbance

Noise

All project phases and components would result in elevated noise levels (above current ambient levels of 35 A-weighted decibels [dBA] day-night average sound levels) from a variety of sources (e.g., blasting activities in the open pit, aircraft, vehicles, construction equipment, barges and other oceanic vessels, operations-related noise), and would occur in varying levels throughout the life of the project. In terms of magnitude and extent, noise levels would be increased above present levels (detailed in Section 4.19, Noise) during all phases of the project because there are currently no recurrent anthropogenic noise sources in the mine site. Blasting would occur on a regular basis during construction as needed at several material sites to construct the access roads and other infrastructure, and during operations in the mine pit (as outlined in Chapter 2, Alternatives). A detailed analysis of the impacts of noise on birds is provided in the following paragraphs.

Birds may experience a wide range of impacts from noise sources in the mine site, transportation corridor, at the ferry terminals, at the port, and the natural gas compressor station on the Kenai Peninsula. In terms of duration, some of the noise sources would occur over the short-term, (such as noise from construction of the mine facilities, installation of the natural gas pipeline, blasting in

the road bed and material sites, and aircraft noise at Amakdedori port, among others), while others would occur during operations (blasting in the pit), and some for the life of the project (vehicle/ equipment [such as the compressor station on the Kenai Peninsula]/vessel noise).

A wide range of avian studies has been conducted to assess the impacts of various noise sources on different bird species. Loud noises from short-term events (e.g., blasting) are known to startle nearby birds and may cause them to leave the area, and can also lead to nest abandonment. Bird use of otherwise suitable habitat may be reduced due to sensitivity to noise. The degree of disturbance would vary among individuals, species, and time of year. Noise can change the composition of avian communities in favor of more noise-tolerant species, thereby reducing nesting species richness (number of species), although not necessarily density. Predatory birds may avoid noisy areas because it could mask their calls or make it more difficult to locate prey, thereby causing nests in noisier areas to be safer from predators (Francis et al. 2009). Birds migrating through the area may avoid the project vicinity during noisy periods rather than stopping over during migration. In terms of magnitude, noise may impact birds through changes in behavior (such as altered nesting and foraging locations and patterns), ability to communicate with conspecifics, ability to detect and recognize predators, decreased hearing sensitivity (both temporarily and permanently), increased stress that may lead to altered reproductive success, and potential interference with breeding individuals and populations (Dooling and Popper 2007). Some bird species are sensitive, at least during the breeding season, to noise levels; and the extent of impacts from disturbance can vary from several feet to more than 2 miles (Kaseloo and Tyson 2004).

Birds have a wide range of hearing capabilities, which varies by species. In general, optimal hearing range is between 1 and 5 kilohertz (kHz), with most sensitive hearing at frequencies of 2 to 4 kHz. In comparison, the optimal range for humans is from 20 Hertz (Hz) to 20 kHz, a much broader range than most birds, and is most sensitive at 0.5 to 4.0 kHz (Dooling and Popper 2007). Permanent physical damage to a bird's ability to hear can occur over time, or from short blasts of loud sounds that exceed 140 dBA for single blasts or 125 dBA for multiple blasts, or from continuous (greater than 72 hours) noise at levels above 110 dBA (Dooling and Popper 2007). A temporary threshold shift in hearing can last from seconds to days depending on the intensity and duration of the noise, with the shift occurring from approximately 93 dBA to 110 dBA for continuous noise. Therefore, understanding the level of noise produced by various project components is necessary to determine buffer thresholds to avoid physical damage to birds' hearing. The magnitude and extent of noise from blasting would be an estimated 109 dBA maximum equivalent sound level (L_{max}) at 50 feet. Therefore, single, non-continuous blasts would not be expected to result in permanent hearing loss for birds within 50 feet.

Noise may also cause chronic stress, which can alter hormone levels and lead to weight loss, decreased disease resistance, and reduced reproductive success (Ortega 2012). Increased noise above ambient levels can reduce the time spent foraging near noise sources, as well as make it more difficult for birds to detect predators or find food sources (e.g., some raptor species that rely on hearing to detect prey). Birds may experience increased difficulty advertising and attracting a mate due to increased noise, and some have been shown to alter their vocalizations to compensate for masking. These include changes in song or call frequency, amplitude, song components, and even temporal shifts to avoid noisy periods (Ortega 2012).

Because it is difficult to determine the potential responses of each avian species to the range of noise levels potentially produced by the project, a conservative noise disturbance and impact threshold was established to be 60 dBA and above (Dooling and Popper 2007; Shannon et al. 2016). This level was determined based on noise levels above which sound masking could be caused. Therefore, noise levels above 60 dBA could produce behavioral disturbance to birds. Noise levels to the 60 dBA range were calculated for a variety of noise-producing project components, and the following distances were estimated as detailed in Table 4.23-3. The

calculations that derived these distance estimates, and the list of assumptions to produce the estimates, are described in *Pebble Project-Noise Concepts and Methodology* (AECOM 2018c), and further detailed in Section 4.19, Noise.

Table 4.23-3: Distances to 60 dBA at Project Components during Project Phases

Project Component	Project Phase	Distance to 60 dBA L_{eq} (feet)[1]	Distance to 60 dBA L_{max} (feet)[1]
Mine Site	Construction	2,900	5,450
	Operations	3,350	6,500
Material Sites[2]	Construction	185	1,300
Access Road	Construction	740	1,130
	Operations	25	38
Ferry Terminals and Port	Operations of Ferry Terminal	140	140
	Operations of Port	890	1,410

Notes:

[1] The L_{eq} value for any given project phase is the energy sum for the individual L_{eq} values (for all equipment), all the calculated sound sources, all added together for the aggregate level. For the L_{max} level, the acoustical usage factor (percent time that a piece of equipment is operating at its full power) for all equipment was set to 100 percent, and therefore assumed that everything was operating at full power. In most cases, the noise source with the greatest L_{max} level (typically blasting) would dominate the combined L_{max}; but if several sources have the same or similar L_{max} values, the aggregate L_{max} could be higher than any individual source.

[2] The projected noise levels at material sites is based on roadway construction blasting with a reference level of 94 dBA L_{max} at 50 feet.

dBA = A-weighted decibel
L_{eq} = sound level equivalent
L_{max} = maximum equivalent sound level

In terms of the magnitude and extent of noise exposure to birds, normal operations of the mine could result in behavioral disturbance to birds between 3,350 and 6,500 feet from the mine site. This distance is a rough estimate based on a variety of assumptions related to the number and types of vehicles and equipment in operation, as well as the detailed blasting information, including the weight per charge, spherical divergence, atmospheric adsorption, ground attenuation, natural barrier effects, and others. This estimated distance may not be the case for all bird species, but initially some birds may avoid this buffer around the mine site, because it would represent a novel source of disturbance that they are not accustomed to. The same logic would apply to the other mine components, but to a lesser extent due to reduced levels of noise. Operational noise levels would be long-term, lasting throughout the life of the mine. Noise impacts during the project closure phase are not provided, because they are anticipated to be similar to the construction phase, but may vary depending on the type of equipment used.

Noise from the compressor station on the Kenai Peninsula would also be expected to cause behavioral avoidance. The compressor station would be constructed on 5 acres of private property east of the Sterling Highway in a residential area north of Anchor Point. In terms of magnitude and extent, noise levels generated by typical operation of the compressor station would equate to 55 dBA day-night sound level at 2,150 feet (Section 4.19, Noise). This area is already exposed to anthropogenic sources of noise from vehicle traffic and residential noise sources. As detailed in Section 3.23, Wildlife Values, common avian species that occur in this area based on North America Breeding Bird Survey data from the Anchor River (3.5 miles south) from 1983 to 2017 include orange-crowned warbler (*Vermivora celata*), varied thrush (*Ixoreus naevius*), fox sparrow (*Passerella iliaca*), American robin (*Turdus migratorius*), hermit thrush (*Catharus guttatus*), alder flycatcher (*Empidonax alnorum*), ruby-crowned kinglet (*Regulus*

calendula), Wilson's warbler (*Cardellina pusilla*), golden-crowned sparrow (*Zonotrichia atricapilla*), and yellow-rumped warbler (*Setophaga coronata*) (Pardieck et al. 2018). These species are generally found in scrub and coniferous forest habitats, which are typical of the vegetation in this portion of the Kenai Peninsula. As with the mine site, these impacts would be long-term, lasting throughout the project life.

Practices to avoid disturbance to raptor nests (e.g., bald eagle) would be followed, and species-specific buffer zones and temporal restrictions would be established based on consultation with USFWS (USFWS 2007; and Richardson and Miller 1997).

There is the potential for noise disturbance of raptor nests during construction of bridge crossings over the Newhalen River. On July 2, 2019, a raptor nest helicopter survey was conducted for these bridge crossings that occur along the mine access road (ABR 2019d). Of the four bald eagle nests that were observed along the Newhalen River, none were within 0.5 mile of bridge locations. The closest nest was 0.9 mile south (downstream) of the southern bridge crossing (Figure 3.23-1; ABR 2019d). The closest nest to the northern bridge crossing was approximately 1.4 miles upstream (see Section 3.23, Wildlife Values). These distances should be adequate to avoid disturbance to bald eagle nest sites at bridge crossings along the Newhalen River, based on the National Bald Eagle Management Guidelines (USFWS 2007c).

Project-specific raptor surveys were also conducted in summer 2018 for areas south of Iliamna Lake along the port access road (Figure 3.23-9). There were no bald or golden eagle nests near the area of the bridge over the Gibraltar River. There is little suitable bald and golden eagle nesting habitat within 0.5 mile of the Gibraltar River along its length from the outflow of Gibraltar Lake to Iliamna Lake (ABR 2019e). The closest nests were over 4 miles from the bridge.

Disturbance from Vessels, Vehicles, and Aircraft

Vehicle traffic along the access roads, vessel and aircraft traffic at the Amakdedori port, and barge traffic on Iliamna Lake may cause behavioral disturbance to birds in the surrounding areas. Impacts may include direct impact on offspring survival due to brood scattering; change in foraging behavior, and an increase in energetically costly behavior; and a loss of suitable habitat (Kaiser and Fritzell 1984; Keller 1991; Korschgen et al. 1985; Mikola et al. 1994). Waterfowl generally respond to both loud noises and rapid movements, such as boats powered by outboard motors or other threatening visible features (Korschgen and Dahlgren 1992).

As detailed in Chapter 2, Alternatives, the magnitude and extent of daily transportation of concentrate, fuel, reagents, and consumables would be up to 35 round trips per 24-hour day for each leg of the mine and port access road, which includes three loads of fuel per day (PLP 2018-065). The magnitude and extent of disturbance from traffic on the mine and port access roads (based on a 24-hour work day) would be one truck passing in either direction approximately every 21 minutes during operations. There would be additional light vehicle traffic (i.e., vehicles other than large trucks transporting concentrate, fuel, and consumables) along the transportation corridor, which would increase the level of disturbance. This magnitude and extent of vehicular traffic may disturb birds, as discussed below.

Disturbances of nesting birds may cause abandonment of the nest, disruption of the pair bond, reduction in clutch size, increased egg mortality, abandonment of the nesting area, and increased predation of the nest. Disturbances during brood-rearing may cause exhaustion of young and an increase in losses from predation (Korschgen and Dahlgren 1992). Disturbances during critical times of the nesting cycle may eventually cause birds to nest elsewhere, or not to nest at all (Korschgen and Dahlgren 1992). Human disturbance may cause waterfowl to modify food habits, feed only at night, lose weight, or desert the feeding area.

Some species are easily disturbed by the presence of humans, vehicles, and other activities around their nest sites, even if their nesting habitat is not directly impacted. Several species of raptors (e.g., golden eagles) are prone to disturbance around nest sites and may abandon them if disturbed early in the nesting season. Disturbance to golden eagle foraging and roosting areas can stress eagles, leading to reproductive failure or mortality (USFWS 2011c).

Habituation of some bird species to disturbance may occur (Stolen 2003). Waterbird responses to vessel traffic may be dependent on species, biological cycle (e.g., breeding, migrating, stopover, and wintering), and/or vessel attributes (e.g., vessel type, size, and speed). In terms of magnitude and extent of impacts, when vessels are closer to occupied habitat, a flight response would be likely to be greater, especially if the vessel is approaching rapidly.

Some waterbirds in Cook Inlet may be habituated to vessel traffic (especially around existing port and harbor locations); however, vessel traffic at the Amakdedori port may cause disturbance, because the area currently has no port development.

Behavioral disturbances to birds in Cook Inlet could occur during pipeline (and an adjacent fiber-optic cable) installation in Cook Inlet, but the duration of the disturbance would be short-term, occurring only during the pipeline installation period, and would be expected to return to current disturbance levels after installation. Pipeline installation is anticipated to occur during summer months, when breeding birds would be nesting. As detailed in Section 3.23, Wildlife Values, in terms of the extent of impacts, there are no seabird colonies in the analysis area (i.e., within 1 mile of the natural gas pipeline) that would be expected to be disturbed (e.g., by being flushed off the nest) during pipeline installation. However, there are multiple seabird colonies north and south of Amakdedori port, but they are over 6 miles away. There would be a potential for impacts to foraging seabirds that are searching for food during summer months. Only birds resting, foraging, and flying through the area have a potential to be temporarily disturbed during summer-time construction activities. As detailed below, depending on the species, birds would dive, fly, or swim out of the path of approaching vessels, and would be expected to return to their foraging areas after the vessel disturbance has passed. However, behavioral disturbance from vessels could cause additional energy expenditure, less time foraging, and potentially temporary avoidance of foraging areas during summer installation of the natural gas pipeline.

As detailed in Chapter 2, Alternatives, during operations, approximately 27 concentrate vessels and 33 supply barges per year would be needed for transport (an average of one vessel per week). Each concentrate vessel would require 10 trips from the lightering barge between the port site and lightering location to fill the bulk carrier, which would be moored for 4 to 5 days. Vessel traffic could cause birds to swim away, fly, dive, or otherwise avoid approaching vessels. Avoidance behaviors have been documented for multiple avian species, resulting in less time spent foraging, and avoidance of areas; increased energetic expenditure; potential for predation; and other indirect impacts. Although Kittlitz's murrelets (*Brachyramphus brevirostris*) have not conclusively been detected in the analysis area, the similar marbled murrelet (*Brachyramphus marmoratus*) has been documented in the analysis area in Kamishak Bay. During a study in Glacier Bay, Alaska, researchers observed Kittlitz's murrelets while vessels were passing by, and found a 30-fold increase in flight behavior, with large and fast-moving vessels causing the greatest disturbance (Agness et al. 2008). Kittlitz's Murrelet were temporarily displaced from habitat, and birds returned to the same habitat within the same day after the disturbance ceased. Negative effects on the bird's daily energy budget can occur, however, when birds expend energy to fly away (Agness et al. 2008).

Additional studies in Europe have documented the spatial scale of displacement caused by vessels flushing waterbirds (Marine Management Organization 2018). A compilation of studies documented displacement effects ranging from 0.1 mile (for eiders) to up to 1.2 miles for common

scoters (*Melanitta nigra)* (Marine Management Organization 2018). One of the studies reviewed (Schwemmer et al. 2011) documented median flushing distances from vessels of 1,325 to 2,638 feet for species of scoter, 961 feet for long-tailed duck, and 682 feet for eiders. Additionally, repeated short-term responses to individual disturbance events may result in longer-term avoidance of areas, and displacement. Seaducks were considered to have high displacement indices in response to transport and traffic activities, and moderate habituation to such activities (Marine Management Organization 2018).

Summary

The magnitude, duration, and extent of impacts would be behavioral disturbance to resident and migratory avian populations during all project phases around the mine site, the immediate vicinity of the ferry terminals, Amakdedori port, along the transportation corridor, and during installation of the natural gas pipeline. In particular, birds would be anticipated to avoid the habitat in close proximity to loud noise disturbances (such as blasting at the mine pit). Avian abundance and distribution may change in the habitat immediately adjacent to project components. The duration of impacts would be for the life of the project, until mining ceases and the habitat is restored. The geographic extent would include the direct footprint of each project component and the surrounding area, depending on noise levels.

Injury and Mortality

Vehicle Collisions

The magnitude and extent of impacts would be that avian mortality from vehicle collisions could occur throughout the mine site and along the transportation corridor. Currently, there are no roads to the mine site, and the project would involve the construction of approximately 74 miles of road through habitat that supports nesting birds; this would create vegetation edge habitats on either side of the road. There would be potential for vehicle collisions for birds flying across the new roads created by the project. In terms of duration of the impact, mortality rates for resident avian species may be expected to decline over time, due to a postulated “learning effect,” whereby resident birds may acclimate to the presence of the road and develop behaviors to avoid collisions (e.g., flying higher when crossing the road to avoid vehicles) (Havlin 1987). However, this is not likely to apply to migratory birds passing through the area that are unfamiliar with the road. Birds have been shown to change flight initiation distances in response to vehicles according to road speed limit (a factor affecting mortality rates on roads) rather than particular car speed, suggesting that birds are able to associate road sections with overall speed limits as a way to assess collision risk (Legagneux and Ducatez 2013). Bird species that spend a considerable amount of time on the ground (e.g., species of grouse and ptarmigan) may be more susceptible to vehicular collisions as opposed to species that are found higher up in the tree canopy (such as species of flycatcher, warblers, and sparrows). Some avian groups tend to fly at a low altitude, close to the ground, and may be more prone to vehicle strikes when flying between brushy areas that are bisected by a road. Additional factors such as vegetation structure and height, proximity of vegetation to the road, terrain, and adjacent habitat areas (such as wetlands and rivers) may all factor into collision risk for avian species.

Clearing of adjacent roadside vegetation and reducing traffic speeds would help reduce the potential for bird collisions (Gunsen et al. 2011). Wildlife safety mitigation measures for the transportation corridor would include vegetation management to increase visibility. Visibility would be improved by reducing roadside vegetation (trimming of shrubs and trees) that may obscure wildlife approaching the road, and reducing its attractiveness. Vehicle speeds would also be reduced along the transportation corridor. The maximum speed limit for the road system would

be set at 35 mph. Wildlife present on the road would be given the right-of-way. Traffic would stop, if necessary, to allow the safe passage of wildlife crossing, or walking along, the road (PLP 2019-RFI 122).

Aircraft Collisions

Bird collisions with aircraft have been well documented and appear to be increasing (Dolbeer et al. 2013). Contributing factors are greater populations of large birds near some airports, more air traffic, and higher use of quieter aircraft (e.g., turbofan-powered). Waterfowl, gulls, and raptors were groups with the most numerous and most damaging strikes. Species with high numbers of strikes in Alaska (Dolbeer et al. 2013) include bald eagle, Canada goose (*Branta canadensis*), American golden-plover (*Pluvialis dominica*), bank swallow (*Riparia riparia*), and ducks (*Anas* species and others), which all occurred in the analysis area.

In terms of magnitude and extent, air traffic over Cook Inlet around Amakdedori port may pose a collision risk to bird species (particularly waterbird and seabird species), as well as a safety hazard to the aircraft. The degree of risk would be related to number and timing of the flights with respect to avian habitats (such as over ponds, lakes, and Cook Inlet), time of year, weather conditions, and flight pathways. During project construction, work crews would access sites by helicopter or boat until the port access road to the south ferry terminal is constructed. A permanent airstrip would be built at Amakdedori port to facilitate the construction phase of the port access road. Twin Otter or similar aircraft would make 20 to 40 flights per month (average of 5 to 10 flights per week) during the construction phase to Amakdedori port, before Kokhanok can be accessed by road. Once road access to Kokhanok is established, flights to and from Amakdedori port would occur infrequently for incidental/emergency access only. During this period after road access is established, fewer birds may be potentially affected because interaction opportunities would be relatively infrequent; however, there would be increased potential during periods of inclement weather with reduced visibility and higher winds, especially during periods of avian migration. Flight paths toward the eastern end of the runway would be over the water on final approach (as low as 300 feet for approximately 1 mile, based on a 3-degree angle [Owl Ridge 2018]). This may result in waterbirds and seabirds swimming, diving, scattering, or flying away, which could lead to avian injury and mortality.

Vessel Collisions

Additionally, collisions may occur from vessel traffic on Iliamna Lake and Cook Inlet. The magnitude, duration, and extent of potential effects on avian species that breed, stage, migrate, and winter on Iliamna Lake and at Amakdedori port would be the risk of collision with watercraft. However, in both locations, the watercraft would be traveling slowly, particularly as they reach the shore; therefore, birds are anticipated to be able to move to avoid collision. In some port areas, waterbirds have become accustomed to boats (particularly around the Homer harbor); therefore, waterbirds are anticipated to develop some level of habituation to vessel traffic at Amakdedori port and the ferry terminals.

Powerline and Communications Tower Collisions

Additional sources of avian injury and mortality may come from collisions with powerlines or elevated structures in project components (such as the monopole communications tower at Amakdedori port). In terms of extent, although no powerlines would be situated along the transportation corridor, there may be distribution lines connecting the mine site power plant with other mine-related facilities. The addition of elevated powerlines, particularly near waterbodies, may cause collision hazards for waterfowl as they land and take off. This would be especially important during periods of low or reduced visibility and during periods of avian migration. Birds

may also suffer injury and mortality from energized components of the electrical distribution system in the mine site, if not adequately protected. There would be a 100- to 150-foot monopole communications tower at Amakdedori port that would be marked with high-visibility paint bands.

In accordance with FAA and USFWS guidelines, the tower may include flashing red lights at the top if required, in addition to being marked with high-visibility paint bands (FAA 2018b). Lights on structures, particularly steady-state red lights, can result in disorientation and increased collision risk for avian species (Manville 2000). Therefore, the communications tower inside the port facilities at Amakdedori may pose a collision hazard for birds.

Night-Time Lighting

A potential impact to avian species that may result in injury and mortality, but begins with behavioral disturbance, would be disorientation caused by night-time lighting, especially during migration. The magnitude and extent of these impacts would encompass all project components where night-time lighting may occur, including the mine site, ferry terminals, port, lighted navigation buoys, and lightering locations (particularly if the bulk carriers are illuminated at night). Permanent structures mounted to the causeway or dock at the port include illumination and navigation lights. If lights are not adequately shielded down and oriented away from the adjacent water, collisions are possible. These impacts would be long-term, beginning with the construction phase and lasting though the life of the project and into closure.

Some avian species have been documented colliding with a variety of structures during nocturnal migration. This includes species of waterbirds (especially eiders), seabirds, and passerines. Bird mortality typically occurs on cloudy, overcast, or foggy nights with reduced visibility and low cloud ceilings, when birds are flying at lower altitudes (Ove Arup & Partners 2002). Rain or other precipitation can cause refraction and reflection of light by rain droplets, which can disorient birds and cause them to collide with structures. Additional factors such as the moon phase and passage of cold fronts can influence the potential for collision. One potential reason for increased injury and mortality during overcast nights with reduced visibility is that birds become spatially disoriented by bright lights due to cloud cover obscuring their navigational reference points, such as the moon and stars (Greer et al. 2010). Even though birds may not collide with structures, the disorientation from night-time lighting can cause birds to fly in circles around the light source, become exhausted, and drop to the ground. Additionally, mortality may occur from hypothermia, predation of incapacitated birds, and collision with the ground. Night-time lighting can also disrupt breeding activities (for both passerines and seabirds) and increase predation (Greer et al. 2010).

In addition to birds physically colliding with structures due to night-time lighting, predator-prey interactions may be altered. In a 2-year study to determine the potential effects of artificial lighting from Pacific outer continental shelf oil and gas facilities on migrating birds in the Southern California Bight, Johnson et al. (2011) found that red-necked phalaropes (*Phalaropus lobatus*)—one of the predominant marine migrants—became temporarily disoriented from night-time lighting on two oil and gas platforms in the Santa Barbara Channel in Southern California, and were preyed on by peregrine falcons (*Falco peregrinus*). Night-time hunting by peregrine falcons was likely facilitated by platform lighting that assisted with prey detection and disorientation of prey, thereby rendering nocturnal migrants vulnerable to predation. Other avian interactions with oil and gas platforms included opportunistic foraging on insects by migrating passerines; use of platforms for night roosting by migrant birds and resident marine birds (gulls, cormorants, and pelicans); and use of platforms for breeding by peregrine falcons (Johnson et al. 2011). Therefore, although birds can become disoriented and suffer injury and mortality from night-time lighting on facilities in and near nocturnal migratory flyways, some structures also provide resting, roosting, and foraging locations for other species. The study corroborated, as reported in the scientific literature, that the weather and lunar cycle affect the likelihood of birds being attracted and potentially

entrapped by night-time lights on offshore structures. This is especially relevant for night-time migrants that depend on celestial clues for navigation, and can become impaired and disoriented when the weather and moonlight conditions are unfavorable for navigation. As applicable to the project, there is a potential for night-time lighting on vessels moored at the lightering locations and lighting from port facilities to cause disorientation and other impacts to night-time migrants.

Increased Predation

In terms of magnitude and extent of effects, birds nesting around the mine site may experience increased predation from common ravens (*Corvus corax*) (and other species) using project infrastructure. The duration of this impact would be long-term, lasting though the life of the mine. A study conducted by Powell and Backensto (2009) on the northern slope of Alaska around the Prudhoe and Kuparuk oil fields documented common ravens nesting on a variety of man-made structures, including processing facilities, drill sites, bridges, radio towers, and inactive drill rigs. The infrastructure permitted common ravens to expand their nesting locations into areas where no nearby natural nesting substrate exists. An analysis of common raven pellets contained a variety of small mammal species, avian remains (eggshell fragments were from geese, ducks, ptarmigan, and other birds), and anthropogenic food items. Therefore, the mine site may provide new structural nesting locations, food, and nesting sources, and increase common raven predation on local small mammal and avian populations.

Care would be taken to minimize access to anthropogenic food sources, and to reduce the chance of subsidizing food resources for wildlife such as bears, red fox, and raven populations at the mine and other sites, including stopped vehicles. Design features should minimize access to anthropogenic food sources. Food and Garbage Management practices that would be implemented are described above.

An additional potential source of predation may come from invasive species. As described in the all-taxa invasive species section of Section 4.26, Vegetation, invasive terrestrial vertebrate species have not been documented from the project area; however, the Norway rat (*Rattus norvegicus*) is a species of high concern due to damaging effect in neighboring ecosystems. Norway rats have high reproductive capacity and are opportunistic feeders capable of large effect on a variety of wildlife populations. Rats may also carry parasites, pathogens, and diseases that can be harmful to other species. In the Aleutian Archipelago, seabird colonies have suffered significant losses due to predation by rats (Buckelew et al. 2011). Most rat infestations in Alaska have resulted from rats escaping from ships while in port (USFWS 2007). Bulk carriers and barges would be coming from locations outside of Alaska and have a potential to inadvertently import Norway rats. Ships that come into contact with seabird colonies on surrounding islands and rocky outcrops in Kamishak Bay (through loss of power, grounding, drifting, or other means) and along the coastline have a potential to introduce a devastatingly effective predator of seabird colonies. Currently, none of the islands or areas around the port site have known rat populations, and ADF&G has developed a plan to keep rats out of Alaska (Fritts 2007). Norway rats are particularly problematic because they can swim hundreds of feet between islands, or between sinking vessels and land. Therefore, rats that could be transported to the port on project vessels have a potential to spread to the port facilities and farther inland on project vehicles and equipment. Despite a lack of seabird colonies in close proximity to the port, any introduction of rats to the port or surrounding area could have negative consequences on the local avian community.

Effects of Roadkill and Mine Site Management Practices

Predatory and scavenging birds (such as common ravens and eagles) that consume roadkill may have difficulty taking off from approaching vehicles, which may result in additional avian collisions. Raptors can consume large amounts of roadkill; and when vehicles approach, the additional

weight may decrease their ability to move out of harm's way, potentially resulting in vehicle collisions and mortality.

Birds may be killed by toxins or poisons used at the mine site, especially if rodenticide is used. The WIP would detail roadkill removal and reduction methods to reduce the potential for avian injury and mortality.

As detailed in Chapter 2, Alternatives, a landfill and incinerator would be constructed and operated at the mine site for domestic waste handling. The landfill would be operated in compliance with state and local permit conditions. Domestic refuse would be disposed of in the on-site landfill, or shipped off site to appropriate disposal sites. Wastes suitable for burning, including putrescible wastes, would be incinerated on site. Improper waste management may attract common ravens and mammalian scavengers to the mine site. If waste is not properly managed, it may provide anthropogenic food sources and nesting material for common raven numbers. In terms of magnitude and extent, this may lead to increased predation on local avian and small mammal populations. The WIP would include measures to reduce the attractiveness of the mine site to common ravens and other species, as well as adaptive management measures. These effects from roadkill and mine site management practices would be of long-term duration.

Water Quality

The project would create new areas of standing water that may attract birds, including the various freshwater storage impoundments, the tailings pond, and the pit lake. The magnitude and extent of the impact would be that environmental contamination by contact with water in these locations would be possible. All water management in the project area would be released back into the environment only after it meets water quality criteria, as detailed in Section 4.18, Water and Sediment Quality. Appendix K4.24, Fish Values, describes the potential impacts to wildlife from changes in water quality (in particular, cadmium, copper, mercury, and selenium) at the discharge locations. The pit lake would be deep; contain no shallow water habitats (due to the steep walls); and not support freshwater vegetation that is attractive to many species of waterfowl and shorebirds. Wildlife management around the pit lake would be addressed in the WIP.

Wildlife may be attracted to flooded open-pit mines that have been abandoned, and these mines have caused wildlife mortality, including waterfowl. The flooding results from incursion of groundwater into the open pit forming a "pit lake." Water quality in these pit lakes varies from highly acidic to alkaline. For example, the Berkeley Pit in Butte, Montana is a 1.5-square-mile open pit approximately 1,700 feet in depth, and has caused mortality of waterfowl using it as a migratory stopover. Groundwater has infiltrated the open pit and created a pit lake about 710 feet in depth with a pH of 2.5. Birds landing in these acidic pit lakes can ingest water, causing trauma to their gastrointestinal tracts and leading to mortality. The acidic water also removes natural oils from the birds' feathers, causing them to perish by drowning or hypothermia (USFWS 2020).

In comparison with the acidic water (pH 2.5) of the Berkeley Pit, the project pit lake would be expected to be initially acidic, becoming slightly alkaline (pH 7.6 to 8.2) over time (see Section 4.18, Water and Sediment Quality). Waterfowl that could land on the pit lake would not be exposed to highly acidic water, such as Berkeley Pit, and would not likely be adversely impacted with regard to internal organ toxic exposure or loss of buoyancy/hypothermia.

The predicted water quality values in the pit lake were projected by Lorax (2018), extending from 20 years to 125 years post-closure. Although there would be some exceedances of water quality standards for specific metals during closure, exposure of wildlife—including birds—would be limited and short-term. These values vary across the years and for the various metals that were analyzed. There is a potential that waterbirds would use the pit lake, especially during migration. However, the pit lake would not provide the same ecological communities (e.g., fish,

macroinvertebrates, vegetative structure) that nearby suitable waterbodies contain; therefore, waterbirds would be less inclined to use the pit lake for extended periods of time. Waterbirds would likely use it periodically for resting, particularly during migration. Several metal levels would remain elevated above water quality standards post-closure, including aluminum, arsenic, cadmium, copper, iron, mercury, manganese, molybdenum, antimony, lead, selenium, and zinc (Lorax 2018).

Waterbirds can ingest metals from a variety of sources, including directly from drinking water, food, substrate, and vegetation. The pit lake would not be anticipated to provide suitable foraging habitat for waterbirds (due the steep sides, and lack of freshwater vegetation); therefore, the most likely route of exposure would be from drinking water from the pit lake. There would be multiple other nearby sources of water (such as nearby Frying Pan Lake to the south, and Long and Nikabuna lakes to the north) that provide higher-quality cover and foraging habitat that birds may favor.

Summary

The magnitude of injury and mortality impacts on avian species would be anticipated to affect a wide range of taxonomic groups, at various life stages, and across all components of the project. The potential for collisions with vehicles, vessels, aircraft, structures, lights, powerlines, added predation from a potential increase in common ravens (and other predators), and changes in water quality would be expected to result in new sources of avian injury and mortality The duration would be for the life of the project, and the extent would include the footprints of all project components.

Habitat Changes

Temporary and permanent habitat loss would occur as existing vegetation is removed and replaced with buildings, roads, runways, the open pit, and other project facilities and infrastructure. See Section 4.26, Vegetation, for information on direct and indirect impacts to vegetation, which would relate to loss of nesting, foraging, migrating, and staging habitat for species in various vegetation communities. Direct and indirect impacts to vegetation (that would also impact wildlife species), such as the introduction of invasive species (such as Norway rats and Elodea), fugitive dust (extending out to 330 feet), and others are discussed in Section 4.26, Vegetation. Additionally, there is the potential for an altered fire regime, which may lead to additional habitat changes.

The direct loss of habitat from all project components (acreages provided in Table 2-2 of Chapter 2, Alternatives) would impact bird species with home ranges in the disturbance area, as well as those migrating through the area. In terms of extent, loss of habitat during migration may affect bird populations beyond the analysis area, because migrating birds could be forced to use other areas to rest and forage. The magnitude of the effect on migrating birds would be less than the effect on breeding birds, because migrants would use the habitat briefly and would not depend on it to feed young. Waterbirds would be the primary migratory species around the mine site that would be impacted. As detailed in Section 3.23, Wildlife Values, there are several important staging areas to the north of the mine site where large numbers of waterbirds congregate. Large numbers of waterbirds stage during spring at Nikabuna Lakes, Long Lake, and along the Chulitna River, over 11 miles north of the mine site. Development of the project would not be anticipated to impact spring migratory waterbird habitat in these distant areas. However, in the fall, high numbers of waterbirds would be directly adjacent to the mine site. Waterbirds would be anticipated to move to other nearby ponds and lakes not directly in or adjacent to the mine site.

The avian response to habitat fragmentation is species-specific. Some species avoid edge habitat for reasons such as less suitable microclimate or increased predation. Some avian species prefer early successional habitats; habitat availability for these species may increase as a result of fragmentation. Some avian species, particularly raptors, would lose foraging habitat because the vegetation communities that support their prey populations in the mine site would be converted to urban/developed land cover types. In terms of magnitude and extent, this could cause raptor species to seek new foraging locations, thereby potentially placing them in competition with nearby occupied territories. This may lead to fewer individual raptor territories in and adjacent to the mine site, reduced number of young, and decreased raptor abundance in the area. Based on the most recent surveys (detailed in Section 3.23, Wildlife Values), one golden eagle nest was within a 1-mile radius of the mine site, plus additional bald and golden eagle nests were in close proximity to the port access road (several less than 0.5 mile away). According to the Bald and Golden Eagle Protection Act (Eagle Act) (16 United States Code (USC) Sections 668-668c), activities that result in nest-site abandonment constitute take under the Eagle Act because they are cited in the definition of "disturb" (Pagel et al. 2010). Disturb also extends to impacts that decrease eagle productivity by substantially interfering with normal breeding, feeding, or sheltering behavior (72 Federal Register 31132). Therefore, impacts to bald and golden eagles may necessitate the application for an Eagle Take Permit (81 Federal Register 91494).

Fugitive dust emissions would be caused by road construction and vehicle travel on unpaved surfaces. This dust has the potential to collect on vegetation in the vicinity of the dust sources. Windblown dust could affect wetland vegetation well beyond the source, but the effect diminishes with distance and is influenced by prevailing winds and topography. The heaviest dust deposition would be anticipated to occur within 35 feet of the road (Walker and Everett 1987); however, dust has been documented at distances of 330 feet from the most heavily traveled roads in Prudhoe Bay (Walker et al. 1987). Dust deposition impacts wetlands primarily by reducing vegetation productivity and altering species composition. Fugitive dust impacts to vegetation are described in Section 4.22, Wetlands and Other Waters/Special Aquatic Sites; and Section 4.26, Vegetation. Based on these sections, it was determined that fugitive dust has a potential to impact a 330-foot buffer around project components. As detailed in Section 4.26, Vegetation, plant communities that have a high percentage of lichens and mosses would be most impacted. Dwarf shrub lichen communities and partially vegetation land cover types (where lichen is dominant) would be the most impacted by fugitive dust within a 330-foot buffer from project components. The avian community that uses lichen and moss-based vegetation types would be most impacted, such as ground nesters that rely on camouflage for protection, including species of ptarmigan, some shorebirds, and ground-nesting songbirds.

With regard to wildlife, winter dust fall in the corridors along roads in Alaska may cause early snow melt and soil thaw, concentrating waterfowl, passerines, ptarmigan, grouse, and their predators in snow-free areas such as along roadsides. These wildlife may become susceptible to collisions with passing vehicles. Caribou may take advantage of the early snow-free areas for grazing, and grizzly bears, raptors, and other predators may use these areas to hunt ground squirrels and voles (Walker and Everett 1987).

An additional habitat change that has the potential to impact avian species is the spread of invasive plant species. In particular, the spread of invasive aquatic plant species, such as elodea (*Elodea* spp.), have a potential to clog waterways and reduce foraging areas, as well as provide cover for other invasive species. Although no freshwater aquatic invasive species have been documented in the analysis area, elodea forms dense monocultures that displace native flora and alter freshwater habitats by decreasing flow and increasing sedimentation (ACCS 2011d; Nawrocki et al. 2011). Such impacts have been shown to degrade habitat for waterfowl and freshwater fish (Schwoerer 2017). If elodea became established in the project area, it could

negatively impact the nesting and foraging areas for waterbirds in the project area by reducing availability to find prey, altering fish habitat, and clogging waterways necessary for diving duck and other waterbirds.

In summary, the magnitude of the impact would be removal of 9,611 acres of habitat occupied by a variety of avian species, including sensitive species that are in decline globally. There would be loss of territories, potential abandonment of previous nesting locations, and interspecific species completion from habitat loss. The duration would be for the life of the project; however, some portions of the project would be restored and eventual revegetation would provide habitat post-mining. The extent of direct impacts would include the footprint of all components, plus additional surrounding habitat that would be indirectly impacted through behavioral avoidance, fugitive dust, potential for invasive plants, altered fire frequency, among others. Impacts would be expected to be noted because they would affect multiple bird species across many habitat types.

4.23.4.2 Terrestrial Wildlife

Behavioral Disturbance

Noise

In terms of magnitude, terrestrial mammals may be affected by blasting and noise from heavy machinery used during construction and operations. See Section 4.19, Noise, for a detailed analysis of the various noise-producing components. In terms of extent of the impact, individuals may move away from the construction areas to avoid loud continuous sounds, periodic percussive sounds, and the presence of people and machinery that would disrupt their normal behaviors. Behavioral responses to disturbance can range from mild “alert” behavior to fleeing, depending on disturbance type, distance, species, season, or other variables. The size of the “avoidance zone” would depend on the type of disturbance, terrain/topography, vegetative cover, as well as species’ behavior, but could result in indirect loss of habitat for each species. Some species, such as moose (*Alces alces*), may habituate (i.e., adapt) to human disturbance; while others, such as gray wolves (*Canis lupus*) and brown bears, may not, and may avoid areas or move away as people and equipment approach. Some facility noise and operations disturbances may allow for habituation. For example, lower-level continuous noise disturbance at the water treatment plant would have lower effects than louder erratic sources of activity, such as blasting, vehicles, or aircraft. The size of the area avoided would vary by species and would fluctuate over time, but would be larger than construction area footprints. Avoidance of project activities could cause increased physical stress, habitat fragmentation, or abandonment, thereby reducing survival and reproductive success for certain species.

Night-Time Lighting

One potential impact from the mine site related to behavioral disturbance would be night-time lighting. Because the mine would operate continuously 24 hours a day, 365 days a year, impacts from artificial night-time lighting into adjacent habitat may disrupt predator-prey interactions and disrupt annual rhythms that are entrained by day length (Longcore and Rich 2016). The nearby topography can cause artificial lighting to be exacerbated by reflecting off nearby hillsides (especially when covered in snow). Some prey species are nocturnal and forage in open areas at night. However, artificial light that extends into adjacent habitat may affect predator-prey interactions, particularly during long winter nights in tundra habitats (Longcore and Rich 2016).

Wildlife Attraction to Waste

Attraction, habituation, food-conditioning, and predator population augmentation are well-understood impacts of industrial development in Alaska. Minimizing attractants and eliminating food rewards include using wildlife-proof storage of food, garbage, and hazardous substances, incineration of wastes, proper disposal of unburned wastes, and enforcing bans on littering and feeding wildlife.

Management of waste requires proper handling of food and non-food materials to reduce impact to local wildlife populations. Handling food waste correctly would limit the attraction of animals (e.g., foxes, gulls, ravens, and bears) to the project area. Procedures include appropriately designated disposal receptacles, storage, cleanliness, and odor limitation throughout the area, including vehicles. Non-food materials (e.g., plastic, rubber, motor oil, fuel, and chemical such as antifreeze) can be attractive to some wildlife species if these materials are not handled properly. Potentially harmful materials would be stored in secure containers or inside buildings/sheds, and would be properly disposed of away from the project area.

As detailed previously and elaborated on in Chapter 2, Alternatives, a landfill and incinerator would be constructed at the mine site for domestic waste handling. This may cause a behavioral shift in some species by attracting them to the landfill. Some species, such as bears and red foxes (*Vulpes vulpes*) that become habituated to food resources may become a nuisance and safety hazard. Although the landfill would be operated according to permit conditions (if issued), the WIP would detail additional measures, should food-conditioned wildlife become a problem.

Behavioral Avoidance

Behavioral avoidance may function as a barrier to movement for some species (particularly small species with reduced home ranges and dispersal distances), or for particular sex and age classes within species. Physical features of the mine and port facilities, access roads, ferry terminals, steep cut banks, holding ponds, material yards, or retaining walls may prevent or limit animal movements through the area. For species with large home ranges, or species that travel seasonally between winter and summer ranges, such as caribou, moose, brown and black bears (*Ursus americanus*), and gray wolves, a barrier to movement could fragment and decrease the size of preferred habitat.

Behavioral changes to wildlife such as movement away from the physical disturbance of pipeline stringing during construction could occur. These impacts would likely be temporary.

During construction, excavated and open pipeline ditches could also disrupt wildlife movement, and pose injury and entrapment hazards for wildlife. Construction activities in the area of the open ditches would generally tend to frighten larger wildlife away, causing temporary displacement, although some injury could occur. Smaller species would be able to traverse or climb out of open ditches. Traffic on the access road during the operations phase would be subject to speed restrictions; but in terms of duration, would last for the life of the project and potentially longer. As detailed in Chapter 2, Alternatives, roads would remain as long as needed for long-term post-closure water treatment and monitoring. The specific fate of the access roads post–long-term closure is undetermined. Because the access roads would be constructed in an area with no previously established roads, this would result in a new visual and auditory source of disturbance. The level of truck traffic would be one truck passing approximately every 21 minutes. There would be additional light vehicle traffic (i.e., vehicles other than large trucks transporting concentrate, fuel, and consumables) along the transportation corridor, which would increase the number of daily vehicle trips.

In terms of extent and duration of impacts, project activities may disturb terrestrial mammals throughout construction, operations, and project closure, with the disturbance zone expanding as the mine is developed to its maximum size. During the closure phase, the mine site would be subject to periodic monitoring activities involving small numbers of workers and vehicles for relatively brief periods of time. Post-closure, the potential disturbance of animals from periodic monitoring activities would be minimal and at regular intervals during long-term management of the mine site.

In addition to inhibiting movement patterns, high levels of disturbance could have effects that range from physiological reactions to stress, potential for injury and mortality from exposure to predators (including interspecific species competition), and from sub-optimal habitats, injury, and mortality for denning mammals and small mammals in subnivean (under snow) spaces during winter construction, and reduced survivability and/or reproductive success in unfamiliar territories. Some species are particularly sensitive at certain times of year (e.g., caribou calving in spring, bear and wolf denning in winter, and moose rutting in fall). Ground-based activities would be the primary concern for most species, but airplane and helicopter traffic could also adversely impact certain species, such as caribou, which are known to react strongly to low-flying aircraft by fleeing.

If animals abandon their familiar territories or alter their movement patterns, they may enter the territories of other animals that aggressively defend their area, with the potential for injury or mortality. They may also be more susceptible to predation through lack of experience with local cover and escape terrain. The magnitude of the effect would be that disturbance may also lead to mortality due to young separation or abandonment, or if the animal is injured trying to flee.

The Amakdedori port and both ferry terminals on Iliamna Lake would be sources of long-term disturbance due to vessel traffic, loading and unloading activities, and the presence of workers, night-time lighting, equipment, and vehicles. The disturbance zone around these facilities would likely be much smaller than the area around the mine site due to a lack of blasting and a reduced footprint.

Caribou

Various studies have been conducted on caribou behavior associated with development such as roads, oil drilling, pipelines, and mines. In Alaska, several studies on caribou have been conducted on the North Slope around Prudhoe Bay to document impacts from roads, oil drilling operations, oil pipelines, and other infrastructure. One study (Shideler 1986) found that maternal caribou groups avoided the Trans Alaska Pipeline corridor (including the Dalton Highway) during every season except fall, while bull caribou did not appear to avoid the corridor. Maternal groups almost completely avoided the Prudhoe Bay oil field during summer. In terms of magnitude, Shideler found that traffic levels averaging 15 vehicles per hour caused significant declines in crossing success of caribou during the mosquito season; traffic levels averaging six vehicles per hour have not impacted crossing success of a road or pipeline complex. Multiple factors affect the ability of caribou to successfully cross a road, including time of year, effects of mosquitoes and other insect harassment, and group size. The anticipated level of truck traffic would be one truck passing in either direction approximately every 21 minutes. There would be additional light vehicle traffic (i.e., vehicles other than large trucks transporting concentrate, fuel, and consumables) along the transportation corridor, which would increase the number of daily vehicle trips. Therefore, the proposed truck traffic (at approximately three trucks per hour), combined with a similar number of light vehicles, would correlate to six vehicles passing every hour. According to Shideler (1986), this level of traffic is unlikely to impact caribou road-crossing success. The actual number of vehicles and time between vehicle passes may result in different reactions by caribou compared to those found by Shideler.

Johnson et al. (2019) assessed caribou use of habitat near energy development on the North Slope for the Central Arctic Herd. This herd has been exposed to oil development on its summer range for over 40 years, and findings in Johnson et al. (2019) suggest that caribou habituation to industrial development in the Arctic is likely weak or absent. Based on a review of 2015-2017 location data for GPS-collared female caribou, they reduced their use of habitat within 3.1 miles of development during the calving period; within 1.2 miles during the post-calving period; and within 0.6 mile during the mosquito harassment period. Female caribou exhibited avoidance responses to infrastructure during all time periods, with the effects waning across the summer. This study confirms that despite long-term presence of infrastructure, caribou exhibit behavioral avoidance, especially during important seasonal habitat occupation.

A study in the Canadian Arctic estimated the zone of influence (i.e., area of reduced caribou occupancy based on a change in behavior, habitat selection, and distribution relative to disturbance) surrounding two open pit mines in a caribou herd's summer range (Boulanger et al. 2012). During operation of the mines, an 8.7-mile zone of influence based on aerial surveys and a 6.8-mile zone based on satellite-collar locations were detected. The study found that caribou were approximately four times more likely to choose habitats greater than 8.7 miles from the mine complex (Boulanger et al. 2012). Caribou responded to industrial development at greater distances, possibly related to fine dust deposition from mine activities in areas of open tundra habitats. Therefore, in terms of the extent of impacts, in addition to avoiding the mine site facilities, caribou may avoid a buffer around the mine site.

A fourth study assessed the human disturbance effects and cumulative habitat loss on two migratory caribou herds in northern Canada (Plante et al. 2018). Caribou avoidance of human disturbances at a large spatial scale were examined, including avoidance of mines, powerlines, roads, and human settlements, along with the barrier effect of roads and their influence on caribou movement rates. The study found that caribou avoided disturbances over large spatial scales, and they avoided all disturbance types except powerlines. Roads were avoided by caribou, which impacted their movements by limiting their access to certain areas or increasing their movement rates. Road avoidance may be exacerbated in areas and at times when caribou are hunted. Caribou avoided mining exploration sites by a few miles around drill or trench sites, but by as much as 13 miles during the winter. The cumulative habitat loss for the two herds by avoiding disturbance areas was estimated at 30 percent of their winter range, and disturbance precluded access to 37 percent of high-quality caribou winter habitat in some years (Plante et al. 2018), effectively limiting the amount of habitat for the two herds. The study demonstrated that a single road could preclude or hinder movements, and caribou avoided long-established infrastructure.

Based on data presented in Section 3.23, Wildlife Values, caribou are less common along the transportation and natural gas pipeline corridor compared with the mine site. Caribou move between calving grounds (May to June), insect relief areas (June to July), and seasonal foraging areas (fall and winter months); however, none of these movements would be through the transportation and natural gas pipeline corridors. They tend to occur farther west (toward the mine site); 29 years of telemetry data that were analyzed found few instances of caribou in the area covered by the transportation and natural gas pipeline corridors. Therefore, caribou are more likely to be impacted by activities at the mine site than the transportation corridor.

In summary, the magnitude and extent of the impact would be caribou avoidance around the mine site and transportation corridor due to behavioral disturbance. The approximate acreages of avoidance areas are provided in the habitat changes section below. The duration would be long-term, and last for the life of the project, including during post-closure due to the need for maintenance of the water treatment facilities. The duration of avoidance may last longer depending on the ultimate fate of the transportation corridor and other project roads. The current plan is to leave roads open for use by local residents, which would extend the duration of

avoidance into the long term. The extent of impacts may stretch beyond the mine site and transportation corridor, including additional avoidance of areas due to increased noise, presence of humans and equipment, and other sources of disturbance. Impacts would be likely to occur, because there is currently little anthropogenic activity in the area compared to the size of the project.

Moose

Moose seasonally migrate between higher elevations in the summer and lower elevations in the winter; bull moose move extensively during the fall rut (in September and October) as they search for cows. These movements may be affected by activities at the mine site, which may cause abandonment of foraging and rutting areas and alteration of movement routes. However, moose densities are low in the mine site due to a lack of suitable habitat (see Section 3.23, Wildlife Values, for specific moose densities).

Moose are known to occur more commonly in the transportation corridor (due to higher-quality habitat), and may be adversely affected for the life of the project. Laurian et al. (2008) found that moose avoid roads by up to 1,640 feet, which can fragment their available habitat. Shanley and Pyare (2011) studied the effect of roads on moose distribution in Yakatat, Alaska, and found that even dispersed vehicular activity on rural road networks significantly affects moose distribution. This activity could also substantially affect the amount of available habitat by moose avoiding areas near roads, particularly if roads would be near preferred habitat. In particular, male moose were negatively impacted at least 1,640 feet from rural roads; for female moose, the road-effect zone extended greater than 3,281 feet (Shanley and Pyare 2011). Therefore, the extent of road avoidance by moose may extend up to 0.6 mile on either side of the road. The level of avoidance may vary depending on time of day, time of year, and adjacency to nearby foraging, rutting areas, or movement corridors. Possible reasons for the road effect may be related to actual vehicle noise, as well as perceived risk from hunting (Stankowich 2008). Stankowich (2008) found that ungulates in rural landscapes with low levels of disturbance are less likely to habituate, and therefore show stronger effects from disturbance.

In summary, the magnitude of impacts on moose would be avoidance of areas in and around the project due to behavioral disturbance. The duration would extend for the life of the project, and the extent would include the direct footprint of all project components plus an additional avoidance buffer. The extent of avoidance may vary around the project components, especially along the access roads, depending on the time of year and location of biological resources (such as summer foraging, wintering, and rutting areas).

Bear

Brown and black bears may experience a range of potential impacts from the project. This includes loss of habitat due to land conversion, altered feeding, denning, and travel routes, increased mortality (from vehicular collisions, defense of life and property, and interspecific competition from avoidance of preferred feeding areas), and behavioral changes based on avoidance of humans. Because brown bears are common around all components of the project (see Section 3.23, Wildlife Values, for specific bear densities), and black bears only occur at a low density in the area primarily north and east of Iliamna Lake, this impact section focuses primarily on impacts to brown bears from behavioral disturbance. The limitations of baseline bear data outlined in Section 3.23, Wildlife Values, were considered in the analysis herein.

Based on surveys conducted for the project and wildlife agency surveys in the region, brown bear densities are high along the port access road and around the proposed port location at Amakdedori. The proposed infrastructure associated with the project would traverse through an

area where currently no established roads exist. Roads can affect wildlife populations through barriers to movement, increased vehicle collisions and road kills, and diminished habitat effectiveness (Flynn et al. 2012). A summary of research on the adverse effects of roads on brown bears includes avoidance of roads at distance from 0.3 mile to 1.9 miles, with most road crossings occurring during decreased periods of traffic and at night (Flynn et al. 2012). Flynn et al. (2012) conducted a pre-construction study of brown bear spatial use, habitat selection, and population ecology along a proposed Juneau road corridor access improvement project; they found that bears extensively used habitats along stream edges and impacts to movement corridors could be reduced simply by widening proposed bridges to encompass more of the stream edge habitat.

A recent study in British Colombia and Alberta, Canada assessed the impacts of resource roads on brown bears and found that motorized access into brown bear habitats can have measurable negative consequences at the individual and population level through habitat use, home range selection, movements, population fragmentation, survival, and reproductive success (Proctor et al. 2018). Researchers found that management of motorized access to roads, where roads are fully closed or restricted to the motorized public, but remain accessible to short-term industry use, was effective mitigation for areas where brown bear conservation and recovery are a priority. Their research also found that industrial use of roads may not be as detrimental to brown bears as recreational use of roads that are open to the public. Therefore, the long-term management of the transportation corridor and roads associated with the mine would be important.

In another study, brown bears have been shown to avoid roads regardless of traffic volume (McLellan and Shackleton 1988), and may avoid mine facilities. McLellan and Shackleton found that most bears used habitat within 328 feet of roads less than expected, resulting in additional habitat loss. They found that roads and adjacent areas were used more at night and were avoided during the day. Additionally, yearlings and females with cubs used habitats near roads more than other bears, likely because roads were avoided by adult male bears. However, some brown bears at a coal mine in Alberta, Canada, have appeared to adapt to disturbance from the mine (Cristescu et al. 2016). Based on the study, female brown bears with cubs appeared most adaptable to mining disturbance (their home ranges overlapped with areas of active mining), while male brown bears appeared to leave the area during active mining. This study concluded that active mining influenced the incidence of encounters between male bears and females with cubs, which may increase the likelihood of cubs' survival while active mining would be taking place. Once mining stopped and the area was restored, male bears appeared to return to the area, and females indicated some flight response (Cristescu et al. 2016).

In Denali National Park, a study was conducted between 1996 and 1997 that compared brown bear, caribou, and moose densities in proximity to the gravel road in the park with backcountry areas (Yost and Wright 2001). Overall, brown bear and caribou distributions indicated no pattern of traffic avoidance, while moose distribution suggested possible traffic avoidance (confounded by preferred forage farther from the road). The road in Denali National Park is primarily a controlled access road with National Park Service-operated buses comprising a majority of vehicles on the controlled access portion of the road. The port and mine access roads would also be controlled access roads during construction and operations of the project. However, post-closure, use of the roads is undetermined.

Roads can also cause functional habitat loss if bears avoid them due to proximity to nearby resources (preferred foraging areas such as salmon streams, and denning locations). Although roads can cause habitat avoidance, alter movement patterns, and become ecological traps, many of the negative effects of roads are related to human use of roads, and not the roads themselves (Northrup et al. 2012). In a study in Alberta, Canada, Northrup et al. (2012) found that traffic patterns caused a clear behavioral shift in brown bears, with increased use of areas near roads and movement across roads during the night, when traffic was low. Typically, brown bears in

areas of low human population are most active during the day, with no daily pattern of road use (Boyce et al. 2010); Northup et al. (2012) found that vehicular activity shifted these patterns. Bears selected areas near roads traveled by fewer than 20 vehicles per day, and were more likely to cross these roads, avoiding roads receiving modest traffic (i.e., 20 to 100 vehicles per day). They strongly avoided high-use roads (i.e., more than 100 vehicles per day) at all times. As detailed previously, the magnitude of truck traffic on the transportation corridor roads would be expected to be approximately one truck passing in either direction every 21 minutes (including at night) during operations, and therefore, bears may avoid crossing the mine access road, especially during daytime hours. In addition to concentrate, supply, and fuel truck traffic, there would be an additional number of lighter vehicle traffic such as support vehicles.

An additional impact of the port access road and port facilities is behavioral avoidance of the area during denning. This would likely be most intense during construction of the port access road, including vegetation clearing, grading, grubbing, blasting, and other construction activities related to landscape modification to create the port access road. Once construction is complete, actual disturbance to denning bears would be reduced mainly to noise, ground vibration, and fugitive dust from passing vehicles. Based on a literature review conducted by Linnell et al. (2000), North American bear species select den sites from 0.6 mile to 1.2 miles from human activities (roads, habitation, industrial activities, etc.). They found that activity closer than 0.6 mile caused a variety of responses, including den abandonment, especially if the disturbance occurred early in the denning period. Linnell et al. (2000) found that den abandonment for bears with cubs of the year led to increased cub mortality, and female brown bears showed a greater degree of den-area fidelity compared with males. A bear study in the Talkeetna Mountains found that bears tend to den in the same general area in different years (Miller 1990). The study also found that dens were located on the periphery of home ranges used during summer and fall, and that some male bears moved long distances (up to 46.6 miles) to den on the same hillsides used previously. This indicates strong selective pressure on bears to return to good denning areas where wind currents assure the den entrance is well-sealed with snow, and where soil and frost characteristics prevent dug dens from collapse during winter (Miller 1990). Therefore, bears that den along the port access road may have a harder time relocating to a new area, and suffer the consequences of being behaviorally excluded from preferred denning areas in close proximity to the road.

Bear denning ecology has been studied by Schoen and Beier (1990) for several years at the Greens Creek Mine on Admiralty Island in Southeast Alaska. To assess the effects of the mine site development on denning bears, they selected six female bears that had denned within 2.5 miles of the mine site in upper Greens Creek. It was assumed that these bears were most influenced by mine site activities, including intensive helicopter traffic. During the first year of observation, these bears denned on average 2.1 miles away from the mine site. The following year, they denned significantly farther from the mine site, with a mean distance of 7.3 miles (Schoen and Beier 1990). When compared with bears that denned outside of the area of mine influence, the mean distance among den sites in subsequent years was significantly greater for the six bears that initially denned closest to the mine. Therefore, bears that had initially denned close to the mine location withdrew their denning locations to areas farther away from the mine. Although the habitat conditions on Admiralty Island (upland old-growth rain forest with alpine tundra) are different than those along the port access road (dwarf shrub vegetation, open/closed forest, and open tall shrub), it is possible that the construction and operations of the port access road and mine site may cause brown bears to locate denning areas farther away from areas of disturbance.

Apart from bears moving dens farther away from the Greens Creek Mine, Schoen and Beier (1990) found that it did not appear that home ranges and seasonal distribution of most adult brown bears were substantially influenced in the short-term by development activities. The established

home ranges of most bears continued to include areas where intensive road construction was occurring. However, bears shifted their activity away from construction activity (by using other salmon streams in their home ranges that were not influenced by construction activities), and then moved in closer to the road once construction activity was reduced (Schoen and Beier 1990). This is likely due to bears having established home ranges with abundance of spawning salmon and sufficient forest cover that kept them out of sight of humans. One potential effect of shifting feeding areas depending on their proximity to construction activities is the potential for reduced fitness for individual bears that are displaced from familiar feeding areas close to human activities.

To further assess the effects that road construction had on bear distribution at the Greens Creek Mine, the number and location of summer day beds was recorded before and after road construction. Before road construction along lower Zinc Creek, Schoen and Beier (1990) recorded 57 day beds within a 1-mile strip. Following construction, they counted 17 day beds in the same stretch, suggesting that bears avoided the streamside area adjacent to road development. When all movement data were taken into account, Schoen and Beier determined that although bears remained in their traditional home ranges (that were identified prior to start of construction activities), they shifted their movements away from active development areas. It is important to note that Schoen and Beier's study looked at the short-term effects of development activities, and the long-term effects of development on the local brown bear population cannot be concluded based solely on these initial findings. Subsequent years of data collection via telemetry flights during the summers of 1990 and 1991 appear to support the claim that bears remain in their home ranges, but shift activity patterns away from active development (Titus and Beier 1992).

To further understand the potential implications of roads acting as potential barriers to movement, one study on the Kenai Peninsula analyzed radiotelemetry data to determine the spatial and temporal distribution of brown bear crossings of the Sterling and Seward highways (Graves et al. 2006). The study found that bears were more likely to cross the highway during night-time than daytime; and when bears crossed the highway, they moved more rapidly and acutely, compared to before or after crossing. Bears may change the period they are active to cross at times with lower traffic and greater cover provided by darkness. Additional factors such as traffic volume, road configuration, and highway mortality can exacerbate population-level effects (Graves et al. 2006).

A study in British Columbia that assessed bear density, food sources, and use patterns in relation to logging road densities found that the density of brown bears was more related to bear avoidance of areas close to open roads and the risk of human-caused mortality, rather than a difference in habitat (between their two study locations) and high-calorie food sources (Ciarniello et al. 2007). They detected avoidance of areas near primary logging roads due to a high volume of logging truck traffic. They also identified roads as potential "sink" or ecological trap areas, where bears are attracted closer to roads (often due to close proximity to food resources), and then experience human-caused mortality. For brown bears to remain viable outside of protected areas, it is important to maintain landscapes that are secure from the risk of human-caused bear mortality (Ciarniello et al. 2007). While project roads would not be at a comparable density to logging roads, the long-term management of the port access road is an important factor for understanding potential long-term impacts on bears in the local area.

Additionally, aircraft disturbance at Amakdedori port during construction of the port access road would likely cause bears to move away from the area. Because bears were detected fishing in Amakdedori Creek, they may be disturbed by construction and operation of the port, and vacate the area. The WIP would detail specific parameters to prevent disturbance to bears. The general limitations of the provided baseline data regarding bear study areas, abundance, distribution, and activity are recognized. Additional bear den surveys may be required prior to construction as a mitigation measure.

In a Lake Clark National Park brown bear study, location data (collected between October 1, 2014 and November 8, 2017) from 46 brown bears collared in Lake Clark National Park and Preserve illustrate that bears move widely across the landscape, including using areas in the mine site and along the north shore of Iliamna Lake (including the mine access road) (NPS 2019). Therefore, impacts to brown bears from the mine site would directly impact brown bears whose home ranges overlap with Lake Clark National Park and Preserve.In summary, the magnitude of impacts would include avoidance of the mine site, the transportation corridor, the ferry terminals, and port, with avoidance distances differing between bear ages, genders, and life history stages. Because there are no established roads in the mine site, along the transportation corridor, and at Amakdedori port, the access roads, mine, port, and ferry terminals represent novel sources of disturbance to the landscape. In particular, the port access road may alter use of habitats and localized movements of bears around the road. The duration would last for the life of the project, and longer depending on how the roads are managed post-closure. The extent of impacts would encompass all project components, but be greatest along the port access road and around the port. Some age and gender groups of bears may avoid the mine site, specifically during operations (such as adult male bears), and others may be less affected or become habituated to mine site disturbance. Vehicular traffic along the transportation corridor (in particular, the port access road) would be anticipated to alter movement patterns, because there are currently no roads in the majority of the transportation corridor. Some bears may avoid resting, denning, and foraging within the transportation corridor, or shift their movement patterns depending on traffic volume. Because the area has a high density of brown bears (see Section 3.23, Wildlife Values), some individuals would experience disturbance. The level of disturbance, displacement of feeding, denning, and other important life stage habitats would likely impact bears of varying age and gender differently. Boars, sows with cubs, and juvenile bears may respond differently, and behavioral avoidance of areas around the port access road may lead to increased interspecific competition. If the mine were permitted and constructed, many of these behavioral disturbance impacts would be expected to occur.

Gray Wolf

Gray wolves travel widely in pursuit of prey, using a variety of habitat types; however, gray wolves strongly avoid roadways and other areas with high levels of human activity (Person 2001; USFWS 2000), and may have a large avoidance zone around the mine site and access roads. Wolf behavior in the transportation corridor may be affected; either by avoiding the roadways, or potentially using them for travel (especially during the winter when roads are plowed/maintained). Overall, the magnitude of impacts would encompass wolf territories that overlap with the mine site and other project components. There are currently no mines in the area, and the disturbance from the project may cause wolves to avoid the area or alter their movement patterns. They may change denning locations or forage in new areas away from the project, especially if the mine causes caribou and moose distributions to change. The duration would last for the life of the project, and the extent would encompass all project components, and potentially longer, if it affects prey populations. Impacts would be expected to occur because wolves have shown avoidance of roadways and areas with high levels of human activity (Person 2001; USFWS 2000).

Small Terrestrial Vertebrates

Some small mammals present in the direct footprint of project components at the beginning of construction are anticipated to vacate the area due to presence of humans and ground-disturbing equipment. Other species may be attracted to project components due to newly created shelter and feeding opportunities. Some individual small mammals and wood frogs (*Lithobates sylvaticus*) may be more susceptible to disturbance during the process of mine site development. Although wood frogs were detected in many of the wetlands and waterbodies in the mine site,

they are likely to also occur along the transportation corridor, around ferry terminals, and the port. Any habitat avoidance during construction and operations would be additive to the direct habitat loss at the project components.

The magnitude and extent of impacts would be that some small terrestrial vertebrates would avoid the transportation and natural gas pipeline corridors and Amakdedori port due to loss of habitat, and resulting edge impacts (e.g., increased predation along edge habitats and habitat changes). In summary, the magnitude of impacts would include behavioral avoidance of the project because many smaller terrestrial mammals may avoid areas during construction; but some species, such as red foxes, may eventually become accustomed to the presence of the mine. The duration would last for the life of the project, and extent would include the entire project footprint.

Injury and Mortality

Species may experience injury and mortality from a variety of sources such as habitat avoidance and food/territory competition, vehicular collisions, lethal removal due to defense of life and property, and increased access to areas for legal hunting. The potential for an increase in access for hunting from the transportation corridor is discussed in detail in Section 4.5, Recreation; and Section 4.9, Subsistence. The WIP would outline measures to reduce impacts to wildlife species, including proper trash disposal, containment of wildlife attractants, defining speed limits on roads, and prohibition of hunting, among others.

The main source of injury and mortality directly related to the project would be the potential for wildlife strikes along the transportation corridor. In terms of extent, injury and mortality would have a low potential to occur at the mine site and Amakdedori port due to the low speeds vehicles would likely be traveling. In terms of magnitude, injury and mortality on project roads would be greatest during construction and operations, because the access roads would be built through previously undeveloped habitats. The extent of impacts would encompass 78 miles of gravel road that would be constructed between the Amakdedori port and the mine site. As previously detailed, during operations, daily truck traffic would equate to one truck every 21 minutes. A regulated speed limit on the gravel transportation corridor roads would be maintained for dust suppression and safety. There would be additional light vehicle traffic (i.e., vehicles other than large trucks transporting concentrate, fuel, and consumables) along the transportation corridor, increasing the number of daily vehicle trips. Use of salt or other applicants on the road surface for safety is currently undetermined. Therefore, the magnitude and extent of impact of wildlife being attracted to the access roads due to salt—and increased potential for injury and mortality —are unknown. The WIP would outline ways to reduce the potential for wildlife mortality along the road; however, varying weather and seasonal conditions would likely cause periods of increased mortality for some species (such as increased moose mortality during winter months, and reduced bear mortality during hibernation). The duration of these impacts would be long-term, lasting through the life of the project.

Clearing of adjacent roadside vegetation and reducing traffic speeds would help reduce the potential for collisions with terrestrial wildlife (Gunsen et al. 2011). Wildlife safety mitigation measures for the transportation corridor would include vegetation management to increase visibility. Visibility would be improved by reducing roadside vegetation (trimming of shrubs and trees) that may obscure wildlife approaching the road, and reducing its attractiveness. Vehicle speeds would also be reduced along the transportation corridor. The maximum speed limit for the road system would be set at 35 mph. Wildlife present on the road would be given the right-of-way. Traffic would stop, if necessary, to allow the safe passage of wildlife crossing, or walking along, the road. (PLP 2019-122).

Caribou

Caribou distribution around project components is detailed in Section 3.23, Wildlife Values. Caribou would not be anticipated to occur in large numbers in the vicinity of the mine site during construction and operations (due to behavioral avoidance); would be anticipated to occur as scattered individuals around Amakdedori port; and would be anticipated to occur uncommonly along the transportation and natural gas pipeline corridors. Caribou would be expected to move away from areas of human activity during operations, especially during blasting. As detailed in Boulanger et al. (2012), in terms of extent, caribou would be expected to avoid a large area of habitat around the mine site due to behavioral disturbance; therefore, caribou would not be anticipated to occur within range of injury or mortality during any blasting. The primary potential for injury or mortality would be through vehicle collision while crossing roads in the mine site and along the transportation corridor. A regulated speed limit at the mine site and a 35 mph speed limit along the transportation corridor, along with measures to be specified in the WIP, would reduce the potential for injury or mortality. Additionally, the WIP would outline vehicle restrictions for when caribou are adjacent to roadways to prevent injury and mortality. There would also be a potential for increased hunting pressure from increased accessibility to areas, especially along the transportation corridor.

In summary, the magnitude and extent of impacts would be the potential loss of individual caribou from mortality on the access roads and increased/altered hunting pressure. The duration would last for the life of the project, and the extent would mainly be limited to the mine and port access roads.

Moose

Moose are known to occur in the analysis area, and are at risk of vehicular collisions during construction and operations; and to a lesser extent, after closure, depending on the final determination of the access roads. Moose-vehicle collisions are well documented, especially during long nights and short, dimly lit winter days. Collisions vary depending on snow conditions and road conditions. In terms of magnitude, the majority of collisions occur during the winter months, when accumulating snow forces moose into lowland areas, often around roads where travel is easier and food sources are more exposed (ADF&G 2019b). Moose sometimes feed near roads (often depending on shoulder vegetation management), and rest or travel along cleared roads during heavy snow conditions. They may cross roads when vehicles are present, and be startled, running from one side to the other. This may cause cows to be temporarily separated from their calves, and increases their risk of injury or mortality through vehicle collisions when the animals try to reunite. Although project vehicles would be restricted to a 35 mph speed limit, the potential for injury and mortality exists during all three project phases, especially at night or during other periods of poor visibility, and in winter when animals may use access roads to escape deep snow. Snow berms along the road would be maintained with breaks to allow moose to safely exit the roadways.

The mine site contains low densities of moose due to less suitable habitat, compared to the habitat of the transportation and natural gas pipeline corridors. Because most vehicles and equipment would be traveling at low speeds in the mine site, moose density is low, and the open, low-growing vegetation permits greater visibility, moose would not be expected to be struck in the mine site footprint.

Although there are low moose densities across the analysis area, moose tend be concentrated in riverine areas where preferred forage occurs. The 74 miles of road that compose the transportation corridor cross many riverine areas where moose may occur; therefore, there is the

potential for moose to be struck by project vehicles. This risk would be greatest around dawn and dusk, when moose are typically more active; during winter; and during periods of low visibility.

The magnitude of impacts would be that few individual moose could experience injury and mortality, especially because moose density is low in the analysis area, and the extent is primarily along the transportation corridor. The duration would last for the life of the project and possibly longer, depending on the ultimate fate and management of roads post-closure. There would be a likelihood of occurrence, because moose are killed on roads, particularly in winter and during periods of reduced visibility.

Bear

Across the species' range, one factor that has caused reduction in brown bear abundance has been the availability of human access into brown bear habitat by roads built for resource extraction (Boulanger and Stenhouse 2014). One study in Alberta, Canada by Boulanger and Stenhouse (2014) attempted to estimate the direct demographic impact of roads on survival rates, reproductive rates, and other demographic parameters for brown bears. They found that sex and age class survival was related to road density, with sub-adult bears being most vulnerable to road-based mortality. Additionally, females with young of the year and/or yearling cubs had lower survival rates compared to females with 2-year-old or no cubs (Boulanger and Stenhouse 2014).

As resource extraction activities enter an area, road construction can provide entry for hunters and other users (McLellan 1989). The port access road would be in an area with high brown bear densities, and occurs directly north of Katmai National Park and Preserve and McNeil River State Game Refuge and Sanctuary. In terms of magnitude and extent, these areas have the highest documented concentration of wild brown bears in the world, and include popular bear-viewing locations (ADF&G 2018b). According to ADF&G, no one has ever been injured by a bear at McNeil River, and no bears have been killed by visitors who felt threatened since the permit program to access the sanctuary was initiated (ADF&G 2018b). Amakdedori port and the port access road would be approximately 13 miles north of McNeil River Falls.

Brown bears are common in the area along the port access road and Amakdedori port, especially along coastal plains in the early summer, and then along salmon-spawning streams later in the summer and fall. This was documented in 2018 Environmental Baseline Data (EBD) studies along the port access road, with bears along the coast in the spring and early summer, and along salmon streams later in the summer. Therefore, bears move around in relation to seasonally available food resources. Bears would be expected to cross the port access road as part of their regular movement patterns, but may show initial caution, or avoidance. Because the road would be a novel item in the landscape, bears may be wary of crossing it initially. As detailed above under Behavioral Disturbance, brown bears in particular would likely avoid the transportation corridor during periods of high vehicular traffic. The magnitude of impacts to brown bears include the potential for an undetermined number to experience injury or mortality along the transportation corridor across the life of the project. Roads may serve as ecological traps for brown bears. Female brown bears with cubs-of-the-year tend to be more attracted to roads due to higher forage availability (often early in the season/springtime), and to avoid potentially infanticidal adult males (Northrup et al. 2012, as cited in Penteriani et al. 2018). The potential for bears to be impacted along project roads would likely fluctuate in relation to age and gender of bears, the location of seasonal resources, movement corridors, time of day, and season. Bears that are forced to den farther away from the transportation corridor due to behavioral avoidance have a potential for injury or mortality through interspecific competition for optimal denning locations. There would also be a potential for bear mortality due to defense of life and property. Bears that become habituated and frequent the mine site, ferry terminals, Amakdedori port, or other project locations, may become a safety risk. Some of these bears may experience hazing and other negative human

interactions, and then travel to areas such as Katmai National Park and Preserve and McNeil River State Game Refuge and Sanctuary. Bears that are negatively habituated to the project, or have become food conditioned, may become a danger to the public at bear-viewing areas. Human food–conditioned bears can become a problem, and dangerous to personal property and human safety (Gunther and Wyman 2008). Most bears conditioned to human foods eventually become aggressive in their efforts to obtain human foods, which may result in damage to property, injury to humans, and ultimately destruction of the bear (Gunther and Wyman 2008). In contrast to food conditioning, human habituation in wildlife, defined as the waning of an animal's flight response (loss of avoidance or escape response) following repeated exposure to inconsequential stimuli, is not necessarily detrimental to bears or humans. The success of McNeil River State Game Refuge and Sanctuary has hinged on bears becoming habituated to humans acting in a predictable manner, often in close quarters. Although the port access road may cause some injury and mortality to brown bears, especially during the initial years during construction and operations, some brown bears have shown the potential to become habituated to regular, consistent, and predictable human behaviors. Habituation can benefit some bears (especially younger bears and females with cubs) by allowing them access to high-quality food resources adjacent to roads that would otherwise be underused (Gunther et al. 2018). Three forms of habituation can occur in Alaska: bear-to-bear, bear-to-human, and human-to-bear (Smith et al. 2005). Bear density is an important factor influencing a bear's overt reaction distance; where bear density increases, the overt reaction distance decreases, as does the likelihood of bear-human interactions. Bear-to-bear habituation is responsible for shaping bear aggregations and for creating the relatively safe environment for bear viewing at locations with high bear densities (Smith et al. 2005). Bears' social flexibility enables them to habituate to one another in areas of rich forage resources. Because bears that use McNeil State Game Refuge that may be bear-to-bear habituated and bear-to-human habituated may use areas along the port access road and around the port, it is crucial that human activity at the port and along the port access road remain predictable and benign.

Many of the general measures, and those specific to brown bears outlined previously above, are designed to reduce the potential for negative bear and human interactions. Specifically, these include the creation and implementation of a detailed bear interaction plan as part of the WIP. Methods to decrease potential negative interactions include use of bear-proof containers and trash receptacles used for food and garbage. Mandatory training would be required for mine workers on ethical behavior around brown bear populations (e.g., strict use of bear-safe trash cans; strict prohibition of bear feeding and harassing). Implementation of a WIP may reduce the potential for conflict between wildlife and humans through a variety of measures, such as enforcing a 35 mph speed limit on project roads. There would be also a potential for increased hunting pressure from increased accessibility to areas, especially along the transportation corridor. The project would have a no hunting, fishing, or gathering policy for non-local employees to minimize competition for local resources. However, the port access road would remain open for use by local residents.

In summary, the magnitude of injury and mortality impacts would be loss of individual bears along the access roads and during defense of life and property, or from other negative human interactions. The duration would last for the life of the project, and potentially longer, depending on the long-term management of the access roads. The extent would include all project components, but could extend into adjacent areas if negatively habituated bears move into public bear-viewing areas. There would be a likelihood of occurrence because bears may be injured or killed along the transportation corridor, and there would be a potential for food-conditioned bears to become a safety hazard.

Gray Wolf

Similar to other large mammal species discussed above, the greatest risk to gray wolves from the project would be the potential for vehicular collisions and the potential for increased hunting pressure. In terms of magnitude of potential effects, surveys did not document large numbers of wolves in the area; therefore, regulated speed limits on the access roads and guidance provided in the WIP would reduce the potential for injury and mortality to gray wolves. The magnitude of impacts may include the rare instance of injury or mortality for individual wolves, especially because wolves are uncommon in the analysis area. The duration would last for the life of the project, and extent would include the entire project footprint.

Small Terrestrial Vertebrates

Small mammal species have the potential for injury and mortality from a variety of sources, and impacts are often species-specific. Blasting and removal of rock and vegetation during construction and operations of the mine (including clearing and vegetation removal) may cause injury and mortality, especially to small mammals and wood frogs that have limited ability to move away or avoid heavy machinery. In terms of extent, some species (such as Arctic ground squirrels [*Spermophilus parryii*] and snowshoe hares [*Lepus americanus*]) may experience injury and mortality due to collisions with project vehicles, especially along the transportation and natural gas pipeline corridors. In terms of magnitude, there would be frequent use of the mine and port access roads by vehicles, especially while mine equipment and construction materials would be delivered to the Amakdedori port and transported on the road. Some species, such as Arctic ground squirrels, may experience an increase in roadkill mortality due to their use of dirt roads for burrowing. The risk of injury and mortality from collisions with vehicles would be higher for young-of-the-year wildlife, and during limited visibility such as during the winter, twilight hours, and during inclement weather. When roads are icy, increased slowing and stopping distances, coupled with decreased visibility, may lead to increased mortality. Additionally, small mammals may experience increased predation from predatory species using the newly created edge habitat. Because the transportation corridor would bisect habitat that currently lacks an established road, small terrestrial vertebrates would experience edge effects such as increased predation and increased mortality due to lack of cover while foraging and transiting throughout adjacent habitat. Wood frogs would likely experience impacts as the mine site is dewatered and wetlands are filled to construct the project. Wood frogs that are not able to vacate the area during construction would likely experience injury and mortality.

In summary, the magnitude and extent of impacts may include mortality of individual small mammals along the 78 miles of new roads. Although the amount of mortality is difficult to quantify, roadkill would likely increase seasonally when small mammal abundance is greatest (in late summer when novice young-of-the-year are present) and during peaks in wildlife population cycles. The duration would last for the life of the project, and the extent would generally include the transportation corridor, and to a lesser extent the mine site. In the mine site, vehicles would move slower, and there is less available adjacent habitat in the mine site; therefore, the potential for vehicle collisions would be reduced. There is a high likelihood of injury and mortality to small terrestrial vertebrates in the vicinity of the transportation corridor in relationship to their seasonal abundance, edge effects, and behavior of foraging along roadsides.

Habitat Changes

There would be permanent and long-term removal of vegetation in the mine site during construction and operations of the mine, which currently provides habitat for a variety of wildlife species. Project component acreages are provided in Chapter 2, Alternatives, Table 2-2, and highlighted in this section. In terms of magnitude and extent, terrestrial wildlife species that use

project components would experience a direct loss of 9,611 acres of breeding, foraging, wintering, and dispersing habitat during construction and operations. Some of the large mammal species such as caribou, moose, bears, and gray wolves occupy the habitat in the mine site at varying densities and at different times of the year. In terms of the duration of effects, a large portion of this habitat would be revegetated once the project would be completed, and the species may return over time as the vegetation and habitat mature to conditions suitable for each species. The open pit lake and other project components that would not be reclaimed and restored would result in a permanent loss of habitat for all terrestrial species.

The Amakdedori port facilities would result in a loss of vegetation that supports a variety of wildlife species. The port facilities would be removed during closure, except for those required to support shallow draft tug and barge access to the dock for the transfer of bulk supplies. Disturbed areas would be recontoured, graded, ripped, and scarified. Topsoil and growth media would be placed as needed, and surfaces would be seeded for revegetation.

Construction of the transportation and natural gas pipeline corridors would include the removal and conversion of vegetation to gravel roads, ferry terminals, and material sites. This habitat removal would be additive to that at the mine site and Amakdedori port; post-closure, the roads would remain in place as long as needed for long-term post-closure water treatment and monitoring.

With regard to terrestrial wildlife, winter dust fall in the corridors along roads in Alaska may cause early snow melt and soil thaw. This may concentrate waterfowl, ptarmigan, and their predators in snow-free areas along the roadside, making these wildlife susceptible to collision with passing vehicles. Caribou may take advantage of the early snow-free areas for grazing; and grizzly bears, raptors, and other predators may use these areas to hunt ground squirrels and voles (Walker and Everett 1987).

Changes in vegetation communities are discussed in Section 4.26, Vegetation. In terms of extent and duration, these changes would affect the availability and quality of habitat for terrestrial wildlife in the analysis area, during both construction and operations, and potentially post-closure. Although all affected habitat would not be directly lost (apart from habitat converted to open water, such as the pit lake), it may be become less suitable, and may cause displacement of individuals to more suitable habitat.

Caribou

Caribou are highly mobile and their range changes with density of animals, snow pack, and forage availability. The main calving areas in the region have changed dramatically in the last 5 years, and historical data show how the range of the Mulchatna herd has changed over time. Currently, the herd is at severely depressed numbers of approximately 13,500 individuals.

As described previously in Section 3.23, Wildlife Values, the mine site is in the range of the Mulchatna caribou herd. The habitat in the mine site is seasonally used by caribou, mainly during the post-calving summer period. Traditional ecological knowledge (TEK) of the Mulchatna caribou herd identified areas of caribou concentration, which has shifted over time from the eastern portion of the range (1960-1979) to the west during the 1990s (Van Lanen et al. 2018). During the mid-1990s, when the Mulchatna herd had reached its peak population, the herd expanded its range north and west. At the same time, the herd shifted away from the analysis area. Although unknown at this time, the Mulchatna caribou herd may shift back toward its traditional calving areas at some point in the future, which would be closer to the mine site. In addition to removal of habitat, per Boulanger et al. 2012, caribou avoided habitat in a radius of 6.8 to 8.7 miles around an active mine in Alberta, Canada. This area of avoidance is considered habitat that may not be used due to behavioral disturbance. In terms of extent of potential impacts, with a conservative

approach, an 8.7-mile buffer around the mine site corresponds to a total avoidance area of approximately 291,313 acres (roughly 1 percent of their current range based on limited radio-collared data).

Additional habitat along the transportation corridor may be avoided due to fugitive dust and impacts to lichen communities along the road. As detailed in Section 4.26, Vegetation, dust-induced changes in plant community composition would likely vary by vegetation type, and could occur out to 330 feet from the edge of the transportation corridor. Lichen- and *Sphagnum*-dominated communities would be the most sensitive to dust deposition (Farmer 1993). Lichens are extremely slow-growing, and take decades to over a century to recover from disturbance (Joly et al. 2010). The sensitivity of lichen-rich communities to dust deposition and disturbance in general is important for caribou, which have been shown to derive much of their winter diet from reindeer lichens (Joly et al. 2010). Because large migratory herds of caribou seek out lichen-rich areas during the winter, once range areas are depleted, they may shift their range to find new areas with high lichen abundance while former range areas recover. Although the recovery period for depleted winter ranges can take up to decades, the recovery period can be hampered by climate change, which favors increased wildfire activity and shrub and deciduous forest expansion (Joly et al. 2010). Therefore, caribou avoidance around the mine site and around other project components, coupled with potential impacts from fugitive dust, may cause caribou to use other areas in their range.

As detailed previously under the behavioral disturbance section, Johnson et al. (2019) found that female caribou reduced their use of habitat within 3.1 miles of development during the calving period; within 1.2 miles during the post-calving period; and within 0.6 mile during the mosquito harassment period. Therefore, if the transportation corridor, including the ferry terminals and terrestrial portion of the port, are buffered by a 3.1-, 1.2- and 0.6-mile radius, the level of additional habitat avoidance would be around 272,589 acres, 111,634 acres, and 57,997 acres, respectively. In summary, the magnitude of potential habitat loss (including both direct and indirect) could reach 291,313 acres, depending on the extent of habitat avoidance. This represents around 1 percent of their current occupied range based on the limited radio-collared data. The additional acreage of avoidance around the transportation corridor, ferry terminals, and port could reach up to 272,589 acres, especially during the calving period. If impacts are assessed during the calving period, the combined acreage of avoidance around the mine site, transportation corridor, ferry terminals, and port, in addition to the direct habitat loss from project components, could total over 563,902 acres of habitat that would be effectively removed from use for the Mulchatna caribou herd. The duration would last for the life of the project, and potentially longer, depending on the level of human activity during post-closure long-term management and from use of the access roads by local residents. The extent of impacts would include all project components. The direct loss of habitat and additional habitat avoidance would be certain to occur if the project is permitted and constructed.

Moose

As detailed in Section 3.23, Wildlife Values, moose density is low in the area around the mine site (i.e., 0.07 moose per square mile) (ABR 2011a). Moose density in the transportation and natural gas pipeline corridors is slightly higher, at an estimated 0.13 moose per square mile (for areas around Iliamna Lake). The magnitude of impacts would be loss of 9,611 acres of habitat that has a low density of moose. The duration would last for the life of the project, and longer in some areas that would not be fully restored. The extent would represent the direct footprint of all mine components, plus a buffer area that is avoided due to disturbance. The impacts would be certain to occur if the project is permitted and constructed because the habitat would be removed, and moose are known to use the area.

Bear

In terms of magnitude and extent of impacts, the direct loss of approximately 9,611 acres of habitat from construction and operations of the project (including the mine site, Amakdedori port, ferry terminals, and transportation and natural gas pipeline corridors) would be expected to displace bears that use the habitat for foraging, denning, and as part of their home range. There would be additional habitat around mine components that would be indirectly removed by avoidance due to behavioral disturbance. Avoidance areas may include salmon spawning streams (and other locations of seasonal food resources), preferred denning habitat (such as near Amakdedori port), and movement corridors. Habitat fragmentation may also cause bears to avoid some areas that contain important life history attributes (such as preventing access to feeding areas). Bears that experience habitat loss (either directly or indirectly) would be anticipated to use the surrounding habitat, although they may encounter increased competition with other bears. Brown bears are distributed throughout the landscape and are seasonally concentrated around resources such as high-quality vegetation sources (sedges, grasses, berry sources) and salmon-spawning streams. In particular, brown bears may avoid locations or alter foraging patterns where the transportation corridor crosses anadromous streams. Habitat loss may also result if some bears are hesitant to cross mine access roads, particularly the port access road. The port access road may inhibit movement patterns, and cause bears to seek out other locations for foraging and denning. As mentioned above under Behavioral Disturbance, brown bears have been shown to avoid habitat within a variety of distances from roads. McLellan and Shackleton (1988) report an avoidance radial buffer of 328 feet from roads, while Flynn et al. (2012) report avoidance of roads ranging from radial distances of 0.3 mile to 1.9 miles, with most road crossings occurring during decreased periods of traffic and at night.

Based on a literature review conducted by Linnell et al. (2000), North American bear species generally select den sites from 0.6 mile to 1.2 miles from human activities (roads, habitation, industrial activities, etc.). Linnell et al. found that activity closer than 0.6 mile caused a variety of responses, including den abandonment, especially if the disturbance occurred early in the denning period. Based on a study conducted at the Greens Creek Mine on Admiralty Island in Southeast Alaska, Schoen and Beier (1990) found that brown bears denned farther from the mine site, with a mean distance of 7.3 miles once construction began. Although the project is not directly comparable to the Greens Creek Mine in terms of bear habitat, mining techniques, etc., the Green Creek Mine still provides a robust example of a well-studied mine and its impacts on the local brown bear population. Therefore, using a 7.3-mile distance as a radial buffer around the mine site, bears may avoid denning in a large area around the mine site.

Specific to black bears, the analysis area is generally considered low-quality, because surveys document few bears (Becker 2010), mainly concentrated to the north and east of Iliamna Lake, and the loss of habitat would be anticipated to have little effect on black bears.

In summary, the magnitude of direct habitat loss would be 9,611 acres plus additional indirect habitat loss through avoidance. The indirect habitat loss through avoidance and habitat fragmentation may include loss of foraging and denning locations, altered movement corridors, and increased interspecific competition. The duration would last for the life of the project and longer, especially because the access roads would remain open for long-term water quality management, and local resident use would be permitted. The extent would include all of the mine components, and in particular, the port access road. Given the high density of brown bears in the area, impacts would be expected to occur if the project is permitted and constructed. Although the impacts to the brown bear population in the area from direct and indirect loss of habitat and subsequent interspecific competition are difficult to accurately quantify, there could be noticeable impacts.

Gray Wolf

Several individual gray wolves were detected dispersed across the analysis area over multiple years, but no packs of wolves or dens were detected in the mine site (ABR 2011a). Two gray wolves were detected in summer 2018 around Amakdedori port. The magnitude of habitat loss would be 9,611 acres of direct impacts plus additional habitat that would be avoided. The duration would last for the life of the project, and the extent would include all of the mine components. Impacts would be expected to occur if the project is permitted and constructed, because wolves have been detected in the area, and would experience direct displacement of foraging areas and indirect avoidance of areas due to behavioral disturbance.

Small Terrestrial Vertebrates

As detailed in Section 3.23, Wildlife Values, multiple smaller mammalian species such as coyotes (*Canis latrans*), red foxes, river otters (*Lontra canadensis*), wolverines (*Gulo gulo*), beavers (*Castor canadensis*), and other species were found throughout the analysis area. There are additional mammal species that are not considered "furbearers," and are known to occur in the analysis area. These include North American porcupine (*Erethizon dorsatum*), hoary marmot (*Marmota caligata*), Arctic ground squirrel, snowshoe hare, tundra hare (*Lepus othus*), collared pika (*Ochotona collaris*), and various species of mice, lemmings, shrews, voles, and wood frogs. These species would experience a direct loss of habitat during construction and operations of the project. Some of the habitat would be restored or reclaimed and likely repopulated by these species from adjacent unaffected areas, but the pit lake and infrastructure necessary for long-term pit lake water management would remain a permanent loss of habitat. In summary, the magnitude of habitat loss would be 9,611 acres, because the home ranges of small mammals would be directly removed. The duration would last for the life of the project, and longer for permanent impacts such as the pit lake. The extent would encompass all project components; impacts would be expected to occur if the project is permitted and constructed.

4.23.4.3 Marine Mammals

Potential impacts specific to construction, operations, and post-closure activities of the mine site, transportation corridor across Iliamna Lake, Amakdedori port, and the natural gas pipeline corridor across Cook Inlet are described in the following sections. The project has the potential to directly and indirectly impact marine mammals through behavioral disturbance and habitat changes, as detailed in the following sections. Injury and mortality of marine mammals have a low potential to occur because vessels would be traveling at slow speeds across Iliamna Lake, and less than 10 knots when transiting between the port and lightering locations in Kamishak Bay.

A detailed analysis for potential impacts to threatened and endangered marine mammal species is provided in Section 4.25 and Appendix K4.25, Threatened and Endangered Species. This includes underwater noise impacts from construction of the port using various designs, and noise related to installation (from vessels and various dredge technologies) of the natural gas pipeline and adjacent fiber-optic cable.The same noise levels and potential impacts have a potential to occur to non-listed marine mammal species such as gray, minke, and killer whales, Dall's and harbor porpoise, and harbor seal in the analysis area. There is also a low potential for California sea lions to be encountered, particularly in shipping lanes in the southern parts of Alaska. In particular, impacts from underwater noise from the construction of the port are not reiterated here. The caisson dock construction would have lower noise levels compared to pile-driving or sheet pile associated with solid fill or pile-supported docks. The same Level A and Level B hazard radii would apply, and marine mammal monitoring by Protected Species Observers (PSO) would be implemented (as detailed in the NMFS biological assessment in Appendix H). Therefore, the discussion of potential impacts to marine mammals below is less focused on impacts to marine

mammals in Cook Inlet, and includes information on potential impacts to the population of harbor seals in Iliamna Lake.

Impacts from the construction and operations of the mine site would not be expected for marine mammals due to their absence in the mine site footprint. Project sources of noise, which may disturb marine mammals in project component areas, include vessels used during installation of the natural gas pipeline across Iliamna Lake and Cook Inlet; construction noise associated with the construction of the Amakdedori port, ice breaking to conduct barging operations across Iliamna Lake; and aircraft used during construction and occasionally during operations at Amakdedori port.

Project components most likely to impact marine mammals would be the marine and freshwater portions of the transportation corridor, which would involve near- and offshore vessel activity across Iliamna Lake and Cook Inlet, the construction of the Amakdedori port and natural gas pipeline and adjacent fiber-optic cable. In this section, species-specific potential impacts are discussed by project component, if information is available. In terms of likelihood, these impacts would be expected to occur if the project is permitted and constructed. Potential impacts from oil or another substance spill are discussed in Section 4.27, Spill Risk.

Behavioral Disturbance

Underwater and Airborne Noise

The effects of underwater and airborne sound from industrial activities on marine mammals may include one or more of the following: tolerance, masking of natural sounds, behavioral disturbance, temporary or permanent hearing impairment, or non-auditory physical effects (Richardson et al. 1995a; Southall et al. 2019). More information on marine mammal underwater and airborne hearing capabilities and general effects from noise on marine mammals is presented in Appendix K4.25, Threatened and Endangered Species. Potential impacts to federally listed marine mammals would be the same for non-federally listed species. Whether a specific noise source would affect a marine mammal depends on several factors, including the distance between the animal and the sound source, the sound intensity, background noise levels, the noise frequency, the noise duration, and whether the noise is pulsed or continuous.

Anticipated sources of noise include vessels used during installation of the natural gas pipeline in Iliamna Lake and Cook Inlet; anchor handling operations associated with natural gas pipeline construction; construction noise associated with the Amakdedori port and ferry terminals on Iliamna Lake; vessels used in the transportation corridor across Iliamna Lake, which includes the need to break ice during mining operations; and aircraft during construction and operations at Amakdedori port.

The caisson dock under Alternative 1a would result in the lowest magnitude of noise impacts to marine mammals, because no sheet- or pile-driving would be necessary. Therefore, underwater noise impacts would be greatly reduced when compared with the earthen causeway dock and pile-supported dock variants described in the alternatives.

Vessel and aircraft noise generally does not exceed thresholds that may result in injury. A summary of noise sources for each activity related to the project is presented in Appendix K4.25, Threatened and Endangered Species.

The magnitude of impacts from underwater and airborne noise on marine mammals would vary depending on the noise source and may affect marine mammals if they are present during construction and operations. For construction of the port, caisson installation would require leveling of the seabed prior to caisson placement. As detailed in Section 4.25, Threatened and

Endangered Species (and applied to all marine mammals), all in-water use of heavy equipment for manipulating the substrate, including fill placement, would require a monitoring zone radius extending out to 984 feet (300 meters) from the sound source to avoid exceeding the NMFS level B marine mammal disturbance threshold of 120 decibels (dB). The ensonified area that would receive noise levels above the level B threshold (120 dB) from installation of the natural gas pipeline (and fiber-optic cable) would extend out 1.7 miles on either side of the pipeline centerline. This buffer would encompass the noise generated by both vessels and dredging equipment. Placement of the mooring buoys at the lightering locations would result in an ensonified area with a radius buffer of 1.7 miles, based on noise levels from tugboats operating bow thrusters. The noise levels generated by bulk carriers in established shipping lanes in Cook Inlet, the Gulf of Alaska, and beyond would extend 1.4 miles on either side of the vessels. The shipping lanes are approximately 4.6 miles wide; and when buffered by 1.4 miles on either side, equate to a shipping lane width of 7.4 miles. All other impacts to marine mammals in Cook Inlet, the Gulf of Alaska, and beyond are detailed in Section 4.25, Threatened and Endangered Species.

Underwater noise from ice-breaking operations in Iliamna Lake could displace harbor seals from overwintering sites. In particular, the ice-breaking ferry would generate loud noises near the Eagle Bay ferry terminal during ice-breaking. Although no studies have been conducted on the noise levels generated by ice-breaking ferries in Iliamna Lake, several studies have been conducted on other marine mammals, and impacts from ice-breaking vessels. In one study, Erbe and Farmer (2000) looked at the zones of impact around ice-breakers affecting beluga whales in the Beaufort Sea. Researchers found that the ice-breaker *Henry Larsen* generated two types of noise (bubbler system and propeller cavitation noise) that were audible to beluga whales from 21.7 to 48.5 miles away, depending on the specific location. They found that the zone of behavioral disturbance was slightly less, and masking of beluga communication signals was predicted to occur within a 8.7- to 44-mile range. It was determined that temporary hearing damage could occur if a beluga whale remained for at least 20 minutes within 0.6 mile to 2.5 miles of the ice-breaker (Erbe and Farmer 2000). Although beluga whales are not necessarily appropriate for comparison with harbor seals (that spend time hauling out of the water and are therefore less prone to impacts from underwater noise while above water), the impacts from underwater noise during ice-breaking activities can cover vast distances. Reactions of pinnipeds to ice-breaking activities appear to be less dramatic, with ringed and bearded seals on pack ice diving into the water within 0.6 mile of a vessel (77 FR 49922). The area where ice-breaking activities would occur is a known winter location for harbor seals, because they haul out under the ice on the shore in this area of the lake. Noise modeling would be conducted prior to submittal of an MMPA permit request, at which time the Applicant would determine the area of ensonification, duration, and density of harbor seals in affected portions of Iliamna Lake to better understand potential impacts from underwater noise on the species. During periods when Iliamna Lake is covered in ice, harbor seals access dry platforms for hauling-out and air spaces for breathing by exploiting air pockets that develop along shorelines when the water levels drop (Burns et al. 2016). If ice-breaking were to occur through these areas, the noise impacts on harbor seals that are under the ice hauled out on land may be difficult to determine, because the seal would not be visible. Noise propagation under the ice, but above the water level during ice-breaking, could cover a large area.

The extent to which project noise would be audible depends on source levels, frequency, ambient noise levels, the propagation characteristics of the environment, and sensitivity of the receptor (Richardson et al. 1995a). The magnitude of the impact from underwater noise from construction, operations, and reclamation activities of the transportation corridor through Iliamna Lake, Amakdedori port, and the natural gas pipeline corridor across Cook Inlet would affect marine mammals in the nearby vicinity. In particular, ice-breaking activities in Iliamna Lake could generate loud noises that disturb harbor seals in Iliamna Lake. However, implementation of industry-standard mitigation measures required through Endangered Species Act (ESA) and

MMPA consultation would reduce impacts. The duration of time that marine mammals may be exposed to underwater sound would be relatively short-term (for example, while a vessel passes by or during ice-breaking activities), but last for the life of the project. In particular, impacts would occur during pipeline installation, port and lightering location construction activities, and from vessel traffic during mine operations, including ice-breaking activities in Iliamna Lake. Exposure to disturbance would be expected when seasonal distribution and habitat selection overlap in time and space with in-water project activities.

Physical Presence (Vessel and Aircraft)

Impacts from physical presence can occur either from increased vessel traffic or newly erected human-made structures. Sources of physical presence include vessels used during installation of the natural gas pipeline in Iliamna Lake and across Cook Inlet; in-water construction associated with the development of Amakdedori port and the ferry terminals; lightering locations; vessels used throughout the transportation corridor (across Iliamna Lake and Cook Inlet); and aircraft and vessels during construction and operations.

The physical presence of low-flying aircraft, including helicopters, can disturb marine mammals, particularly individuals resting on the sea surface (reviewed in BOEM 2012) or hauled-out on land (Greig and Allen 2015; Kucey 2005; Suryan and Harvey 1999). Observations made from low-altitude aerial surveys report that the behavioral responses of marine mammals are highly variable, ranging from no observable reaction to diving or rapid changes in swimming speed or direction (Smultea et al. 2008). One response of marine mammals hauled-out on land to low-flying aircraft is to rapidly seek refuge in nearby water.

Reactions of marine mammals to vessels while in the water often include changes in activity (from resting or feeding to active avoidance), changes in surfacing-respiration-dive cycles, and changes in speed and direction of movement (NMFS 2013a).

Minke whales (*Balaenoptera acutorostrata*) have been observed to avoid boats when approached, and approach boats when they are stationary (Richardson et al. 1995a). Minke whales are thought to react similarly to other baleen whales, namely the humpback (*Megaptera novaeangliae*) and fin (*Balaenoptera physalus*) whales, discussed in Section 4.25, Threatened and Endangered Species. Harbor porpoises (*Phocoena phocoena*) often rest at the surface, and their reaction to boats can be strong within 1,300 feet (Polacheck and Thorpe 1990) out to 10.9 miles (Palka 1993). Harbor porpoises have often been seen changing direction in the presence of vessel traffic (Richardson et al. 1995a). Avoidance has been documented up to 1 mile away from an approaching vessel, but the avoidance response is strengthened in closer proximity to vessels (Palka 1993).

The distances at which harbor seals in the marine environment were disturbed and the level of disturbance (e.g., detection, alarm, and harassment) varied by region, type of vessel, and vessel speed. No information is known about reactions to disturbance of seals inhabiting freshwater; however, in the case of the seals that inhabit Iliamna Lake, they are the same species as marine harbor seals, and without literature specific to their reactions, the best available information to use in lieu of detailed studies is those of harbor seals as a whole species. The presence and movements of ships in the vicinity of seals can cause disturbance to harbor seals' normal behaviors (Jansen et al. 2010), and could potentially cause seals to abandon their preferred breeding habitats in areas with high traffic (Reeves 1998). Depending on circumstance, seals may not respond at all to vessel traffic, or may respond by deflection from the noise source, avoidance behavior, short-term vigilance behavior, or short-term masking behavior (NMFS 2015). Harbor seals hauled-out on mudflats have been documented returning to the water in response to nearing boat traffic (Richardson et al. 1995a). Harbor seals in the marine environment are known for

vessel tolerance (Richardson et al. 1995a). However, vessels that approach haul-outs slowly may also elicit alert reactions without flushing from the haul-out; small boats with slow, constant speed elicit the least noticeable reactions (Richardson et al. 1995a). In Alaska specifically, harbor seals are documented to tolerate fishing vessels with no discernable reactions, and habituation is common (Johnson et al. 1989). Overall, vessel noise does not seem to strongly affect pinnipeds that are in the water (Richardson et al. 1995a).

Reactions of freshwater seals—such as those that inhabit Iliamna Lake—to vessel presence is unknown. There is a high level of use of Iliamna Lake by recreational and subsistence watercraft in the open water season. The impacts of a large ice-breaking ferry during winter would have disturbance impacts to seals, especially if seals are using air pockets under the ice that are then disrupted during ice-breaking activities. Additionally, noise associated with ice-breaking may cause seals to leave the area. Operations of the ferry across Iliamna Lake under Alternative 1a would be in the middle of the lake, and although seals are generally not observed in high density in the middle of the lake, there are several islands where they haul out, forage, and pups have been sighted that the ferry would travel past. In terms of geographical extent, as discussed under Underwater and Airborne Noise, above, harbor seals inhabiting Iliamna Lake are most commonly observed on the northeastern side of the lake, east of an imaginary line between Kokhanok and Newhalen, and therefore east of the natural gas pipeline and transportation corridor. Also, the transportation corridor lies to the west of the imaginary line between Kokhanok and Newhalen. Although seals that inhabit Iliamna Lake are largely found in the northeastern portion, there is a potential for adverse interactions with vessels during construction of the natural gas pipeline and operation of the ferry. The extent that physical presence would occur would be expected to only affect the area in the immediate vicinity of the project activity.

The magnitude of impacts from physical presence of vessels and equipment on marine mammals during all project phases would vary depending on the season, and sensitivity of marine mammals to disturbance. The physical presence of project vessels, equipment, and human operators are likely to cause behavioral avoidance of areas in the immediate vicinity of Amakdedori port and the lightering locations. The duration of impacts from vessels would last for the life of the project. The extent would be localized in Kamishak Bay. If any responses of marine mammals associated with aircraft were to occur, they would likely be of short duration. An incremental addition of vessels associated with the project may negatively affect marine mammals, as discussed above. In terms of extent, the construction of the natural gas pipeline would disturb marine mammals occurring in the immediate area. The duration that marine mammals would be exposed to vessel presence during construction would be short-term (during one summer [June through August]), occurring during pipeline installation and construction activities. Continued vessel presence throughout the life of the project (through operation of the mine until closure) would result in a long-term increase in physical presence from vessels accessing the port site and operations of the ferry across Iliamna Lake. Vessels associated with activities would have a transitory presence in any specific location and would be traveling slowly, allowing marine mammals to leave or avoid the area. The magnitude of impacts would be limited to brief behavioral responses such as reducing surface time, diving, swimming away, and leaving haul-out sites, in the case of harbor seals and Steller sea lions (discussed in Section 4.25, Threatened and Endangered Species), which could negatively impact marine mammals. Pinnipeds physiologically require a certain amount of time hauled out to meet their resting needs (Brasseur et al. 1996); if they are forced to leave haul-out locations from physical presence of vessels associated with the project, they could be expending energy that could have negative affects on other life history aspects. Likewise, harbor seals in particular can experience chronic stress if vessel traffic or other anthropogenic disturbances causes the animals to flush into the water (Cates and Acevedo-Gutierrez 2017), particularly during pupping in cold locations where they endure thermal stress (Jansen et al. 2010).

The magnitude of impacts from the physical presence of aircraft at Amakdedori port on marine mammals may occur during construction of the port access road, and include displacement from haulout and feeding locations. Aircraft landing at Amakdedori would likely cause marine mammals underneath the aircraft approach and take-off locations to swim away, dive, or otherwise vacate the area during aircraft operations. The duration that marine mammals may be exposed to aircraft presence would be temporary, because aircraft support would be expected to be intermittent and of short duration (2 years); only during construction of the port access road. Important harbor seal haul-out areas occur in Kamishak and Kachemak bays and along the coast of the Kodiak Archipelago and the Alaska Peninsula. Chinitna Bay, Clearwater and Chinitna creeks, Tuxedni Bay, Kamishak Bay, Oil Bay, Pomeroy and Iniskin Islands, and Augustine Island are also important spring-summer breeding and molting areas and known haulout sites (seals have a need to haul out in late June and July (pupping) and August (molting). The extent of impacts would primarily include the area around Amakdedori port, and any other locations where aircraft, including helicopters, may occur. Potential exposure to aircraft is expected to be of short duration and limited to landing and taking off of aircraft. These critical stages of flight are the noisiest, and are also when the aircraft are flying the lowest, well below the suggested 1,500 feet above ground level suggested by regulatory agencies to negate the physical presence reactions of marine mammals. Aircraft-related noise and visual disturbance are expected to have a negative effect on marine mammals limited to behavioral responses (such as diving, swimming away, reducing surfacing time). If marine mammals are forced to leave haul-out locations or flush in the water as a result of aircraft associated with the project, they could be expending unnecessary energy that could have negative effects on other life history aspects.

One potential impact from the physical presence of the port and lightering locations is the potential for marine mammal movement to be influenced by bright lights. Several studies summarized in Greer et al. (2010) describe how some pinniped species in certain areas have learned to use artificial lighting from bridges and vessels to forage on prey species at night. Additional studies looked at the risk to marine mammals from lighting from offshore development around Australia, and found no evidence that artificial lighting negatively affected migration, feeding, or breeding behaviors in cetaceans, largely because cetaceans used acoustic rather than visual cues to monitor their environment. Although there are currently no forms of artificial light around Amakdedori, the port facilities are not in any known marine mammal migration corridors. A lighting plan would be developed for the port to reduce the construction and operational impacts from lights that might impact marine birds, which could reduce potential impacts from lighting on marine mammals as well.

Injury and Mortality

Vessel Collision

Marine mammal species are vulnerable to collisions with moving vessels (Pace 2011). There would be increased vessel traffic in Cook Inlet, as well as through Iliamna Lake, as a result of the project components, and therefore a greater possibility of vessel strike impacts to marine mammals. Of the marine mammals that occur in lower Cook Inlet, only one ship strike of a gray whale (*Eschrichtius robustus*) was reported in Alaska between 1999 and 2003 by the California Stranding Network (Allen and Angliss 2012). Specifically, in Cook Inlet, no collisions of gray whales with vessels have been reported. The majority of the gray whale population migrates south of the mouth of lower Cook Inlet in the Gulf of Alaska. There have been three reports of whale-vessel collisions in Cook Inlet between 1978 and 2011 (one humpback, one unidentified whale, and one beluga whale) (Neilson et al. 2012), but none have been reported in lower Cook Inlet. In rare instances, killer whales (*Orcinus orca*) have been injured or killed by collisions with

passing ships and powerboats, primarily from being struck by the propeller blades (Carretta et al. 2004).

An increase in vessel traffic across Iliamna Lake may increase the likelihood of vessel interactions with the Iliamna Lake seal. Given this population of harbor seals is around 400 animals, the loss of animals to vessel strike may have adverse effects on the success of the population. Therefore, the magnitude of impacts from injury and mortality would be that a few individuals could be affected; however, the potential for vessel encounters would be reduced, given the slow speeds that vessels would be traveling when they transit between the port and lightering locations (less than 10 knots). The duration that marine mammals may be exposed to vessel collisions along the natural gas pipeline corridor would be short-term, during pipeline installation and construction activities. The duration of impacts in Iliamna Lake and at Amakdedori port would last for the life of the project. The extent would encompass the footprint of project activities in Cook Inlet and Iliamna Lake.

Habitat Changes

In terms of magnitude, the development of the north ferry terminal in Eagle Bay and the south ferry terminal in Iliamna Lake have a potential to cause both direct habitat loss and indirect loss through avoidance of known year-round feeding locations to less suitable areas for Iliamna Lake seals. Furthermore, the small islands around the Eagle Bay ferry terminal are used by Iliamna Lake seals for foraging, and for summer and winter hauling-out. The area between Eagle Bay and the south ferry terminal contains several early spring pressure cracks and seal haulout sites, as well as some winter pressure cracks and haulout sites. The south ferry terminal is a known seal feeding site, and seal pups have been observed along the shore near the mouth of the Gibraltar River. The habitat changes would be most impactful on Iliamna Lake seals during the winter months, when the ice-breaking ferry has the potential to disrupt their winter haul-out site under the ice around the Eagle Bay ferry terminal. There would be a small amount of acreage lost in comparison to total available habitat in Iliamna Lake, due to the construction of the ferry terminals. There is a potential for ice-breaking activities to negatively impact harbor seals during the winter months by either creating new, open leads for seals to inhabit—thereby increasing the likelihood of a vessel interaction—or by direct loss of air habitat (e.g., sea ice). Therefore, the area around both ferry terminals and the ferry route is used by Iliamna Lake seals for different reasons throughout the year.

For harbor seals in Kamishak Bay, onshore support facilities might displace harbor seals from hauling out or foraging near the Amakdedori port. In Cook Inlet, harbor seals tend to haul out near areas with available prey, and avoid areas with high anthropogenic disturbance (Montgomery et al. 2007). They select sides with rock substrate that are near deep water. Specific to the project, harbor seals were hauled out in Iliamna and Iniskin bays, around Augustine Island, around Nordyke Island, on rocky intertidal reefs that are exposed at low tide in Kamishak Bay, and several areas in southern Kamishak Bay, especially around Douglas River Shoals (Montgomery et al. 2007). Although there were no haul-out locations specifically at the proposed port location, the presence of the port at Amakdedori Port and associated human disturbance has a potential to cause avoidance of haulout locations in Kamishak Bay that may be transited past by project vessels. These impacts would occur in the vicinity of the facilities (including vessel routes) and extend for the life of the project. The magnitude of direct impacts to harbor seals (and other marine mammals foraging in the area) would be 10.7 acres of loss of benthic marine habitat from construction of Amakdedori port.

The extent of habitat alteration in the summer would only be expected to affect the immediate area around the north and south ferry terminals in Iliamna Lake and Amakdedori port during construction. The extent of habitat alteration in the winter may affect the immediate area where

the ferry would transverse, including an additional area immediately adjacent to the vessel track where broken ice may occur. Potential effects from seafloor habitat disturbance would be expected to limit the foraging quality of the disturbed area during construction. Potential effects from ice disturbance would persist throughout the life of the project in the winter months, when the ferry is actively breaking ice to traverse Iliamna Lake.

During installation of the natural gas pipeline, marine mammals that forage during the summer in Cook Inlet and those that occur year-round may be temporarily displaced from feeding areas and experience increased turbidity in waters adjacent to active trenching/dredging for pipeline installation. Although the exact method of natural gas pipeline installation is currently not determined, there would be disturbance to the seafloor while the pipeline is trenched into place. The duration that marine mammals may be exposed to habitat alteration in the form of increased turbidity from construction in marine and freshwater environments would be temporary, because construction activities would be of short duration. The duration that marine mammals may be exposed to direct habitat loss from development of Amakdedori port and the north and south ferry terminal in Iliamna Lake would be permanent. Impacts would likely be due to loss of foraging habitat.

Potential Impacts on Food Sources—Habitat alteration, turbidity, and discharge from routine activities may impact marine mammal prey species. In terms of magnitude and extent, turbidity may affect the prey species' distribution and diversity, as well as the ability of marine mammals to locate prey in the immediate area of the project activity. The effects of habitat alteration would not be expected to impact gray or minke whales, because gray whales are not expected to feed in the shallow waters offshore from the port, and minke whales are not found in great concentrations in Cook Inlet (see Section 3.23, Wildlife Values, for more information on species occurrence in the analysis area).

During installation of the natural gas pipeline, increased turbidity from trenching/dredging for pipeline installation may impact marine mammal prey in several ways. The trenching/dredging technology may crush benthic and epibenthic invertebrates from the physical components of the dredge, benthic organisms may be dislodged, and the suspended sediment may settle out and clog the gills or feeding structures of sessile invertebrates (82 FR 22099). Material that is removed during trenching/dredging would temporarily increase turbidity (which would be rapidly dissipated by strong tidal currents) and cause avoidance by mobile fauna. Planktonic species would not be able to avoid increased turbidity in the water column, and may experience increased abrasion and potential mortality. If jetting technology is used as the pipeline installation method, it may result in increased suspension of sediments, which may be carried long distances in the strong tidal currents of Cook Inlet. The effects would be limited in extent (but range farther away from the source depending on the method of pipeline installation); the duration would be short-term and temporary; and turbidity would rapidly return to background levels following active dredging.

The magnitude of impacts to killer whales from habitat alteration would include reduced prey availability from increased turbidity over the short-term, during pipeline construction. The extent would be limited to the natural gas pipeline corridor through Cook Inlet. Habitat alteration from installation of the natural gas pipeline is not anticipated to have adverse effects on populations of fish and shellfish prey for marine mammals.

Potential impacts of noise on food sources are discussed in detail in Appendix K4.25, Threatened and Endangered Species. Because Iliamna Lake seals are principally dependent on lake resources, especially in early life, responses of this population to environmental change are likely to differ from those of the marine harbor seal populations (Brennan et al. 2019), and further information is necessary to understand such impacts. Harbor seals endemic to Iliamna Lake have been subject to large shifts in sockeye salmon returns in Bristol Bay, and therefore, tributaries of

Bristol Bay. The stability of the Iliamna Lake harbor seal population may in part be due to the seal's ability to integrate across lake and marine resources (Brennan et al. 2019). It is not known whether these seals migrate between the lake and ocean, nor is it known to what extent seals rely on trophic resources predicted from in Iliamna Lake versus the ocean (Brennan et al. 2019). Stomach content from seal harvested in Iliamna Lake contained no evidence of marine prey items (Burns et al. 2016).

4.23.5 Alternative 1

Impacts to wildlife from construction, operations, and closure of the mine site under Alternative 1 are similar to those discussed previously under Alternative 1a and are generally not reiterated here. The only major differences between Alternative 1 and Alternative 1a are the mine access road that parallels Upper Talarik Creek, a short Iliamna spur road, north ferry terminal, and ferry and natural gas pipeline route across Iliamna Lake. There are no new terrestrial wildlife species in the area of Alternative 1, and there are no new impacts for terrestrial wildlife. For Alternative 1, the ferry route crossing Iliamna Lake would be farther west from the locations of Iliamna Lake seals, so there would be a lower impact to these seals. Also, the port for Alternative 1 includes the earthen fill causeway and sheet pile dock variants. These types of dock construction would increase the noise impacts on wildlife (specifically marine mammals) over Alternative 1a, which is a caisson dock that requires no sheet pile or pile-driving).

Impacts that may occur to wildlife species along Alternative 1 transportation and natural gas pipeline corridors are discussed below. These impacts would be expected to occur if Alternative 1 is permitted and constructed.

Birds

Impacts to birds that occur along the transportation and natural gas pipeline corridor would be similar to Alternative 1a and are not repeated herein. In terms of magnitude, impacts would include a loss of foraging and nesting habitat as a result of construction, increased potential for injury and mortality along the road, behavioral disturbance due to increased noise, and other edge effects associated with a road.

Behavioral Disturbance

For terrestrial avian species, impacts from the transportation corridor may result in temporary avoidance during construction.

The magnitude of impacts for marine birds along the natural gas pipeline corridor caused by behavioral disturbance may result in birds avoiding foraging areas while project-related vessels transit through. For waterbird and seabird species, the project vessels would have to pass through these areas throughout the year. This may increase time and energy spent avoiding vessels, although vessels would be traveling slowly. The duration of impacts would last for the life of the project, and extent would include all project components.

Injury and Mortality

There would be potential for avian mortality along the transportation corridor while flying between patches of habitat bisected by the road. There may be increased predation from predatory species along the road due to increased visibility and clear flight path along the road edge.

The Amakdedori port area is used throughout the year by waterbirds and seabirds. Therefore, the magnitude and extent of impacts would be that injury and mortality to birds along the transportation corridor and around the port would be expected to occur. The duration would be

for the life of the project. However, overall impacts to birds from vehicle or vessel collisions would be minimized because of restricted vehicle and vessels speeds.

Habitat Changes

Loss of habitat from construction of the transportation and natural gas pipeline corridors would occur primarily in forested habitat types. There would be suitable habitat adjacent to the transportation corridor that species may disperse to; however, loss of some individual territories and preferred habitat may occur. Loss of habitat would occur at a narrow strip along the transportation corridor with suitable adjacent habitat.

At Amakdedori port, there would be a loss of nearshore benthic foraging habitat through construction of the port. The magnitude and extent of impacts would include loss of 9,600 acres, which encompasses all mine components.

The duration would last for the life of the project. Specifically, habitat changes at the Amakdedori port would include loss and avoidance of marine habitat for waterbird and seabird species, while the mine site and transportation corridor would involve direct loss of breeding habitat. If Alternative 1 is permitted and constructed, impacts from loss and avoidance of habitat would be expected to occur for a range of avian species, including raptors, waterbirds, seabirds, landbirds, and shorebirds.

Terrestrial Wildlife

The magnitude, duration, extent, and likelihood of impacts to terrestrial wildlife from the mine site under Alternative 1 would be similar to those for Alternative 1a, and are not repeated here.

In terms of magnitude and extent, impacts to moose, brown and black bears, gray wolves, and other terrestrial wildlife would be primarily related to behavioral disturbance (through increased noise, vehicular traffic, and human interaction), injury and mortality, and loss of habitat (both directly through vegetation removal, and avoidance of areas near the transportation and natural gas pipeline corridors).

The magnitude, duration, and likelihood of impacts to small mammal species and wood frogs would be similar to those detailed under Alternative 1a. Impacts would be primarily related to loss of habitat, increased potential for injury and mortality along the access road, and increased edge effects.

Behavioral Disturbance

Wildlife would be anticipated to avoid the transportation and natural gas pipeline corridors as a result of vehicular traffic in areas that currently have no established roads. Moose have been known to avoid roads by up to 1,000 feet, and bears would be anticipated to alter feeding patterns in salmon-spawning streams adjacent to the transportation and natural gas pipeline corridors. Traffic would be anticipated to temporarily disturb wildlife while vehicles are passing. The magnitude of the visual, noise, and fugitive dust disturbance from passing vehicles would be minimized in forested areas due to buffering effects of tall, dense vegetation. The extent of behavioral disturbance to wildlife would be an impact on individuals along the transportation corridor. Some species may avoid the transportation corridor, especially where it overlaps with favored foraging areas, such as along salmon streams.

The duration of behavioral disturbance impacts would extend for the life of the project (and longer depending on the ultimate fate of the access roads and their use in long-term management of the pit lake and by local residents), and the extent would include all project components. It would be

likely that behavioral impacts would occur to some species and individuals, especially those that would not be accustomed to vehicular traffic.

Injury and Mortality

A regulated speed limit of 35 mph and other measures in the WIP would be designed to minimize wildlife injury and mortality.

The extent of potential for injury and mortality would be along the mine and port access roads to the mine site. Moose, bears, wolves, and smaller terrestrial wildlife that cross the road have a potential to collide with truck traffic. In terms of magnitude, the potential would be greatest at dawn and dusk, night-time, during the winter, and during periods of reduced visibility. Additionally, there would be a potential for increased mortality due to increased access for hunting. The magnitude of impacts would correspond to the number of wildlife injured or killed by the project, especially along the transportation corridor. The duration would last for the life of the project, and extent would include the entire project footprint. If Alternative 1 is chosen, permitted, and constructed, impacts would be expected to occur, especially with wildlife being killed along project roads, although such injury and mortality may occur infrequently.

Habitat Changes

In terms of magnitude, construction and operations of the transportation and natural gas pipeline corridors would result in loss of wildlife habitat detailed in Chapter 2, Alternatives (see Table 2-2). Habitat removal would result in edge effects, such as wildlife traveling along the road in winter (especially if the road would be plowed), dust accumulation on surrounding vegetation, changes in plant phenology due to earlier spring melt in vegetation along the road prism, and other vegetation changes that directly affect foraging habitat for wildlife species. The magnitude is the loss of 9,600 acres of habitat, and extent encompasses all project components. The duration would last for the life of the project, and the extent would include all of the project components. If Alternative 1 is selected, permitted, and constructed, impacts from loss and avoidance of habitat would be expected for a range of terrestrial species such as moose, bears, wolves, and smaller terrestrial wildlife.

Marine Mammals

The analysis area for Alternative 1 is the same as Alternative 1a. There are no new geographical areas in the marine environment of Cook Inlet under Alternative 1 beyond those detailed above for Alternative 1a. Aside from the more western ferry and pipeline routes across Iliamna Lake, the only significant difference between Alternative 1a and Alternative 1 with a potential to impact marine mammals are two different dock designs or variants at Amakdedori. The on-land portion of the port on the beach and bluff at Amakdedori would be the same regardless of the variant. The two in-water variants of the port are:

- earthen causeway and wharf (sheet pile dock structure)
- Pile-Supported Dock Variant

Details for the two dock variants are included in Chapter 2, Alternatives. Each of these would result in different impacts to the marine environment, including the amount of disturbance to the benthic marine environment and the amount of noise generated during construction. The earthen causeway and wharf would have the greatest level of disturbance to the benthic marine environment (largest in-water footprint), followed by the pile-supported dock. Both the earthen causeway and pile-supported dock would generate differing levels of sheet/pile-driving associated with underwater noise. Once construction of the port is complete, port operations would be the

same regardless of dock construction design. There would be no change in the level of vessel or aircraft traffic, which was previously analyzed under Alternative 1a. There would be no change in the installation of the natural gas pipeline, and it would follow the same route detailed above for Alternative 1a. The main source of disturbance to marine mammals would be noise from sheet pile or pile-driving in dock construction, and habitat loss.

Behavioral Disturbance

Behavioral disturbance to marine mammals from airborne noise and physical presence is the same as Alternative 1a, and is not repeated here. However, the earthen causeway and wharf or pile-supported dock variants would have a greater level of disturbance on marine mammals than the caisson dock in Alternative 1a. The ferry crossing and pipeline route across Iliamna Lake would be farther west from the locations of Iliamna Lake seals, so a lower impact to Iliamna Lake seals would be expected.

Injury and Mortality

Impacts from injury and mortality from vessel collisions and entanglement are the same as Alternative 1a, and are not repeated here.

Habitat Changes

Other than a reduction in the acreage of benthic marine habitat lost in the footprint of Amakdedori port, potential impacts on food sources from habitat changes are the same as Alternative 1a, and are not repeated here.

4.23.5.1 Variants Impact Analysis

Summer-Only Ferry Operations Variant

Under the Summer-Only Ferry Operations Variant, trucks would only operate when the ferry(ies) would be running (during the open water season), which would double the number of round-trip truck trips to 70 per day on each side of the ferry terminals during the summer (PLP 2018-RFI 065). Truck traffic would occur 24 hours a day, and the number of truck trips on the access road would be one truck passing in either direction approximately every 10 minutes during the summer. There would be additional light vehicle traffic (i.e., vehicles other than large trucks transporting concentrate, fuel, and consumables) along the transportation corridor that would add additional daily vehicle trips. Impacts to wildlife would vary by species; but overall, the magnitude of the primary impact from an increase in summer truck traffic on the access roads would be an increase in potential for injury or mortality from collisions, especially for those species that hibernate and migrate. Because increased truck traffic would occur generally when species are out of hibernation and migratory species are breeding, collision potential would be elevated. Wildlife species would have an increased potential for both behavioral avoidance of the access roads (due to higher truck passage rates and increased noise levels), and potential for collisions, especially for young-of-the-year wildlife that are not accustomed to the road. The increase in truck traffic may increase species avoidance of foraging and breeding areas. However, this variant may also reduce injury and mortality for some species. Because the truck traffic would be eliminated during winter months, there would be a potential reduction in collisions for species that do not hibernate, such as moose. A reduction in winter-time truck traffic would also decrease the potential for moose (and other wildlife) collisions, due to improved visibility for truck drivers during summer.

Specific to marine mammals, under this variant, ice breaking would not occur; therefore, no effect on overwintering seals in Iliamna Lake would occur. There would be no change in the lightering of concentrate from Amakdedori port; therefore, there would be no change in impacts to marine mammals in Cook Inlet under this variant.

The magnitude of impacts would be 9,661 acres of habitat removal plus avoidance of surrounding habitat due to behavioral disturbance, an increased potential for injury and mortality for some species, and a decreased potential for others. The duration of impacts would last for the life of the project, but only occur during the open water season when the ferry would be operational. The impacts to wildlife would vary depending on the species and time of year. An increase in summer truck traffic would increase the potential for wildlife mortality along the access roads for some species, but decrease the potential during winter due to elimination of truck traffic. The extent of impacts would be primarily limited to the access roads, and it would be expected that some wildlife would experience mortality. These impacts would be expected to occur if this variant is chosen and the project is permitted and built.

Kokhanok East Ferry Terminal Variant

Under this variant, the extent of impacts to wildlife would vary slightly because the south ferry terminal would be shifted north around Kokhanok. In terms of magnitude, this would reduce impacts to wildlife species (such as brown bears) around Gibraltar Lake and along Gibraltar Creek because the port access road would lead north to Kokhanok and avoid Gibraltar Lake. This variant would increase the number of bald eagle nests that may experience impacts, because there are two bald eagle nests less than 1 mile from the port access road along the shore of Iliamna Lake near Kokhanok. This variant would bring ferry operations closer to areas where the harbor seals that inhabit Iliamna Lake are more regularly observed. There would be no new impacts to species at the mine site, mine access road, north ferry terminal, Amakdedori port, or in Cook Inlet. The magnitude of impacts would result in a loss of 9,635 acres. The duration would last for the life of the project, and longer, depending on final disposition of the road to Kokhanok; and the extent would be limited to the Kokhanok east ferry terminal and access road. If this variant is chosen and the project is permitted and built, it would be expected that impacts to wildlife around Kokhanok would occur.

Pile-Supported Dock Variant

Under this variant, the footprint of Amakdedori port would be reduced to 0.07 acre of impacts to the benthic marine environment. In terms of magnitude, this would decrease the acreage of habitat loss for marine wildlife. During construction, noise levels may be higher during pile-driving activities, as opposed to construction of an earthen causeway and wharf. There would be reduced impediment to marine wildlife that move along the western edge of Cook Inlet, because some species would pass through the piles instead of having to navigate around the earthen causeway and wharf. All other impacts to wildlife species would remain the same, except for a slight reduction in overall acreage of the project (9,589 acres). The magnitude of impacts would be a reduction in benthic marine habitat loss; the duration would last for the life of the project until the port would be removed; and the extent would encompass the marine portion of the port. If this variant is selected, and the project is permitted and built, it would be expected that a reduction in impacts would occur.

4.23.6 Alternative 2—North Road and Ferry with Downstream Dams

Impacts to wildlife from construction, operations, and closure of the mine site under Alternative 2 are similar to those discussed previously under Alternative 1a and Alternative 1. Under Alternative 2, the mine site footprint would result in slightly more habitat loss for wildlife species. However, the primary difference with Alternative 2 is the geographical shift of the transportation and natural gas pipeline corridors to the north at the eastern end of Iliamna Lake, and the Diamond Point port in Iliamna Bay. This shift north includes more forested areas along the northern side of Iliamna Lake, and a sheltered, rocky, coastal marine environment where Diamond Point port would be. Additionally, there would be no airstrip at the port, because the Pedro Bay airstrip that would be used during construction is farther inland. Impacts that may occur to wildlife species along Alternative 2 transportation and natural gas pipeline corridors and at Diamond Point port are discussed below. These impacts would be expected to occur if Alternative 2 is permitted and constructed.

4.23.6.1 Birds

Impacts to birds that occur along the transportation and natural gas pipeline corridor would be similar to Alternative 1a, but different in geographic extent, due to the location along the northern shore of Iliamna Lake. In terms of magnitude, impacts would include a loss of foraging and nesting habitat as a result of construction; increased potential for injury and mortality along the road; behavioral disturbance due to increased noise; and other edge effects associated with a road. Also in terms of magnitude, the avian community that would be impacted by Alternative 2 includes more species that occur in forested habitats, which are common along the transportation and natural gas pipeline corridor. Additionally, the Diamond Point port would be in an area that provides important migratory bird stop-over habitat (especially for shorebirds), important summering and wintering habitat for a variety of waterbirds, and an important nesting area for several species of seabirds. Many of the islands and rocky islets at the mouths of Iliamna and Iniskin bays that project vessels would transit past are in the Alaska Maritime National Wildlife Refuge.

Behavioral Disturbance

As discussed in Section 3.23, Wildlife Values, there are several golden eagle nests along the Williamsport-Pile Bay Road, one peregrine falcon nest at Diamond Point, a bald eagle nest adjacent to the Diamond Point barge dock cut-and-fill area, one bald eagle nest adjacent to the road at the Eagle Bay ferry terminal, and bald and golden eagle nests in the valley between Ursus Cove and Cottonwood Bay. Construction of the transportation corridor to Diamond Point, and construction of the port would likely cause disturbance through increased noise (particularly where blasting would be needed to construct the road), and increased human presence. In terms of magnitude, the greatest source of disturbance would occur during road construction, because there is currently no road to Diamond Point or to Eagle Bay. Disturbance to any golden eagle or bald eagle nest would require coordination with the USFWS, and possibly an Eagle Take Permit (81 Federal Register 91494). Additional avian species may experience behavioral avoidance of the habitat immediately adjacent to the mine access road (from the Eagle Bay ferry terminal to the mine site) in an area where no road currently exists. This may cause avoidance of the road edge habitat due to vehicular traffic.

Impacts to avian species may also occur through noise and physical presence of vessels at Diamond Point port and near the mouths of Iliamna and Iniskin bays, where multiple seabird species (e.g., gulls, cormorants, puffins, oystercatchers) nest on adjacent cliffs, rock outcrops, and small islands, and forage in the surrounding waters. Although the exact number of vessels using Iliamna Bay is not currently known; during summer months, approximately 50 fishing boats

are transferred on the Williamsport-Pile Bay Road annually, and approximately 22 barge loads of fuel and cargo were transported on the road in 2009 (Kevin Waring and Associates 2011c). Therefore, there is currently a low level of vessel activity in Iliamna Bay, primarily during summer months. In terms of magnitude, the project would result in approximately 10 lightering trips to fill each bulk carrier, which would be moored for 4 to 5 days at the lightering location. Annual vessel traffic at the port would consist of up to 27 concentrate vessels and 33 supply barges. This equals at least two lightering trips per day to fill each concentrate vessel while it would be moored in Iniskin Bay, or west of Augustine Island at the alternate lightering location. This increase in vessel traffic would likely cause disturbance to birds molting, wintering, feeding, resting, and migrating through Iliamna and Iniskin bays. In particular, the protected waters of Iliamna and Iniskin bays provide sheltered feeding and wintering habitat for a variety of waterbirds (especially scoter species). There are multiple seabird colonies around the mouths of Iliamna and Iniskin bays; and in terms of extent, vessels passing by White Gull Island (at the mouth of Iliamna Bay) would likely be less than 0.25 mile from the island, depending on the specific route taken. Many of these islands are protected as part of the Alaska Maritime National Wildlife Refuge. Vessel traffic may cause species to swim away, fly, dive, or otherwise avoid approaching vessels. Although Kittlitz's murrelets have not conclusively been detected in Iliamna and Iniskin bays, the similar marbled murrelet has been documented throughout both bays (ABR 2011d). Agness et al. (2008) observed a 30-fold increase in flight behavior for Kittlitz's murrelets, with large and fast-moving vessels causing the greatest disturbance. Negative effects on the bird's daily energy budget occur when birds expend energy to fly away from disturbances.

In summary, the magnitude of impacts caused by behavioral disturbance may result in birds avoiding foraging in areas while project-related vessels would be transiting through. For waterbird and seabird species, the project vessels would have to pass through areas of high avian density throughout the year. This may increase time and energy spent avoiding vessels, although vessels would be traveling slowly. For terrestrial avian species, impacts from the transportation corridor may result in temporary avoidance during construction (especially near eagle nests). Because there is an existing road near the Diamond Point port (the Williamsport-Pile Bay Road), some of the eagles in the surrounding area are likely accustomed to occasional road traffic, especially during the summer. The duration of impacts would last for the life of the project, and extent would include all project components, but especially the Diamond Point port and surrounding waters.

Injury and Mortality

There would be potential for avian mortality along the transportation corridor while flying between patches of habitat bisected by the road. Because the transportation corridor along the north shore of Iliamna Lake includes large portions of forested habitats, the avian species that may be impacted include warblers, thrushes, waxwings, sparrows, finches, kinglets, flycatchers, woodpeckers, and other birds that use those habitat types. There may be increased predation from predatory species along the road due to increased visibility and clear flight path along the road edge.

There would be increased potential for bird collisions during inclement weather in Iliamna and Iniskin bays, especially if lights are used on the lightering vessels and bulk carriers. As detailed in Section 4.25, Threatened and Endangered Species, some waterbird species such as eiders have a potential to collide with stationary objects, especially if illuminated by lights at night during inclement weather. Therefore, there would be potential for vessels moored at the lightering location to pose a collision hazard to birds in Iniskin Bay. The lightering location would be near the mouth of Iniskin Bay, and the local topography creates narrow passage at the mouth where there would be increased potential for avian collisions. As detailed in Section 3.23, Wildlife Values, both bays are used throughout the year by large numbers of waterbirds and nesting

seabirds. Therefore, the magnitude and extent of impacts would be that injury and mortality to birds along the transportation corridor and around the Diamond Point port would be expected to occur. The duration would be for the life of the project. However, overall impacts to birds from vessel collisions would be reduced because vessels would be traveling at slow speeds (less than 10 knots).

Habitat Changes

Loss of habitat from construction of the transportation and natural gas pipeline corridors would occur primarily in forested habitat types to the north of Iliamna Lake. There would be suitable habitat adjacent to the transportation corridor that species may disperse to; however, loss of some individual territories and preferred habitat may occur. Loss of habitat would occur at a narrow strip along the transportation corridor with suitable adjacent habitat. At Diamond Point port, there would be a loss of nearshore benthic foraging habitat through construction and periodic dredging of the port. The magnitude and extent of impacts would include loss of 9,763 acres, which encompasses all mine components. The duration would last for the life of the project. Specifically, habitat changes at the Diamond Point port would include loss and avoidance of marine habitat for waterbird and seabird species, while the mine site and transportation corridor would involve direct loss of breeding habitat. If Alternative 2 is permitted and constructed, impacts from loss and avoidance of habitat would be expected to occur for a range of avian species, including raptors, waterbirds, seabirds, landbirds, and shorebirds.

4.23.6.2 Terrestrial Wildlife

The magnitude, duration, extent, and likelihood of impacts to terrestrial wildlife from the mine site under Alternative 2 would be similar to those for Alternative 1a. The primary difference would be the impact to wildlife from the transportation and natural gas pipeline corridors along the northern part of Iliamna Lake. This area is forested compared to the mine site, and therefore has a lower abundance and distribution of caribou, and a higher population of moose and black bears. Overall, the abundance of caribou from Newhalen east to Cook Inlet along the transportation and natural gas pipeline corridors is low (due to a lack of suitable caribou habitat); therefore, impacts to caribou would not be expected from construction and operations of the transportation and natural gas pipeline corridor and Diamond Point port. In terms of magnitude and extent, impacts to moose, brown and black bears, gray wolves, and other terrestrial wildlife would be primarily related to behavioral disturbance (through increased noise, vehicular traffic, and human interaction), injury and mortality, and loss of habitat (both directly through vegetation removal, and avoidance of areas near the transportation and natural gas pipeline corridors).

The magnitude, duration, and likelihood of impacts to small mammal species and wood frogs would be similar to those detailed under Alternative 1a. Impacts would be primarily related to loss of habitat, increased potential for injury and mortality along the access road, and increased edge effects. The extent of these impacts would be expected to be localized to the area around the access road, and impact species with home ranges that overlap the road, as well as impacting dispersing individuals (e.g., juveniles seeking new territories, or wildlife in search of mates).

Behavioral Disturbance

Wildlife would be anticipated to avoid the transportation and natural gas pipeline corridors as a result of vehicular traffic in an area that currently has no established roads (apart from the existing Williamsport-Pile Bay Road). Moose have been known to avoid roads by up to 1,000 feet, and bears would be anticipated to alter feeding patterns in salmon-spawning streams adjacent to the transportation and natural gas pipeline corridors. Traffic volumes, at 35 round-trip truck trips per 24-hour day (one vehicle every 21 minutes) would be anticipated to temporarily disturb wildlife

while vehicles are passing. There would be additional light vehicle traffic (i.e., vehicles other than large trucks transporting concentrate, fuel, and consumables) along the transportation corridor that would add daily vehicle trips. The magnitude of the visual and noise disturbance from passing vehicles would be reduced due to the forest habitat that most of the transportation corridor passes through. The extent of behavioral disturbance to wildlife would be an impact on individuals along the transportation corridor. Some species may avoid the transportation corridor, especially where it overlaps with favored foraging areas, such as along salmon streams. Bear may also opt to den farther from the transportation corridor. As detailed in Section 3.23, Wildlife Values, wildlife cameras were placed along seven anadromous streams along the north shore of Iliamna Lake, from Roadhouse Mountain to the Pile River (ABR 2015a). Bear use reflected salmon run timing, with the highest activity from late July to early August. Small, shallow streams with high numbers of spawning salmon were the preferred foraging areas. The highest level of activity occurred during early morning and late evening, but bears spent little time fishing in the portions of the river in the camera's viewshed, according to the time-lapse photography (ABR 2015a). Conversely, this finding may not fully represent the extent of bear use at these locations throughout the year, but provides a snapshot of activity levels during one summer. The duration of behavioral disturbance impacts would extend for the life of the project, and the extent would include all project components. It would be likely that behavioral impacts would occur to some species and individuals, especially those that would not be accustomed to vehicular traffic apart from occasional use of the Williamsport-Pile Bay Road.

Because black bears are more common along the north shore of Iliamna Lake, they have the greatest potential to be impacted through construction and operations of the mine access road and port access road for Alternative 2. One bear study in the North Cascades of Washington looked at the effect of roads (including level of vehicle traffic) on potential habitat effectiveness (probability of black bears using landscape features) for female black bears (Gaines et al. 2005). The study found that roads consistently had a negative influence on black bear resource selection functions across seasons. During all seasons, roads reduced the habitat effectiveness across study areas, with potential habitat value changes ranging from 1.7 to 16.9 percent. Therefore, the presence of roads makes the surrounding habitat less likely to be used by black bears, but this can vary depending on the season and level of vehicle traffic. It was found that female black bears in one study area (Snoqualmie Study Area, composed of moist western Cascade forests) were negatively associated with areas within 1,644 to 3,281 feet, and 3,284 to 6,562 feet of roads that received moderate (roads with 1 to 10 vehicles per hour) levels of vehicular traffic (Gaines et al. 2005). Under Alternative 2, traffic levels would fall within the moderate level (approximately 3 trucks per hour with additional light vehicle traffic) of vehicle traffic (as defined by Gaines et al. 2005), and therefore, black bears are expected to exhibit some avoidance of the road corridor, but the full extent of avoidance is difficult to accurately predict.

The magnitude of impacts from behavioral disturbance would be loss of habitat by avoidance from construction and operations noise, fugitive dust, and the presence of human activity, among other factors. The avoidance distance would vary by species and time of year; but for some species, such as caribou and brown bears, the level of avoidance can extend for several miles, especially during post-calving for caribou and the denning season for brown bears. The duration of behavioral avoidance is likely to last for the life of the project, but would decrease as habitat is reclaimed and human activities in the area decrease during the post-closure phase. The extent would encompass all project components; and if Alternative 2 is chosen, permitted, and constructed, impacts would be expected to occur, especially around the mine site, with levels of disturbance varying between species.

Injury and Mortality

Because the transportation and natural gas pipeline corridors roughly parallel the north shore of Iliamna Lake, wildlife that follow the various creek and stream drainages that flow towards Iliamna Lake would be expected to intersect the access road. Although fish passage structures would permit some wildlife to pass underneath the road along anadromous streams, other wildlife may be forced to cross over the road while moving to and from Iliamna Lake. A regulated speed limit and WIP would be designed to minimize wildlife injury and mortality. Increased moose densities along several of the creek and river drainages that flow into Iliamna Lake, along with increased black bear density, may result in greater wildlife injury and mortality for these species compared to Alternative 1a. The extent of potential for injury and mortality would be along the mine access road from the Eagle Bay ferry terminal to the mine site, and along the portion that overlaps with the Williamsport-Pile Bay Road. Moose, bears, wolves, and smaller terrestrial wildlife that cross the road have a potential to collide with truck traffic, which would entail a truck passing by approximately every 21 minutes. There would be additional light vehicle traffic (i.e., vehicles other than large trucks transporting concentrate, fuel, and consumables) along the transportation corridor, including use by local residents, which would add daily vehicle trips. In terms of magnitude, the potential would be greatest at dawn and dusk, night-time, during the winter, and during periods of reduced visibility. Additionally, there would be a potential for increased mortality due to increased access for hunting. The area around the Iliamna River has a greater concentration of moose than other portions of the transportation corridor, and increased hunting pressure in some of the drainages sloping into Iliamna Lake may occur. The magnitude of impacts would correspond to an unknown number of wildlife injured or killed along the transportation corridor. The duration would last for the life of the project, and extent would include the entire project footprint. If Alternative 2 is chosen, permitted, and constructed, impacts would be expected to occur, especially along project roads, with levels of injury and mortality varying between species. Generally, smaller-bodied terrestrial wildlife with smaller home ranges and high overall abundance (such as arctic ground squirrels and snowshoe hares) are more likely to suffer injury and mortality along the road compared with larger wildlife with vast home ranges that are less common on the landscape (such as bears, moose, caribou, and gray wolves).

Habitat Changes

In terms of magnitude, construction and operations of the transportation and natural gas pipeline corridors would result in loss of wildlife habitat detailed in Chapter 2, Alternatives (Table 2-2). Habitat removal would result in edge effects, such as wildlife traveling along the road in winter (especially if the road would be plowed), dust accumulation on surrounding vegetation, changes in plant phenology due to earlier spring melt in vegetation along the road prism, and other vegetation changes that directly affect foraging habitat for wildlife species. The magnitude is the loss of 9,763 acres of habitat, and extent encompasses all project components. Additional habitat would be lost by wildlife avoidance. For caribou, which are known to avoid locations of human disturbance such as roads and other development, the range of avoidance would depend on the time of year. Caribou show the greatest avoidance of human disturbance during the calving period, up to several miles away from project activities. Caribou would experience habitat loss through avoidance around the transportation corridor, ferry terminals, and port. This would be in addition to habitat avoidance around the mine site and from direct loss of habitat from project components.

Bears exhibit similar areas of avoidance. Based on a literature review conducted by Linnell et al. (2000), North American bear species generally select den sites from 0.6 mile to 1.2 miles from human activities (e.g., roads, habitation, industrial activities). They found that activity closer than 0.6 mile caused a variety of responses, including den abandonment, especially if the disturbance

occurred early in the denning period. Based on Schoen and Beier (1990), where brown bears denned significantly farther from the mine site with a mean distance of 7.3 miles once construction began, bears may avoid denning in a large area around the mine site. Therefore, given habitat that may be avoided around the mine site and other project components, brown bears may experience a large amount of habitat avoidance.

The duration would last for the life of the project, and the extent would include all of the project components. If Alternative 2 is selected, permitted, and constructed, impacts from loss and avoidance of habitat would be expected for a range of terrestrial species such as moose, bears, wolves, and smaller terrestrial wildlife.

4.23.6.3 Marine Mammals

A discussion of the affected environment for marine mammals is presented in Section 3.23, Wildlife Values. Impacts to marine mammals from construction of the Diamond Point port and natural gas pipeline corridor would be the same as those listed under Alternative 1a for Amakdedori port, but shifted north into Iliamna Bay. Impacts would be similar to those presented above for Alternative 1a. One of the main differences for marine mammals with Alternative 2 would be that vessel access to Diamond Point port would require regular dredging, and subsequent noise and water turbidity in the marine habitat. In terms of magnitude and duration, this would result in short-term modification of marine benthic habitat resulting from an increase in turbidity and decreased water quality during dredging activities. Increased turbidity may potentially have impacts on marine mammal prey.

The Alternative 2 ferry route would transit through the northeastern portion of Iliamna Lake, where most of the harbor seal haul-outs and highest seal concentrations occur (Burns et al. 2016). Many of the islands that are in the eastern part of Iliamna Lake are part of a 12,700-acre conservation easement that was created by the Bristol Bay Heritage Land Trust (Troll 2019). The islands in the northeastern part of Iliamna Lake are critically important for all life stages of the Iliamna Lake seals. Although the ferry route would not physically impact any of the islands, it would transit through waters that are used year-round by the seals for foraging and transiting. In several cases, the ferry would come in proximity to known haul-out locations, and has a potential to impact overwintering locations. Sensitive life stages of the Iliamna Lake seals are discussed in Section 3.23, Wildlife Values, along with a map of known haulout locations. Burns et al. 2016 detail many of the important resources in the eastern part of Iliamna Lake that are used by the seals. The Alternative 2 ferry route would travel approximately 0.5 mile offshore from several of the islands used by the seals. Potential impacts include year-round disturbance from vessel traffic (including disruption of feeding, pupping, and haul-out locations, especially during winter from the ice-breaking ferry), potential for injury and mortality, and potential disturbance to prey resources.

In terms of magnitude of impacts, the Alternative 2 ferry route has a potential to increase adverse behavioral interactions with vessels and harbor seals that inhabit the lake. This longer route may also cause a potential heightened rate of vessel strikes with Iliamna Lake seals. An increase in vessel traffic across Iliamna Lake, especially through the northeastern portion of the lake, may increase the likelihood of vessel interactions with the Iliamna Lake seal. Given this population of harbor seals is around 400 animals, the loss of animals to vessel strike may have adverse effects on the success of the population. The Eagle and Pile Bay ferry terminals would intersect concentrated harbor seal haul-out locations (see figures in Section 3.23, Wildlife Values). The northeastern portion of Iliamna Lake is where seals pup, molt, forage, and overwinter (Burns et al. 2016). In summary, the magnitude of impacts to marine mammals in Cook Inlet would include habitat disturbance during dredging activities at Diamond Point port and behavioral disturbance from the physical presence and noise created by the ferry transiting past harbor seal haul-out locations in Iliamna Lake. The duration of impacts would last for the life of the project. The extent

would be limited to Diamond Point port in Cook Inlet and the northeastern side of Iliamna Lake, where seal haul-outs are located and the highest concentrations of seals are found. If Alternative 2 is selected, there is a likelihood of impacts to marine wildlife, particularly harbor seals inhabiting Iliamna Lake.

4.23.6.4 Variant Impacts Analysis

Summer-Only Ferry Operations Variant

Under the Summer-Only Ferry Operations Variant, trucks would only operate when the ferry(ies) would be running (during the open water season), which would double the number of round-trip truck trips to 70 per 24-hour day on each side of the ferry terminals during the summer (PLP 2018-065). The number of truck trips on the access roads would be one truck passing in either direction every 10 minutes during the summer. There would be additional light vehicle traffic (i.e., vehicles other than large trucks transporting concentrate, fuel, and consumables) along the transportation corridor, which would add daily vehicle trips.

The increase in vessel traffic during seasons when seals are seen in high concentrations throughout Iliamna Lake (Burns et al. 2016) may increase the likelihood of vessel interactions with Iliamna Lake seals. Given this congregation of harbor seals is around 400 animals, the loss of animals to vessel strike may have adverse effects on the success of the population.

Impacts to wildlife would vary by species; but overall, in terms of magnitude, the primary impact from an increase in summer truck traffic on the access roads would be an increase in potential for injury or mortality from collision, especially to those species that hibernate and migrate. Because higher truck traffic would occur generally when species are out of hibernation, and migratory species are breeding, collision potential would be elevated. Wildlife species would have an increased potential for both behavioral avoidance of the access roads (due to higher traffic volumes, increased noise, and increased levels of fugitive dust), and potential for collisions, especially for young-of-the-year wildlife that would not be accustomed to the road. The increase in truck traffic may increase species avoidance of foraging and breeding areas. However, this variant may also reduce injury and mortality for some species. Because the truck traffic would be eliminated during winter months, there would be a potential reduction in collisions for species that do not hibernate, such as moose. A reduction in winter-time truck traffic would decrease the potential for moose (and other wildlife) collisions, due to improved visibility for truck drivers during summer.

Specific to marine mammals, under this variant, ice-breaking would not occur, thereby eliminating negative effects of vessel traffic on overwintering seals in Iliamna Lake.

The magnitude of impacts would be 9,819 acres of habitat removal plus avoidance of surrounding habitat due to behavioral disturbance, an increased potential for injury and mortality for some species, and a decreased potential for others. The duration of impacts would last for the life of the project, but occur only during the open water season when the ferry(ies) would be operational. The extent of impacts would be primarily limited to the access roads; and if this variant is chosen and the project is permitted and constructed, it is expected that some wildlife would experience mortality.

Newhalen River North Crossing Variant

Under Alternative 2 there would be a bridge over the Newhalen River upstream of the south crossing location by approximately 0.74 mile. All impacts to wildlife species would be similar, apart from potential impacts to nesting bald eagles. No suitable golden eagle nesting habitat is present in the area around the Newhalen River bridge crossings, because the habitat is primarily riparian,

with large spruce and cottonwood trees. As detailed in Section 3.23, Wildlife Values, the latest nesting raptor surveys were conducted in July 2019, and the closest nest (determined to be active based on surveys) was approximately 1.4 miles upstream of the bridge location. There is a material site adjacent to the northern bridge abutment that is approximately 1 mile from the closest active bald eagle nest. If construction of the bridge occurs during the bald eagle nesting season (generally February through August), there is a potential for visual and noise disturbance from construction activities, depending on noise levels (especially if blasting is conducted at the material site). Prior to construction, additional permitting would likely be necessary with the USFWS to determine potential impacts to all bald and golden eagle nests in project areas. This would include additional nest surveys prior to any construction activities to determine the location of active nests, and potential avoidance and minimization measures (including avoidance buffers as detailed in Richardson and Miller 1997). Although bald eagles nest in close proximity to human activity at various locations throughout Alaska, USFWS would be consulted to determine measures necessary to ensure the nest is not disturbed during bridge construction. Once bridge construction is complete, operations are unlikely to disturb nesting eagles, because regular vehicle traffic would create less noise and would result in predictable vehicle movement. Overall, the magnitude of impacts would be low, because the only currently known active nest is 1.4 miles away from the bridge, and measures would be required by USFWS to prevent disturbance if construction occurs during the nesting season. The extent would encompass the immediate vicinity of the bridge and material site, and although the duration of noise impacts would be brief—only during construction—additional noise impacts may occur longer, depending on use of the material site. Vehicle traffic along the mine access road would last for the life of the project and potentially longer, depending on use of the road post-closure.

Pile-Supported Dock Variant

Under this variant, the total combined area of the pilings would result in less than 0.1 acre of impacts to the benthic marine environment. In terms of magnitude of impacts, this variant would decrease the acreage of habitat loss for marine wildlife. Dredging could still occur; therefore, 58 acres of the benthic marine environment would be dredged on a periodic basis. Also in terms of magnitude and extent, during construction, noise levels may be higher during pile-driving activities, as opposed to construction of an earthen causeway and wharf. In terms of extent of impacts, there would be reduced impediment to marine wildlife foraging around the port, because some species would pass between the piles instead of having to navigate around the earthen causeway and wharf. All other impacts to wildlife species would remain the same. The magnitude of impacts would be 9,753 acres of habitat loss, which includes a reduction in benthic marine habitat loss. The duration would last for the life of the project until the port is removed, and the extent would encompass the marine portion of the port. If this variant is permitted and constructed, a reduction in impacts compared to an earthen causeway port would be expected to occur.

4.23.7 Alternative 3—North Road Only

The magnitude, duration, extent, and potential for direct and indirect impacts from the mine site to wildlife species from Alternative 3 would be similar to Alternative 1a. The main differences would be no ferry in Iliamna Lake (and no ferry terminals) under Alternative 3, and the length of the road associated with the transportation corridor would be 83 miles. In terms of magnitude, this all-road option for the transportation corridor would increase the amount of permanent habitat loss and increase the potential for vehicular collisions with terrestrial wildlife, including birds. Up to 35 round trips per day for trucks transporting concentrate, fuel, and consumables would equate to a truck passing in either direction approximately every 21 minutes during a 24-hour period. There would be additional light-vehicle traffic (i.e., vehicles other than large trucks transporting concentrate, fuel, and consumables) along the transportation corridor, which would add daily

vehicle trips. Impacts to birds and terrestrial wildlife from behavioral disturbance and injury and mortality from this level of truck traffic would be similar to that previously described for Alternative 1a. The main difference would be that the transportation corridor for Alternative 3 traverses more forested vegetation communities (compared with the other alternatives) along the northern side of Iliamna Lake. In terms of extent of impacts, forested habitat along the access road would buffer some of the noise and fugitive dust generated by truck traffic, so that the distance where behavioral impacts to birds and other wildlife may occur would be less. Additionally, forested habitat along the road provides a visual buffer and adjacent cover for wildlife to use. Forest habitats also tend to trap fugitive dust from spreading farther away from the road, compared with more open habitats (which are present in greater abundance along the transportation corridors for the other alternatives).

In terms of habitat avoidance by species, caribou may avoid the transportation corridor and port by up to 3.1 miles during the calving period. Brown bears may avoid denning around the mine site, up to 7.3 miles away. They may also avoid denning around the transportation corridor and port by up to 1.2 miles.

Alternative 3 would have no ferry in Iliamna Lake; therefore, there would be no impacts to harbor seals in Iliamna Lake from the project. All other impacts to marine mammals would be similar to Alternative 2, but the Diamond Point port would be farther in Iliamna Bay under Alternative 3. There is no pile-supported dock variant under Alternative 3, and no earthen causeway and sheet pile dock. There would be a caisson dock, similar to the one described under Alternative 1a. The caisson dock would include a maintenance dredging channel that would be periodically dredged to maintain the necessary depth.

Although the full details of the port are described in Chapter 2, Alternatives, some key elements that impact wildlife include the use of an elevated, fully enclosed conveyor system to load concentrate from the port onto the lightering barges for eventual transfer to the bulk carriers moored in Iniskin Bay. There would be only one proposed lightering location in a deepwater trench on the western side of Iniskin Bay near the mouth of the bay. There would be no secondary lightering location on the western side of Augustine Island. Therefore, the risk of entanglement with cables would be less under Alternative 3. The only port design is a caisson dock design, which reduces underwater noise from sheet or pile-driving, but would necessitate dredging. The dock would be constructed in a dredged area, with a large navigation channel for vessels to approach the dock at all tidal stages, and a turning basin. This channel and turning basin would require maintenance dredging approximately every 5 years to maintain the necessary depths. This dredging would likely be conducted with a barge-mounted cutterhead suction dredge approximately every 5 years, with the dredged material stored onshore. There would be no airstrip at the Diamond Point port; instead, the existing airstrip at Pedro Bay would be used. This would remove potential overflight noise and visual disturbance impacts to marine mammals and other wildlife around the port. There would be a monopole communications tower ranging from 100 to 150 feet, with high-visibility bands and flashing red lights, in compliance with FAA and USFWS guidance. The access road to the port would be shorter compared with Alternative 2, and therefore have reduced impacts to the marine intertidal zone.

In summary, the magnitude of impacts from Alternative 3 would be a loss of 10,130 acres of habitat for a variety of wildlife species. There are no impacts to wildlife species that are unique to Alternative 3, with impacts similar to those discussed previously for Alternative 1a and Alternative 2. The duration of impacts would extend for the life of the project and longer, depending on the post-construction use of the transportation corridor. The extent would include the footprint of all project components, especially the transportation corridor. If Alternative 3 is permitted and constructed, these impacts would be expected to occur.

4.23.7.1 Variant Impacts Analysis

Concentrate Pipeline Variant

Anticipated wildlife impacts include habitat loss from the concentrate pipeline pump house (1 acre in the mine site), booster station (0.7 acre), and an increase in the transportation and natural gas pipeline corridor width by 3 feet to accommodate the concentrate pipeline and optional return water pipeline. The concentrate pipeline (and the optional return water pipeline) would be co-located in a single trench with the natural gas pipeline at the toe of the road corridor embankment. The magnitude of impacts under this variant would be 10,132 acres. Impacts to wildlife would be reduced, because the number of truck trips necessary to transport concentrate to Diamond Point port would be reduced to 18 truck trips per day (15 truck trips would transport molybdenum, and the other trips would transport consumables). This would equate to a truck passing in either direction every 40 minutes. There would be additional light vehicle traffic (i.e., vehicles other than large trucks transporting concentrate, fuel, and consumables) along the transportation corridor, which would add daily vehicle trips. The Concentrate Pipeline Variant would lower impacts by reducing the potential for injury and mortality, fugitive dust, and noise. Because the lightering barges would be loaded directly with concentrate (instead of using International Organization for Standardization containers as proposed for the other alternatives), fewer lightering trips would be needed to fill each bulk carrier. Approximately 5 to 6 lightering trips would be necessary to load each bulk carrier, as opposed to 10 trips for the other alternatives. A reduction in these impacts may cause wildlife to have less behavioral avoidance of the transportation corridor. The duration of impacts would extend for the life of the project and vary in the post-closure phase, depending on the level of vehicle traffic from local residents and traffic related to post-closure and reclamation activities. The extent would encompass the transportation and natural gas pipeline corridor; and if Alternative 3 with this variant was selected, permitted, and constructed, impacts would be expected to occur, but overall, would be lower compared with the other alternatives.

4.23.8 Cumulative Effects

Impacts to wildlife would include behavioral disturbance (from noise or presence of humans, vehicles, and equipment, and structures among others); injury and mortality from vehicular collisions, exposure to contamination or defense of life and property; or habit changes from loss, fragmentation, fugitive dust, spills, changes in water quality, or introduction or spread of invasive species. See additional discussion and impact analysis in Section 4.18, Water and Sediment Quality; Section 4.20, Air Quality; Section 4.22, Wetlands (fugitive dust); Section 4.25, Threatened and Endangered Species; Section 4.26, Vegetation (fugitive dust); and Section 4.27, Spill Risk (spills).

The cumulative effects analysis area for wildlife encompasses the footprint of the project, including alternatives and variants, the expanded mine footprint (including road, pipeline and port facilities), and any other reasonably foreseeable future actions (RFFAs) in the vicinity of the project that would result in potential synergistic and interactive effects where direct and indirect impacts to wildlife can be expected from project construction, operations, and closure. In this area, a nexus may exist between the project and other past, present, and RFFAs that could contribute to a cumulative effect on wildlife. Section 4.1, Introduction to Environmental Consequences, details the comprehensive set of past, present, and RFFAs considered for evaluation as applicable.

The cumulative effects of mineral exploration and development have been studied in the Northwest Territories of Canada, where recent mineral discoveries have led to unprecedented levels of exploration and development (Johnson et al. 2005). Specifically, the impacts of mines

and other major developments, exploration activities, and outfitter camps were assessed for their impacts to barren-ground caribou, gray wolves, brown bears, and wolverines. Researchers attempted to quantify the reduction in habitat effectiveness as a function of disturbance based on wildlife locations (from satellite and radio collars) collected during previous studies. Their results varied between species and time of year, with caribou during the post-calving season exhibiting the greatest avoidance of major development areas, which resulted in a 37 percent reduction in area of high-quality habitat, and an 84 percent increase in low-quality habitats. Both brown bears and wolves demonstrated the strongest negative response to disturbance, and a corresponding reduction in habitat effectiveness. Wolverines exhibited the lowest reduction in high-quality habitats. Research observed a decreased use of habitats within 1,640 feet to 3.1 miles from disturbance, with avoidance distances highest for major development (Johnson et al. 2005). This research is especially important for caribou, because it highlights how avoidance of major developments during the post-calving period can lead to a substantial reduction in high-quality habitat. Because the Mulchatna caribou herd is currently at severely depressed levels, and the mine site and surrounding areas are in post-calving habitat, there is a potential for cumulative impacts to a large area of seasonally important habitat.

Past, present, and RFFAs in the cumulative impact study area have the potential to contribute cumulatively to impacts on wildlife. Section 4.1, Introduction to Environmental Consequences, details the past, present, and RFFAs considered for evaluation in Figure 4.1-1. Several of these RFFAs are considered to have no potential for cumulatively impacting wildlife resources in the analysis area, such as those outside the analysis area. Some of the RFFAs include tourism, recreation, fishing, and hunting, among others. Although these ongoing activities do not necessarily result in habitat loss for wildlife species, they can result in impacts to species in the analysis area (such as regulated hunting), and therefore are cumulative. For example, access roads put in for the project have a potential to provide increased access for regulated activities, such as legal hunting by local residents, because the roads would remain open for local residential use.

4.23.8.1 Past and Present Actions

Past and present actions that have or are currently affecting wildlife in the analysis area include infrastructure development, marine vessel traffic, oil/gas and mineral exploration, residential activities, sport and subsistence hunting and sport subsistence, and commercial fishing. Most of the analysis area is undisturbed by human activity, with only a few small villages and roads. There are currently no major development projects under way. These activities have had, and are having, minimal, site-specific impacts on wildlife. In addition, many of these impacts are temporary and seasonal, based on the nature of disturbance.

4.23.8.2 Reasonably Foreseeable Future Actions

RFFAs in the cumulative effects analysis area were evaluated for impacts to both terrestrial wildlife and birds, and to impacts to marine mammals. Impacts to marine mammals would be similar to those detailed in Section 4.25, Threatened and Endangered Species, for impacts to threatened and endangered marine mammal species.

RFFAs included in this analysis are those that contribute to the cumulative loss of habitat for terrestrial wildlife, such as direct habitat loss, or avoidance of areas that are noisy or have increased human presence. Habitat loss for raptors, waterbirds, landbirds, and shorebirds would contribute to the global decline of many avian species. In particular, many species of shorebirds and songbirds are experiencing global declines; and loss of important breeding habitat, confounded by impacts of climate change, would contribute to species' declines. The cumulative impact to birds from current climate change trends could potentially favor some species (such as

shrub-breeding songbirds), but potentially lead to a decrease in other species due to habitat conversion, potential for increased fire frequency, and altered forage fish populations in Cook Inlet.

Loss of habitat and habitat fragmentation for wide-ranging species, such as caribou, may occur through the creation and expansion of new roads into calving areas and other critical life stage areas. New active mining projects in the range of the Mulchatna caribou herd may cause the herd to shift locations at critical times or seek out new foraging areas, thereby reducing overall fitness. New roads, gas lines, and other infrastructure features have the potential to cause habitat fragmentation and avoidance of preferred habitat areas, including migratory pathways. Moose would be at risk of vehicular collisions while crossing new roads, and may avoid areas of high-quality forage habitat in close proximity to roads. Additional development may alter predator-prey relationships through increased levels of certain predators, such as red foxes. Bears may change their foraging and denning areas and have increased mortality from new roads, and mortality from defense of life and property.

The following RFFAs identified in Section 4.1, Introduction to Environmental Consequences, were carried forward in this analysis based on their potential to impact terrestrial wildlife in the analysis area: Pebble Project expansion scenario; mining exploration activities for Pebble South/PEB, Big Chunk South, Big Chunk North, Fog Lake, Groundhog, Shotgun and Johnson Tract mineral prospects; Alaska Liquefied Natural Gas, Drift River Oil Pipeline, Cook Inlet Lease Sales and exploration, onshore hydrocarbon exploration; Lake and Peninsula Borough transportation, infrastructure and energy projects; Kaskanak Road Project and other road improvements; and the continued development of the Diamond Point Rock Quarry.

Potential impacts on marine mammals from RFFAs primarily include noise and behavioral disturbance, displacement from habitat alteration, altered prey resources, and bottom sediment disturbance. The potential future actions included in this analysis are based on the spatial and temporal overlap of activities on marine mammals. Some potential future actions would increase exposure to marine mammals (e.g., underwater noise, vessel traffic).

Noise, behavioral disturbance from physical presence, and vessel and aircraft traffic associated with routine operations could affect marine mammals. Noise generated during construction and operations may temporarily disturb some marine mammals, causing them to leave or avoid the area. Noise from operations of the port, lightering locations, and project vessels would last for the life of the project, and longer during post-closure. Potential effects of underwater noise on marine mammals are detailed in Appendix K4.25, Threatened and Endangered Species, and loud underwater noises can cause temporary or permanent hearing loss, mask other sounds, and cause disturbance in other ways (Southall et al. 2019). All projects with a potential to disturb marine mammals would have to comply with the MMPA (and ESA if there are ESA-listed species that might be impacted), during which time the approximate number of marine mammals that may be impacted would be determined in consultation with the USFWS and NMFS.

Those individuals or groups of marine mammals that could be disturbed by the project may experience high vessel activity during summer from recreation, commercial fisheries, barging, and other forms of commercial and scientific vessel traffic. Because of this frequent vessel activity in Cook Inlet, some marine mammals in the area may be at least partially habituated to vessel presence and noise, and impacts from vessel traffic from the project would add incremental effects to marine mammals.

The following present and RFFAs were carried forward in this analysis based on their potential to impact marine mammals in Cook Inlet: Pebble Project expansion scenario; Johnson Tract mineral exploration, Cook Inlet Oil and Gas Lease Sales, Alaska Stand Alone Pipeline Project/Alaska Liquefied Natural Gas (one or the other, project would be developed based on funding), Driver River Oil Pipeline Transportation Project, Lake and Peninsula Borough and other regional Renewable Energy Initiatives, Commercial, Sport and Subsistence Fishing, Subsistence Activities, Scientific Surveys and Research, and the continued development of the Diamond Point Rock Quarry.

The No Action Alternative would not contribute to cumulative effects on wildlife.

The RFFA contribution to cumulative effects on wildlife are summarized by alternative in Table 4.23-4.

Table 4.23-4 Contribution to Cumulative Effects on Wildlife

Reasonably Foreseeable Future Actions	Alternative 1a	Alternative 1 and Variants	Alternative 2 and Variants	Alternative 3 and Variant
Pebble Project expansion scenario	**Mine Site:** The mine site footprint would have a larger open pit and new facilities to store tailings, waste rock, and manage water, which would contribute to cumulative effects related to habitat loss, disturbance, and potential injury/mortality. At the mine site, 31,892 acres (almost 50 square miles) of habitat would be directly lost, plus additional habitat around the mine site would be avoided, with the avoidance buffer varying by species. Some species are particularly sensitive during critical life stages, such as caribou during calving and the post-calving season and bears while denning. These species in particular would likely avoid a large area around the mine site, effectively reducing the overall amount of available habitat, and potentially interrupting migration or movement corridors. **Other Facilities:** A north access road, and concentrate and diesel pipelines would be constructed along the Alternative 3 road alignment, and extended to a new deepwater port site at Iniskin Bay. Pipeline construction would have potentially limited impacts on soils from trenching activities. The construction and operation of concentrate and diesel pipelines from the mine site to Iniskin Bay would result in the loss of an additional 1,022 acres of habitat. The pipeline would follow the route of the north access road proposed under Alternative 3. The new pipeline would require construction of an adjacent access road, to be constructed in a previously undisturbed area. The construction and operation of this additional linear feature would increase the project footprint compared to Alternative 2 and Alternative 3. This would increase the likelihood of habitat fragmentation effects, because road density can adversely	**Mine Site:** Impacts would be similar to Alternative 1a, with a permanent footprint of 32,418 acres. **Other Facilities:** Impacts would be similar to Alternative 1a, except that the portion of the access road from the north ferry terminal to the existing Iliamna area road system would already be constructed. The north access road would be extended east from the Eagle Bay ferry terminal to the Pile Bay terminus of the Williamsport-Pile Bay Road. Concentrate and diesel pipelines would be constructed along the Alternative 3 road alignment and extended to a new deepwater port site at Iniskin Bay. **Magnitude:** The duration and extent of cumulative impacts to wildlife would be similar to duration and extent of Alternative 1a, although affecting a smaller number of acres. **Duration/Extent:** The duration and extent of cumulative impacts to wildlife would be similar to the duration and extent of	**Mine Site:** Impacts would be similar to Alternative 1a, with a permanent footprint of 31,528 acres. **Other Facilities:** The north access road would be extended east from the Eagle Bay ferry terminal to Iniskin Bay. Concentrate and diesel pipelines would be constructed along the Alternative 3 road alignment and extended to a new deepwater port site at Iniskin Bay. The construction and operation of concentrate and diesel pipelines from the mine site to Iniskin Bay would result in the loss of an additional habitat. The loss of habitat at the Iniskin Bay port would be the same as for Alternative 1a. Under Alternative 2, the additional compressor station would be at the Diamond Point port instead of the Amakdedori port, and the concentrate and diesel fuel pipelines to Iniskin Bay would be added to the natural gas pipeline trench along the existing sections of the north access road. Because the natural gas pipeline and portions of the road would already exist	**Mine Site:** Impacts would be similar to Alternative 1a, with a permanent footprint of 31,541 acres. **Other Facilities:** Overall expansion would use the existing north access road; concentrate and diesel pipelines would be constructed along the existing road alignment and extended to a new deepwater port site at Iniskin Bay. Loss of wildlife habitat would be less than Alternative 1a, Alternative 1, or Alternative 2. Because the natural gas pipeline and most of the road would already exist under Alternative 3, the amount of additional disturbance to terrestrial wildlife resulting from the Pebble Project expansion scenario would be less than the same scenario under Alternative 1a, Alternative 1, or Alternative 2. Marine mammals in the vicinity of the Diamond Point port and Iniskin Bay port would be affected by the increased vessel traffic at these locations. Effects would be compounded by

Table 4.23-4 Contribution to Cumulative Effects on Wildlife

Reasonably Foreseeable Future Actions	Alternative 1a	Alternative 1 and Variants	Alternative 2 and Variants	Alternative 3 and Variant
	affect wildlife distribution (Shanley and Pyare 2011; Fahrig and Rytwinski 2009). Habitat loss and fragmentation over an additional 78-year period is likely to have a permanent impact on terrestrial wildlife species around the mine. The concentrate and diesel pipeline would reduce the amount of truck traffic on the access roads to approximately 21 truck trips per day, plus additional light vehicles, which would add daily vehicle trips. The construction and operation of a deepwater port in Iniskin Bay would affect wildlife habitat by direct loss of 30 acres of nearshore habitat and disturbance of marine-associated species, and a wide variety of birds (waterbirds, seabirds, and shorebirds). Iniskin Bay has a large seasonal concentration of brown bears at the end of the bay, which would be directly impacted. Marine mammals may be affected by the construction noise and vessel traffic in the vicinity of the Iniskin Bay port. The Amakdedori port would be constructed and operate concurrently with the Iniskin Bay port. The additional compressor station at Amakdedori port is not expected to affect terrestrial wildlife. **Magnitude:** Pebble Project expansion scenario project footprint would directly impact approximately 31,892 acres, compared to 32,418 acres under Alternative 1 (see Table 4.1-2 for detailed acreage breakdown). There would be a substantial amount of additional habitat indirectly impacted through avoidance that would vary by species. Caribou would likely experience the greatest amount of cumulative habitat loss because they tend to avoid areas of disturbance. Bears would likely den farther away from disturbance, effectively	Alternative 1a, although affecting a smaller number of acres. **Contribution:** The contribution to cumulative effects would be slightly less than Alternative 1a, but more than Alternative 2 and Alternative 3.	under Alternative 2, the amount of habitat loss necessary for mine expansion would be lower under Alternative 2 compared to Alternative 1. In addition, there would be one linear feature during mine operations, rather than two; therefore, the magnitude of habitat fragmentation impacts under Alternative 2 would be lower than Alternative 1. **Magnitude:** Overall expansion would affect fewer acres than Alternative 1 (31,528 acres compared to 32,418 acres) given that a portion of the north road and all of the gas pipeline would already be constructed. The magnitude of cumulative impacts from this alternative would be lower than Alternative 1a and Alternative 1, but higher than Alternative 3. **Duration/Extent:** The duration and extent of cumulative impacts to soil would be similar to duration and extent of Alternative 1a, although affecting a smaller amount of acreage. The geographic extent of impacts would be localized. The	the close proximity of the two ports. **Magnitude:** Overall expansion would affect less acreage than Alternative 1a (31,541 acres compared to 31,892 acres), Alternative 1 (31,541 acres compared to 32,418 acres) or Alternative 2 (31,541 acres compared to 31,528 acres), given that the north road and gas pipeline would already be constructed. The magnitude of cumulative impacts from this alternative would be lower than either Alternative 1a, Alternative 1, or Alternative 2. The duration of impacts would increase to 78 years, extending recurring impacts. **Duration/Extent:** The duration and extent of cumulative impacts to soil would be similar to duration and extent of Alternative 1 and Alternative 2, although affecting a smaller number of acres and smaller geographic area. The geographic extent of impacts would be localized. **Contribution:** The contribution to cumulative impacts would be similar to Alternative 1 and

Table 4.23-4 Contribution to Cumulative Effects on Wildlife

Reasonably Foreseeable Future Actions	Alternative 1a	Alternative 1 and Variants	Alternative 2 and Variants	Alternative 3 and Variant
	reducing the overall amount of available denning habitat. Species would shift areas that they currently use away from development, thereby placing them in competition with conspecifics, potentially resulting in decreased wildlife abundance. **Duration/Extent:** The Pebble Project expansion scenario would increase the magnitude, duration, extent, and likelihood of impacts. The longer duration of mining activities would also increase the likelihood of injury or mortality to wildlife, and cause longer habitat avoidance of nearby areas. **Contribution:** Mine expansion contributes to cumulative effects of habitat for terrestrial wildlife, such as direct habitat loss, or avoidance of areas that are noisy or have increased human presence. The potential for injury and mortality to wildlife also increases over a longer duration and larger geographic area. The additive stress of climate change, in conjunction with the expansion scenario, may cause additional habitat loss for some species. The cumulative loss of occupied habitat for many species under the expansion scenario could lead to local population declines or shifts in use areas.		additional compressor station at the Diamond Point port is not expected to affect wildlife. **Contribution:** The contribution to cumulative impacts would be similar to Alternative 1, although affecting a smaller number of acres over a smaller geographic area.	Alternative 2, although affecting a smaller number of acres over a smaller geographic area.
Other Mineral Exploration Projects	**Magnitude:** Some RFFAs associated with mineral exploration activities (e.g., Pebble South, Big Chunk North, Big Chunk South, Fog Lake, and Groundhog) could have wildlife impacts—primarily, disturbance from aircraft and drilling (noise and vibrations)—and localized effects on water quality in watersheds common to the project (e.g., drill pads, camps); however, the exploration activities would be seasonally sporadic, temporary, and localized. Any impacts to wildlife populations from development based on the results of mineral exploration activities	Impacts would be similar to Alternative 1a.	Impacts would be similar to Alternative 1a.	Impacts would be similar to Alternative 1a.

Table 4.23-4 Contribution to Cumulative Effects on Wildlife

Reasonably Foreseeable Future Actions	Alternative 1a	Alternative 1 and Variants	Alternative 2 and Variants	Alternative 3 and Variant
	would be analyzed separately during the environmental review process, and are not included herein. **Duration/Extent:** Exploration activities typically occur at a discrete location for one season, although a multi-year program could expand the geographic area affected in a specific mineral prospect. Table 4.1-1, Section 4.1, Introduction to Environmental Consequences, identifies seven mineral prospects in the analysis area where exploratory drilling is anticipated (four of which are in relatively close proximity to the Pebble Project). **Contribution:** Although exploration activities are considered to have minimal cumulative impacts to wildlife, there could be potential for greater impacts from disturbance and temporary habitat loss from future development.			
Oil and Gas Exploration and Development	**Magnitude:** Onshore oil and gas exploration activities could involve seismic and other forms of geophysical exploration; and in limited cases, exploratory drilling. Seismic exploration would involve temporary overland activities, with permit conditions that avoid or minimize soil disturbance. Should it occur, exploratory drilling would involve the construction of temporary pads and support facilities, which would result in habitat fragmentation. Cook Inlet RFFAs, including Alaska Stand Alone Project, Alaska Liquified Natural Gas, and Cook Inlet lease sales, would increase shipping traffic, and result in temporary disturbance to waterbirds, seabirds, shorebirds, and marine mammals. Loss of marine habitat associated with new ports and drill rigs would be minimal in the context of Cook Inlet.	Impacts would be similar to Alternative 1a.	Impacts would be similar to Alternative 1a.	Impacts would be similar to Alternative 1a.

Table 4.23-4 Contribution to Cumulative Effects on Wildlife

Reasonably Foreseeable Future Actions	Alternative 1a	Alternative 1 and Variants	Alternative 2 and Variants	Alternative 3 and Variant
	Duration/Extent: Seismic exploration and exploratory drilling are typically single-season temporary activities. The 2013 Bristol Bay Amended Plan shows 13 oil and gas wells drilled on the western Alaska Peninsula, and a cluster of three wells near Iniskin Bay. It is possible that additional seismic testing and exploratory drilling could occur in the analysis area, but based on historic activity, it is not expected to be intensive. Temporary effects from sedimentation during construction are likely, but expected to be minimal. Potential impacts to marine mammals from shipping activities would be intermittent over the long-term. **Contribution:** Onshore oil and gas exploration activities would be required to minimize surface disturbance, and would occur in the analysis area, but distant from the project. The project would have minimal contribution to cumulative effects.			
Road Improvement and Community Development Projects	**Magnitude:** Road improvement projects would take place in the vicinity of communities, and have impacts through grading, filling, and potential increased erosion. Communities in the immediate vicinity of project facilities, such as Iliamna, Newhalen, and Kokhanok, would have the greatest contribution to cumulative effects with regard to potential wildlife injury/mortality, disturbance/avoidance, and habitat fragmentation. The Williamsport-Pile Bay Road improvements project would involve additional habitat loss from roadway widening, which may cause temporary disturbance during construction, and increase the risk of wildlife/vehicle collisions if traffic increases.	Impacts would be similar to Alternative 1a.	The footprint of the Diamond Point rock quarry in Alternative 1 coincides with the Diamond Point port footprint in Alternative 2 and Alternative 3. Cumulative impacts would be limited to a potential increase in localized marine mammal impacts from commonly shared project footprints with the quarry site.	Impacts would be similar to Alternative 2; less than Alternative 1.

Table 4.23-4 Contribution to Cumulative Effects on Wildlife

Reasonably Foreseeable Future Actions	Alternative 1a	Alternative 1 and Variants	Alternative 2 and Variants	Alternative 3 and Variant
	The annual Williamsport channel dredging project maintains a 150-foot by 500-foot channel and turning basin by annually dredging 2,250 cubic yards at the approach to the barge ramp. This causes minor annual impacts to Iliamna Bay. Additionally, the Kaskanak Road project, if constructed, could lead to additional wildlife mortality along the Kvichak River drainage, as well as habitat loss and fragmentation. Some limited road upgrades could also occur in the vicinity of the natural gas pipeline starting point near Stariski Creek, or in support of mineral exploration previously discussed. Expansion of the Diamond Point Rock Quarry has potential to increase wildlife disturbance in analysis area. The estimated area that would be affected is approximately 140 acres (ADNR 2014a). **Duration/Extent:** Disturbance from road construction would typically occur over a single construction season. Potential wildlife injury/ mortality, disturbance/avoidance, and habitat fragmentation associated with road construction would be long-term. Geographic extent would be limited to the vicinity of communities and Diamond Point. **Contribution:** Road construction would be required to minimize surface disturbance, and would occur in the analysis area but removed from the project. Any new roads would also contribute to increased hunting pressure on local wildlife populations. The road projects would have minimal contribution to cumulative effects.			

Table 4.23-4 Contribution to Cumulative Effects on Wildlife

Reasonably Foreseeable Future Actions	Alternative 1a	Alternative 1 and Variants	Alternative 2 and Variants	Alternative 3 and Variant
Summary of Project contribution to Cumulative Effects	Overall, Alternative 1a would contribute to cumulative effects on wildlife populations in the region. This primarily includes both the direct loss (almost 50 square miles) and indirect loss through avoidance of habitat surrounding areas of development. The cumulative loss of habitat may result in local declines for species in the area.	Impacts would be similar to Alternative 1a, although slightly more acres of wildlife habitat would be impacted by the Pebble Project expansion scenario.	Impacts would be similar to Alternative 1a, although fewer acres of wildlife habitat would be impacted by the Pebble Project expansion scenario.	Impacts would be similar to Alternative 2, although slightly more acres of wildlife habitat would be impacted by the Pebble Project expansion scenario.

Note:
RFFAs = Reasonably Foreseeable Future Actions