4.6 COMMERCIAL AND RECREATIONAL FISHERIES

This section addresses the direct and indirect effects of the No Action Alternative and action alternatives on commercial and recreational fishing. The Alaska Department of Fish and Game (ADF&G) Commercial Salmon Fishery Area T and Area H; ADF&G Commercial Shellfish Area H; Cook Inlet Management Area (for groundfish); and ADF&G Statewide Harvest Survey (SWHS) areas S, T, N, and P comprise the Environmental Impact Statement (EIS) analysis area for this resource.

Potential impacts include:

- Short- or long-term direct and indirect changes in salmon populations, or harvestability of returning salmon, which reduce the number of returning adult spawners available for harvest by commercial permit holders, thus reduce:
  - Wholesale fisheries value, payments to permit holders and crew, and expenditures into local economies
  - Delivery of fish to processors, revenue generated by processed fish, and employment of and payments to processing labor
  - Generation of tax revenue to state and local governments through sales tax, real property tax, and raw fish tax
  - Directed commercial and sport recreational fishing effort
- Short- or long-term direct and indirect changes in groundfish or shellfish populations in Cook Inlet, thus reducing:
  - Wholesale fisheries value, payments to permit holders and crew, and expenditures into local economies
  - Delivery of fish to processors, revenue generated by processed fish, and employment of and payments to processing labor
  - Generation of tax revenue to state and local governments through sales tax, real property tax, and raw fish tax
  - Directed commercial and sport recreational fishing effort
- Reduction in consumer willingness to buy Bristol Bay salmon due to a perceived loss of quality, resulting in a lower price paid to commercial harvesters
- A reduction or displacement of recreational fishing effort associated with affected waterbodies, along with an associated reduction in guide/lodge company revenues and government revenue generated by the professional guide tax if the proposed project reduces fish populations or the real or perceived quality of fishing opportunities
- An increase in recreational fishing effort associated with long-term project-driven population changes and/or changes in the regional transportation network

The magnitude (i.e., size) of impact from the project is primarily determined by the number of fish that would be impacted; the duration and geographic extent of impacts depends on the location and season that the disturbance occurs (construction, operations, or closure); and the potential of impact is the likelihood that the project would impact fisheries. Duration would be considered long term if the effect lasted throughout the life of the project, or for years to decades.

Scoping comments specifically addressed concerns that Bristol Bay commercial and recreational fisheries would be impacted, and that the Bristol Bay wild salmon brand would be damaged by the presence of the project because the watershed would no longer be pristine. Other comments expressed concern that all commercial fishing jobs would be lost, that construction and operation

of the Amakdedori port would conflict with commercial salmon fishing, and that increased marine traffic would impede other fishing operations.

Commercial Fisheries—The project has potential to affect the Bristol Bay commercial fisheries sector and related fiscal contributions through two primary mechanisms. One potential mechanism of effect would be a decline in the productivity of Bristol Bay river systems due to destruction of fish habitat from the placement of fill, and from changes in habitat quality such as increased sedimentation or altered stream flows and water quality. These effects of these mechanisms would be reflected through a decline in total fishery harvest. The other mechanism, though not expected to occur, would be a change in market reception of Bristol Bay fish. The total value of the fishery in economic terms starts with volume (i.e., productivity) and price (i.e., what the market will pay for the fish). Although permit holders and processors are the two most frequently discussed groups associated with the fishery, the economic connections of the fishery extend to crew members, shipping companies, local businesses, utilities, and governments. In Cook Inlet, impacts on fisheries would be in the form of potential disruption of traditional fishing practices and locations (e.g., groundfish fisheries, salmon fisheries in the Cottonwood and Chenik subdistricts); or by affecting productivity (e.g., the Kamishak Bay Weathervane scallop [*Patinopecten caurinus*] beds or the recovery of Pacific herring [*Clupea pallasi*] populations). Mitigation measures to reduce impacts to fish populations and thus reduce impacts on the economic value of the fish are discussed in Chapter 5, Mitigation.

In terms of magnitude, the loss of any harvestable fish from a project-induced decline in productivity would result in a lower total fishery value. Every harvested salmon has a quantifiable value to permit holders, processors, and state and local governments. This value varies from year to year with average ex-vessel price and average wholesale value, but it is demonstrable that every salmon lost to harvest has an economic value. Estimates of lost productivity as analyzed in Section 4.24, Fish Values, are used to estimate lost ex-vessel payments, lost wholesale value, and lost fishery-related government revenues.

It is easier to connect lost productivity in the fishery to lost ex-vessel and first wholesale values than it is to connect the effect of a change in consumers' willingness to pay for Bristol Bay salmon to these same measures. Bristol Bay prices reflect both the market for wild Alaska salmon products and the broader market for all salmon products, including farmed salmon (see Section 3.6, Commercial and Recreational Fisheries). Bristol Bay salmon has traditionally received a price discount compared to other sockeye salmon [*Oncorhynchus nerka*] fisheries in Alaska because of factors such as unbranded status, distance, product mix, high operating costs, and run timing (McDowell 2014). In 2016, the Bristol Bay Regional Seafood Development Association launched the fishery's first effort to develop a cohesive brand identity in an attempt to change the traditional price discount and potentially establish a premium price as the Copper River fishery has done. It is currently a challenge for many consumers to identify Bristol Bay salmon at their point of sale (McDowell 2014), but the Bristol Bay Regional Seafood Development Association is consistently working to make it easier for consumers to do so. These efforts have the potential to raise prices, but higher visibility also increases the potential for a reduction in consumer willingness to pay if consumers feel that brand is threatened or not representative of the product for sale.

In Cook Inlet, the project could affect commercial groundfish, shellfish, and salmon harvests. Because the fishery is smaller, the magnitude of these disruptions would be smaller than potential Bristol Bay effects, but broader in extent. Commercial groundfish harvesters may have to change where they place fixed gear, such as pots and longlines, because of the natural gas pipeline. They could experience changes in harvest rates or increased operational costs. Processors would only experience effects if the project caused a change in the timing and distribution of harvests, which is not expected for these fisheries. Commercial salmon harvesters could experience

changes in fishing patterns in the Chenik and Cottonwood subdistricts of the Lower Cook Inlet salmon fishery. In addition, the harvest and long-term productivity of the Kamishak Bay weathervane scallop fishery could be affected by the route of the natural gas pipeline. These effects would be long term and expected to occur to some degree if the pipeline is permitted and constructed.

Recreational Fisheries—Specific potential effects of the project on recreational fisheries could be:

- Direct loss of angler days on portions of the North and South Fork of the Koktuli River, which are in the project area
- Changes in angler behavior and charter business behavior in Cook Inlet to avoid the route of the natural gas pipeline or to adapt to change in the geographic distribution of the Pacific halibut resource caused by the pipeline or port operations
- A reduction in angler days downstream of the project area if the project reduces fish populations of target species such as Rainbow trout (*O. mykiss*), Dolly Varden (*Salvelinus malma)*, and adult salmon in downstream waters
- Reduction in angler days caused by a change in the quality of the fishing experience (e.g., changes in catch rates and/or the aesthetic quality of the experience) on waterbodies affected by the selected transportation routes
- Reduction in and/or redistribution of income to commercial guides, lodges, and air transporters based on reduction in angler days or redistribution of angler response to changes in the quality of the fishing experience
- An increase in angler days caused by an increase in the number of opportunities through expansion of the local road network or an increase in regional population

The Bristol Bay watershed is renowned for the diversity of its recreational angling opportunities. Therefore, fishing effort (angler days) and the ability of anglers and guides to redirect operations to substitute sites are key in determining the magnitude and duration of recreational fishing impacts.

4.6.1 Summary of Key Issues

Under normal operations, the alternatives would not be expected to have a measurable effect on fish numbers or result in long-term changes to the health of the commercial fisheries in Bristol Bay (Table 4.6-1). In terms of magnitude and extent, Alternative 1a would be expected to have minimal effects on commercial fisheries in Cook Inlet, with the highest probability of impacts centered around the Amakdedori port site and the siting of the natural gas pipeline. The Chenik subdistrict salmon harvests and the Kamishak Bay weathervane scallop fishery are the fisheries most likely to experience direct effects from construction and operations activities. The Cook Inlet groundfish fishery could also experience direct effects because of pipeline construction and operations. The Pacific herring fishery in Kamishak Bay could experience direct or cumulative effects, but the magnitude of effects is unknown. In terms of geographic extent of impacts, Alternative 2 and Alternative 3 avoid the noted Cook Inlet salmon, scallop, and herring interactions of Alternative 1a and Alternative 1.

With regard to recreational fishing, the extent of project impacts would be displacement of recreational fishing effort by mining activities along a short length of the upper Koktuli River, and by road transportation activities along Upper Talarik Creek under Alternative 1. In terms of magnitude of effects, ADF&G SWHS data indicate that effort along these rivers is modest, with a 1996 through 2016 average of 424 angler days a year along the entire Koktuli River and 147 angler days per year on the entire Upper Talarik. The Koktuli does not appear in ADF&G Guide

Logbook data for 2011 through 2014, and the estimated average number of guided days on the Upper Talarik is fewer than 50 angler days per year. Alternative 1a and Alternative 1 would result in a new road alongside and across the Gibraltar River. This river receives roughly the same total annual recreational fishing effort and six times the guided angling effort of the Koktuli River and Upper Talarik Creek, combined. Alternative 1a, Alternative 2, and Alternative 3 would intersect with the Newhalen and Iliamna rivers. These rivers are already connected by road to local communities and together host approximately 2,900 angler days per year (Table 4.6-1). Alternative 3 would also intersect the Pile River, which has measurable recreational fishing effort. The road corridor intersections may result in the redistribution of some angler days along the river.

Table 4.6-1: Summary of Key Issues for Commercial and Recreational Fisheries

Effect	Alternative 1a	Alternative 1 and Variants	Alternative 2 and Variants	Alternative 3 and Variant
Mine Site				
Effects to commercial fisheries	Impacts from the mine site would be the same across all alternatives. The mine site would result in loss of fish habitat in the upper North and South Fork Koktuli rivers. This disturbance would not be expected to have measurable effects on the number of adult salmon returning to the Nushagak and Kvichak district (see Section 4.24, Fish Values). The mine site area is not connected to the Togiak, Ugashik, Naknek, and Egegik watersheds and is not expected to affect fish populations or harvests from these watersheds. The mine site is not expected to affect Cook Inlet commercial fisheries.			
Effects to recreational fisheries	All alternatives would affect upper portions of the North and South Fork Koktuli rivers. The Koktuli River does not appear in some ADF&G SWHS publications because not enough survey respondents report fishing on the river. The river also does not appear in ADF&G Guide Logbook data for 2011 through 2014. The unpublished ADF&G SWHS estimates for the entire Koktuli River for 2007 through 2016 average 285 angler days per year. Some of these days would be displaced if they occurred in the project area. The mine site is not expected to affect Cook Inlet recreational fisheries.			
Transportation Corridor				
Effects to commercial fisheries	This corridor would intersect with Upper Talarik Creek, the Gibraltar River, Dunuletak Creek, Amakdedori Creek, and the Newhalen River, and would cross Iliamna Lake. This alternative would not be expected to have measurable effects on the number of adult salmon, and therefore would have no impact to commercial fisheries.	This corridor would intersect with Upper Talarik Creek, Pete Anderson Creek, the Gibraltar River, Dunuletak Creek, and Amakdedori Creek, and would cross Iliamna Lake. This alternative would not be expected to have measurable effects on the number of adult salmon, and therefore would have no impact to commercial fisheries. The Kokhanok East Ferry Terminal Variant would avoid impacts to Gibraltar River.	This corridor would intersect with Upper Talarik Creek, the Newhalen River, and the Iliamna River while crossing Iliamna Lake. This alternative would not be expected to have measurable effects on the number of adult salmon, and therefore would have no impact to commercial fisheries.	This corridor would intersect with Upper Talarik Creek, the Newhalen River, Chekok Creek, Canyon Creek, Knutson Creek, the Pile River, and the Iliamna River. This alternative would not be expected to have measurable effects on the number of adult salmon, and therefore would have no impact to commercial fisheries.

Table 4.6-1: Summary of Key Issues for Commercial and Recreational Fisheries

Effect	Alternative 1a	Alternative 1 and Variants	Alternative 2 and Variants	Alternative 3 and Variant
Effects to recreational fisheries	The Gibraltar River (approximately 650 angler days per year) and the Newhalen River (approximately 1,900 angler days per year) are the most frequently fished waterbodies along this route. The Gibraltar River is currently roadless, and the project would change the character of the river in the immediate vicinity of the intersection with the access road. Angling pressure on the river may redistribute to other locations along the waterbody or to other waterbodies. Along the Newhalen River, transport activity may disrupt fishing effort where the corridor intersects the river, but this effort would be redistributed. These impacts could impact the revenue of guides, lodges, and air transporters who support recreational fishing in this area, with related impacts to local and state revenue. Overall impacts should be limited in magnitude, with the potential for large-magnitude localized impacts for anglers and businesses who focus on the Gibraltar River in particular. The corridor would cross Iliamna Lake, which (including its tributaries) hosts 1,900 to 2,200 angler days per year. Transport across the lake should not affect these fisheries.	Only the Gibraltar River hosts a measurable amount of angling pressure (approximately 650 angler days per year). The Gibraltar River is currently roadless, and the project would change the character of the river in the immediate vicinity of the access road intersection. Angling pressure on the river may be redistributed to other locations along the waterbody or to other waterbodies. This could impact the revenue of guides, lodges, and air transporters who support recreational fishing in this area, with related impacts to local and state revenue. The corridor would cross Iliamna Lake, which (including its tributaries) hosts 1,900 to 2,200 angler days per year. Transport across the lake would not be expected to affect these fisheries. The Kokhanok East Ferry Terminal Variant would avoid impacts to Gibraltar River. The Summer-Only Ferry Operations Variant would result in more impacts than Alternative 1 to recreational fishing setting at the Gibraltar River.	The Newhalen River drainage (approximately 1,900 angler days per year) and the Iliamna River (approximately 1,000 angler days per year) are the most frequently fished waterbodies along this route. Transportation activity may disrupt fishing effort where the corridor intersects with these creeks, but this effort should redistribute along the waterbodies as long as fish populations are unaffected. Overall effects should be low in magnitude, but higher-magnitude localized effects are possible. Iliamna Lake (including its tributaries) hosts 1,900 to 2,200 angler days per year. Transport across the lake should not affect these days. Only the pipeline ROW would intersect with the smaller creeks noted in Alternative 3, impacting recreation experience primarily during construction. The Summer-Only Ferry Operations Variant would result in more impacts to recreational fishing at the Newhalen River, based on increased truck traffic.	The Newhalen River drainage (approximately 1,900 angler days per year) and the Iliamna River (approximately 1,000 angler days per year) are the most frequently fished waterbodies along this route. Transportation activity may disrupt fishing effort where the corridor intersects with these creeks and other waterbodies, but this effort would redistribute along the waterbodies. Overall effects should be low in magnitude, but higher-magnitude localized effects where transportation corridors cross the river are possible.

Table 4.6-1: Summary of Key Issues for Commercial and Recreational Fisheries

Effect	Alternative 1a	Alternative 1 and Variants	Alternative 2 and Variants	Alternative 3 and Variant
Port Site				
Effects to commercial fisheries	The Amakdedori port site intersects with the Chenik subdistrict of the Kamishak Bay District and is the location of an annual salmon fishery. In addition, the port site is in an area that hosted a historical Pacific herring fishery. This fishery is now closed because of low biomass, but could reopen in the future.		The Diamond Point port site is near a chum salmon (*O. keta)* fishery, which does not experience harvest every year. Permit holders and ADF&G have expressed concern that the presence of the port would interfere with tidal seine operations during years when there is harvest and that operations could impact juvenile rearing areas.	
Effects to recreational fisheries	The Amakdedori port site is near Amakdedori Creek, which does not appear in SWHS or guide logbook data. The closest waterbody with measurable fishing effort Is the Kamishak River, which is approximately 20 air miles south.		There are no recreational fishing resources of note near the Diamond Point port site. The closest waterbody with measurable fishing effort is the Iliamna River.	
Pipeline Route				
Effects to commercial fisheries	On the western side of Cook Inlet and in the Bristol Bay watershed, the natural gas pipeline would not directly interact with the Bristol Bay salmon fishery after construction. The pipeline would cross waters fished by the Cook Inlet salmon fishery and Cook Inlet groundfish fisheries. The pipeline would not directly interact with the drift net salmon fishery, given that the salmon fishery occurs in the top 30 feet of the water column. Seine gear in the Chenik subdistrict could be impacted by the pipeline. Alternative 1a and the Alternative 1 pipeline route could disturb the northern Kamishak Bay weathervane scallop bed, negatively affecting biomass and delaying or impeding the reopening of that fishery. Alternative 2 and Alternative 3 avoid this potential effect. The ROW of Alternative 2 and the transportation corridor of Alternative 3 would intersect with Brown's Peak Creek, which has a sustainable escapement goal for pink salmon (*O. gorbuscha)*. Comments from ADF&G indicate that this creek is periodically targeted by commercial fisheries.			
Effects to freshwater recreational fisheries	The pipeline would follow the transportation corridor and would not be expected to affect recreational fishing resources beyond those aforementioned under the transportation corridor. Cook Inlet and Anchor River fishing opportunities would be unaffected.	The pipeline would follow the transportation corridor and would not be expected to affect recreational fishing resources beyond those aforementioned under the transportation corridor. Cook Inlet and Anchor River fishing opportunities would be unaffected.	The pipeline would cross the same streams as the north access road under Alternative 3. Access along the ROW may increase for recreational fishing, but the increase would be low intensity. Cook Inlet and Anchor River fishing opportunities would be unaffected.	The pipeline would follow the transportation corridor and would not be expected to affect recreational fishing resources beyond those aforementioned under the transportation corridor. Cook Inlet and Anchor River fishing opportunities would be unaffected.
Effects to Cook Inlet saltwater recreational fisheries	The pipeline would cross waters used by Cook Inlet salmon and groundfish anglers. Salmon in saltwater are traditionally caught by trolling in the upper reaches of the water column. Because the pipeline would lie on the seabed, salmon anglers are unlikely to be affected by it. Groundfish anglers traditionally target Pacific halibut by placing baited and weighted hooks on or just above the seabed. They may need to avoid the pipeline route, or may be affected by the disruption of traditional halibut "holes" and the potential for changes in local halibut abundance.			

Notes:
ADF&G = Alaska Department of Fish and Game
ROW = right-of-way
SWHS = Statewide Harvest Survey

4.6.2 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.

Therefore, no future direct or indirect effects on commercial or recreational fisheries would be expected, and current trends in commercial and recreational fisheries would continue.

4.6.2.1 Commercial Fishing

The total value of the Bristol Bay salmon fishery depends on two primary factors: the volume of salmon harvested and the value per pound of that salmon. Direct and indirect effects to commercial fishing from the project require a connection between any alternative and either or both of those factors.

Permit Holders and Crew Members

Under the No Action Alternative, there would be no project-associated change that could affect price in the number of returning fish available for harvest, the long-term productivity from the Nushagak and Kvichak river systems, or the reputational value of the fishery. The ex-vessel value of the fishery earned by permit holders and wages paid to crew members would continue to be affected by the broader drivers of the value of the Bristol Bay salmon fishery, including world protein markets, world salmon markets, the overall productivity of the fisheries, and the decisions of processors about what products to produce.

The Processing Sector

Without an effect on the value or volume of salmon produced by the ecosystem, the No Action Alternative would not have any effect on the processing sector.

Fiscal Contributions

The No Action Alternative would not negatively affect fiscal contributions to state and local governments. It is possible that the future attractiveness of the fishery could increase if permit holders and processors have been withholding investment in recent years with the expectation that the proposed project would be built and would materially affect the fishery. However, there is no evidence that permit holders or processors have been withholding investment in the fishery. In 2014, Silver Bay Seafoods opened the fishery's first new major plant in several years. The company expanded the plant in 2015 and has the capability to expand more if the flexibility is needed (SBS 2018). Over the last decade, permit holders have installed refrigerated seawater

systems to properly chill their salmon immediately after harvest and obtain the chilling bonuses offered by processors. The amount of slush ice in Bristol Bay, usually provided by processors, has not increased in recent years. Without growth in slush ice availability, new chilling capacity is coming from refrigerated seawater installations (NEI 2018).

4.6.2.2 Recreational and Tourism-Based Fishing

Recreational fishing is driven by two populations: resident anglers and non-watershed resident anglers, including other Alaskans. The Bristol Bay region is renowned for its productive rainbow trout, king salmon, and sockeye salmon fisheries, as well as its ability to provide an uncrowded fishing experience in a remote and pristine environment. Fishery effort varies with fishing conditions, the availability of tour providers/guides, and the state and world economy. Recreational fishing in areas N, S, and T declined from 2000 to 2002 and from 2007 to 2009 as the US economy experienced economic recessions (see Section 3.6, Commercial and Recreational Fisheries). Recreational fishing in Area T also declined from 2014 to 2016. Effort in individual fisheries varies with the quality of the runs, and weak Chinook salmon (*O. tshawwytscha*) returns can affect participation in Chinook fisheries. For example, weak runs over the last decade have reduced the number of guided angler days on the Kenai River between Cook Inlet and the Soldotna Bridge from 34,000 in 2008 to just under 22,000 in 2016. In 2010, the Nushagak River closed to the retention of Chinook salmon. Angler days between the ADF&G sonar site and the mouth of the Mulchatna River declined from 8,100 in 2009 to 3,600 in 2010. The data imply that retention closures reduced angler days by more than 4,000, or 50 percent of prior year effort (ADF&G 2018d). In Cook Inlet, total saltwater effort currently stands at approximately 185,000 days per year. Effort in Cook Inlet is slowly growing but is economically sensitive; total effort dropped from 175,000 days in 2008 to 166,000 days in 2009. Effort recovered to 196,000 days in 2014 as the local and national economies recovered, but then dropped to 181,000 days in 2016 as Alaska entered the largest recession since the 1980s. Under the No Action Alternative, recreational fishing would continue under current conditions and trends, affected by temporally limited events such as recessions and temporary restrictions on fishing effort or harvest.

Commercial Fishing Guides, Lodges, and Air Transporters

The high-value fishing experience that can be found in the Bristol Bay Region and portions of Cook Inlet supports a number of commercial fishing guides and charter operations, commercial fishing lodges, and air transporters. Under the No Action Alternative, the availability of sport fish that support these operations and the quality of the fishing experience would remain the same in the EIS analysis area.

Fiscal Contributions

Under the No Action Alternative, recreational fishing fiscal contributions, including guide and air taxi revenues, government sales, and use tax revenues, would continue under current conditions and trends.

4.6.3 Alternative 1a

Project construction and operations could have an impact on both the commercial fishing community (e.g., crew members or processing), on the recreational sector via recreational fishing, and on revenue generated to state and local government. Potential impacts are influenced by project-related effects on fish population, habitat, and runs (see Section 4.24, Fish Values), as well as real and perceived effects on the quality of the fish, environment, and fishing experience.

4.6.3.1 Commercial Fishing

The ADF&G manages for the maximum sustain yield of the fishery by ensuring that a minimum, but preferably optimal, number of spawners reach their home rivers (see Section 3.6, Commercial and Recreations Fisheries). The ADF&G has no control over external factors such as ocean conditions, so it largely manages the number of returning spawners by adjusting commercial and recreational fishing harvest via effort. The ADF&G restricts effort when the strength of the returning run requires less harvest to meet the escapement goals, and liberalizes harvest opportunity when run strength threatens to exceed optimal escapement maximums goals. ADF&G reviews escapement goals every 3 years and adjusts them when data indicate that system productivity, and the optimal number of spawners, has changed. Beyond the scheduling of fishing openings and closures, the ADF&G also has the ability to define the geographic extent of fishery openings. For example, the points at which the Naknek and Kvichak rivers empty into Bristol Bay are just miles apart. In years when the Kvichak sockeye run has been weak, the ADF&G has restricted the fishing fleet to the mouth of the Naknek River to limit the harvest of Kvichak-bound fish. Under more normal conditions, this district is managed with less specificity.

ADF&G manages the fishery to try to obtain a river's maximum sustainable yield. This goal means ensuring that the optimal number of spawners, based on carrying capacity, return to natal streams. If system productivity is reduced, resulting in a measurable reduction in returning fish (after ADF&G management adjustments), then permit holders, crew, and processors will harvest and process fewer fish and very likely earn a reduced income. Crew members, permit holders, processors, and local municipalities are all dependent on the total value of the Bristol Bay fishery, which is a function of market price and harvested volume. When permit holders harvest fewer fish, the net result is that permit holders receive a lower net income, crew members are paid less, processors have less product to sell, and municipalities have less economic activity to tax.

Alternative 1a would not have measurable effects on the number of adult salmon returning to the Kvichak and Nushagak river systems as a result of project construction and operations, due the limited lineal footage of upper Koktuli River fish habitat affected by placement of fill (see Section 4.24, Fish Values). Section 4.27, Spill Risk, discusses the potential for salmon loss resulting from spills.

As noted above, the commercial fishing sector has expressed concerns that the existence of the project could lower the perceived quality of Bristol Bay salmon and thus lower price. Prices paid in Bristol Bay are nearly always lower than those paid in other Alaska salmon fisheries producing similar products, which reflects the higher transportation expense associated with Bristol Bay's geographic location and the lack of a strong brand identity that could boost average prices. Other salmon fisheries in Alaska exist in conjunction with non-renewable resources. For example, the Cook Inlet salmon fisheries exist in an active oil and gas basin, and there are headwaters near developed areas of Anchorage and the Matanuska-Susitna Borough. The Copper River salmon fishery occurs in a watershed with the remains of the historic Kennecott Copper Mine, and the Trans-Alaska Pipeline System crosses the headwaters of portions of the fishery. Both of these fisheries have average higher prices per pound than the Bristol Bay Salmon Fishery (see Section 3.6, Commercial and Recreational Fisheries). This information noted, no other wild salmon fishery in the world exists in conjunction with an active mine of this size, so existing examples are limited in their usefulness as working comparisons. Section 4.27, Spill Risk, discusses the impacts of the *Exxon Valdez* oil spill and the Fukushima nuclear accident on fish prices.

The Amakdedori port would be situated in the Chenik subdistrict of the Kamishak Bay District of the Lower Cook Inlet Management Area. Commercial salmon harvest in this area averages approximately 57,596 sockeye salmon in the years when fishing occurs, but harvests vary

significantly from year to year (see Section 3.6, Commercial and Recreational Fisheries). In terms of the magnitude of impacts, construction and operation of the project would not be expected to have measurable effects on the number of adult salmon returning to the area. In terms of the geographic extent of impacts, commercial harvesters may have to change fishing patterns based on the proximity of fishing to port operations, or could experience losses if port operations affected salmon returns. This area also historically hosted a commercial Pacific herring sac roe fishery, which has been closed since 2000 because of low abundance. The ADF&G, has expressed concern that there is the potential that the Pacific herring biomass might recover enough during the life of the project to support a reopening of the fishery. The department also expressed concern that project activities at the port site could delay the recovery of the biomass, and if the fishery were reopened "purse seine gear interacts with the bottom in waters shallower than approximately 95 feet and may create a conflict with the natural gas pipeline and port activities" (ADF&G 2018q). The department did not provide projections for biomass recovery, but simply noted the potential for recovery of the historic resource.

Alternative 1a would route the natural gas pipeline through the Kamishak Bay scallop beds identified in Section 3.6, Commercial and Recreational Fisheries. If the Kamishak Bay scallop fishery reopens, then it would be expected that fishing gear and the pipeline would interact unless fishing effort avoided the area around the pipeline. Scallops are harvested by lowering a scallop dredge to the ocean floor. It is not usual for scallop harvesters to lose dredges when they encounter rock formations, other lost fishing gear, sunken vessels, communication cables, etc. These interactions can reduce harvest efficiency and damage gear, increasing permit holder operating costs and lowering profits. Fishers work to avoid areas with known seabed hazards. In addition to gear interaction costs, routing through the pipeline corridor could adversely affect long-term bed productivity (over the life of the project). The fishery is currently closed because of low biomass but could reopen before the mine closes. The ADF&G expressed concern that the pipeline under this alternative could affect the timing of the reopening of the fishery or affect biomass enough to result in the closure of a reopened fishery. The magnitude and extent of impacts would depend on the placement of the pipeline relative to the location of the resource, and both elements are highly uncertain at this time.

On the western side of Cook Inlet and in the Bristol Bay Watershed, the natural gas pipeline would not directly interact with the Bristol Bay salmon fishery after construction. Construction activities would be timed to minimize effects on anadromous salmon streams and would not be anticipated to affect these streams in a material manner. On the eastern side of Cook Inlet, numerous existing anadromous resources on the Kenai Peninsula are crossed by subservice pipelines without causing an effect to commercial and recreational fisheries. Although the pipeline would cross waters of the Cook Inlet salmon fishery, it would not directly interact with the salmon fishery (outside of the Chenik subdistrict noted above), given that the salmon fishery occurs in the top 30 feet of the water column. After construction, groundfish commercial harvesters (in the halibut and Pacific cod fisheries) may need to adjust the placement of their bottom gear, such as pots or longlines, to avoid the natural gas pipeline. As described above, permit holders frequently avoid areas with known seabed obstructions. A change in location could result in decreased harvest efficiency and increased costs and risks. The magnitude and extent of these effects is expected to be limited, given the size of the fishing area relative to the size of the pipeline corridor. Typically, the duration of impacts on commercial fisheries from the gas pipeline would be long term occurring throughout the life of the project. Displacement is likely to be most intense during construction.

Permit Holders and Crew Members

Based on estimations of the effect to fish populations (see Section 4.24, Fish Values), this alternative would not result in changes in permit holder revenues, crew member payments, or permits in Bristol Bay due to a change in the return of adult spawners.

Commercial fishers in Cook Inlet face potentially higher costs associated with gear/infrastructure interactions and the potential for reduced earning associated with the Chenik subdistrict salmon fishery. The impacts are expected to be negligible relative to areawide fishing opportunities and revenues. There is the potential for reduced earnings associated with delayed recoveries in Pacific herring and weathervane scallop stocks, but the magnitude of the recovery delay for both stocks is unknown; at this time, no timelines for recovery for either stock are known.

The Processing Sector

Reductions in harvest by permit holders is generally transmitted to the processing sector as fewer fish to be processed and sold into the world sockeye market. The exception to this case is when processors are operating at maximum capacity and additional fish cannot be processed; this phenomenon is known as "being plugged." When plants are not "plugged," the lost harvest results in lower total wholesale value for processors. The magnitude of the financial loss depends on the size of the harvest reduction and individual choices by processor regarding adjustments to their product mix. Processors make these decisions based on run size, their individual capabilities, and the needs of the world market, which means that any long-term loss in harvest would express itself differently each year based on the aforementioned factors. As noted above, under this alternative, no measurable effects on the number of returning salmon and the historical relationship between ex-vessel values and wholesale values would not be expected. Therefore, the alternative would not be expected to result in changes to wholesale values or processor operations (see Section 4.24, Fish Values).

Fiscal Contributions

As noted above, the fiscal contributions of the Bristol Bay salmon fishery to state and local government depend on the long-term health of the fishery. In terms of magnitude of impacts, lost harvest value would be directly expressed through reduced Fisheries Business Tax and Raw Fish Landings Taxes. Significant reductions in long-term value of the fishery would affect property taxes, sales taxes, and use taxes (see Section 4.3, Needs and Welfare of the People—Socioeconomics, for a discussion of potential effects of reductions in state and local revenue). However, no long-term measurable changes in the fishery would be expected; therefore, there would be no long-term changes expected in fishery fiscal contribution attributable to this alternative (see Section 4.24, Fish Values).

Changes in fiscal contributions from Cook Inlet saltwater fisheries are expected to be negligible or nonexistent, particularly given the uncertainty surrounding the potential for and magnitude of impacts on resources such as the Pacific herring and the weathervane scallop.

4.6.3.2 Recreational and Tourism-Based Fishing

Recreational fishing effort in areas S, T, N, and P is based on several different types of fisheries with different goals, attributes, and experiences. For example, a Chinook salmon angler on the Nushagak River is likely to be fishing from a boat and focused on the harvest of Chinook salmon for consumption. An angler fishing the Gibraltar River is fishing a much smaller waterbody with more shore fishing and is more likely to be targeting rainbow trout for a non-consumptive purpose. The effects of Alternative 1a on the overall recreation fishery would depend on the factors noted above and the availability of alternative opportunities. There are few worldwide alternatives to the

Nushagak River, which has one of the largest recreational Chinook fisheries in Alaska. In 2016, anglers harvested more than 7,500 Chinook from the Nushagak, nearly as many as the 8,500 Chinook harvested from the Kenai River, and more than the 4,700 harvested in the entire Susitna River drainage (ADF&G 2018d).

In terms of extent of impacts, the three most important recreational fisheries that would interact with Alternative 1a are Iliamna Lake and the Gibraltar and Newhalen rivers. Iliamna Lake and its unnamed tributaries host roughly 1,900 to 2,200 angler days per year. This effort is dispersed across the lake and numerous unidentified tributaries without enough SWHS survey responses to allow for individual effort estimates. Under normal operations, the ferry across the lake would not be expected to limit or affect the quality of these fishing days.

The Gibraltar River (approximately 650 angler days per year) primarily hosts fly-in wade and float anglers. The river is currently not accessible via road, and the transportation corridor would create a new road and crossing along the river. There would be no anticipated measurable changes in the number of fish along the river, but the presence of the road and bridge crossing would change the fishing experience on the river, particularly for float anglers who would have to pass the bridge to float the length of the river (see Section 4.24, Fish Values). Construction activities would be disruptive, and the road and bridge would be in place through project operations and post-closure until they are no longer needed. Therefore, potential adverse impacts to the recreational fishing experience would be long term.

The Gibraltar River offers a remote fishing experience for rainbow trout but is one of several streams offering this type of experience in the Bristol Bay region. Rainbow trout are common, and angling opportunities in remote conditions are widespread throughout the region. The loss of fishing opportunities in these areas would be more likely to be experienced by select guide and lodge operators than by a substantial portion of all anglers in the Bristol Bay region. For example, between 2011 and 2014, ADF&G Freshwater Guide Logbook data recorded nine businesses providing 289 fishing days a year on average for the Gibraltar River system. Across all of Area S, the Kvichak River drainage, guided anglers generated an average of 10,400 fishing days per year. Therefore, the Gibraltar River system represents less than 3 percent of all angling effort in Area S. Affected operators could substitute fishing on different streams, albeit at potentially higher costs to themselves and their consumers, or anglers could redirect their fishing to other sites in the Bristol Bay region or in Alaska. Anglers themselves would likely be able to find similar opportunities on other streams in the region if the extent of effects of Alternative 1a are limited to a subset of regional fishing opportunities. Impacts would be long term, lasting through construction and operations, but opportunities would be available at other locations.

The Newhalen River drainage (approximately 1,900 angler days per year) is the most frequently fished waterbody along the mine access road. Most of this effort is by unguided anglers. ADF&G Freshwater Guide Logbook data indicate a cumulative average of fewer than 200 guided days per year on Newhalen River, determined by an average of nine and seven businesses, respectively. In terms of magnitude and extent of impacts, trucking activity may displace the fishing effort of anglers who prefer solitude, particularly where the road corridor intersects or run along these waterbodies. Conversely, for anglers who are less sensitive to transportation activity, roads frequently provide new access points for anglers. Aggregate fishing effort should not be adversely affected as long as fish populations are unaffected but may redistribute along the waterbodies.

Mine facilities under Alternative 1a would directly impact portions of the tributaries of the North and South Fork Koktuli River watersheds, and support and transportation infrastructure would affect the Gibraltar River and Iliamna Lake (see figures in Chapter 2, Alternatives). In terms of potential magnitude of effects, these watersheds account for a small portion of overall recreational

fishing effort in SWHS areas S, T, and N (see Section 3.6, Commercial and Recreational Fisheries). The ADF&G SWHS estimates and Guide Logbook Program data indicate that total fishing effort on the entire Koktuli River is fewer than 50 angler days per year, and total effort in SWHS areas S and T is estimated at more than 40,000 days per year.

The waterbodies affected by Alternative 1a have fewer total recreational angler days than the waterbodies affected by Alternative 2 or Alternative 3. The main angling waterbodies affected by Alternative 2 and Alternative 3 (the Newhalen, Pile, and Iliamna rivers) already have some road access from local communities. In contrast, Alternative 1a differs from Alternative 2 and Alternative 3 because it includes new road affecting the Gibraltar River, a waterbody without current road access and more than 500 recreational fishing days per year; the rivers affected by Alternative 2 and Alternative 3 already have some road access and do not share the Gibraltar River's roadless state. Impacts would be expected to occur under Alternative 1a and would be long term, lasting through closure until the road is no longer used.

The Amakdedori port site is closer to the Kamishak River, which hosts several hundred guided angler days per year, more than the Diamond Point port site in Alternative 2 and Alternative 3. This resource is approximately 20 air miles south of the port site; the magnitude, extent, and duration of the effects of project operations on recreational fishing at that location is unclear.

In terms of magnitude and geographic extent of impacts, Cook Inlet saltwater recreational fishing could be affected by the natural gas pipeline, which could disrupt traditional groundfish fishing locations. The pipeline is not expected to have measurable effects on the numbers of groundfish, salmon, or rockfish, but could result in changes in the localized distribution of groundfish resources, which could then affect angler success rates or costs. These impacts would be long term and would be expected to occur.

Shore-based anglers and boat anglers in Kachemak Bay would not be expected to notice the project or need to change their behavior because of it. In terms of extent of impacts, some anglers fishing from just north of Anchor Point to the boundary between Cook Inlet and the Northern Gulf of Alaska could interact with the natural gas pipeline if they were targeting groundfish such as Pacific halibut and Pacific cod. Pacific halibut are the primary target of recreational anglers in Cook Inlet, with the species accounting for approximately 60 percent of the recreational harvest, based on SWHS data. The next most commonly harvested species are "rockfish"[1] (approximately 12 percent of harvest), Chinook salmon (approximately 6 to 7 percent of harvest), and silver salmon (approximately 6 to 7 percent of harvest). These species account for more than 80 percent of area's recreational harvest. The salmon species are primarily caught through trolling or by shore anglers at the Homer Spit; the natural gas pipeline would not be expected to impact these angler days. Anglers fishing for Pacific halibut can catch the species while trolling for salmon, but the dominant method is to place weighted and baited hooks on the seafloor where halibut live. In terms of magnitude and extent of impacts, these anglers would risk losing gear if fishing over the pipeline, and the pipeline itself could disturb traditional halibut concentrations referred to as "holes." The impacts would be long term and would be expected to occur under Alternative 1a.

Commercial Fishing Guides, Lodges, and Air Transportation

There would be no measurable impacts on sport fish populations that could affect commercial fishing guides, lodges, or air transporters (see Section 4.24, Fish Values). The extent of the effect of construction and operations of the project would be to affect the quality of fishing experience in the immediate vicinity of the project where project facilities are visible or project activities are

[1] The SWHS does not collect data on harvest by species in the rockfish complex (*Sebastes spp.*). All species are grouped under the term "rockfish."

audible, as described above. In addition, some anglers may be sensitive to the idea of an operational mine in the area regardless of whether they would experience any activity or disturbance associated with it. Although English et al. (2018) centers on the effect of the Deepwater Horizon oil spill and not the on existence of an industrial facility, authors note that beaches unaffected by the spill saw reduced angler days. Perception mattered to a certain number of anglers, particularly when it came to a spill. In terms of magnitude, there could be associated reductions in and/or redistribution of income to commercial guides, lodges, and air transporters based on reductions in angler days. Redistribution of angler response to changes in the quality of the fishing experience would depend on the availability and appeal of substitute fishing destinations. Fishing packages in Bristol Bay cost between $600 and $1,000 per night. Client concerns about the quality of the experience could result in cancellations and associated economic impacts to the guide companies, lodges, air transporters, and the communities that support them. In terms of duration, such effects would be more pronounced during construction, but would continue during operations, be long term in duration, and would be expected to occur.

Fiscal Contributions

Under Alternative 1a, the magnitude of impacts on fiscal contributions from recreational fishing would be a potential reduction in guide and air taxi revenues, as well as government sales and use tax revenues if anglers reduced fishing effort in the region. In terms of the extent of impacts, if anglers shift effort in the region but do not change overall effort, then revenues would shift between municipalities and companies. The municipality most likely to be affected by any shift in effort is the Lake and Peninsula Borough, which has both a guided fishing tax and a bed tax, and encompasses much of the project area. At the same time, positive or negative shifts in revenue could also affect the Bristol Bay Borough (bed tax) and the city of Dillingham (sales taxes), depending on whether anglers shift effort towards or away from recreational fishing business in these communities.

Changes in fiscal contributions from Cook Inlet saltwater recreational fisheries are expected to be negligible or nonexistent, particularly given the uncertainty surrounding the potential for and magnitude of impacts on resources such as the Pacific herring and the weathervane scallop.

4.6.4 Alternative 1

4.6.4.1 Commercial Fishing

Alternative 1 and any of its variants would not be expected to measurably affect the health or value of Bristol Bay salmon fishery, including permit holder earnings, permit holder value, crew earnings, fishery first wholesale values, processor earnings, or state and local fiscal contributions. The extent, duration, and likelihood of effects on Cook Inlet fisheries would be identical to Alternative 1a, as discussed above.

4.6.4.2 Recreational and Tourism-Based Fishing

Mine and transportation facilities under Alternative 1 would directly impact portions of the same tributaries discussed under Alternative 1a, and would also affect the Upper Talarik Creek watershed. In terms of potential magnitude of effects, this watershed accounts for a small portion of overall recreational fishing effort in SWHS areas S, T, and N (see Section 3.6, Commercial and Recreational Fisheries). The ADF&G SWHS estimates and Guide Logbook Program data indicate that total fishing effort on Upper Talarik Creek averages fewer than 150 angler days per year, but total effort in SWHS areas S and T is estimated at more than 40,000 days per year.

The Newhalen River at the Newhalen spur road and the Gibraltar River at the port access road are the most frequently fished waterbodies along the Alternative 1 transportation corridor from the Amakdedori port to the mine site. For these resources, interactions and impacts would be the same as described for Alternative 1a.

This alternative does not differ from Alternative 1a with respect to Cook Inlet recreational fisheries. Interactions and impacts would be the same as described for Alternative 1a.

Commercial Fishing Guides, Lodges, and Air Transporters

The magnitude, duration, and likelihood of potential economic impacts to commercial fishing guides, lodges, and air transporters would be similar to those described under Alternative 1a. The extent would differ because some different recreational fishing areas would be affected along the mine access road, potentially affecting different service providers. [2]

Fiscal Contributions

As under Alternative 1a, under Alternative 1, recreational fishing fiscal contributions, including guide and air taxi revenues as well as government sales and use tax revenues, could be affected if anglers reduced fishing effort in the region. In terms of magnitude and extent, if anglers shift effort in the region but do not change overall effort, then revenues would shift between municipalities and companies. The municipality most likely to be affected by any shift in effort is the Lake and Peninsula Borough, which has both a guided fishing tax and a bed tax and encompasses much of the project area. At the same time, positive and negative shifts in revenue could also affect the Bristol Bay Borough (bed tax) and the city of Dillingham (sales taxes). The duration of these impacts would be long term, lasting throughout the life of the project.

Changes in fiscal contributions from Cook Inlet saltwater recreational fisheries are expected to be negligible or nonexistent, particularly given the uncertainty surrounding the potential for and magnitude of impacts on resources such as the Pacific herring and the weathervane scallop.

4.6.4.3 Alternative 1—Kokhanok East Ferry Terminal Variant

Under this variant, the impacts to recreational and commercial fishing on the Gibraltar River from the transportation corridor would not occur because this variant would not cross the river.

4.6.4.4 Alternative 1—Summer-Only Ferry Operations Variant

In terms of magnitude and extent, truck traffic under this variant would double during the summer, which would increase impacts to the setting of recreational fishing where the transportation corridor crosses the Gibraltar River. This impact would be long term, lasting though operation of the mine, and would be certain to occur under this variant.

4.6.4.5 Alternative 1—Pile-Supported Dock Variant

The Pile-Supported Dock Variant would result in impacts with magnitudes, extents, durations, and likelihoods similar to those described above for commercial and recreational fisheries.

[2] In the comment period for the Draft EIS, commenters mentioned possible effects to Lower Talarik Creek. The viewshed analyses indicate that mine operations could not be seen or heard from the Lower Talarik Creek watershed. However, anglers might be able to see the mine during flight operations traveling to/from Lower Talarik Creek.

4.6.5 Alternative 2—North Road and Ferry with Downstream Dams

Under Alternative 2, the magnitude, extent, duration, and likelihood of project effects on commercial fishing would be expected to be the same as Alternative 1a; mine operations would be the same, and the different transportation corridors would not be expected to cause any long-term effects to fish populations. The magnitude, extent, duration, and likelihood of impacts to the commercial and recreational fisheries in Cook Inlet from the pipeline would also be similar to Alternative 1a; however, in terms of extent, the port access road under the Alternative 2 transportation corridor would affect different recreational fishery resources. This alternative would avoid the currently roadless Gibraltar River area and the Amakdedori area, and would be much farther away from the Kamishak River. However, the mine access road and/or the pipeline right-of-way (ROW) would cross a number of waterbodies with fishing pressure, including the Newhalen River and the Iliamna River.

4.6.5.1 Commercial Fishing

As with Alternative 1a, in terms of magnitude and extent, Alternative 2 would not be expected to affect the health or value of the Bristol Bay salmon fishery, including permit holder earnings, permit holder value, crew earnings, fishery first wholesale values, processor earnings, or local fiscal contributions. With respect to the magnitude and extent of impacts in Cook Inlet, Alternative 2 would avoid the potential effects on the Chenik subdistrict salmon fishery, the Kamishak Bay Pacific herring fishery, and the Kamishak Bay Weathervane scallop fishery. However, the Diamond Point port has the potential to interfere with an intermittent chum salmon fishery near Cottonwood Creek. The average harvest numbers for Iliamna and Iniskin bays in years when harvest was recorded was slightly more than 27,000 chum salmon and approximately 3,600 pink salmon (ADF&G 2018q). Commercial permit holders expressed concern that port operations at this site would interfere with tidally dependent seine opportunities. The magnitude and duration of disruption to these fisheries would be due to additional boat traffic. More boat traffic would be expected during construction than operations.

The pipeline ROW of Alternative 2 and the transportation corridor of Alternative 3 would intersect with Brown's Peak Creek, which has a sustainable escapement goal for pink salmon. Comments from ADF&G indicate that this creek is periodically targeted by commercial fisheries. There would be no measurable impact to returning fish in this creek, and no impact would be expected to commercial fisheries.

4.6.5.2 Recreational and Tourism-Based Fishing

The Newhalen River drainage (approximately 1,900 angler days per year) and the Iliamna River (approximately 1,000 angler days per year) are the most frequently fished waterbodies along the Alternative 2 transportation corridor route. Impacts to the Newhalen River would be the same as those discussed under Alternative 1a.

Along the Iliamna River, most of this effort is by unguided anglers. ADF&G Freshwater Guide Logbook data indicate an average of slightly more than 400 guided days per year on the Iliamna River, determined by an average of nine and seven businesses, respectively. The impacts would be similar to those at the Newhalen River, discussed under Alternative 1a.

In terms of magnitude and extent of impacts on recreational and tourism-based fishing:

- Alternative 2 would affect freshwater waterbodies with higher fishing effort than Alternative 1a and Alternative 1, but it would not establish new roads near waterbodies such as the Gibraltar River, which are known for the remote characteristics and have measurable fishing effort.

- Alternative 2 crosses fewer waterbodies along the Iliamna Lake's northern boundary than Alternative 3 by virtue of the ferry from Eagle Bay to Pile Bay and the road corridor to Diamond Point port.
- Alternative 2 and Alternative 3 would use a port at Diamond Point. As noted above, this port site is farther from Kamishak River, which hosts several hundred guided angler days per year, more than the Amakdedori port site in Alternative 1a and Alternative 1.
- The pipeline ROW under Alternative 2 would cross the same streams as discussed below for Alternative 3. In terms of the magnitude and extent of effects, access along the ROW could increase slightly for recreational fishing. To the extent that fishing efforts are redistributed, there could be adverse economic impacts to fishing guides and lodges. The impacts would be long term, lasting through the duration of operations.

Commercial Fishing Guides, Lodges, and Air Transporters

The magnitude, duration, and likelihood of potential economic impacts to commercial fishing guides, lodges, and air transporters would be similar to those discussed under Alternative 1a. The extent would differ because different recreational fishing areas would be affected as described above, consequently affecting different service providers.

Fiscal Contributions

As with Alternative 1a, under Alternative 2, recreational fishing fiscal contributions, including guide and air taxi revenues as well as government sales and use tax revenues, could be affected if anglers reduced fishing effort in the region. In terms of magnitude and extent, if anglers shift effort in the region but do not change overall effort, then revenues would shift between municipalities and companies. The municipality most likely to be affected by any shift in effort is the Lake and Peninsula Borough, which has both a guided fishing tax and a bed tax and encompasses much of the project area. At the same time, positive and negative shifts in revenue could also impact the Bristol Bay Borough (bed tax) and the city of Dillingham (sales taxes). The duration of these impacts would be long term, lasting throughout the life of the project.

Changes in fiscal contributions from Cook Inlet saltwater recreational fisheries are expected to be negligible or nonexistent, particularly given the uncertainty surrounding the potential for and magnitude of impacts on resources such as the Pacific herring and the weathervane scallop.

4.6.5.3 Alternative 2—Summer-Only Ferry Operations Variant

In terms of magnitude and extent of impacts, truck traffic under this variant would double during the summer; this would increase impacts in relation to Alternative 2, to the setting of recreational fishing where the transportation corridor crosses the Newhalen and Iliamna rivers. These impacts would be long term and would be expected to occur under this variant.

4.6.5.4 Alternative 2—Pile-Supported Dock Variant

The Pile-Supported Dock Variant would result in impacts with magnitudes, extents, durations, and likelihoods similar to those described above for Alternative 2 for commercial and recreational fisheries.

4.6.5.5 Alternative 2—Newhalen River North Crossing Variant

The Newhalen River North Crossing Variant would result in impacts with magnitudes, extents, durations, and likelihoods similar to those described above for Alternative 2 for commercial and recreational fisheries.

4.6.6 Alternative 3—North Road Only

Under Alternative 3, the magnitude, duration, and likelihood of effects of the project on commercial and recreational fishing would not be expected to be different than under Alternative 1a because mine operations would be the same, and the transportation corridor would not be expected to affect fish populations over the long term. However, though overall effects would remain the same, the extent of impacts due to Alternative 3 would differ because different recreational fishery resources and less-used recreational fishery resources would be affected compared to Alternative 1a. Alternative 3 would avoid the currently roadless Gibraltar River, but would cross a number of waterbodies with measurable recreational fishing pressure, including the Pile River and the Iliamna River.

4.6.6.1 Commercial Fishing

As with Alternative 1a, Alternative 3 would not be expected to measurably affect the health or value of Bristol Bay salmon fishery, including permit holder earnings, permit holder value, crew earnings, fishery first wholesale values, processor earnings, or local fiscal contributions. The extent, duration, and likelihood of effects on Cook Inlet fisheries are identical to Alternative 2, with fewer expected effects than Alternative 1a and Alternative 1, as discussed above.

4.6.6.2 Recreational and Tourism-Based Fishing

The Alternative 3 transportation corridor would extend from Diamond Point on land across Chekok, Canyon, and Knutson creeks; on to Pile Bay; across the Pile River; and then cross the Iliamna River, leading to the mine site.

As noted for Alternative 2, the Newhalen River drainage and the Iliamna River are the most frequently fished waterbodies along this route. The magnitude and extent of impacts from Alternative 3 are that transport activity may displace fishing effort where the corridor intersects with these waterbodies, but the corridor overlap would be short in length. Construction activities would be disruptive and truck traffic would adversely affect the recreation experience that occurs in the vicinity of the road for those anglers that prefer a more remote experience. Fishing effort should not be adversely affected overall, but in terms of extent may be redistributed along the waterbodies as long as fish populations are unaffected by changes in distribution of fishing effort.

With respect to additional waterbodies cross by Alternative 3 compared to Alternative 2:

- ADF&G data indicate that Chekok Creek has limited fishing activity (fewer than 50 days per year).
- Other waterbodies along the Alternative 3 transportation corridor, including the Pile River, do not appear in published ADF&G data. A consistent absence from the SWHS and the Freshwater Guide Logbook Program generally indicates a lack of fishing pressure in that area.
- It is very likely that Alternative 3 would increase fishing pressure on freshwater waterbodies because of the presence of a continuous road providing access to these waterbodies along the north side of Iliamna Lake between the mine site and Pile Bay. These impacts would last for the life of the road.

Additionally, with respect to impacts from Alternative 3:

- Alternative 2 and Alternative 3 would use a port at Diamond Point. As noted above, this port site is farther from Kamishak River, which hosts several hundred guided angler days per year, more than the Amakdedori port site in Alternative 1a and Alternative 1.

- The transportation corridor under Alternative 3 (shared with the Alternative 2 pipeline ROW) would cross a number of streams. In terms of the magnitude and extent of effects, access along the ROW could increase slightly for recreational fishing. To the extent that fishing efforts are redistributed, there could be adverse economic impacts to fishing guides and lodges. The impacts would be long term, lasting through the duration of operations.

Commercial Fishing Guides, Lodges, and Air Transporters

The magnitude, duration, and likelihood of potential economic impacts to on commercial fishing guides, lodges, and air transporters would be similar to those discussed under Alternative 1a. The extent would differ because different recreational fishing areas would be affected as described above, consequently affecting different service providers.

Fiscal Contributions

Under Alternative 3, recreational fishing fiscal contributions, including guide and air taxi revenues as well as government sales and use tax revenues, could be affected if anglers reduced fishing effort in the region. In terms of magnitude and extent, if anglers shift effort in the region but do not change overall effort, then revenues would shift between municipalities and companies. The municipality most likely to be affected by any shift in effort is the Lake and Peninsula Borough, which has both a guided fishing tax and a bed tax and encompasses much of the project area. At the same time, positive and negative shifts in revenue could also impact the Bristol Bay Borough (bed tax) and the city of Dillingham (sales taxes). The duration of these impacts would be long term, lasting throughout the life of the project. Alternative 3 would affect more waterbodies than Alternative 1a, but would not establish new roads near currently roadless waterbodies with existing fishing effort.

Changes in fiscal contributions from Cook Inlet saltwater recreational fisheries are expected to be negligible or nonexistent, particularly given the uncertainty surrounding the potential for and magnitude of impacts on resources such as the Pacific herring and the weathervane scallop.

4.6.6.3 Alternative 3—Concentrate Pipeline Variant

The concentrate pipeline variant would add two additional pipelines (concentrate and water return) in the road/natural gas pipeline corridor, increasing the width of visual disturbance that could affect the quality of the fishing recreational experience. It would result in impacts with magnitudes, extents, durations, and likelihoods similar to those described above for Alternative 3 for commercial and recreational fisheries. However, it would reduce truck traffic associated with shipment of concentrate and potentially have less impact on the nature of the recreational fishing experience.

4.6.7 Cumulative Effects

Impacts to commercial and recreational fisheries would include short- or long-term changes in fish populations or harvestability, reduction in consumer willingness to buy Bristol Bay salmon due to perceived loss of quality, reduction or displacement of recreational fisheries, or an increase in recreational fishing caused by population changes. Potential cumulative impacts to commercial fisheries could be affected by productivity losses, including incremental loss of spawning and rearing habitat, fragmentation of habitat, changes in wetland types, and loss or degradation of ecosystem functions. Potential cumulative impacts to recreational fisheries could be affected by any reduced fish populations (both salmon and non-salmon) associated with productivity losses, as well as loss of scenic and recreational value of fishing sites.

The EIS analysis area includes commercial and recreational fisheries, the ADF&G Commercial Salmon Fishery Area T and Area H, the Cook Inlet Management Area (including associated federal waters), and the ADF&G SWHS areas S, T, N, and P.

Past, present, and reasonably foreseeable future actions (RFFAs) in the cumulative effects analysis area have the potential to contribute cumulatively to impacts on commercial and recreational fisheries. Section 4.1, Introduction to Environmental Consequences, details the past actions, present actions, and RFFAs considered for evaluation. Several of the RFFAs detailed are considered to have no potential for cumulatively impacting commercial and recreational fisheries in the analysis area. These would include non-industrialized point-source activities that are unlikely to result in any appreciable impact on wetlands beyond a temporary basis (such as tourism, recreation, fishing, and hunting). Other RFFAs removed from further consideration include those outside the analysis area.

Section 4.24, Fish Values, does not estimate fish population changes associated with cumulative effects of the RFFAs. It is clear that changes in the number of returning salmon spawners have a direct effect on the value of the Bristol Bay salmon fishery. The ADF&G is obligated to manage for the long-term health of the resource, prioritizing that health over the economic condition of the fishery. This prioritization means ensuring that enough spawners return to their natal streams. If the returning number of adult fish drops, ADF&G will prioritize making sure enough of the fish enter the river system to spawn, and commercial and recreational harvest opportunities may drop as result.

Cumulative effects on recreational fisheries are harder to quantify than those on commercial fisheries. In addition to salmon, recreational anglers in the region primarily target rainbow trout and Dolly Varden, which depend on salmon eggs and salmon flesh for a good portion of their annual caloric intake. Mineral development could contribute cumulatively to the reduction of the undeveloped nature of the region, and thereby reduce opportunities available for recreation activities fishing in remote areas. However, recreational anglers are more mobile and have the option to select similar substitute experiences. The most likely effect is a redistribution of days to different locations rather than a large reduction in total days. Lodges are not mobile, and providers who frequent rivers that may no longer provide the same experience they once did may choose to change the services that they offer, access different locations via air, and/or lose a portion of their clientele. Changes in angler demand for trips in the region would depend on the magnitude of changes in the angling experience, angler preferences, and the type of responses by trip providers.

4.6.7.1 Past and Present Actions

Past and present actions that have or are currently affecting commercial and recreational fisheries in the analysis area are minimal. Current development consists of six communities on or near Iliamna Lake and nearby roads. Present activities include mining exploration and non-mining related projects, such as transportation, oil and gas development, or community development actions. These actions have resulted in a loss of some fish habitat, and aircraft activity associated with mining exploration can degrade the quality of a remote recreational fishing experience. As noted in Section 4.22, Wetlands and Other Waters/Special Aquatic Sites; and Section 4.24, Fish Values, given the relatively small amount of past and present effects in individual watersheds and the project area in general, as well as the limited footprint of drilling, past/present cumulative impacts on fisheries are minimal in extent and magnitude for all alternatives.

4.6.7.2 Reasonably Foreseeable Future Actions

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

The No Action Alternative would not contribute to cumulative effects on commercial and recreational fishing.

Collectively, the project alternatives with RFFAs' contribution to cumulative effects on commercial and recreational fisheries are summarized in Table 4.6-2.

Table 4.6-2 Contribution to Cumulative Effects on Commercial and Recreational Fisheries

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, which would contribute to cumulative effects on surface waters and fish habitat through removal of overburden, waste rock, and ore. **Other Facilities:** A north access road, concentrate and water return pipelines, and diesel pipeline would be constructed along the Alternative 3 road alignment to Eagle Bay, and extended to a new deepwater port site at Iniskin Bay. Pipeline construction would have potentially limited impacts on surface waters and fish habitat from trenching activities. **Magnitude:** The primary potential future impacts to fish from the Pebble Project expansion would be direct loss of habitat, fish displacement and injury, habitat degradation, and changes in the natural flow regime. These impacts would be similar to those described for the project in Section 4.24, Fish Values, but with additional amounts of acreage and length of stream affected. With the mine expansion, the duration of these impacts would be extended by 78 years. The construction of the south waste rock facility collection pond would affect the South Fork Koktuli and Upper Talarik Creek watersheds, affecting sockeye, coho (*O. kitsuch*), chum, and Chinook salmon. Expanded development would increase the magnitude and duration of disturbance impacts. Any impacts that result in a reduction in the number of returning adult spawners would affect commercial fisheries. Commercial fishing impacts related to expansion of the mine site are limited to the Bristol Bay commercial fishery. The construction and operation of a deepwater port in Iniskin Bay would affect the commercial chum and pink salmon	**Mine Site:** Identical to Alternative 1a. **Other Facilities:** The north access road and concentrate and diesel pipelines would be constructed along the Alternative 3 road alignment to a new deepwater port site at Iniskin Bay. **Magnitude:** The magnitude of cumulative impacts to commercial and recreational fisheries would be similar to that under Alternative 1a. **Duration/Extent:** The duration/extent of cumulative impacts to commercial and recreational fisheries would be similar to those under Alternative 1a. **Contribution:** The contribution to cumulative effects would be slightly more than that under Alternative 1a, and more than those under Alternative 2 and Alternative 3.	**Mine Site:** Identical to Alternative 1a. **Other Facilities:** The north access road and concentrate and diesel pipelines would be constructed along the Alternative 3 road alignment to a new deepwater port site at Iniskin Bay. Truck traffic along the north access road transportation corridor would decrease with construction of the concentrate pipeline, potentially decreasing the effects on quality of the recreational fishing experience in adjacent areas. **Magnitude:** As noted in Section 4.24, Fish Values, the magnitude of cumulative fish effects, and therefore of commercial and recreational fishery effects, would be lower than Alternative 1a because it would not affect the Gibraltar River. However, the magnitude of effects would be higher than that under Alternative 3 because it would stagger road	**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:** Although Alternative 3 would have the same cumulative mine site effects as the other alternatives, cumulative effects related to transportation and infrastructure would be less, as the alternative would avoid the Gibraltar River and the need for a ferry, and because the natural gas pipeline and most of the road would already exist under Alternative 3. **Duration/Extent:** The duration/extent of cumulative impacts to commercial and recreational would be similar in duration to those under the other alternatives, but less in

Table 4.6-2 Contribution to Cumulative Effects on Commercial and Recreational Fisheries

Reasonably Foreseeable Future Actions	Alternative 1a	Alternative 1 and Variants	Alternative 2 and Variants	Alternative 3 and Variant
	fishery in that area and could affect the recovery of the Pacific herring fishery. These effects would be similar to the potential direct effects described for Alternative 2 and Alternative 3. Cumulative effects on recreational fishing would mirror those for commercial fishing because recreational target species include salmon or species that are dependent on salmon. The desirability and viability of the South Fork Koktuli River and Upper Talarik Creek as recreational fishing locations would follow changes in salmon and salmonid populations and recreation experience. The construction of a deepwater port at Iniskin Bay with associated pipelines (concentrate and diesel) and access roads would result in recreational fishery effects similar in magnitude to potential combined direct effects described for Alternative 1a and Alternative 3 over a 78-year period. **Duration/Extent:** The Pebble Project expansion scenario would result in an additional 78 years of mining/milling and include a larger open pit mine, with expanded and new storage facilities for tailings and waste rock. **Contribution:** Expanded development and associated contributions to cumulative impacts would be the same for all alternatives for commercial and recreational fisheries, although there would be greater impacts to the affected portion of the Koktuli and Talarik creek watersheds.		construction and ferry operations over a longer period of time. **Duration/Extent:** The duration/extent of cumulative impacts to commercial and recreational fisheries would be similar in duration and extent to those under Alternative 1a, except that a smaller geographic area would be affected with the operation of only one access road. **Contribution:** The contribution to cumulative impacts would be similar to that under Alternative 1a, although affecting fewer acres.	extent, particularly compared to Alternative 1a. **Contribution:** The contribution to cumulative impacts would be similar to those under the other alternatives, although affecting a smaller number of acres.
Other Mineral Exploration Projects	**Magnitude:** Mining exploration activities would include additional borehole drilling, road and pad construction, and development of temporary camp facilities. Exploration activities, including additional borehole drilling and temporary camp facilities, would not affect commercial fishing but might affect the quality of experience of recreational fishing,	Similar to Alternative 1a.	Similar to Alternative 1a.	Similar to Alternative 1a.

Table 4.6-2 Contribution to Cumulative Effects on Commercial and Recreational Fisheries

Reasonably Foreseeable Future Actions	Alternative 1a	Alternative 1 and Variants	Alternative 2 and Variants	Alternative 3 and Variant
	depending on the location and the level of associated aircraft noise. **Duration/Extent:** Exploration activities typically occur at a discrete location for one season, although a multi-year program could expand the geographic area affected within a specific mineral prospect (see Section 4.1, Introduction to Environmental Consequences, which identifies seven mineral prospects in the EIS analysis area where exploratory drilling is anticipated [four relatively close to the Pebble Project]). Impacts to commercial and recreational fisheries are expected to be limited in extent and low in magnitude. **Contribution:** This contributes to cumulative effects on commercial and recreational fisheries, although the areal extent of disturbance is a relatively small portion of the Kvichak and Nushagak watersheds.			
Oil and Gas Exploration and Development	**Magnitude:** Onshore oil and gas exploration activities could involve seismic and other forms of geophysical exploration, and exploratory drilling in limited cases. Seismic exploration would involve temporary overland activities, with permit conditions that avoid or minimize surface water disturbance. Should it occur, exploratory drilling would involve the construction of temporary pads and support facilities, with permit conditions to minimize anadromous fish water disturbance and restore drill sites after exploration activities have ceased. Offshore oil and gas exploration and development in Cook Inlet would be unlikely to have any population level effects on fish used for commercial and recreational fisheries. However, construction activities and location of offshore facilities could displace fishing effort on a short- and long-term basis, and affect the quality of marine recreational fishing experience. Barge traffic from the Pebble	Similar to Alternative 1a.	Similar to Alternative 1a.	Similar to Alternative 1a.

Table 4.6-2 Contribution to Cumulative Effects on Commercial and Recreational Fisheries

Reasonably Foreseeable Future Actions	Alternative 1a	Alternative 1 and Variants	Alternative 2 and Variants	Alternative 3 and Variant
	Project and either the Alaska LNG or Alaska Stand Alone Pipeline project would add to the cumulative impacts to commercial fishing on Cook Inlet. **Duration/Extent:** Seismic exploration and exploratory drilling are typically single-season temporary activities. **Contribution:** Onshore oil and gas exploration activities would be required to minimize surface disturbance; they would occur in the analysis area but be distant from the project. The project would have minimal contribution to cumulative effects on commercial and recreational fisheries.			
Road Improvement and Community Development Projects	**Magnitude:** Road improvements projects would take place in the vicinity of communities and potentially have impacts on fish important to commercial and recreational fisheries through grading, filling, drainage disruptions, and potential increased erosion. Communities in the immediate vicinity of project facilities (e.g., Iliamna, Newhalen, Kokhanok, and Pedro Bay) would have the greatest contribution to cumulative effects, and would be affected by any road and port upgrades associated with the Williamsport-Pile Bay Road. 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. The construction of linear features and sedimentation could reduce functional productivity and result in changes to salmon and non-salmon fish populations, thus affecting the value of the commercial fishery and recreational fishing opportunities. Some of these improvements could result in additional access to recreational fisheries. Two potential small-scale hydroelectric projects, at Knutson Creek and Igiugig, could have some limited	Similar to Alternative 1a.	Similar to Alternative 1a.	Similar to Alternative 1a.

Table 4.6-2 Contribution to Cumulative Effects on Commercial and Recreational Fisheries

Reasonably Foreseeable Future Actions	Alternative 1a	Alternative 1 and Variants	Alternative 2 and Variants	Alternative 3 and Variant
	effects on fish. Although the Knutson Creek facility would be situated in that drainage, have limited effects, and be subject to mitigation required by ADF&G, the Igiugig facility would be in the Kvichak River, which provides migration for large numbers of adult spawning salmon and out-migrating smolt. Effects on fish populations are expected to be minimal but would be subject to a fish monitoring program. **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. **Contribution:** Road construction would be required to minimize surface disturbance and would occur in the analysis area, but removed from the project. The project would have minimal contribution to cumulative effects.			
Summary of Project contribution to Cumulative Effects	Overall, the contribution of Alternative 1a to cumulative effects on commercial and recreational fisheries when taking other past actions, present actions, and RFFAs into account, would be minor to moderate in terms of magnitude, duration, and extent, given the limited acreage affected and permit requirements	Similar to Alternative 1a, although slightly more acres 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 than by other alternatives.

Notes:
ADF&G = Alaska Department of Fish and Game
EIS = Environmental Impact Statement
LNG = Liquefied Natural Gas
RFFA = reasonably foreseeable future action