4.9 SUBSISTENCE

This section describes potential impacts of the project on subsistence in communities near Iliamna Lake, in the Kvichak and Nushagak river drainages, and on the southwest coast of Kenai Peninsula. The magnitude, geographic extent, and duration of impacts are assessed for each project phase. The magnitude of impact from the project depends on the past and current level of subsistence use that would be impacted, the extent to which opportunities to harvest and experiences are altered, as well as the ability of subsistence users to use alternative areas with similar harvest opportunities and experiences. The duration and geographic extent of impacts depends on the location and season that the disturbance occurs during construction, operations, or closure, as well as the changes to subsistence use areas. Duration would be considered long term if the effect lasted throughout the life of the project (i.e., years to decades) while a short-term effect would be expected to last no longer than the construction phase (i.e., months to years). The potential of impacts is related to how likely the project would be to alter subsistence opportunities, experiences, and use level.

Potential impacts include:

- Changes in resource availability (including changes to resource quality): Construction and operation of project facilities may impact fish and wildlife habitat, and decrease or displace fish, wildlife, and vegetative resources used for subsistence.
- Changes in access to resources: Project facilities and transportation corridors may open or remove areas from subsistence activities, or facilitate or restrict access to subsistence resources. In addition to physical access, project activity may change the character of the subsistence activities.
- Changes in competition for resources: Changes to local population from direct and indirect employment and construction of project transportation access corridors may result in increased competition for subsistence resources.
- Changes in sociocultural conditions: Direct/indirect employment opportunities for local residents and the presence of new large-scale industrial facilities may have adverse and beneficial sociocultural effects and may have an adverse impact on subsistence users' experience.

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

Scoping comments not only requested that all subsistence hunting practices be considered in the analysis of effects, but requested consideration of the heavy reliance on fish for all users in the area. Specific impacts due to disturbance from mine transportation needs and potential effects of contaminants from the project on subsistence resources were also addressed by commenters.

4.9.1 Summary of Key Issues

Table 4.9-1: Summary of Key Issues

Impact	Alternative 1a	Alternative 1 and Variants	Alternative 2 and Variants	Alternative 3 and Variant
Impacts to availability of subsistence resources	Reduced availability of subsistence resources through habitat loss, disturbance and displacement of resources, fugitive dust deposits on resources, and increased costs and time for traveling to harvest areas.	Similar impacts to Alternative 1a. The magnitude of impact to the availability of freshwater seals would be less compared to Alternative 1a. The Summer-Only Ferry Operations Variant would disturb freshwater seals less in winter. Other variants would not affect the availability of resources.	Similar impacts to Alternative 1a. The Summer-Only Ferry Operations Variant would disturb freshwater seals less in the winter. Other variants would not affect the availability of resources.	Similar impacts to Alternative 1a, except that the transportation corridor would not impact the availability of freshwater seals. The Concentrate Pipeline Variant would not affect impacts to the availability of resources.
Impacts to access to subsistence resources	Road and pipeline construction could interrupt or impede overland travel by subsistence users. Snowmachine access could be disrupted in the winter by the ice-breaking ferry and could also create a safety hazard. PLP would put measures in place to minimize impacts, such trail marking and crossings.	Impacts would be the same as for Alternative 1a, except that impacts would occur farther away from the communities of Iliamna, Newhalen, and Nondalton, and the magnitude of impacts to subsistence users' access to freshwater seal harvest locations would be less. The Kokhanok East Ferry Terminal Variant would allow for access to Sid Larson Bay without crossing the ferry route. The Summer-Only Ferry Operations Variant would disrupt snowmachine travel less than Alternative 1. The Pile-Supported Dock Variant would have the same impacts to access as Alternative 1.	Impacts would be the same as Alternative 1a, except that the routes affected would be trails from Pedro Bay and the north and east end of the lake instead of the mid-lake region. The Summer-Only Ferry Operations Variant would disrupt snowmachine travel less than Alternative 2. The Pile-Supported Dock Variant and the Newhalen River North Crossing Variant would have the same impacts to access as Alternative 2.	Impacts would be similar to Alternative 2, except the magnitude of impacts from Pile Bay to Eagle Bay would be higher. Disruptions to wintertime access caused by the icebreaking ferry under the other action alternatives would not occur under Alternative 3. Subsistence users' access to freshwater seal harvest locations would not be impacted. The Concentrate Pipeline Variant would have the same impacts to access as Alternative 3.
Impacts in competition for resources	There would be some availability to access other areas for harvest of resources, which could increase competition in some areas by providing additional access for local residents.	Similar to Alternative 1a. Variants would be the same as Alternative 1.	Similar to Alternative 1a, but the longer overland pipeline ROW may increase competition for resources in that area by providing additional access for local residents. Variants would be the same as Alternative 2.	Similar to Alternative 2, but the road paralleling the overland pipeline ROW would further facilitate access for local residents and could further increase competition for resources. The Concentrate Pipeline Variant would not affect impacts to competition.

Table 4.9-1: Summary of Key Issues

Impact	Alternative 1a	Alternative 1 and Variants	Alternative 2 and Variants	Alternative 3 and Variant
Impacts to sociocultural dimensions of subsistence	Beneficial effects from new income to invest in subsistence activities. Challenges in balancing time required for employment and time for subsistence activities. Adverse effects from out-migration, particularly if high-harvesting households leave.	Same as Alternative 1a. Variants would be the same as Alternative 1.	Same as Alternative 1a. Variants would be the same as Alternative 2.	Same as Alternative 1a. The Concentrate Pipeline Variant would not affect impacts to sociocultural dimensions of subsistence.

Notes:
PLP = Pebble Limited Partnership
ROW = right-of-way

4.9.2 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, Pebble Limited Partnership (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.

No additional future direct or indirect effects to subsistence resources or access to subsistence resources would be expected, and existing habitat and resource trends discussed in Section 3.9, Subsistence, would continue. It should be noted that exploration activities associated with the project provided some local employment and income; the latter could contribute to pursuit of subsistence activities. Any displacement of current subsistence activities from exploration activities may continue.

PLP would be required by the State of Alaska to reclaim any remaining sites at the conclusion of their exploration program. The state determines reclamation approval after the cessation of reclamation activities and can require continued authorization for ongoing monitoring and reclamation work as deemed necessary.

4.9.3 Alternative 1a

4.9.3.1 Changes in Resource Availability

During the 4-year construction phase, project activities would, in varying degrees, affect the availability, abundance, and quality of traditional and subsistence resources through habitat loss; individual mortality, behavioral disturbance and displacement resulting from increased noise, vehicle/aircraft/ferry traffic, and human activity; fugitive dust deposits on vegetation; concerns about contamination of resources; avoidance of subsistence harvest areas; and increased costs and times for traveling to more distant areas (see Section 4.23, Wildlife Values; Section 4.24, Fish Values; Section 4.25, Threatened and Endangered Species; and Section 4.26, Vegetation, for discussions of project impacts on fish, wildlife, and vegetation). In addition, available areas for subsistence may not be the same habitat or quality as the areas residents could be displaced from, leading to more activity in higher-quality habitat areas. Adaptations would add a burden of increased expense and time needed to harvest subsistence resources. Adaptations could also result in inter-community conflicts if subsistence users from one community begin harvesting in areas typically used by another community.

During the operations phase, the effects of project activities would be similar. However, the effects would last for 20 years, and occur with less intensity along the transportation corridor than during construction because operations activities along the transportation corridor would generally be less disruptive than construction activities. Regular vehicle and ferry traffic and the physical presence of transportation corridor elements would continue to affect availability of subsistence resources over the long term, lasting through the life of the project and closure. Around the mine site, effects could occur with more intensity, associated with mining activity, noise, and expansion of the open pit and waste rock and tailings storage.

Resources and species of concern that have been identified through the scoping process and environmental baseline documents include salmon, caribou, moose, freshwater seal, berries, small mammals, and firewood. With regard to the mine site, displacement and individual mortality of fish would occur in the upper portions of the North and South Fork Koktuli rivers (including Tributary 1.190) directly affected by mine facilities; however, given the limited number of fish observed in that area and the quality of fish habitat, impacts would not be noticeable downstream from the affected channels (see Section 4.24, Fish Values). Similarly, there would be displacement of moose, caribou, brown bears (and black bears, to a lesser extent), gray wolves, small land mammals, and upland birds (grouse and ptarmigan) that use the mine site, but this would represent a small percentage of overall available habitat. Terrestrial wildlife would be anticipated to avoid the mine site due to behavioral disturbance, with avoidance distance varying between species and individuals. Some species may shift feeding, denning, and other critical life stages away from the mine site into adjacent habitat with less human disturbance. Alternatively, some species such as red fox, may be attracted to the mine site due to the presence of human food. Overall, impacts to fish and wildlife would not be expected to impact harvest levels because no population-level decrease in resources would be anticipated.

Subsistence users also may avoid harvesting waterfowl because of concerns about birds becoming contaminated from landing on and using open water at mine site facilities. Additionally, subsistence users may avoid the mine site area and other project features because of the association with industrial activity. In research conducted by the Alaska Department of Fish and Game (ADF&G), Nondalton residents said they are now avoiding the Frying Pan Lake basin west of Groundhog Mountain, a traditional winter and spring caribou hunting area for the Dena'ina people and a calving area for the Mulchatna caribou herd, because of the extensive exploration activity in this area associated with the project (Van Lanen et al. 2018).

With regard to transportation facilities such as the mine and port access roads and Iliamna Lake ferry operations, the magnitude of impacts would be in the amount of habitat lost from the facility footprint, potential displacement of individual fish and wildlife from human activities and noise, and potential injury and mortality from ferry traffic (salmon and seals) and strikes with truck traffic (large and small land mammals and birds) (see Section 4.23, Wildlife Values; and Section 4.24, Fish Values). However, the facility footprint would be small in comparison to the total habitat available and culverts on the access roads would allow fish passage. There would not be population-level effects from injury and mortality resulting from the entrainment of salmon and seal strikes from ferries or vehicle collisions with large and small land mammals and birds. There would be some site-specific habitat fragmentation from project facilities, causing behavioral disturbance to terrestrial wildlife and birds and localized changes in distribution. These impacts would occur if the project is permitted and built.

The magnitude, duration, and extent of direct impacts would be a long-term loss of resource availability for berries and firewood in the project footprint and the immediate area of mine and transportation facilities; but these resources are commonly available in the analysis area, and alternative gathering areas are available, which are traditionally used.

The extent of impacts from fugitive dust would occur in a narrow corridor on either side of the roadways as described in Section 4.26, Vegetation. The heaviest dust deposition would be anticipated to occur within 35 feet of the road; vegetation collection and berry picking activity may avoid dusted areas. Some localized impacts of dust settlement in stream channels where fishing occurs may be noticeable, but implementation of dust suppression and enforcement of slow speed limits at all stream crossings would minimize dust-related impacts to aquatic ecosystems (see Chapter 5, Mitigation). Impacts would be expected to extend through the life of the project and would be localized to the area of disturbance. Fugitive dust from construction, roadways, and mining activities deposited in streams and on berries, other traditionally used plants, plants that animals eat, and water, would discourage subsistence users from harvesting these resources near the areas affected by the mine site and the transportation corridor. Impacts associated with fugitive dust may be realized if the project were permitted, constructed, and built.

The communities closest to project infrastructure and transportation activities, including the mine site, transportation corridor, the ferry and terminals, port, and airports, would be the most affected by changes in resource availability. These communities include Nondalton, Iliamna, Newhalen, Pedro Bay, Igiugig, and Kokhanok. In contrast, communities in the Nushagak River drainage and in the Kvichak River drainage below Igiugig would experience little to no impact on resource availability as the potential impact on fish and wildlife would be small (see Section 4.23, Wildlife Values). Residents in Port Alsworth use an area in the vicinity of the mine site and along the mine access road to harvest caribou, moose, other land mammals, waterfowl, upland birds, and berries though the areas closer to and surrounding this community see higher concentrations of use. Little to no impact on resource availability in the concentrated use areas closer to the community of Port Alsworth during operations would be expected to occur. Additionally, specific individuals and families that own Native Allotments located near project infrastructure and transportation facilities would be disproportionately impacted if project construction and operations activities reduced the availability or value of subsistence resources on or surrounding the Native Allotments. On the east side of Cook Inlet, the construction and decommissioning of the natural gas pipeline would disturb a small area of approximately 5 acres near the Sterling Highway, distant from communities traditionally pursuing subsistence activities.

During construction and operations, the effects of project activities on resource availability would be primarily localized in the vicinity of project facilities and activities. Although the mine site is in subsistence harvest areas used by five communities (see Section 3.9, Subsistence), it provides relatively poor fish and wildlife habitat. Portions of the transportation corridor, primarily in the

vicinity of the Newhalen River, and Gibraltar Lake and River are more heavily used (see Section 3.9 and Appendix K3.9, Subsistence). Truck traffic along these portions of the transportation corridor could displace moose and other land mammals in the immediate vicinity of the access roads, including where the transportation corridor crosses the Gibraltar and Newhalen rivers. Subsistence users that harvest resources in the immediate vicinity of the transportation corridor, particularly those from Iliamna, Newhalen, and Kokhanok, would likely need to make some adjustments to where they harvest some subsistence resources in order to target areas that would be less affected by project activities. Because there would not be population-level decreases to fish and wildlife species, these adaptive approaches would likely sustain harvest levels for affected communities; however, these adaptations would add a burden of increased expense and time needed to harvest subsistence resources and could impact retention and transmission of traditional knowledge and practices related to the areas affected by project activities. The duration of effects would be long term, lasting through the life of the project and closure and they would be certain to occur under Alternative 1a.

Many project features would be removed, reclaimed, or both during closure. Once restoration activities have been completed, impacts on the availability of subsistence resources would be reduced as these areas would revegetate. The pit lake at the mine site would fill during the decades after mine closure. This would introduce a new standing waterbody, and concern about contamination of waterfowl was expressed during scoping. While there would be exceedance of water quality standards for specific metals, during closure (see Appendix K4.18), exposure of wildlife and birds from potential contaminants exposure would be limited and short term. The pit lake would not support habitat that is attractive to many species of waterfowl and shorebirds; alternate habitat, including open water for staging, is common and available in the area. Some project facilities, including the pipeline, power plant, limited camp and storage facilities, access roads, and mine water treatment plant, would remain in use after mine closure as long as needed to support closure activities. Impacts on resource availability would be localized in the vicinity of remaining infrastructure and activities (see Section 4.26, Vegetation; and Section 4.23, Wildlife Values, for discussions on vegetation restoration and impacts to wildlife). Suggested mitigation measures are listed in Appendix M1.0, Mitigation Assessment.

The magnitude and extent of impacts to subsistence resources would be: disturbance, displacement, individual mortality from vehicle collisions and physical loss of stream habitat, and the loss of habitat due to placement of project components.; however, population-level effects to fish and wildlife would not be expected (see Section 4.24, Fish Values; and Section 4.23, Wildlife Values), and similar habitat is generally available. The duration of impacts on subsistence resources would be long term lasting throughout the life of the mine and post closure because a perception of contamination of waterfowl and other species could remain. Impacts from the transportation corridor and associated uses would be intermittent to prolonged over the construction period and 20-year operations period. The duration of impacts would extend beyond the life of the mine but would decrease in intensity after closure. Some impacts on subsistence would be certain to occur under this alternative.

4.9.3.2 Changes in Access to Resources

Subsistence harvest patterns are dynamic and strategic, as users concentrate their efforts in areas likely to be productive, with abundance and distribution of resources that change year by year. The figures in Section 3.9 and Appendix K3.9, Subsistence, show the multi-year subsistence use areas and the relative number of subsistence users for the six communities closest to the project components. The magnitude, extent, and duration of impacts would be to impair or restrict access to resources during construction in the immediate vicinity of project components. Such restrictions would affect communities located near project infrastructure that

use this land for or to access subsistence fishing, hunting, gathering, education of youth on subsistence traditions, and other customary practices. Construction of linear features, such as the roads and pipeline, could interrupt or impede travel to resources or communities on the other side of the right-of-way (ROW), especially during construction. For example, construction of the natural gas pipeline and port access road could interrupt or impede residents of Kokhanok from accessing subsistence areas south and west of the community during 1 of the 4 years of construction. Additionally, construction-related vessel traffic crossing Iliamna Lake could interrupt other vessel traffic and subsistence activities. Safety considerations and presence of project equipment and personnel may restrict hunting activities near project facilities and would be subject to consultation with potentially affected communities. These impacts would be expected to occur under Alternative 1a.

During the operations phase, the magnitude and extent of impacts would be the restriction of access to subsistence resources at the project footprint of the mine site and in the mine site safety boundary, Iliamna Lake ferry terminals, mine and port access roads, and Amakdedori port. The duration of the impact would be long term, lasting throughout the life of the project and closure. Hunting may be restricted in the vicinity of those areas and a raised gravel road may present a barrier to snowmachine and all-terrain vehicle (ATV) crossing. There could also be disruption to access to marine resources in Cook Inlet from barge activity and pipeline construction; however, such restrictions would have minimal impact on access to subsistence resources because these project components would occupy a relatively small portion of the nearby communities' harvest areas related to the available area, and because mitigating measures would be in place to minimize or avoid impact. These measures, such as providing marked crossing points across the transportation corridor and around the ferry terminals (PLP 2018-RFI 027), are discussed in Chapter 5, Mitigation. These adverse impacts would be long term, lasting for the life of the project, and would be certain to occur if the project is permitted and built.

PLP has stated that they would work with local communities to identify safe, practicable ways for residents to use the access roads, such as scheduled escorted convoys for private vehicle transport, and address hunting guidelines near project facilities. Trails and crossing points would be clearly identified and appropriate traffic controls would be established to ensure public safety (PLP 2018-RFI 027); however, crossing at designated points or avoidance of ferry traffic may add travel time and expense for subsistence users. Once constructed, the transportation corridor roads and the natural gas pipeline corridor ROW could have a positive, long-term effect on access to subsistence resources (depending on the level of access agreed to between the State, PLP, and the Lake and Peninsula Borough [LPB]) because these cleared routes could facilitate some overland travel by ATVs and snowmachines. The use of pipeline ROWs would likely occur.

The magnitude and extent of impacts from the Iliamna Lake ice-breaking ferry would be to disrupt winter travel over the frozen lake by creating a corridor of open water, potentially adding to travel time, complicating travel logistics, increasing the risk of accident and injury, and increasing fuel and vehicle maintenance expenditures for subsistence users. In addition, the open water in the ferry's wake would present a safety hazard for subsistence users. To help mitigate these impacts, PLP has stated that they would work with communities (and supply funding) to provide for the marking and maintenance of snowmachine trails connecting communities across Iliamna Lake when lake ice is thick enough to support such traffic (PLP 2018-RFI 071a) (see Section 3.12, Transportation and Navigation). PLP has stated that they would also work with local communities to find solutions for ferry transportation use (PLP 2018-RFI 027).

At closure, roads in the transportation corridor would remain in place for monitoring purposes and potentially for local traffic; roads could continue to facilitate overland travel for subsistence access. The ferry facilities would be removed and supplies would be transported across the lake using a summer barging operation; therefore, there would be no impacts from ice-breaking ferries after

closure. Many of the other project features would be removed and/or reclaimed, greatly reducing adverse impacts on access to subsistence resources.

The magnitude and extent of impacts from the transportation corridor on subsistence users would be potential restrictions to access in the EIS analysis area. The impact would be limited in geographic extent and subsistence users would be able to access other areas for harvest of resources. This is primarily because the mine access road portion of the transportation corridor is identified as a high-overlapping area for subsistence uses for two communities (Iliamna and Newhalen) and is used by two others (Nondalton and Igiugig). Additionally, the Gibraltar River and Lake portion of the transportation corridor is a high-overlapping subsistence use area for Kokhanok that is also used by Igiugig. Impacts from the transportation corridor and associated uses would be intermittent to prolonged over the 24-year period of project construction and operations. The duration of impacts would be long term, extending beyond the life of the mine. In terms of likelihood, the impacts would be certain to occur.

The following sections evaluate project impacts on access to subsistence resource harvest areas for the six communities located closest to the project infrastructure (i.e., Iliamna, Newhalen, Pedro Bay, Nondalton, Igiugig, and Kokhanok) as project facilities and activities may restrict access in areas of overlapping subsistence use by these communities. It is based on reported use of these areas as described by SRB&A (2011b), Fall et al. (2006), and Krieg et al. (2009) (see Section 3.9, Subsistence). For most of the communities, the contemporary harvest areas are similar to the areas that have historically been used to harvest subsistence resources, though harvest areas may fluctuate over time as environmental changes occur or resource populations and location change; this can affect some communities more than others. For example, over the past two decades, the Mulchatna caribou herd population has declined and their range has expanded west and north, resulting in a more scattered and sporadic distribution of caribou. Over the same time period, the expansion of deciduous shrubs has led to increased moose availability in the area. One coping response to these changing conditions has been for subsistence hunters to change their target species from caribou to moose and use different areas (Van Lanen et al. 2018). The figures in Section 3.9 and Appendix K3.9, Subsistence, show the multi-year subsistence use areas and the relative number of subsistence users for the six communities closest to the project components. It is possible that some downriver communities in the Kvichak and Nushagak River drainages may occasionally use the EIS analysis area for subsistence activities, but their high frequency use areas are closer to the location of their communities (see Appendix K3.9, Subsistence).

The impacts to use areas and access to these areas from construction and operations of the natural gas pipeline would be the same as described for the transportation corridor.

The mine site would impact all six of these communities in similar ways. Construction, operations, and closure may affect access to subsistence hunting and fishing on these lands. Project-related activities, such as blasting and operation of heavy equipment and helicopters, would adversely restrict access. Iliamna Lake community residents that may have otherwise traveled through the mine site area to reach subsistence resources farther north, west, and south would have to take alternative routes and potentially travel longer distances to avoid the mine site and infrastructure. However, the mine site is not shown as a high-overlapping use area for any of the six communities.

The magnitude and extent of impacts to accessing the mine site for subsistence use and harvest would be most concentrated near the mine site area and would diminish with distance. The effects would be limited in geographic extent; these areas are broken down by community below. Impacts of the mine site and associated uses would be intermittent to prolonged. The duration of impacts

would extend beyond the life of the project with diminishing intensity as the site is reclaimed during closure. The impacts would be certain to occur if the project is permitted and built.

Iliamna

The mine access road from Eagle Bay would be located in medium- to high-use areas accessed by residents of Iliamna and would likely impact access. There are overlapping use areas near the Newhalen River and farther inland, and near the site of the ferry terminal at Eagle Bay. The south ferry terminal and port access road, including the crossing at the Gibraltar River, would be located in lower overlapping use areas, which Iliamna residents access for resources. There would be no impact to access of subsistence resources from Amakdedori Port.

Newhalen

The mine access road would be in the vicinity of a medium to high overlapping use area near the Newhalen River and would impact access to resources in the areas inland north of the community. In the winter, the ice-breaking ferry could disrupt access to all resource use areas on the lake. The south ferry terminal and port access road, including the crossing at the Gibraltar River, would be located in an area with lower overlapping uses, which Newhalen residents access for resources. There would be no impact to access to subsistence resources from Amakdedori Port.

Pedro Bay

The effects of the mine access road and north ferry terminal on subsistence access would be to displace access to a small portion of the overall harvest areas in comparison to the total harvest area available near Eagle Bay, which shows overlapping uses for Pedro Bay harvesters. There would be no impacts to subsistence access from the port access road, including the crossing at Gibraltar River, or Amakdedori port.

Nondalton

The mine and port access roads of Alternative 1a are likely to impact access to resource harvest areas for Nondalton residents as they would be located in the vicinity of medium overlapping use areas. Access through the mine site area to subsistence areas to the south would be disrupted. Impacts would be similar to those described for Iliamna.

Igiugig

The south ferry terminal and port access road would be located in areas that Igiugig residents have reported accessing for resources, including the crossing at the Gibraltar River. There is little subsistence activity at the north ferry terminal or along the mine access road.

Ferry traffic would be noticeable to those using Iliamna Lake to access areas at the north east end of the lake, in the Sid Larson Bay and areas around the community of Kokhanok. These areas are all accessed by a low number of subsistence users in Igiugig. The impact would be of higher magnitude in the winter, when the ice-breaking ferry would be operating.

Kokhanok

The magnitude and extent of impacts from construction and operations of the mine and port access roads and ferry terminals on Kokhanok residents would be to interrupt or impede access to portions of the overlapping harvest use areas in the vicinity of the community as well as the Gibraltar River and Gibraltar Lake areas.

During the winter when the ferry would be breaking ice, ferry traffic would be noticeable to those using Iliamna Lake to access areas at the north east end of the lake, in Sid Larson Bay, and areas around the community of Kokhanok. Traditional access routes used by some Kokhanok residents would be affected.

The magnitude and extent of construction and operations of the Amakdedori port under Alternative 1a would be to interrupt or impede access for residents of Kokhanok to overlapping use areas for taking of marine invertebrates and seals in Kamishak Bay.

4.9.3.3 Changes in Competition for Resources

The project would result in employment opportunities for non-local workers during construction and operations. However, such opportunities are unlikely to increase competition for subsistence resources from sport hunting and fishing in areas where project employees are working or housed. Employees would be prohibited from hunting, fishing, and gathering while on site during their two-week shift to minimize competition for local subsistence resources (PLP 2018-RFI 071a). Non-local mine site employees would be transported to and from the mine site by aircraft, enabling them to continue to live outside the region and commute to project work sites. Furthermore, access to and use of project roads and other facilities for non-resident sport hunting would be prohibited. The magnitude of the impact would be that non-local workers would not contribute to an increase in recreational use, although a small number may visit for recreational trips to nearby destinations including for the purpose of sport fishing or hunting when off-duty. After closure, the potential for non-local project employees to visit the area when off duty for the purpose of recreational hunting/fishing would decrease, as fewer people would be getting introduced to the area.

There is the potential for a slight population increase in communities closest to the mine site (see Section 4.3, Needs and Welfare of the People—Socioeconomics), which could increase resource competition among local residents. The magnitude and extent of the effect of an increase in population would be an increase in recreational and sport hunting; however, such activities would be subject to the management of the ADF&G. It is also possible that increased local access and adjustments to hunting areas in response to project facilities and activities could result in an increase in resource competition among local residents. Available areas for subsistence may not be the same habitat or quality as the area's residents could be displaced from, leading to more activity in higher-quality habitat areas. Additionally, if private landowners restrict access, suitable areas of subsistence would be less available, which can increase competition. The largest impacts could occur in Iliamna, which may see a small increase in population related to business development to support the project. The duration of impacts would be long term, lasting for the life of the project.

4.9.3.4 Changes in Sociocultural Dimensions of Subsistence

Project construction and operations would result in both beneficial and adverse effects on sociocultural dimensions of subsistence. Subsistence activities are both cash dependent and highly cash-efficient. Cash income is required to pay for equipment, supplies, and operating costs, but modest cash investments can result in successful subsistence harvests and improve well-being. Increased incomes from project employment for local employees would be partially invested in subsistence activities, increasing the efficiency and reliability of subsistence equipment while providing financial resources for a greater level of subsistence activities. Project activities would increase employment opportunities for residents of the analysis area, particularly for those living in communities surrounding Iliamna Lake. The number of local people who would be hired during the construction phase is not known, but PLP intends to prioritize opportunities for area residents or those with close ties to the area (PLP 2018-RFI 027). The magnitude and

duration of the effect would be that during operations, an estimated 50 employees would come from communities connected to project sites by road and an additional 200 employees would come from surrounding communities (out of 850 total employees during operations) (PLP 2018-RFI 027). These effects on sociocultural dimensions would be expected to occur if the project is permitted and built.

The effect of income on subsistence success (i.e., subsistence production) is evident among households with unique demographic structures. The magnitude of the effect of income is such that in many communities, 30 percent of households produce 70 percent of the subsistence harvest. These "super households" are distinguished because they include multiple working-age males, tend to have high incomes, and often are involved in commercial fishing. These three factors support high-producing households to be able to combine subsistence activities with paid employment and to arrange considerable labor in flexible ways that maximize harvests of subsistence foods, which are then shared with other households in the community and region. In contrast, the low-producing households usually have lower incomes and are led by a single female or non-Native head of household, are single-person households, or households composed of elders (Wolfe et al. 2010).

At the same time, subsistence activities are labor intensive and require large investments of time and effort in hunting, fishing, and processing subsistence foods. Many subsistence resources are available only at certain times of the year. Harvest effectiveness may decline to the extent that project-related employment reduces the time available for these employees to participate in subsistence activities and to pass on skills and knowledge to the next generation. If high-harvesting members of "super households" find project-related employment and have less time for subsistence activities, the rest of the community and households in other communities could end up receiving less wild food through sharing and trading relationships, which could include vulnerable populations, such as elders. Shift-work schedules, with 2 weeks at the project site and 2 weeks off in the community would likely reduce, but not eliminate, the conflict between project employment and subsistence activities.

Increased employment of adults and changes in work schedules could impact the nature of time spent teaching young people to hunt, fish, gather, process, and preserve subsistence resources. The effect could be a change in the amount and quality of traditional knowledge passed on to younger generations and could potentially result in a long-term or permanent adverse effect to communities. Households and communities would have to adjust to new roles of subsistence labor, changes in sharing networks, and possible changes in harvest levels. Rotational work schedules could affect levels of subsistence in different ways, because some families could adapt positively, while some would find this an adverse effect. Legal hunting seasons are short, and if work schedules conflicted with seasons, then the effect on subsistence harvests could be greater. A high-harvesting hunter's absence from the community at important times of the season or year could have a greater impact. However, the effects could be reduced, but not eliminated, with planned periods of leave options that allow for continuation of traditional subsistence practices and schedules during subsistence harvest periods.

Out-migration of mine project employees from local communities has been identified as an adverse sociocultural effect on subsistence. At the Red Dog Mine, nearly 50 percent of the workforce from local communities eventually out-migrated to lower cost, to higher amenity communities like Anchorage and Wasilla, because the mine operator provided no-cost transportation to the mine site for workers' shifts (Tetra Tech 2009). To the extent that high-harvesting households relocated away from the community, the reduction in subsistence foods available in the community would be disproportionately larger. Similarly, the increased availability of jobs for local residents could result in some ex-residents returning to communities. Although a large in-migration or out-migration of population is not anticipated, Alternative 1a may lead to

changing population patterns in the region (see Section 4.3, Needs and Welfare of the People—Socioeconomics). The population in some potentially affected communities has been declining due to out-migration. The project could reduce or eliminate the decline because of the increase in employment opportunities and indirect effects improving education and infrastructure. Therefore, the impacts on population and effects to sociocultural changes of subsistence are difficult to anticipate.

Local residents participate in subsistence activities to a high degree. The level of participation may be affected by changes in resource abundance and quality, season and bag limits, changes in physical access, changes in cultural perceptions of resources (e.g., fish and animals are seen as tainted/contaminated, or water as polluted), the physical presence of project facilities in an area that was previously undeveloped and comfort level pursuing subsistence activities in their vicinity, and the time and funds available for subsistence activities. Changes in harvest participation are a leading indicator of cultural changes; continued participation is important to the transfer of knowledge and skills across generations, to the formation of social relationships in and between communities, and to cultural continuity. Salmon provide a large proportion of nutritional food resources for Yup'ik and Dena'ina peoples in the analysis area and represent an essential part of the language, spirituality, and social relations. In particular, subsistence and customary practices are the foundation of culture, maintain the connection of people to their land and environment, and support healthy diet and nutrition (Boraas and Knott 2013; USDA 2004).

Traditional knowledge and skills such as what to harvest, where and when to harvest, how to harvest different resources using specialized tools and techniques, and how to process and preserve wild food efficiently and safely are learned through demonstration and supervision from elders and family members, observation of skilled experts, and a lot of practice. The culture and practice of subsistence is learned by living it. Interruptions and discontinuities that affect implementation and transmission of knowledge may also affect subsistence lifeways in the area. There is no substitute or replacement for this traditional knowledge and how it is passed from generation to generation. Changes ranging from cash-paying employment to resource access and availability can have a compounding effect on the subsistence way of life by decreasing the quality and quantity of time available to engage in subsistence activities and to provide hands-on learning experiences for younger generations. Likewise, adapting to different harvest areas or resources can lead to a loss of knowledge about traditional use and the areas traditionally used for subsistence.

To the extent that project activities would have adverse impacts on resource abundance, availability, quality, and access, corresponding adverse sociocultural impacts on affected communities would occur, related to community health and well-being, spiritual ties to subsistence, experience and enjoyment of subsistence activities, and cultural identity. Under routine operating conditions, the communities affected would likely be limited to those closest to the project's infrastructure and transportation activities: Nondalton, Iliamna, Newhalen, Pedro Bay, Igiugig, and Kokhanok. However, there could still be community concerns regarding the perception of contamination and the safety of subsistence resources in communities downriver from the mine site. Beliefs about subsistence resources being contaminated or unsafe can impact the mental and spiritual health of the community and can interrupt the transmission of traditional knowledge and practices. These impacts would be long term, potentially lasting post-closure, and likely to occur if the project is permitted and constructed.

At closure, both time commitments for and cash income from project employment would cease. Households would have to adjust to reduced cash income to support the maintenance and operating costs of a subsistence lifestyle. Workers who moved out of local communities may choose not to return. The indirect effects of mine employment and income on subsistence

practices would decrease. Some long-term impacts may include loss of subsistence knowledge and skills, and a decrease of participation during mine operations continuing after closure.

4.9.4 Alternative 1

In general, the type of impacts from changes in resource availability and access to subsistence resources at the mine site would be similar to those under Alternative 1a. Impacts from competition for resources and the changes in the sociocultural dimension of subsistence would be the same as Alternative 1a for all project components. Along the transportation corridor and natural gas pipeline, impacts would be similar to Alternative 1a, except for differences described below.

Changes in resource availability along the transportation corridor and the natural gas pipeline would be of a similar magnitude as Alternative 1a for most subsistence activities but would occur in a different area north of Iliamna Lake. The mine access road and natural gas pipeline would be farther away from the communities of Nondalton, Iliamna, and Newhalen. Along the ferry route there would be a lower magnitude of impact to the availability of and access to freshwater seals than under Alternative 1a because the ferry would pass through fewer seal hunting and haulout areas under Alternative 1. Individual mortality, behavioral disturbance, and displacement of subsistence resources would occur at approximately the same levels as described under Alternative 1a.

4.9.4.1 Changes in Access to Resources

Impacts to access to subsistence resources for the six communities closest to the project would be similar to those described for Alternative 1a, as described below.

Iliamna

The magnitude and extent of impacts from construction and operations of the mine access road (including a bridge over the Newhalen River) and the north ferry terminal under Alternative 1 would be the disruption of access to a portion of the overall harvest areas near Upper and Lower Talarik creeks, which are medium- to high-use areas for Iliamna subsistence users, particularly for moose and other land mammals. While there are other areas shown as medium- to high-use areas for moose and other land mammals, hunters who traditionally use the Upper and Lower Talarik creek areas would be affected. The south ferry terminal and port access road (including a bridge over the Gibraltar River) would be in lower overlapping use areas that Iliamna residents' access for resources. The duration of impacts would be long term and they would be likely to occur if the project is permitted and built. There would be no impact on access to subsistence resources from Amakdedori Port.

Until Iliamna Lake is connected to Cook Inlet through the transportation corridor at the south ferry terminal, the Williamsport-Pile Bay Road may be used to transport supplies to Iliamna Lake during construction (PLP 2018-RFI 037). If this route were to be used, the volume of traffic on Williamsport-Pile Bay Road would increase during construction, which could affect access to resources.

Newhalen

The magnitude and extent of impacts on subsistence use from construction and operations of the mine and port access roads (including a bridge over the Newhalen River) and the north ferry terminal under Alternative 1 may be a disruption of access to a portion of the overall harvest areas near Upper and Lower Talarik creeks, which are medium- to high-use areas for Newhalen subsistence users. Impacts to access would be similar to those described for Iliamna. The south ferry terminal and port access road (including a bridge over the Gibraltar River) would be in an area with lower overlapping uses, which Newhalen residents access for resources. The impacts would be long term and would be likely to occur.

If the Williamsport-Pile Bay Road is used during construction, the volume of traffic on this route would increase, which could affect access to resources.

Pedro Bay

The magnitude and effects of construction and operations of the mine access road and north ferry terminal under Alternative 1 on subsistence use would be to displace access to a small portion of the overall harvest areas in comparison to the total harvest area available near the Upper and Lower Talarik creeks, which show overlapping uses for Pedro Bay harvesters. The duration of the impact would be long term and it would be expected to occur. There would be no impacts to subsistence access from the port access road, including the crossing at Gibraltar River or Amakdedori Port.

If the Williamsport-Pile Bay Road is used during construction, the volume of traffic on this route would increase, which could affect access to resources in an area accessed by a moderate to high number of residents.

Nondalton

With respect to the magnitude and extent of the impacts, construction and operations of the mine and port access roads (including bridges over the Newhalen and Gibraltar rivers) and ferry terminals under Alternative 1 would restrict access to the documented subsistence use areas near the Upper and Lower Talarik creeks. Access through the mine site area to subsistence areas to the south would be disrupted. Impacts on access to this area would be similar to those described for Iliamna, and would be long term and certain to occur.

Igiugig

The magnitude and extent of impacts due to construction and operation of the mine and port access roads (including bridges over the Newhalen and Gibraltar rivers) and the north ferry terminal under Alternative 1 would be the disruption of access to a small portion of the overall harvest areas near Upper and Lower Talarik creeks, although they are low-use areas for Igiugig subsistence users. The impacts would last though the life of the project through closure and would be expected to occur. The south ferry terminal and port access road would be in areas that Igiugig residents have reportedly accessed for resources.

The ferry traffic would be noticeable to those using Iliamna Lake to access areas at the north east end of the lake, in Sid Larson Bay, and areas around the community of Kokhanok. These areas are all used by a low number of subsistence users in Igiugig. The impact would be of higher magnitude in the winter, when the ice-breaking ferry would be operating.

Kokhanok

The magnitude and extent of impacts from construction and operations of the mine and port access roads (including bridges over the Newhalen and Gibraltar rivers), ferry terminals, and the east Kokhanok ferry terminal on Kokhanok residents would be to interrupt or impede access to portions of the overlapping harvest use areas in the immediate area surrounding the community, and the Gibraltar River and Lake areas. Portions of overlapping use areas near the Upper and Lower Talarik creeks where large land mammals are hunted would also be affected. These impacts would be long term and certain to occur under Alternative 1.

During the winter when the ferry would be breaking ice, ferry traffic would be noticeable to those using Iliamna Lake to access areas at the north east end of the lake, in Sid Larson Bay, and areas

around the community of Kokhanok. Traditional access routes used by some Kokhanok residents would be affected.

The magnitude and extent of construction and operations of the Amakdedori port under Alternative 1 would be to interrupt or impede access for residents of Kokhanok to overlapping use areas for taking of marine invertebrates and seals in Kamishak Bay. The impacts would last throughout the life of the project and would occur if the port is permitted and constructed. Construction of the Amakdedori port under Alternative 1 would not be expected to impact access to resources for communities other than Kokhanok because residents of other communities do not harvest resources in that area.

4.9.4.2 Alternative 1—Kokhanok East Ferry Terminal Variant

The Kokhanok East Ferry Terminal Variant would result in similar impacts to those described above for changes in resource availability, access to resources, changes in competition for resources, and changes in the sociocultural dimension. However, the east location could cause additional subsistence conflicts compared to the Alternative 1 location.

Under the Kokhanok East Ferry Terminal Variant, snowmachine access to Iliamna Lake would be provided east of the terminal to enable access to the Sid Larson Bay area without crossing the ferry route (PLP 2018-RFI 078). PLP has stated that they would work with local communities to find solutions for ferry transportation use (PLP 2018-RFI 027). The duration of these impacts would be long term and they would be certain to occur if the project is permitted and constructed.

4.9.4.3 Alternative 1—Summer-Only Ferry Operations Variant

The Summer-Only Ferry Operations Variant would result in similar impacts to those described above for changes in resource availability, access to resources, changes in competition for resources, and changes in the sociocultural dimension. However, under the Summer-Only Ferry Operations Variant, the magnitude of the impact would be doubling of the volume of haul trucks on the mine and port access roads in the summer, which could result in a greater impact in terms of access to resources and disturbance of wildlife in the use areas near the ferry terminals and access roads. Summer ferry traffic would also double, increasing from one daily round-trip to two; however, boat traffic from subsistence users would be minimally affected by the increase. The impact would last throughout the life of the project and would be expected to occur if the project is permitted and constructed.

The Summer-Only Ferry Operations Variant would not have an impact to winter access, harvest activities, or safety concerns for travel across Iliamna Lake that are associated with the ice-breaking ferry discussed in the Alternative 1 sections above.

4.9.4.4 Alternative 1—Pile-Supported Dock Variant

The Pile-Supported Dock Variant would result in similar impacts to those described above for changes in resource availability, access to resources, changes in competition for resources, and changes in the sociocultural dimension.

4.9.5 Alternative 2—North Road and Ferry with Downstream Dams

In general, the type of impacts from the changes in resource availability, access to subsistence resources, and competition for resources, would be the similar to Alternative 1a at the mine site. Impacts from the changes in the sociocultural dimension of subsistence would be the same as or similar to Alternative 1a for all project components. Along the transportation corridor and natural

gas pipeline, impacts in the availability, access, and competition for resources would be similar to Alternative 1a, with the exception of the differences described below.

Changes in resource availability along the transportation corridor and the natural gas pipeline for Alternative 2 would be similar to Alternative 1a, but would affect a different area for the port access road, ferry, pipeline, and port, and would therefore affect the lake communities to a different degree. Individual mortality, behavior disturbance, and displacement of subsistence resources would occur at approximately the same levels as under Alternative 1a. The primary difference is that there are fewer communities using the area in between Pile Bay and Williamsport for subsistence; therefore, the magnitude of the impact would be less than Alternative 1a and Alternative 1. Based on the areas of overlapping subsistence uses, Nondalton, Newhalen, and Pedro Bay use the mine access road alignment to the Eagle Bay ferry terminal to a lesser degree than Iliamna does (see figures in Section 3.9, Subsistence). Pedro Bay has high use of the area of the Pile Bay terminal and portions of the port access road from Pile Bay to Williamsport. Kokhanok would be affected to a lesser degree. All six analysis area communities use the eastern end of Iliamna Lake for seal hunting to some degree.

Under Alternative 2, there would be an overland natural gas pipeline ROW from Pile Bay to the mine site, including the area between ferry terminals. This could introduce some competition to subsistence users from recreational sport hunting and fishing.

4.9.5.1 Changes in Access to Resources

Impacts to access to subsistence resources for the six communities closest to the project would be similar to those under Alternative 1a, as described below.

Iliamna

The mine access road (including a bridge over the Newhalen River) from Eagle Bay would be located in medium- to high-use areas accessed by residents of Iliamna and would be likely to impact access. There are overlapping use areas near the Newhalen River and farther inland, and near the site of the ferry terminal at Eagle Bay. The ferry under Alternative 2 would traverse the eastern portions of Iliamna Lake that are accessed by residents with low to medium overlapping uses. The ice-breaking ferry would disrupt access to these areas, and similar to Alternative 1a, safe winter travel routes would need to be developed with arrangements between PLP and affected communities.

The magnitude of the impact of the addition of a pipeline ROW would be to potentially create an overland route that could be used by Iliamna residents to access additional subsistence resources.

Diamond Point port construction and operations under Alternative 2 could affect Iliamna residents' access to harvests locations in Cook Inlet. However, though long-term, the changes to access would affect areas that are reported as low-use areas for harvested resources near Iliamna Bay and north of Augustine Island.

Newhalen

The mine access road of Alternative 2 would be in the vicinity of a medium to high overlapping use area near the Newhalen River and would impact access to resources in the areas inland north of the community. The ferry route would be south of the islands in Iliamna Lake that are accessed by residents, but would not pass close to the islands and would not likely disrupt access in the summer. In the winter, the ice-breaking ferry could disrupt access to all resource use areas on the northeast end of the lake.

The addition of a pipeline ROW would potentially create an overland route that could be used by Newhalen residents to access additional subsistence resources. The duration of the impact would be long term and likely to occur under Alternative 2.

Diamond Point port construction and operations under Alternative 2 would not be expected to affect Newhalen residents' access to harvests locations, as they do not access resources in that location.

Pedro Bay

The mine and port access roads and use of the Williamsport-Pile Bay Road under Alternative 2 would likely impact access to resource harvest areas for Pedro Bay residents in high overlapping use areas near the community, on Iliamna Lake, inland from Iliamna Lake, and in Pile Bay, and have similar impacts to access as described in Alternative 1a and Alternative 1. Pedro Bay has experience with the adverse and beneficial effects of a road on subsistence access from the existing Williamsport-Pile Bay Road, but the magnitude would be greater with more traffic on the road. The ferry route would be south of the islands in Iliamna Lake that are used by residents of Pedro Bay; therefore, access to those islands and their resources would not be likely to be affected. As described for Iliamna, winter ferry operations would impact traditional access and create travel safety concerns that would need to be mitigated in consultation with PLP.

The addition of a pipeline ROW would potentially create an overland route that could be used by Pedro Bay residents to access additional subsistence resources, particularly during the winter when there is snow cover. The impact would be long term and likely to occur.

The magnitude of effects on access to resources from Diamond Point port construction and operations under Alternative 2 would be to interrupt or impede access to subsistence activities and fishing and marine invertebrate harvesting for Pedro Bay residents in Iliamna Bay and near Augustine Island as the port would be located in the vicinity of these use areas. There is existing vessel traffic to Williamsport during the summer months, and some vessel traffic associated with the quarry at Diamond Point, but the magnitude of impact would increase with project vessel traffic. The impacts would last for the life of the project and would be likely to occur.

This community has a smaller population than the other lake communities and residents do not harvest subsistence resources as far away from their community as residents of the other lake communities do; therefore, disruption form the project could have a greater intensity of impact to this community.

Nondalton

The mine and port access roads of Alternative 2 (including a bridge over the Newhalen River) are likely to impact access to resource harvest areas for Nondalton residents as they would be located in the vicinity of medium overlapping use areas. Access through the mine site area to subsistence areas to the south would be disrupted. Impacts would be similar to those described for Iliamna. The ferry route would be south of the islands in Iliamna Lake that are used by residents of Nondalton; therefore, access to those islands and their resources would not likely be affected. However, winter subsistence harvest of seals would be affected by ferry operations, similar to impacts discussed for Iliamna.

The addition of a pipeline ROW would potentially create an overland route that could be used by Nondalton residents to access additional subsistence resources. The duration of this impact would be long term and would be likely to occur under Alternative 2.

Diamond Point port construction and operations under Alternative 2 would not be expected to affect Nondalton residents' access to harvests locations as they do not access resources in that location.

Igiugig

The transportation corridor, ferry, and Diamond Point port under Alternative 2 are not anticipated to impact access to resource harvest areas for Igiugig residents as fewer subsistence users search for and harvest resources in these areas.

Kokhanok

The mine and port access roads of Alternative 2 are less likely to impact access to resource harvest areas for Kokhanok residents as fewer subsistence users search and harvest in areas inland from the north side of Iliamna Lake and closer to the mine site.

The ferry route would be south of islands in Iliamna Lake accessed by residents for seal hunting, but would not pass close to the islands and would not likely disrupt access in the summer. In the winter, the ice-breaking ferry could disrupt access to seal hunting, which is the preferred time of year that this activity occurs.

Diamond Point port construction and operations under Alternative 2 would not be expected to affect Kokhanok residents' access to harvest locations as they do not typically access resources in that location.

4.9.5.2 Alternative 2—Summer-Only Ferry Operations Variant

The Summer-Only Ferry Operations Variant would result in similar impacts to those described above for changes in resource availability, access to resources, changes in competition for resources, and changes in the sociocultural dimension. However, under the Summer-Only Ferry Operations Variant, the volume of haul trucks on the mine and port access roads would double in the summer. This could result in a greater magnitude impact in terms of access to resources and disturbance of wildlife in the use areas near the ferry terminals and access roads. Summer ferry traffic would also double, increasing from one daily round-trip to two; however, boat traffic by subsistence users would only be minimally affected by the increase. The duration of the impact would be long term and the impact would occur under this variant.

The Summer-Only Ferry Operations Variant would not impact winter access, harvest activities, or safety concerns for travel across Iliamna Lake associated with the ice-breaking ferry discussed under Alternative 2 sections above.

There would be less impact to freshwater seal hunting with summer-only ferry operations as the seals, which like to haulout at open leads in the lake ice, would not be disrupted by the ice-breaking ferry; summer is not the preferred time for hunting freshwater seals (see Section 4.23, Wildlife Values).

4.9.5.3 Alternative 2—Pile-Supported Dock Variant

The Pile-Supported Dock Variant would result in similar impacts to those described above for changes in resource availability, access to resources, changes in competition for resources, and changes in the sociocultural dimension.

4.9.5.4 Alternative 2—Newhalen River North Crossing Variant

The Newhalen River North Crossing Variant would result in similar impacts to those described above for changes in resource availability, access to resources, changes in competition for resources, and changes in the sociocultural dimension.

4.9.6 Alternative 3—North Road Only

In general, the type of impacts from the changes in resource availability, access to subsistence resources, and competition for resources at the mine site would be similar to Alternative 1a. Impacts from changes in the sociocultural dimension of subsistence would be the same as Alternative 1a for all project components. Along the transportation corridor and natural gas pipeline, impacts would be the same as Alternative 2, except that there would be no ferry operations and access would be provided entirely by road.

Changes in resource availability along the transportation corridor and the natural gas pipeline alignment for Alternative 3 would be similar to Alternative 2. Individual mortality and behavioral disturbance to, and displacement of, subsistence resources would occur at approximately the same levels on land but would avoid impacts to seals in Iliamna Lake. As with Alternative 2, there are slightly fewer communities using the area between Pile Bay and Williamsport for subsistence (Iliamna, Newhalen, Nondalton, and Pedro Bay). However, there are a high number of overlapping use areas along the road corridor of Alternative 3 from Pedro Bay to the mine site for Iliamna and Pedro Bay.

Under Alternative 3, there would be a road from Pile Bay to the mine site, alongside the natural gas pipeline. The magnitude of the effect of this road would be to increase the level of activity along that route compared to Alternative 2. This north access road would be under controlled access, limiting potential competition to subsistence uses of resources from non-local recreational sport hunting and fishing. However, it could facilitate access to subsistence resources for area residents and lead to increased competition along the transportation corridor. The duration of the impact would be long term and would occur under Alternative 3.

Access to subsistence resource use areas would be the similar to Alternative 2 for residents of Iliamna, Newhalen, Pedro Bay, Nondalton, Igiugig, and Kokhanok. The primary difference is the road from Pile Bay to the mine site, which would increase the ease of access to the lands and subsistence resources along the transportation and pipeline ROW corridor. There would be no ferry operations, and therefore no impacts to seal hunting or access on Iliamna Lake, and no disruptions to wintertime travel on the lake caused by the ice-breaking ferries.

4.9.6.1 Alternative 3—Concentrate Pipeline Variant

A concentrate pipeline would be built from the mine site to Diamond Point alongside the natural gas pipeline; additional disturbance to the gas pipeline and road construction corridor would not be expected. Water treatment for dewatering the concentrate would occur at Diamond Point, and would be discharged to marine waters in compliance with state water quality standards. There would be little to no additional effect on subsistence resources or access as compared to Alternative 1a.

4.9.7 Cumulative Effects

Potential cumulative impacts to subsistence include changes in resource availability, access to resources, competition for resources, and effects on social and cultural values. The cumulative effects analysis area for subsistence is the same as the EIS analysis area for subsistence, which includes habitat and migration routes for subsistence resources, community subsistence search and harvest areas, and areas used by harvesters to access resources (see Section 3.9, Subsistence).

Only a few of the actions identified in Section 4.1, Introduction to Environmental Consequences, are considered to not have potential to contribute to cumulative effects on subsistence resources in the analysis area. These include offshore-based developments, activities that may occur in the analysis area but are unlikely to result in any appreciable impact on subsistence resources (such

as industrial clean-up), or development actions that are not anticipated to occur during the operations timeframe of the project.

4.9.7.1 Past and Present Actions

Past and present actions have caused noticeable effects to subsistence resources, access, competition and social and cultural values. Such activities include subsistence activities, sport fishing and hunting, mining exploration, and non-mining related projects, such as transportation, oil and gas development, or community development actions. As described in Section 3.9, Subsistence, the subsistence harvest of sockeye salmon in the Kvichak River drainage has decreased over the past 20 years. Several communities observed that habitat change in southwest Alaska is affecting the Mulchatna caribou herd, causing the herd to move farther away from communities in the EIS analysis area, which impacts subsistence harvest. Habitat changes include warming temperatures and increased shrub habitat, which is preferred by moose. Consequently, these habitat changes have benefitted moose, resulting in increased moose harvest by local residents in the EIS analysis area over the last 10 years. Additionally, Nondalton local residents have noted declines in caribou numbers due to disturbance from helicopters, and declines in caribou and moose numbers due to overharvest by sport hunting. Residents of Pedro Bay also observed a decline in Dolly Varden in the Iliamna River due to overharvest by sport fishing and habitat disturbance from motorized boats. Subsistence harvest of Cook Inlet beluga whales prior to 2000 led to population decline and severe limitation on the subsequent subsistence harvest. Mining and oil/gas exploration have caused some site-specific disturbance to subsistence resources, area-specific limitations to subsistence access, and sociocultural dimension of subsistence, but such effects have been seasonal and short term in nature, with no population-level effects on subsistence resource populations in the analysis area. The same is generally true of community and transportation infrastructure. Construction and operation of the Williamsport-Pile Bay Road disturbed subsistence activities and resources in the vicinity of the road during summer months, and has potentially created some non-resident competition for fish and wildlife resources, particularly in the vicinity of Pedro Bay.

4.9.7.2 Reasonably Foreseeable Future Actions

Past, present, and reasonably foreseeable future actions (RFFAs) as described in Section 4.1, Introduction to Environmental Consequences, have the potential to contribute cumulatively to effects on subsistence resources and uses. RFFAs apply to the consideration of cumulative effects on subsistence resources and uses. Each of these RFFAs contribute to the increased potential for impacts on subsistence resources, as each has aspects and associated activities that could lead to the disturbance and displacement of subsistence resources at these locations.

The No Action Alternative would not contribute to cumulative effects associated with changes to resource availability, access to resources, or competition for resources. If there were fewer local employment opportunities associated with future exploration of the Pebble deposit, there could be less income that could contribute to support subsistence activities; however, that could be offset by exploration of other nearby mineral deposits.

The project alternatives with the RFFAs' contribution to cumulative effects on subsistence resources are summarized collectively in Table 4.9-2.

Table 4.9-2 Contribution to Cumulative Effects on Subsistence

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 manage water and store tailings and waste rock. The Pebble Project expansion scenario at the mine site would affect more fish habitat in the upper reaches of the North Fork and South Fork of the Koktuli River, as well as Upper Talarik Creek. It would also generate more noise over a slightly larger area for a longer period of time, potentially affecting caribou that might transit the area, and affect subsistence access and user experience, although the mine site area is not heavily used for subsistence. A longer mine life would extend the potential for contamination and perception of contamination through the longer operating period. **Other Facilities:** A north access road, concentrate pipeline, and diesel pipeline would be constructed along the Alternative 3 road alignment, and extended to a new deepwater port site at Iniskin Bay. This would increase both the area of disturbance and availability of local access. The concentrate pipeline would reduce truck traffic to 21 daily round trips (eliminating shipment of copper/gold concentrate by truck), reducing subsistence impacts associated with those project components. Impacts to Pedro Bay would be introduced, although all six lake communities would be affected to some degree over the expanded operating life. **Magnitude:** The Pebble Project expansion scenario project footprint would impact approximately 31,892 acres. Although truck traffic associated with concentrate shipment on the south access road would be eliminated, there would still be some level of truck traffic on both the north and south access roads. Impacts to	**Mine Site:** Identical to Alternative 1a. **Other Facilities:** 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 not already be constructed. 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. **Magnitude:** The magnitude of cumulative impacts to subsistence would be similar as under Alternative 1a, although more intense because of the larger amount of acreage. **Duration/Extent:** The duration/extent of cumulative impacts to subsistence would be similar to those under Alternative 1a, although affecting a larger amount of acreage. **Contribution:** The contribution to cumulative	**Mine Site:** Identical to Alternative 1a. **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. **Magnitude:** The Pebble Project expansion scenario and associated contributions to cumulative impacts would be similar to but less than Alternative 1a, because the Amakdedori port and connecting transportation infrastructure would not be built. Under Alternative 2, project expansion would continue to use the existing Diamond Point port facility, would use the same natural gas pipeline, and would use the constructed portion of the access roads. After 20 years, ferry operations would be discontinued; road connections between ferry terminals would be constructed in a manner similar to that described for Alternative 3; and the port	**Mine Site:** Identical to Alternative 1a. **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. **Magnitude:** Under Alternative 3, project expansion would continue to use the existing Diamond Point port facility, would use the same natural gas pipeline, and would use the same north access road and Concentrate Pipeline Variant but extend the concentrate pipeline and a service road to Iniskin Bay. The port site and associated facilities would be constructed at Iniskin Bay, as discussed under Alternative 1a. A diesel pipeline from the mine site to Iniskin Bay would be constructed as described under cumulative effects for Alternative 1a. **Duration/Extent:** The duration/extent of cumulative impacts to subsistence would be similar to those

Table 4.9-2 Contribution to Cumulative Effects on Subsistence

Reasonably Foreseeable Future Actions	Alternative 1a	Alternative 1 and Variants	Alternative 2 and Variants	Alternative 3 and Variant
	subsistence resources and negative changes in access would potentially increase costs associated with subsistence and reduce cultural opportunities for teaching and sharing of resources. In addition, concerns regarding contamination and safety of consuming subsistence foods would likely continue through the period of expansion and extended operations. **Duration/Extent:** The Pebble Project expansion would contribute to cumulative effects with additional infrastructure (mine site, two access roads, and two ports), habitat loss, subsistence resource disturbance, and positive/negative changes in subsistence access over a longer period of time, up to an additional 58 years depending on the period of post-mining milling and closure. **Contribution:** Additional habitat loss associated with the mine site would affect fish and wildlife that use that habitat (see Section 4.23, Wildlife Values; and Section 4.24, Fish Values). With regard to fish, the Alaska Department of Fish and Game manages escapement and harvest levels with subsistence harvest as the priority over other uses of fish. Mine expansion would not be expected to affect the availability of fish for subsistence purposes, Construction of other facilities can affect the quality and cultural experience of subsistence activities, leading to adverse impacts on subsistence resources that are central to cultural belief systems and the way of life of local people. Effects such as habitat fragmentation, noise, and potential for increased access for recreational hunting and fishing disrupt subsistence cycles, which may result in direct impacts on resource gathering areas and	effects would be slightly more than under the other alternatives.	site and associated facilities would be constructed at Iniskin Bay, as discussed under Alternative 1a. A concentrate pipeline and diesel pipeline would be constructed between the mine site and Iniskin Bay, as discussed under cumulative effects for Alternative 1a. **Duration/Extent:** The duration/extent of cumulative impacts to subsistence would be similar to those under Alternative 1a, although affecting a smaller amount of acreage with a single port/road transportation corridor. **Contribution:** Cumulative impacts from Alternative 2 combined with the Pebble Project expansion scenario to resource availability, access to resources, and competition for resources would be of lesser magnitude and extent than under Alternative 1a because the south transportation system/ferry would not be in place. As a result, potential cumulative subsistence impacts to Kokhanok would also be less under this alternative.	under the other alternatives, although affecting a smaller number of acres. **Contribution:** The Pebble Project expansion site development and associated contributions to cumulative impacts would be similar to the those under other alternatives. Because the Pebble Project expansion scenario would use the north access road system that would already be built under Alternative 3 and would not include any ferry operations, cumulative impacts from Alternative 3 combined with the Pebble Project expansion scenario to resource availability and access to resources would be less than those under the other alternatives. Potentially affected communities would be similar to those under Alternative 2.

Table 4.9-2 Contribution to Cumulative Effects on Subsistence

Reasonably Foreseeable Future Actions	Alternative 1a	Alternative 1 and Variants	Alternative 2 and Variants	Alternative 3 and Variant
	harvest quantities. Local residents have observed that there has already been a loss to subsistence opportunities and the way of life due to planning and exploration activities that are associated with the Pebble Project expansion from helicopter traffic, and that there have been disruptions to local wildlife. Concerns regarding contamination and food safety would be extended with the Pebble Project expansion. The cumulative impacts would be long-term over extended operations and decrease in magnitude as closure is implemented. See Section 4.23, Wildlife Values; and Section 4.24, Fish Values, for discussion on cumulative effects to fish and wildlife.			
Other Mineral Exploration Projects	**Magnitude:** Mining exploration activities would include additional borehole drilling, road and pad construction, and development of temporary camp facilities. Actions that expand mineral exploration near the Pebble deposit and around Iliamna Lake contribute to landscape-level effects, where there is recurring introduction of additional impediments to the movement of people and animals on a seasonal and site-specific basis; increased noise, vibration, and emissions; and increased numbers of people to the area. This would lead to effects to resource availability, access to resources, competition for resources, and sociocultural conditions similar to those described above for the Pebble Project expansion scenario. **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. Section 4.1, Introduction to Environmental Impacts, identifies seven mineral	Similar to Alternative 1a.	Similar to Alternative 1a.	Similar to Alternative 1a.

Table 4.9-2 Contribution to Cumulative Effects on Subsistence

Reasonably Foreseeable Future Actions	Alternative 1a	Alternative 1 and Variants	Alternative 2 and Variants	Alternative 3 and Variant
	prospects in the EIS analysis area where exploratory drilling is anticipated (four in relatively close proximity to the project). **Contribution:** Actions that expand mineral exploration near the Pebble deposit and around Iliamna Lake contribute to landscape-level effects, where there is recurring introduction of additional impediments to the movement of people and animals; increased noise, vibration, and emissions; and increased numbers of people to the area. This would lead to effects to resource availability, access to resources, competition for resources, and sociocultural conditions similar to those described above for the Pebble Project expansion scenario.			
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. This has historically occurred south of King Salmon and would not likely have additive or synergistic effects with the project on subsistence. An increase in resource exploration development actions in Cook Inlet could impact the subsistence activities/experience of those communities that use the Amakdedori area. **Duration/Extent:** Seismic exploration and exploratory drilling are typically single-season, temporary activities that may occur over sequential years in specific lease areas. **Contribution:** The cumulative impacts on subsistence from oil and gas exploration activities would be long term and geographically broad in scope (e.g., regional level), but would primarily affect subsistence user experience on the western side of Cook Inlet.	Similar to Alternative 1a.	Similar to Alternative 1a.	Similar to Alternative 1a.

Table 4.9-2 Contribution to Cumulative Effects on Subsistence

Reasonably Foreseeable Future Actions	Alternative 1a	Alternative 1 and Variants	Alternative 2 and Variants	Alternative 3 and Variant
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. 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. These transportation projects would increase access to the area, which could improve access to subsistence resources, but could also increase traffic in areas previously used for subsistence activities, with potential effects on subsistence resources, competition for resources, and user experience. **Duration/Extent:** Disturbance from road construction would typically occur over a single construction season. The geographic extent would be limited to the vicinity of communities and Diamond Point. Potential effects with increased traffic would be long term. **Contribution:** Road construction would increase access to the area, which could improve access to subsistence resources but also introduce additional disturbance to and competition for resources, affecting all communities in the cumulative effects analysis area.	Similar to Alternative 1a and Alternative 2; greater than Alternative 3.	The footprint of the Diamond Point rock quarry in Alternative 1a coincides with the Diamond Point port footprint in Alternative 2 and Alternative 3. Cumulative impacts would likely be less under Alternative 2 due to project footprints commonly shared with the quarry site.	Similar to Alternative 2; less than Alternative 1a and Alternative 1.
Additional RFFAs	Additional RFFAs that have the potential to affect subsistence in the cumulative effects area include energy and utility projects, the Diamond Point rock quarry, and various village infrastructure development projects. These projects would have similar effects to the Pebble	Similar to Alternative 1a.	Similar to Alternative 1a.	Similar to Alternative 1a.

Table 4.9-2 Contribution to Cumulative Effects on Subsistence

Reasonably Foreseeable Future Actions	Alternative 1a	Alternative 1 and Variants	Alternative 2 and Variants	Alternative 3 and Variant
	Project but would be of lesser magnitude and geographic extent; however, when considered in combination with the Pebble Project, impacts to resource availability, access to resources, and competition for resources would increase.			
Summary of Project contribution to Cumulative Effects	Overall, the contribution of Alternative 1a to cumulative effects to subsistence, when taking other past, present, and reasonably foreseeable future actions into account, would be from impacts on access to, competition for, and availability of subsistence resources.	Similar to Alternative 1a, although slightly more acreage would be affected by expansion of the Pebble mine.	Similar to Alternative 1a, although slightly fewer acres would be affected by expansion of the Pebble mine.	Similar to Alternative 1a, although fewer acres would be affected by expansion of the Pebble Project than any of the other alternatives.

Note:
EIS = Environmental Impact Statement
RFFA = reasonably foreseeable future action