DOCKET NO. CP17-___-000

RESOURCE REPORT NO. 3

FISH, WILDLIFE, AND VEGETATION RESOURCES

PUBLIC

DOCUMENT NUMBER: USAI-PE-SRREG-00-000003-000

RESOURCE REPORT NO. 3 SUMMARY OF FILING INFORMATION[1]	
Filing Requirement	**Found in Section**
1. Classify the fishery type of each surface waterbody that would be crossed, including fisheries of special concern. (18 C.F.R. § 380.12(e)(1))[2] • This includes commercial and sport fisheries as well as coldwater and warm water fishery designations and associated significant habitat.	Section 3.2
2. Describe terrestrial and wetland wildlife and habitats that would be affected by the project. (18 C.F.R. § 380.12(e)(2)) • Describe typical species with commercial, recreational or aesthetic value.	3.4 Resource Report No. 2 for wetlands
3. Describe the major vegetative cover types that would be crossed and provide the acreage of each vegetative cover type that would be affected by construction. (18 C.F.R. § 380.12(e)(3)) • Include unique species or individuals and species of special concern. • Include nearshore habitats of concern.	Section 3.3
4. Describe the effects of construction and operation procedures on the fishery resources and proposed mitigation measures. (18 C.F.R. § 380.12(e)(4)) • Be sure to include offshore effects, as needed.	Section 3.2.7 and 3.2.8
5. Evaluate the potential for short-term, long-term and permanent impact on the wildlife resources and state-listed endangered or threatened species caused by construction and operation of the project and proposed mitigation measures. (18 C.F.R. § 380 .12(e)(4))	Sections 3.4.10, 3.4.11, and 3.5.3
6. Identify all federally listed or proposed endangered or threatened species that potentially occur in the vicinity of the project and discuss the results of the consultations with other agencies. Include survey reports as specified in (18 C.F.R. § 380.12(e)(5)). • See 18 C.F.R. § 380.13(b) for consultation requirements. Any surveys required through 18 C.F.R. § 380.13(b)(5)(I) must have been conducted and the results included in the application.	Section 3.5
7. Identify all federally listed essential fish habitat (EFH) that potentially occurs in the vicinity of the project and the results of abbreviated consultations with the National Marine Fisheries Service (NMFS), and any resulting EFH assessment. (18 C.F.R. § 380.12(e)(6))	3.2.5, Appendix D
8. Describe any significant biological resources that would be affected. Describe impact and any mitigation proposed to avoid or minimize that impact. (18 C.F.R. § 380.12(e)(4&7)) • For offshore species be sure to include effects of sedimentation, changes to substrate, effects of blasting, etc. This information is needed on a mile-by-mile basis and will require completion of geophysical and other surveys before filing.	Sections 3.2, 3.3, 3.4, 3.5

[2] FERC Guidance Manual for Environmental Report Preparation (August, 2002). Available online at http://www.ferc.gov/industries/gas/enviro/erpman.pdf.

RESOURCE REPORT NO. 3

SUMMARY OF FILING INFORMATION[1]

Filing Requirement	Found in Section
Additional Information Often Missing and Resulting in Data Requests	
Provide copies of correspondence from federal and state fish and wildlife agencies along with responses to their recommendations to avoid or limit impact on wildlife, fisheries, and vegetation.	Will file as received
Provide a list of significant wildlife habitats crossed by the project. Specify locations by milepost, and include length and width of crossing at each significant wildlife habitat.	See Appendices A and B and figures in text and other appendices.

Resource Report No. 3 Agency Comments and Requests for Information Concerning Fish, Wildlife, and Vegetation Resources			
Agency	**Date**	**Comment**	**Response/Resource Report Location**
Bureau of Land Management (BLM)	9/26/2016	The proposed pipeline runs through an area where large, severe, stand-replacing, lightning- caused wildfires are the natural fire regime. In general, the strategy is to allow fires to burn as they would naturally in areas away from human settlement and put them out where human settlements exist. Please address the following in a Wildfire Management Section:	Comment acknowledged. Please see responses below to the follow-up Parts 1, 2, 3, and 4 of the comment.
BLM	9/26/2016	1. Effect of the project on Fire Ecology: e.g.. The land clearing of XX acres of land associated with the project will likely obstruct fire spread in areas of Limited and Modified Fire management. The effect is expected to last XX years or remain indefinitely. This is either a cumulative effect with other rights of way or not, depending on the final route.	The effect of Project land clearing on fire suppression along the Mainline right-of-way (ROW) and at associated Project facilities, including the area/acres involved and duration, is addressed in Resource Report No. 3, Sections 3.3.7 Potential Construction Impacts and Mitigation Measures and 3.3.8 Potential Operational Impacts and Mitigation Measures (Subsections 3.3.7.1.2 Clearing and Grading and 3.3.7.2.1.3 Pipeline Aboveground Facilities, 3.3.8.1 Liquefaction Facility, and 3.3.8.2.1.3 Pipeline Aboveground Facilities).
BLM	9/26/2016	2. Effect of the project on Fire Suppression: e.g.. The project design is such that it will or will not require protection from wildfire. Estimated cost is XX this will be paid by XX. Address the pipeline as well as associated infrastructure and man camps for construction phase. Ideally, the project would be designed such that it did not require protection from wildfire, if this is not possible, the need for suppression should be communicated in advance to the land management agencies. In areas of Limited and Modified Fire management, it would be particularly important to address this since the general strategy is to allow wildfire in those areas.	The Mainline is a buried pipeline and would not require protection. Aboveground facilities such as compressor and heater stations and Mainline block valves (MLBVs) may need some protection. Text to this point has been added to Resource Report No. 3, Section 3.3.1, for both construction and operation. For construction, it would also be added to Section 3 of the Project Fire Prevention and Suppression Plan (Resource Report No. 8, Appendix G). Fire suppression/protection designs, safety measures, and prevention measures are provided in Resource Report Nos. 1, 3, 8 (Appendix G), 11, and 13.
BLM	9/26/2016	3. Effect of the project on Fire Suppression: e.g.. Firebreaks created by the clearing of XX acres of land will assist with fire suppression in areas of Critical or Full Suppression. The effect is expected to last XX years or remain indefinitely.	The effect of Project land clearing on fire suppression along the Mainline ROW and at associated Project facilities, including the 5area/acres involved and d6uration, is addressed in Resource Report No. 3, Sections 3.3.7 Potential Construction Impacts and Mitigation Measures and 3.3.8 Potential Operational Impacts and Mitigation Measures (Subsections 3.3.7.1.2 Clearing and Grading 3.3.8.2.1.1 and

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			3.3.7.2.1.3 Pipeline Aboveground Facilities, 3.3.8.1 Liquefaction Facility, and 3.3.8.2.1.3 Pipeline Aboveground Facilities
BLM	9/26/2016	4. Effect of and potential for human caused Fires: eg. Those responsible for human caused fires will be held liable for associated costs, including but not limited to, suppression costs and resource damage costs. List any potential design features such as fire suppression tools, spark arrestors on small engines, etc.	Comment acknowledged. Discussion of human-caused fires and liabilities for associated costs will be added to Resource Report No. 3, Sections 3.3.7 and 3.3.8. In Resource Report No. 8, Appendix G Fire Prevention and Suppression Plan, additional Project fire safety and prevention design features and fire suppression tools are discussed in the Fire Prevention and Suppression Plan and in Resource Report Nos. 1, 3, 8, 11 and 13.
BLM	9/26/2016	5. TAPs has a bit of a summary on Wildfire Management in the renewal FEIS. Basically they describe the Fire management plan, the roles of jurisdictional and protection agencies and state that the pump stations would need more protection than the rest of the pipeline. In practice, they seem to be more concerned about something falling and hitting the pipeline (either as a result of structural damage from burning or suppression operations) than heat from the actual fire: http://tapseis.anl.gov/documents/index.cfm Probably worth taking a look at their approach.	Comment acknowledged.
BLM	9/26/2016	Some helpful resources: Alaska Interagency Fire Management Plan: http://fire.ak.blm.gov/content/admin/agencyadministratorguide/Appendices/Appendix%20B%20-%20Alaska%20Fire%20Management%20Plans/01.%20AIWFMP/2016%20AIWFMP.pdf	Comment acknowledged.
BLM	9/26/2016	Fire management options map: http://fire.ak.blm.gov/predsvcs/maps.php	Comment acknowledged.
BLM	9/26/2016	1. Several places make mention that "there will be efforts made, where practicable, to salvage timber," or similar statements. There is also discussion of the use of timber for riprap, of mulching timber, or disposal of timber by unspecified means. Per 43 CFR 2885.13, the United States retains "ownership of the resources of the land covered by the grant [of right of way] or TUP, including timber and vegetation or mineral materials and any other living or non-living resource. You have no right to use these resources, except as noted in §2885.12 of this subpart." Thus, timber cleared from BLM-managed lands for this project must be purchased and harvested. "Efforts made, where practicable, to salvage timber" will not be acceptable, and no project use or disposal of timber can occur prior to purchasing the timber. BLM normally sells timber	See revised text in Section 3.3.7.2.1 Pipeline (subsection Timber Harvesting) and Section 3.3.7.2.1.4 Pipeline Associated Infrastructure.

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		on a cruise basis, though log scale or weight are options if they make more sense in particular circumstances. Timber cruises will need to be scheduled ahead of clearing, which will affect the project schedule and cost. This was not mentioned in the resource reports.	
BLM	9/26/2016	1. I found no mention of forest health prevention measures to be taken during clearing. Usual practices required by BLM include: a. Tops shall be lopped and brush shall be scattered flat and away from standing trees to avoid creation of fuel ladders; b. No trees shall be left lodged into other trees; c. To the extent practicable and concerns for safety, permittee shall remove the entire bole of any trees cut, from a 6" stump to a 4" top; d. Harvested timber must be removed from Public lands. Storage or disposal of harvested timber on Public land must be permitted separately; e. Any green tree bole 6" DBH or larger that cannot be removed from Public lands within 12 months of felling must be limbed and scored at least one inch deep for the entire length of the bole to facilitate drying.	See text in Resource Report No. 3, Section 3.3.7.2.1.1 Mainline – Clearing and Grading and Timber Harvest that has been revised to reflect such practices.
BLM	9/26/2016	When the requirement for ultra-low sulfur diesel came into effect there was a decision made not to put a desulfuring plant on the north slope. As a result, truck traffic hauling diesel up the Dalton Highway increased considerably, and truck rollovers with fuel spills went from one every couple of years to 7 or 8 in one year. Given the amount of diesel required for this project, the applicant may want to consider including a desulfuring plant on the north slope. If not, then the EIS needs to include a thorough analysis of the risks of fuel spills, associated costs, and potential mitigations associated with the expected increase in trucking of fuel on the Parks and Dalton Highways.	The Applicant would use existing commercial sources to supply ultra-low sulfur diesel (ULSD) for construction and operations. The transportation systems are describe in Resource Report No. 5 (Sections 5.3.5.2, 5.4.2.7, and 5.4.3.6) and the use of ULSD is outlined in Resource Report No. 5 Section 5.4.2.6.6.3. Spill prevention and response measures are provided in Resource Report No. 2 Appendix N (Spill Prevention, Control and Countermeasure Plan).
BLM	9/26/2016	Subsistence impacts need to consider more than fish and wildlife. Large crews of workers in an area could inadvertently wipe out a berry crop or displace wildlife without realizing the impact to subsistence users. Subsistence use of firewood and timber is a hot issue in the Dalton Corridor (could be both positive and negative impacts from this project in that respect). Trap lines that parallel the highway could be entirely wiped out without even realizing they're there. The Right of Way could provide new/different access pathways to subsistence resources. The section 810 analysis for this will have some complexities that other projects may not.	Comment acknowledged. More than 80 percent of the ROW is located on state and federal land. The Applicant anticipates that, in addition to the BLM 810 consultation, any authorized use of these lands, such as a mining claim etc., would be identified through the ROW leasing process. For federal land north of the Yukon River, access is limited due to off-road vehicle limitations. The land use permitting process would identify issues such as those in the comment and develop measures to mitigate potential impacts if necessary.
BLM	9/26/2016	During our meeting, FERC asked about references for revegetation and reclamation in northern	Comment acknowledged.

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		environments. Here are some to consider: http://yukonrevegetationmanual.ca/ ; http://emrlibrary.gov.yk.ca/placer_secretariat/fish_habitat_design_operation_and_reclamation_workbook.pdf ; http://dnr.alaska.gov/ag/RevegManual.pdf	
BLM	9/26/2016	The proposed pipeline is of a scale and duration that is likely to have significant short and long- term impacts on the ecology of this area. Many of these impacts are well described in the reports. Below are some general comments, some but not all, of which are acknowledged to some degree in the reports.	See responses below to subparts of this comment.
BLM	9/26/2016	1. Collocation of development and applying lessons learned: We strongly encourage that the proposed action is conducted such that, to the full extent feasible, activities and development are co-located with previously extant development and minimize creation of new footprints on the landscape. Furthermore, many of the issues associated with the proposed natural gas pipeline echo those previously and/or currently encountered by the oil pipeline (TAPS). This natural comparison came up multiple times in our meeting last week. It is strongly recommended that lessons learned by the TAPS building and maintenance are applied to the new project.	Use of previously disturbed land is preferable for the Project, and several such locations have been identified for use. Collocation is discussed in Section 1.3.2.1 and Table 1.3.2-2 of Resource Report No. 1. The Applicant has hired past Alyeska Pipeline Service Company employees to provide lessons learned from the Trans-Alaska Pipeline Service (TAPS) construction and operation. Please recognize that the TAPS pipeline, approximately 50 percent buried and 50 percent above ground, is a hot oil pipeline and will interact with the environment differently than the gas pipeline would, because the gas pipeline would transport gas that has been chilled.
BLM	9/26/2016	1. Permafrost, water table and adjacent vegetation communities and wildlife habitat: Long- term observations of vegetation communities adjacent to developed areas suggest that the proposed activity will have significant localized impacts on the vegetation community and wildlife habitat within 100 meters of areas where a gravel pad is part of the proposed development. For example, along the Dalton Highway, there are long stretches in permafrost-rich areas where it is abundantly obvious that the late successional black spruce forest is being at least partially replaced by early successional poplar trees. To our knowledge environmental factors that contribute to this evident impact have not been investigated but further study is warranted. There are implications for localized wildlife habitat in impacted areas. It is likely that the obvious changes to adjacent stands around gravel pads will attract different wildlife species assemblages. For example early successional stands may be more attractive to moose who select for young deciduous trees such as poplar for browse; higher moose density will be accompanied by higher predator density. a. Suggested	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process

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		mitigation: the above impacts to wildlife habitat in permafrost represent just one reason why it is important to minimize the impacts on permafrost. It is strongly recommended that construction/engineering techniques which minimize the impacts to permafrost are utilized. The proposed activity includes what sounds like a pretty shallow gravel pad over the extent of the project. Can engineering techniques that be used in conjunction with gravel pads (foam?) that would: i. Minimize impacts to permafrost and water table changes and therefore wildlife habitat; ii. Minimize the need for long-term gravel dependent resource extraction from the area for maintenance of the gravel as shifts in the underlying permafrost and water table lead to disintegration of the gravel pad (e.g. potholes).	
BLM	9/26/2016	1. Water extraction/waterbody creation and Wildlife Habitat: It is important that all possible measures to prevent negative impacts to migratory birds are taken. This topic is addressed in the FERC reports but there are several other factors of concern related to a project on this scale that have historically been ignored but should be addressed, especially for a project of this scale.	Comment acknowledged.
BLM	9/26/2016	Water extraction and Water-level impacted bird habitat: Nesting waterfowl and sandpipers and other species seasonally occupy lakes and ponds of various sizes as well as wetlands throughout the area proposed for development. Nest success is linked to water levels. The proposed project includes the extraction of water from waterbodies convenient to the project activities (e.g. potable water for crews, water extraction for dust mitigation). Water extraction should not occur during the nesting season. The FERC reports mentions the creation of wells for support of project related water needs. This would be a potentially less impactful approach to meeting the water needs associated with this project.	The Applicant would utilize surface-water and groundwater resources under Alaska Department of Natural Resources (ADNR) water use permits and would follow the stipulations of those permits. The stipulations of the permit guide whether water can be taken from a surface waterbody and how much water may be extracted to minimize impacts to fish and wildlife and to allow recharge to occur. Acute, and often temporary, surface and groundwater use will sometimes occur during the nesting season, as is standard practice for industry construction and operation.
BLM	9/26/2016	Pond/Lake Creation and Wildlife Habitat: It is inevitable that, regardless of the mitigation measures employed for the proposed action, the land-clearing activities associated with this project will lead to the creation of new lakes and ponds of variable sizes adjacent to the disturbed areas as well as some loss of suitable habitat for wildlife. To offset some of the habitat loss, the permittee should consider a measured approach to waterbody creation. Not all waterbodies adjacent to or resulting from ground disturbing development are utilized by wildlife; some studies of the requisite characteristics of wildlife suitable waterbodies are currently underway. The permittee should investigate what physical parameters are most	The Applicant will address this comment prior to issuance of the Draft Environmental Impact Statement (DEIS).

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		conducive to wildlife inhabitance (e.g. depth, substrate, slope) should occur prior to project start and ensure that new waterbodies meet those criteria. It would be good to see plans for this in the project reports.	
BLM	9/26/2016	Fine gravel storage: It will be required that substrate suitable for bank swallow colonization (fine materials) are stored at less than vertical slopes to prevent bank swallow colonization.	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process
BLM	9/26/2016	Appendix J. Wildlife Avoidance- it is good that there is an outline provided here for this Appendix to be completed. Please share it with the BLM for review as soon as possible. We have established guidelines for minimizing these impacts and may have some additional guidance for this project.	Comment acknowledged. The plan is provided for review and commenting and the Applicant is willing to discuss fleshing this plan out for completion. Wildlife avoidance measures would also be discussed in the ROW stipulations negotiated for state and federal lands.
BLM	9/26/2016	3.2.7 Potential Construction Impacts and Mitigation Measures. 7. The lack of a Project Restoration Plan (Appendix P) minimizes an assessment of whether potential effects will, or can be mitigated. When complete, the BLM will need to assess the Project Restoration Plan for compatibility with the management plan for the Utility Corridor Resource Management Plan (UC RMP).	A Draft Project Restoration Plan is provided for review as Appendix P to Resource Report 3 as part of the FERC application. The Draft Restoration Plan summarizes the goals and objectives of the Project restoration effort for the Mainline pipeline trench and associated right-of-way and the various site preparation and plant cultivation techniques that may be employed to achieve the goals and objectives. This Plan is intended to provide Alaska-specific restoration practices to address impacts from pipeline construction.
BLM	9/26/2016	Table 3.2.7-2 and 6.0 Summary of Mitigation Table 17. 9. The terms “to the extent practicable” and “as soon as practical” are used in the tables to describe mitigation. These terms-practices should be replaced with specific time lines or limits of disturbance.	The Applicant would work with the landowners and other state and federal on site-specific application of the mitigation measures. The Applicant has identified potential construction impacts and proposed mitigation measures for fish (Table 3.2.7-2). The proposed mitigation measures will be described in more detail during the permitting process.
BLM	9/26/2016	Methods that address bank stabilization should be addressed in the Waterbody Crossing portions of these tables.	Appendix N of Resource Report No. 2 contains the Project's Wetland and Waterbody Crossing Procedures.
U.S. Environmental Protection Agency (EPA)	9/26/2016	We also recommend that the Reports include the characterization of the marine benthic environment and mapping of the seafloor geomorphology in Cook Inlet and Prudhoe Bay, including the distribution of submerged aquatic vegetation, such as eelgrass.	Geophysical surveys have been conducted along the route and in marine construction areas in Cook Inlet (Fugro Consultants, Inc. 2014 and 2015) and in Prudhoe Bay (Coastal Frontiers 2016) and the reader is referred to those reports

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			for detailed descriptions and mapping. The findings of these reports are briefly discussed in Section 4.0 of the Essential Fish Habitat (EFH) Assessment Report (Resource Report No. 3, Appendix D). New information on the benthic invertebrates has been added to Resource Report No. 3, Section 3.4.8, and on submerged aquatic vegetation in Resource Report No. 3, Section 3.3.6.
EPA	9/30/2016	Table 3.2.7-1. We recommend that the Reports include the Dredge Material Testing and Sampling Plan, and Dredging Material Management Plan. We recommend the Reports include a Pile Driving Plan and Hydrostatic Testing Plan to avoid/minimize impacts to marine fisheries and EFH.	No dredge testing and sampling would be required for West Dock because no dredging is planned. The Applicant would provide a Dredge Sampling and Analysis Plan for proposed dredging in Cook Inlet to the agencies during required permitting activities. Pile driving will be addressed in the required permits.
EPA	9/30/2016	Dredging/Dredge Disposal Impacts to Marine Fisheries and EFH (Cook Inlet) – We recommend that the Reports include an evaluation of the potential impacts of summer dredging and disposal of the dredged material to marine fisheries and EFH. Impacts from maintenance dredging operations and disposal should also be evaluated for creating potential barriers to fish passage and migration, and impacts to submerged aquatic vegetation, such as eelgrass. We recommend that the noise impacts associated with summer dredging activities to marine fisheries be evaluated in the Reports.	The potential effects (including noise) of proposed dredging and dredge spoil disposal in Cook Inlet are addressed in Resource Report No. 3, Section 3.2.7.1.2, and in Section 5.2.1 of the EFH Assessment (Resource Report No. 3, Appendix D). Underwater sound energy generated by dredging and potential effects on marine fish and EFH are discussed in greater detail in Section 5.2.1.6 (Noise) of the EFH Assessment (Resource Report No. 3, Appendix D). Effects on marine/submerged vegetation are addressed in Resource Report No. 3, Section 3.3.7.1.1; some text has been added to Resource Report No. 3, Section 3.2.7.1.2.1 as well as in the EFH Assessment.
EPA	9/30/2016	We recommend that the Reports include a commitment to develop and implement a Pile Driving Plan to protect marine fisheries and EFH.	Pile driving will be addressed in the appropriate permit applications.
EPA	9/30/2016	Dock Construction, Dredging/Disposal – Turbidity Impacts (Prudhoe Bay) – We recommend that the Reports evaluate impacts to marine fish and EFH resulting from the construction at West Dock, DH 4, and maintenance dredging and dredge material disposal contributing to turbidity in Prudhoe Bay. We recommend that turbidity plume and water column testing/modelling should be conducted to evaluate the magnitude and distribution of turbidity plumes associated with DH4 construction, and different dredging and disposal methods.	Dredging is no longer proposed for construction of Dock Head 4 (DH 4) at West Dock in Prudhoe Bay. See Resource Report No. 3, Section 3.2.7.3.2.2 of Resource Report No. 3 and Section 5.2.1 of the EFH Assessment (Resource Report No. 3, Appendix D) for discussion of dock construction impacts.

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EPA	9/30/2016	Dredging/Dredge Disposal Impacts to Marine Fisheries and EFH (Prudhoe Bay) – We recommend that the Reports evaluate the potential impacts of winter dredging and transportation of dredged material by trucks to the nearshore disposal site for the navigational channel and turning basin at the proposed DH4, West Dock, in Prudhoe Bay to marine fisheries and EFH. We recommend that impacts from summer maintenance dredging operations be evaluated for creating potential barriers to fish passage and migration. We recommend the noise impacts associated with winter and summer dredging and disposal activities to marine fisheries and EFH also be evaluated in the Reports.	Dredging, dredge disposal, and screeding are no longer proposed for the construction and maintenance of the berthing basin or navigational channel or other work at DH4 at West Dock; see Section 1.4.2.4.2.3 in Resource Report No. 1 and revised text at Section 3.2.7.3.2.2 in Resource Report No. 3.
EPA	9/30/2016	Dredging/Dredge Disposal Impacts to Marine Fisheries and EFH (Cook Inlet) – We recommend that the Reports evaluate the potential impacts of dredging and disposal of dredged material in Cook Inlet at the MOF for the LNG Facility and the MOF at Beluga to marine fisheries and EFH. We recommend that the noise impacts associated with winter and summer dredging and disposal activities to marine fisheries and EFH be evaluated in the Reports. We recommend that turbidity plume and water column testing/modelling be conducted to evaluate the magnitude and distribution of turbidity plumes associated with dredging, and different dredging and disposal methods. We recommend that turbidity testing/modelling also be conducted for the placement of the subsea mainline pipeline in Cook Inlet	The potential effects (including noise) of proposed dredging and dredge spoil disposal in Cook Inlet are addressed in Resource Report No. 3, Section 3.2.7.1.2, and in Section 5.2.1 of the EFH Assessment (Resource Report No. 3, Appendix D). Underwater sound energy generated by dredging and potential effects on marine fish and EFH are discussed in greater detail in Section 5.2.1.6 (Noise) of the EFH Assessment (Resource Report No. 3, Appendix D). Effects on marine/submerged vegetation are addressed in Resource Report No. 3, Section 3.3.7.1.1; some text has been added to Resource Report No. 3, Section 3.2.7.1.2.1 as well as in the EFH Assessment.
EPA	9/30/2016	Dredging/Dredge Disposal Impacts to Marine Fisheries and EFH (Cook Inlet) – We recommend that the Reports evaluate the potential impacts of dredging and disposal of dredged material in Cook Inlet at the MOF for the LNG Facility and the MOF at Beluga to marine fisheries and EFH. We recommend that the noise impacts associated with winter and summer dredging and disposal activities to marine fisheries and EFH be evaluated in the Reports. We recommend that turbidity plume and water column testing/modelling be conducted to evaluate the magnitude and distribution of turbidity plumes associated with dredging, and different dredging and disposal methods. We recommend that turbidity testing/modelling also be conducted for the placement of the subsea mainline pipeline in Cook Inlet	The potential effects (including noise) of proposed dredging and dredge spoil disposal in Cook Inlet are addressed in Resource Report No. 3, Section 3.2.7.1.2, and in Section 5.2.1 of the EFH Assessment (Resource Report No. 3, Appendix D). Underwater sound energy generated by dredging and potential effects on marine fish and EFH are discussed in greater detail in Section 5.2.1.6 (Noise) of the EFH Assessment (Resource Report No. 3, Appendix D). Effects on marine/submerged vegetation are addressed in Resource Report No. 3, Section 3.3.7.1.1; some text has been added to Resource Report No. 3, Section 3.2.7.1.2.1 as well as in the EFH Assessment.

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EPA	9/30/2016	Marine Vegetation Resources – We recommend the Reports include a survey of marine vegetation, include eelgrass and other submerged aquatic vegetation which provide habitat of fish, shellfish, and other marine organisms, particularly for Cook Inlet and Prudhoe Bay. Eelgrass is defined as a "special aquatic site" under the Clean Water Act Section 404 regulations. We recommend that the location, area, abundance and species of aquatic vegetation be identified on bathymetric maps in the Reports.	See revised text in Section 3.3.6.
EPA	9/30/2016	Construction Impacts on Vegetation – We recommend that the Reports include a Revegetation Plan that includes general best management practices and mitigation measures that address restoration and revegetation of land disturbance areas during construction or decommissioning of facilities. We recommend that the Plan describes measures to sort, separate, and stockpile topsoil and overburden material from other materials to use in revegetation efforts.	A Draft Restoration Plan is provided for review as Appendix P to Resource Report 3 as part of the FERC application. The Draft Restoration Plan summarizes the goals and objectives of the Project restoration effort for the Mainline pipeline trench and associated right-of-way and the various site preparation and plant cultivation techniques that may be employed to achieve the goals and objectives. No other impacts requiring restoration are anticipated for the Project; however, if they occur, a site-specific restoration plan would be developed. Restoration efforts will be focused on site stabilization, which includes a productive vegetation cover to minimize subsidence. Revegetation methods will depend on the conditions and goals defined in collaboration with agencies and landowners. Please see Appendix M of Resource Report No. 1 for more discussion on surface organics handling.
EPA	9/30/2016	The MOF area would be dredged to -35 feet MLLW. Dredge materials would be discharged in deep water within 5 miles of the Liquefaction Facility. We recommend that the Reports include a map depicting the location of the deep water disposal site(s). We recommend that the Reports identify the depth of the dredged material disposal site and the area (acres) of the disposal site.	See revised text in Section 3.4.10.1.3 of Resource Report No. 3.
EPA	9/30/2016	Dredging/Dredge Disposal Impact to Terrestrial and Marine Mammals, T&E species (Prudhoe Bay and Cook Inlet) – We recommend that the Reports evaluate the potential impacts of winter dredging and transportation of dredged material by trucks to the nearshore disposal site for the navigational channel and turning basin at the proposed DH4, West Dock, in Prudhoe Bay to Polar Bears and	Dredging is no longer proposed for construction of DH 4 at West Dock in Prudhoe Bay. The effects of dredging and dredging sound on marine mammals are discussed in Section 3.4.10.1.2.1 of Resource Report No. 3 and Section 6.5 of the Marine Mammal Protection Act

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		seals, which use the snow pack for denning and rearing pups, and for hunting. We recommend that the Reports evaluate summer maintenance dredging operations for impacts to bowhead whales and other marine mammals migrating through the area. We recommend that the noise impacts associated with winter and summer dredging activities to terrestrial and marine mammals be evaluated in the Reports. In Cook Inlet, we recommend that the Reports evaluate the impacts from summer dredging and disposal of dredged material to beluga whales and other marine mammals migrating through the area. We recommend that the noise impacts associated with dredging activities to terrestrial and marine mammals be evaluated in the Reports.	(MMPA) Assessment (Appendix F) and in the Biological Assessment (Appendix C).
National Park Service (NPS)	9/26/2016	In response to requested fisheries expertise relative to the Alaska Pipeline Project (APP) I reviewed the following documents: Draft Resource Report No. 3 Fish, Wildlife, and Vegetation (for AKLNG), and Appendix L. Fisheries Survey Reports. I also reviewed numerous maps seeking illustration of where a potential Denali route might traverse the Park both on the Army Corps ASAP website as well as that provided by AKRO Planning team. Fish survey protocols developed by both USGS (Fitzpatrick et al. 1998) and USEPA 2013 were also reviewed. The surveys described in AK LNG Chapter 3 and Appendix L do not adequately characterize the fish assemblages that could potentially be present based on the information presented. It would be insufficient if applicants collected similar data and used similar methodologies for determining freshwater fish assemblages at stream crossings for a Denali National Park ROW. Specifically, Section 2.8 Appendix L, indicates that the fish survey reach for each wadable survey site was the width of the project corridor, which in most cases was 300'; minimum stream reach lengths for electrofishing were determined by multiplying the stream width by 20; authors cite Fitzpatrick et al. 1998 (http://pubs.usgs.gov/wri/wri984052/pdf/wri98-4052.pdf) and state that "Electrofishing stream reaches of 20 widths or greater provides a sufficient level of detection to accurately document fish assemblages." But this is a misstatement and the citation should have been more carefully reviewed and followed since it indicates that survey reaches of just 20 widths are sufficient to characterize habitat but not biota. "In general, the reach length is determined by multiplying the mean wetted channel width (MCW) by 20. The width is multiplied by 20 because, in meandering streams, 20 times the channel width typically encompasses at least one complete meander wavelength (Leopold and others, 1964). This ensures that all	Comment acknowledged; however, the reports in Appendix L are historical reports that should not be changed.

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		habitat types are represented within the reach. A minimum reach length is necessary to ensure the collection of representative samples of biological communities, and a maximum reach length is needed to prevent unnecessary sampling and to minimize crew fatigue (and associated reduction of sampling efficiency). Therefore, minimum and maximum reach lengths for wadable streams are the same as for biota sampling, 150 and 300 m, respectively." (pg. 21; Fitzpatrick et al. 1998) Additional wadable stream survey protocols developed by EPA (2013a) and used nationwide recommend a minimum aquatic habitat survey reach length of 40 times the wetted stream width or 150 m, whichever is greater (see pg. 25 of https://www.epa.gov/sites/production/files/2016-04/documents/nrsa1314_fom_wadeable_version1_20130501.pdf). NPS would request robust characterization of fish habitat and fish assemblages in wadable and non- wadable running waters for which such data are lacking and that will be crossed by the selected Denali route within the Park. Surveys should follow statistically valid, robust survey methods such as those outlined by either Fitzpatrick et al. (1998) or USEPA (2013a, 2013b), however, the USEPA protocols are more robust when characterizing fish assemblages.	
NPS		This project has the potential (would likely) result in the permanent conversion of areas 'natural' undisturbed vegetation and soils into disturbed, unnatural areas that are similar to roadsides and other areas within the footprint of human disturbance. This conversion would levy several long term costs upon the NPS including the need to monitor and control exotic species that would almost inevitably become established in this disturbance. Because the pipeline would be a very long, linear feature that intersects with roadsides, building pads and other areas containing long-established populations of non- native species it will almost certainly represent a long term increase in the area infested by nonnative plants in the Park, and require us to expand our operations in the area already most affected by this management issue in Denali. The owners of the pipeline would need to address how they will mitigate the impacts.	Comment acknowledged, the Denali route alternative is not the preferred alternative.
NPS		Should the NPS receive an application for a gasline through Denali National Park, the NPS has concerns about three primary (inter-related) issues:1) accurately defining and describing the scope and scale of revegetation necessitated by this massive disturbance event; 2) how to best deal with and reduce the near-certainty that the footprint of exotic species would increase dramatically in the Park as a result of this; and 3) what are the possible magnitude and type of consequences and possible mitigation strategies for park ecosystems in the	The DNP&P Alternative is currently not the preferred route. The speculative study will be further defined if and when the Alternative Route through DNP&P becomes the preferred route.

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		event of a future spill. Actions taken to deal with any spill would, in themselves, incur further damage to the natural landscape mosaic of the Park. There are thus a variety of very important issues that an analysis of this project should directly address in order to be complete: 1) Specific estimates should be generated from a GIS of the area (ft2) in various categories of natural vegetation (forest, scrub, tundra) and terrain (slope, aspect, elevation, surface soil) in order to understand the scope, scale and types of revegetation of park land that will be required if this project is completed. This would be an unprecedented scale for revegetation efforts in Denali (by orders of magnitude). 2) What is the plan for logistics for saving and storing of “tundra mats” of intact vegetation to assist in the revegetation of the completed pipeline disturbance upon completion? Will there be staging areas and storage sites in the plans to facilitate utilization of these materials for revegetation. 3) The analysis should identify and quantify the availability of seed sources of the species that are valuable for revegetation of the large amount of disturbed area. It seems possible, if not likely, that there is not sufficient availability of native seeds sources for high-value species for revegetation available in the local area to meet to potential needs created by this massive disturbance (7 miles x 20’ ?). If this is the case, what are the alternatives for revegetation? 4) What is the volume of soil fill that will be required to accomplish this project and where will this material come from? It needs to come from certified wed-free sites in order to reduce the high- probability that non-native species are seeded along the pipeline right-of-way. 5) Analyses of extant weed populations in proximity to the envisioned right-of-way would be required to better outline the risks for where exotic species might invade the pipeline right of way, because once they do become established in this ROW, the likelihood that they will spread in the disturbed ground is quite high. 6) Explicit mention should be made of areas need to park and stage large excavators and other equipment needed for the project, and how provisions for certifying this equipment as weed-free would be implemented.	
NPS		An analysis for impacts to vegetation in Denali National Park should explicitly use what empirical data may be available from the history of studies of the trans-Alaska pipeline to address the potential scope and scale of the exotic species issue as it relates to disturbing 7 mile linear scar feature on the park landscape. According to one report, “[o]observations and photographs at 60 sites located along the trans- Alaska pipeline indicated … frequent problems, such as erosion, slope instability, poor scheduling of seed application,	The preferred route does not traverse the Denali National Park and Preserve (DNPP) and this detailed analysis is not required at this time.

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		occurrence of weed species, failure to optimally reuse topsoil and fine-grained soil, and low- rates of native species reinvasion." (Revegetation & Selected Terrain Disturbances Along The Trans-Alaska Pipeline, 1975-1978; CRREL report, 81- 12; Hanover, New Hampshire: Cold Regions Research and Engineering Laboratory, 1981; vii, 115p.: ill., figures, photos., tables; 28cm.). Should a gasline in Denali be proposed, the applicant should undertake a comprehensive evaluation of the possible and likely expansion of various NPS monitoring and other activities that would be made necessary by the completion of a large disturbance scar and open right-of-way on Park land. For example, the staffing and funding for exotic and revegetation program would certainly need to be increased, likely in perpetuity. The cumulative effects of this should be explicitly estimated by the NPS for this project.	
NPS		In the table of potential impacts and mitigation to species of concern, potential impacts for most birds should include collision and contaminants	See revised Tables 3.5.3-1 and 3.5.3-2 in Resource Report No. 3.
NPS		The vegetation clearing window for Denali National Park is 1 May - 31 July - longer than USFWS recommendations for Interior AK.	See revised footnotes in Table 9 of the draft Avian Protection Plan (Appendix of Resource Report No. 3).
NPS		The analysis in the EIS should include facilities/window collisions and contaminants/spills and their impacts on birds.	Potential impacts to birds from collisions are discussed in Section 3.4.10 Potential Construction Impacts and Mitigation Measures; see Sections 3.4.10 and 3.4.11 of Resource Report No. 3 for revised text on potential impacts due to contaminants/spills.
NPS		The applicant would need consult with NPS wildlife biologists prior to conducting any surveys of eagle nests within Denali NP.	The DNP&P Alternative is currently not the preferred route. The speculative study will be further defined if and when the Alternative Route through DNP&P becomes the preferred route.
NPS		The applicant would need to consult with NPS wildlife biologists prior to completion for NPS survey date on moose, caribou, sheep, and wolves.	The DNP&P Alternative is currently not the preferred route. The speculative study will be further defined if and when the Alternative Route through DNP&P becomes the preferred route.
NPS		Currently only outlined. NPS requests that NPS wildlife biologists be consulted as experts when completing this section.	The DNP&P Alternative is currently not the preferred route. The speculative study will be further defined if and when the Alternative Route through DNP&P becomes the preferred route.
Alaska Department of Natural Resources (ADNR)/ Division of Agriculture/ Plant	9/25/2016	General comment for this resource report. The PMC has a website, plants.alaska.gov that could be a helpful resource for the Draft Restoration Plan. A guidebook titled 'Streambank Revegetation and	The Applicant will address State of Alaska comments during required permitting activities.

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Materials Center (PMC)		Protection: A Guide for Alaska' is a great resource for restoration techniques of streams after construction.	
ADNR/AG/ PMC	9/25/2016	Waiting for Draft Restoration Plan to be included in FERC Application.	The Applicant will address State of Alaska comments during required permitting activities.
ADNR/ Division of Mining, Land & Water (DMLW)/ Northern Region Office (NRO)	9/25/2016	What is the expected timeline to have the areas revegetated that were disturbed for temporary activities such as access road construction	The Applicant will address State of Alaska comments during required permitting activities.
ADNR/DMLW/NRO	9/25/2016	"Granular fill placed during construction would not be removed, but would be revegetated for associated infrastructure that is not retained during operations." Will this be done with sod, or will top soil be brought in and seeded?	The Applicant will address State of Alaska comments during required permitting activities.
Alaska Department of Fish and Game (ADF&G)	9/25/2016	Tables 3.2-1 and 3.21-1 To eliminate excessive redundancy in species lists (given that Alaska hosts many electively anadromous species), we suggest grouping into a single species-presence table and simply indicate the life history associated with each species in the table (Res, Anad, Res/Anad).	The Applicant will address State of Alaska comments during required permitting activities.
ADF&G	9/25/2016	Table 3.2-1 If species lists cannot be merged into a single table, Table 3.2-1 is missing several species that can assume a resident life history (least cisco, Bering cisco, and Inconnu)	The Applicant will address State of Alaska comments during required permitting activities.
ADF&G	9/25/2016	Table 3.2-1 Alaska Brook Lamprey is also found in the Interior region (Yukon drainage).	The Applicant will address State of Alaska comments during required permitting activities.
ADF&G	9/25/2016	Table 3.2-1 Wild Arctic char are also found in Big Lake (Mat-Su) and several surrounding lakes.	The Applicant will address State of Alaska comments during required permitting activities.
ADF&G	9/25/2016	Table 3.2-1 Suggest rewording lake chub description to include "Locally abundant throughout the Yukon River drainage upstream from Nulato. Common in low gradient off channel habitats of larger rivers".	The Applicant will address State of Alaska comments during required permitting activities.
ADF&G	9/25/2016	Table 3.2-1 Pygmy whitefish are also sporadically present in Southcentral Alaska	The Applicant will address State of Alaska comments during required permitting activities.
ADF&G	9/25/2016	Table 3.2-2 Broad whitefish, humpback whitefish, and Inconnu are all optionally anadromous and should be designated as such with a superscript a.	The Applicant will address State of Alaska comments during required permitting activities.
ADF&G	9/25/2016	Table 3.2-2 The inclusion of longfin smelt is probably not warranted. Limited data suggesting its presence in the study area are available. Also, where it exists, it is generally anadromous.	The Applicant will address State of Alaska comments during required permitting activities.
ADF&G	9/25/2016	Table 3.2-2 Alaska blackfish is repeated, though with different column values. Delete the second Alaska blackfish row and put an "X" in the West Cook Inlet column in row 1.	The Applicant will address State of Alaska comments during required permitting activities.
ADF&G	9/25/2016	Table 3.2-2 There should be a footnote in this table describing what "S" and "I" represent. This was done in Table 3.2.2-1 but was not included here.	The Applicant will address State of Alaska comments during required permitting activities.

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ADF&G	9/25/2016	Paragraph 1 discusses the spatial representation of the Anadromous Waters Catalog (AWC) (atlas). It should be noted that the AWC atlas generally represents AWC streams as a single line tied to the National Hydrography Dataset (NHD) arc (often even in complex river channels). Because of this, adjacent side channels and off-channel habitats are often not spatially represented in the AWC. It should generally be considered that these habitats, when closely connected by surface flow to mainstem anadromous habitats, also support anadromous fish. Currently ADF&G, in collaboration with other organizations, is pursuing methods for more closely marrying the AWC and the NHD to improve the spatial reliability and consistency of both data sets. This effort may result in more accurate AWC coverage in these complex systems.	The Applicant will address State of Alaska comments during required permitting activities.
ADF&G	9/25/2016	Table 3.2.1-1 Bering cisco, Inconnu, and least cisco should all have superscript a to indicate that they are optionally anadromous and that resident populations are also expected to exist in the study area.	The Applicant will address State of Alaska comments during required permitting activities.
ADF&G	9/25/2016	Paragraph 1: Pink salmon and rainbow smelt are also known to occur in the North Slope region and would be included in the group of species that do not represent large spawning stocks. Paragraph 3: Dolly Varden and rainbow smelt also occur in the Putuligayuk River. Pink and chum salmon also occur in the Sagavanirktok River. Paragraph 5: The sensitive period for overwintering fish in the Atigun River valley (and elsewhere on the North Slope) should be October through mid May, rather than November and December.	The Applicant will address State of Alaska comments during required permitting activities.
ADF&G	9/25/2016	Paragraph 1: Several species of whitefish as well as Arctic lamprey are also very valuable species to indigenous peoples. Paragraph 2: Anadromous Inconnu also occur in the Middle Fork Koyukuk River. Paragraph 4: While rearing fish are abundant from May through October, overwintering habitats in these areas are most sensitive given the compression of large numbers of fish into small physiologically suitable habitats. The Tolovana River supports anadromous fish to throughout its reach to approximately Livengood.	The Applicant will address State of Alaska comments during required permitting activities.
ADF&G	9/25/2016	Suggest rewording “hatch” to “emerge” . Juvenile Chinook likely hatch in winter, but alevins may not emerge from the gravel until late winter or possibly early spring (depending on temperature region and run-timing).	The Applicant will address State of Alaska comments during required permitting activities.
ADF&G	9/25/2016	In several streams in Southcentral, coho salmon can be found actively spawning through February.	The Applicant will address State of Alaska comments during required permitting activities.
ADF&G	9/25/2016	Table 3.2.2-1Wild populations of Arctic char occur in the Mat-Su (Big Lake etc.). Put an “X” under Susitna River ecoregion in the Arctic char row.	The Applicant will address State of Alaska comments during required permitting activities.

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ADF&G	9/25/2016	Arctic grayling generally spawn in tributary streams to the Sagavanirktok River. The Sagavanirktok River should not be considered most sensitive from May through June, but rather from October through May when ice and reduced stream flow restrict habitat available for overwintering.	The Applicant will address State of Alaska comments during required permitting activities.
ADF&G	9/25/2016	Arctic grayling only spawn in spring, and not "also in fall" as indicated in sentence 3.	The Applicant will address State of Alaska comments during required permitting activities.
ADF&G	9/25/2016	Table 3.2.3-3 The periodicity charts for use of coldwater resident and anadromous fish for Interior Alaska streams are confusing and should be clarified for all species. For example, juvenile sheefish peak use is indicated to be only late April to early July and that they potentially disappear from the area for the rest of the year (although rearing is indicated to be year-round without any apparent distinction between juvenile use and rearing). Peak use for adults is August and September yet spawning (by adults) is early September through early November. Juvenile, adult, and rearing usage needs to be clearly defined and the charts adjusted accordingly for all listed species.	The Applicant will address State of Alaska comments during required permitting activities.
ADF&G	9/25/2016	Arctic cisco and rainbow smelt are not known to have freshwater populations in northern Alaska.	The Applicant will address State of Alaska comments during required permitting activities.
ADF&G	9/25/2016	Paragraph 4: The second sentence states that 65 EFH streams will be crossed, but Table 3.2.5-1 lists 67. The sentence beginning with EFH is awkward and needs revision. This sentence also states EFH streams have been assessed for spawning and overwintering habitat as determined by ADF&G and the AWC. The AWC only classifies a habitat as "Spawning" if unambiguous, site-specific observations of actively spawning salmon are made. There may be instances where spawning habitat and spawning occurs within a classified stream that has not yet been identified. It should be noted that overwintering habitat is not identified in the AWC, and that limited data exist throughout the state accurately describing the locations of these habitats. Consider investigating the availability of existing Susitna-Watana Hydro telemetry data to gain a more complete distribution of spawning salmon in Susitna River drainage streams that may be crossed by the Project.	The Applicant will address State of Alaska comments during required permitting activities.
ADF&G	9/25/2016	Table 3.2.7-2 In footnote C, change Alaska Statute 41.14.870(a) to AS 16.05.871(a).	The Applicant will address State of Alaska comments during required permitting activities.
ADF&G	9/25/2016	Dall's sheep should be mentioned in this section describing large mammal species found along the pipeline corridor within the Alaska Range.	The Applicant will address State of Alaska comments during required permitting activities.
ADF&G	9/25/2016	The Hunt Types section is mostly incorrect (refer to the 2016-2017 Alaska Hunting Regulations booklet, page 15, for accurate descriptions).	The Applicant will address State of Alaska comments during required permitting activities.

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ADF&G	9/25/2016	Strike [Additionally, the Dalton Highway Corridor Management Area (DHCMA) consists of those portions of GMUs 20, 24, 25, and 26 north of the Yukon River, extending for 5 miles on either side of the Dalton Highway (Figure 3.4.3-1)]. Replace with: "Additionally, statutes prohibit hunting with a firearm in portions of GMUs 20, 24, 25, and 26 north of the Yukon River and extending for 5 miles on both sides of the Dalton Highway. This area is also referred to as the Dalton Highway Corridor Management Area (DHCMA) (Figure 3.4.3-1)."	The Applicant will address State of Alaska comments during required permitting activities.
ADF&G	9/25/2016	Edit the second paragraph as follows: The Project crosses through 8 of the 26 GMUs, including portions of 12 subunits. To harvest game or fur animals in Alaska, a valid state hunting or trapping license, and in most cases permits, tags, or harvest tickets are required. There are [five] seven types of [non- subsistence] hunts: general season, drawing, [permit], registration, [and] targeted, Tier I, Tier II, and CSH. Hunting regulations, including season dates, game animals, and bag limits, vary by GMU and hunt type. Harvest tickets are required for most big game animals and may be acquired at any time during the year, but expire at the end of the regulatory year on June 30. [General season and harvest ticket hunts do not require a permit. All other hunts require a permit and restrict harvest] (ADF&G, [2015] 2016 g).	The Applicant will address State of Alaska comments during required permitting activities.
ADF&G	9/25/2016	Change General season – Hunts [are] can be open to Alaska residents and nonresidents. General season hunts are the least restrictive hunts and require a license,[tag, or] and harvest ticket; nonresidents are required to have a tag as well;	The Applicant will address State of Alaska comments during required permitting activities.
ADF&G	9/25/2016	Edit Drawing hunts as follows: Drawing hunts – Hunts can be [A]available to both Alaska residents and nonresidents. These hunts require an application fee and are awarded by lottery. [Strike: The application period for draw hunts is during November and December and must be submitted online. Applications may be submitted for up to six moose; only three may be bull hunts, but all six can be antlerless;]	The Applicant will address State of Alaska comments during required permitting activities.
ADF&G	9/25/2016	Strike [Permit hunts – Take place in areas where hunter demand is higher than is sustainable for game population and can close early by emergency order;]	The Applicant will address State of Alaska comments during required permitting activities.
ADF&G	9/25/2016	Add the following hunt types: Tier I hunts – Open to residents only, these hunts provide for subsistence harvest of game where it is anticipated that a reasonable opportunity can be provided to all residents who engage in that subsistence use. Tier II hunts – Open to residents only, these hunts provide for subsistence harvest of game on a limited availability basis because a reasonable opportunity to engage in the subsistence use cannot be provided to all eligible residents. These hunts require an application, and applications are	The Applicant will address State of Alaska comments during required permitting activities.

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		scored and awarded to those with the highest points. Community Subsistence Harvest hunts – Open to residents only, these hunts provide for traditional subsistence hunting practices and create group bag limits rather than individual bag limits. These hunts require an application, and additional restrictions may apply.	
ADF&G	9/25/2016	Add to the final sentence of the first paragraph: In some hunts [R]esident hunters wishing to hunt brown bear or muskoxen must also buy locking tags in addition to a hunting license.	The Applicant will address State of Alaska comments during required permitting activities.
ADF&G	9/25/2016	Update references to 2016-2017 from 2015-2016 hunting and trapping regulations to reflect the most current regulations.	The Applicant will address State of Alaska comments during required permitting activities.
ADF&G	9/25/2016	Remove wolf and wolverine from the list of fur animals and add something like: Wolf and wolverine are also big game animals and may be harvested under hunting regulations.	The Applicant will address State of Alaska comments during required permitting activities.
ADF&G	9/25/2016	Add to the first sentence in the final paragraph: In most cases (but not all) hunting waterfowl requires a state and federal duck stamp…	The Applicant will address State of Alaska comments during required permitting activities.
ADF&G	9/25/2016	A small portion of GMU 14B borders the project, but not [14C].	The Applicant will address State of Alaska comments during required permitting activities.
ADF&G	9/25/2016	Also, the Mainline would follow the eastern boundary of the Minto Flats Management Area and Minto Flats State Game Refuge. This is a high density moose area important for hunting moose (subsistence and non-subsistence) and should be addressed.	The Applicant will address State of Alaska comments during required permitting activities.
ADF&G	9/25/2016	The final sentence of this section should read: The Mainline would cross through calving, rut, and winter moose habitat in GMU 20B as well as the valley along the border between GMU 20A and 20C.	The Applicant will address State of Alaska comments during required permitting activities.
ADF&G	9/25/2016	The most recent population estimate for GMU 16A: the 2009 Geo-Spatial Population Estimator estimate was 2,574 ± 294 (80% CI;) moose. (Peltier, 2014). Peltier, T. C. 2014. Unit 16A moose. Chapter 17, Pages 17-1 through 17-10 [In] P. Harper and L. A. McCarthy, editors. Moose management report of survey and inventory activities 1 July 2011–30 June 2013. Alaska Department of Fish and Game, Species Management Report ADF&G/DWC/SMR-2014-6, Juneau.	The Applicant will address State of Alaska comments during required permitting activities.
ADF&G	9/25/2016	The estimated population for mainland GMU 16B (excluding Kalgin Island) is 6,782 ± 1,562. (Peltier and Rinaldi, 2014). Peltier, T. C., and T. A. Rinaldi. 2014. Unit 16B moose. Chapter 18, Pages 18-1 through 18-14 [In] P. Harper and L. A. McCarthy, editors. Moose management report of survey-inventory activities 1 July 2011–30 June 2013. Alaska Department of Fish and Game, Species	The Applicant will address State of Alaska comments during required permitting activities.

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		Management Report ADF&G/DWC/SMR-2014-6, Juneau.	
ADF&G	9/25/2016	In 2011 the moose population in GMU 14A was estimated at 7,993 ± 1,167 (80% CI) (Peltier, 2014) Peltier, T. C. 2014. Unit 14A moose. Chapter 13, Pages 13-1 through 13-15 [In] P. Harper and L. A. McCarthy, editors. Moose management report of survey and inventory activities 1 July 2011–30 June 2013. Alaska Department of Fish and Game, Species Management Report ADF&G/DWC/SMR-2014-6, Juneau.	The Applicant will address State of Alaska comments during required permitting activities.
ADF&G	9/25/2016	Table 3.4.4-2 GMU 16B currently has 6-12 wolf packs; the density estimate remains the same.	The Applicant will address State of Alaska comments during required permitting activities.
ADF&G	9/25/2016	Denali State Park. Although caribou are occasionally reported in DSP, assigning them to a specific herd is speculative. Strike [Caribou from the Denali herd occur within the park] Replace with: "Moose, black bears, and brown bears are common in the park. Caribou are occasionally reported as well."	The Applicant will address State of Alaska comments during required permitting activities.
ADF&G	9/25/2016	Within Wildlife, (Del Frater and Spraker, 1991) should read (Del Frate and Spraker 1991).	The Applicant will address State of Alaska comments during required permitting activities.
ADF&G	9/25/2016	Table A-4 The two PTTL water source lakes in this table, Unnamed Lake 12 and Lake #10-01, are not anadromous waterbodies.	The Applicant will address State of Alaska comments during required permitting activities.
ADF&G	9/25/2016	It would be helpful for assessing potential impacts and mitigation measures if the proposed mode of crossing was included in this table. Consider rewording the "Anadromous Salmon and/or Trout" column heading to "Anadromous." The only anadromous trout present in the study area is the Steelhead; Dolly Varden are a char, and there are many other species of anadromous fish that are neither a salmon or a trout, but their presence still invokes an elevated level of conservation sensitivity. A complete list of all stream crossings would be helpful, not just those that are determined at this point to be of special concern.	The Applicant will address State of Alaska comments during required permitting activities.
ADF&G	9/25/2016	The Wildlife Avoidance and Interaction Plan will need to be detailed as outlined in the draft template presented in this appendix. Substantial effort will need to be made to address separation of wildlife and humans as well as minimizing attractants to wildlife. Temporary work camps as well as permanent facilities need to be surrounded by electric fences to minimize human interactions with foxes, and brown and black bears that were common during construction of the Trans-Alaska Pipeline. The temporary storage and proper disposal of putrescible wastes will be an important part of minimizing human/carnivore interactions, as well as the prohibition of direct feeding of animals. A bear-human interaction plan will need to be	The Applicant will address State of Alaska comments during required permitting activities.

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		developed and implemented before preconstruction and construction activities occur. The plan will need to address topics including prohibition of direct feeding of bears and other wildlife by humans; minimizing the attraction of bears to facility and work sites; the layout of facilities and work areas to minimize interactions between humans and bears; measures to warn and protect site personnel; deterrence of bears, if authorized, from the work area or facility; proper storage and disposal of materials that may be toxic to bears; and proper handling, temporary storage, and disposal of putrescible wastes. The bear-human interaction plan could be a component of a larger more comprehensive carnivore- human interaction plan that addresses not only bears, but foxes, wolves, coyotes, and wolverines that occur in the project area. The plan should account for the differences in the carnivore presence within various construction segments so that additional emphasis can be placed within segments with known issues regarding human-carnivore interaction.	
ADF&G	9/25/2016	The stream crossing component of the restoration plan needs to be developed to ensure long term site stability with minimal maintenance. The stream crossing component should include three distinct but interrelated components: streambed restoration, bank restoration, and riparian restoration. The plan should strive to restore stream crossings to pre-construction conditions to the extent practicable, recognizing pre-construction conditions may be impossible to achieve in some situations.	The Applicant will address State of Alaska comments during required permitting activities.
U.S. Fish and Wildlife Service (USFWS)	9/26/2016	In October 2014, the Applicant submitted a request for information regarding federal listed threatened or endangered species or critical habitat that may occur within the footprint of the proposed Project. The Service responded to the request in December 2014. In our April 3, 2015 comment letter, the Service noted the introduction of the Wood Bison as a threatened species that may range within the project area. In addition, on February 29, 2016, the 9th Circuit Court of Appeals reinstated, on all points, polar bear critical habitat on the North Slope of Alaska. Polar bear critical habitat therefore should be incorporated into the document as appropriate.	See Sections 3.5.1.2.2 and 3.5.1.2.3 in Resource Report No. 3 and the Biological Assessment (Appendix C).
USFWS	9/26/2016	A statement in RR 3 (Table 3.1.3-1) indicates initiation of section 7 consultation via a letter from the Applicant (dated 10/27/2014). We note this request for information does not equate to initiating section 7 consultation for the proposed Project. Further, section 7 consultation can only be conducted with the lead Federal Agency (Action Agency) unless the Action Agency has designated this authority to the applicant in writing.	Table 3.1.3-1 notes that this is only regarding informal consultation. However, by regulation the Federal Energy Regulatory Commission (FERC) can, and has, designated the Project as the non-federal representative.

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USFWS	9/26/2016	To adequately evaluate impacts on listed species, the Service will require more detailed maps on the location of excavation and placement of fill associated with the proposed Project. In particular, the Service would like to be involved in discussions regarding facility siting, especially regarding facilities on the North Slope and Kenai Peninsula, to help minimize potential effects to listed species and critical habitat. Project plans include dredging to accommodate vessels with deep drafts. Please provide information regarding where this dredging would occur, plans for disposal of dredge material, and how these activities may affect listed species. In addition, a more complete description of marine routes for vessel traffic with respect to listed and candidate species as well as designated critical habitat should be included in the Biological Assessment document.	Detailed maps depicting footprints are found in Resource Report No. 1 Appendix A, and overlain on resource mapping in Appendix A and B of Resource Report No. 3. Vessel traffic and vessel routes are discussed in the Biological Assessment (Appendix C of Resource Report No. 3) and figures therein, as well as Appendix G of Resource Report No. 3 (Marine Mammal Distribution Maps).
USFWS	9/26/2016	Hydrocarbon Spills- The RRs do not contain an in-depth spill analysis for LNG and other petroleum products. A thorough discussion of impacts associated with accidental releases of liquefied natural gas and/or fuel spills into watercourses and the coastal and marine environments of Cook Inlet and the Beaufort Sea is warranted. Section 4.12 of the NPR-A IAP/EIS (2012) (http:www.blm.gov/ak) could be used as a template for this discussion. The Service would appreciate reviewing the spill analysis before the RRs are finalized.	The Applicant will address this comment prior to issuance of the Draft Environmental Impact Statement (DEIS).
USFWS	9/26/2016	"and how these activities may affect listed species". Please provide information regarding where this dredging would occur, plans for disposal of dredge material. In addition, a more complete description of marine routes for vessel traffic with respect to listed and candidate species as well as designated critical habitat should be included in the Biological Assessment document.	See descriptions of proposed dredging in Cook Inlet in Sections 1.4.1.2.1, 1.5.2.2.1.16 and 1.5.2.4.2 of Resource Report No. 1 and in Sections 2.1 and 2.4 of the Biological Assessment (Appendix C of RR 3). See response above to Comment RR 3, 101 with regards to vessel traffic and vessel routes to the extent they are known.
USFWS	9/26/2016	Section 5.14.3 acknowledges polar bears may be affected through the likely expansion of facilities in the Point Thomson Unit (PTU) associated with the proposed project. However, there is no discussion as to how these impacts would occur or what measures would be taken to mitigate the impacts. The Service recognizes these are non-jurisdictional facilities, however, but for the proposed Project, expansion of facilities within the PTU would be unnecessary and therefore potential changes to these facilities should be addressed as interrelated and interdependent effects.	The Applicant has provided the information available from the Point Thomson Unit (PTU) and the operators of that Unit would be submitting permits associated with their expansion that will be reviewed by agencies at that time.
USFWS	9/26/2016	If an expansion of the Point Thomson Central Pad is warranted, we recommend the expansion occur on the south end of the existing pad. Pad expansions on the east or west sides of the Central Pad adjacent to the coastal shoreline should be	Comment acknowledged. See Figure 1.3.9-1 in Resource Report No. 1. Proposed expansion is to the south/southwest.

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		avoided to allow polar bears to have unobstructed passage along the coast. The existing Central Pad potentially impedes movement of bears and as a result a bear detection and monitoring system has been established to identify bears before they reach the pad. The monitoring system and storage restrictions will continue to be enforced for the life of the project, including any expansion pertaining to the proposed Project. We recommend referring to the 2012 Point Thomson Biological Opinion for further detail on protective measures the facility has adopted for polar bears.	
USFWS	9/26/2016	The Service does not consider the Avian Protection Plan (APP) as currently written to be a complete document. The development of an APP is important to guide FERC in meeting their regulatory obligations for permitting the Project in accordance to Executive Order (EO) 13186 and the Memorandum of Understanding (MOU) between FERC and the Service regarding implementation of EO 13186, "Responsibilities of Federal Agencies to Protect Migratory Birds." The overall goal of an APP is to reduce bird fatalities, provide mitigation for fatalities, and incorporate measures to reduce impacts. As stated in our previous comment letter, the Service would be happy to work with the Applicant and FERC to produce a complete APP for this Project, and in particular to develop project-specific Best Management Practices (BMPs) to reduce impacts to birds and their habitats. Two documents, USFWS Revised Voluntary Guidelines for Communication Tower Design, Siting, Construction, Operation, Retrofitting and Decommissioning and an updated USFWS Recommended Periods to Avoid Land Disturbance and Vegetation Clearing for Migratory Birds, are attached to this letter. More specific comments regarding the current APP and potential project-related impacts to migratory birds are included in our attached comment matrix.	Comment acknowledged. The Avian Protection Plan is not considered anything but a draft document to initiate consultation by providing pertinent information for assessing impacts to avian species. The Applicant welcomes the U.S. Fish and Wildlife Service's (USFWS's) comments to this plan on a path forward to finalize prior to construction.
USFWS	9/26/2016	The Project may displace over 900 shorebirds from nesting habitats in the Beaufort Coastal Plain ecoregion. Passerines, numbering in the thousands, may be displaced from nesting habitats in many of the ecoregions, and over 1,000 seabirds may be displaced from nesting habitats in the Cook Inlet Basin ecoregion by the Project. We assume most birds would find suitable, alternative sites in which to construct future nests. However, depending on the habitats impacted by the Project, displacement could result in significant impacts to some species. Therefore, the Service encourages the applicant to make adjustments to the Project footprint whenever possible to avoid those habitats/vegetation types considered to be limiting, special, or sensitive in the vicinity of the mainline corridor (e.g., dry, upland habitat types, riparian	Comment acknowledged. The Mainline route was designed based on several criteria as discussed in Section 10.4.2 of RR 10, including avoidance of sensitive environmental features (listed species habitat, high quality wetlands, known nesting locations of listed species, etc.) and open water features (ponds, lakes, reservoirs). Furthermore, as discussed in Section 3.4.10.2.1.1, Site Preparation, Birds, vegetation clearing would occur outside of the nesting season, active nests with young are not expected to be impacted by construction. Impacts

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		areas, and Arctophila ponds and lakes in the Arctic Coastal Plain (ACP), as well as those areas known to have high concentrations of particular taxa during nesting or other critical life history stages. This comment applies to all ecoregions traversed by the mainline.	and mitigation measures for Sensitive Wildlife Habitat Areas and Alaska Game Management Areas during operations are discussed in Section 3.4.11.2.1.1.
USFWS	9/26/2016	Effect Determination Terminology: There should be a significance level in between minor and significant (e.g. "moderate"). Minor to significant is a big jump. Suggest adding the italicized words: "…significant effects have the potential to result in a substantial adverse change in the physical, biological, or human environment."	Comment acknowledged. See Section 2.1.2.
USFWS	9/26/2016	We were unable to locate a section discussing large spills and their potential environmental impacts, including in the marine environment (at both the North Slope and Liquefaction Facility ends of the gasline). If there is not such a section, this needs to be addressed in future drafts. Section 4.12 of the NPR-A IAP/EIS (2012) may be a good template for use in this discussion.	The Applicant will address this comment prior to issuance of the Draft Environmental Impact Statement (DEIS).
USFWS	9/26/2016	"10/27/2014 – Letter to USFWS – Initiation of Informal Section 7 consultation – request for information regarding federally threatened or endangered species or critical habitat that may occur within the project footprint." USFWS provided a Species List in response to this request. This request does not equate to initiating section 7 consultation and it is not within the applicant's authority to do so, unless previously designated by the lead federal agency (Action Agency) to represent them as the designated non-federal representative for the proposed project. Consultation for this project under section 7 of the ESA has not begun, and responsibility for initiating lies with the Action Agency, FERC in this case.	As indicated in the October 2014 informal consultation request, the Project Participants are the Commission's designated non-Federal representative under 18 C.F.R. Section 380.13(b)(1) for the purpose of informal consultation with the USFWS under the Endangered Species Act (ESA). FERC does not routinely send in letters designating applicants as their non-federal representative because these regulations already designate applicants as the non-federal entity.
USFWS	9/26/2016	"5/26/2015 – Alaska LNG Project USFWS Section 7 Consultation Initiation". Same comment as above, section 7 consultation is initiated by the federal Action Agency and consultation does not begin until the USFWS has all the information required (e.g., BA with complete, and final project description) to complete our analysis	Comment acknowledged. Formal consultation would begin once the Biological Assessment has been completed by FERC and the reviewing agencies.
USFWS	9/26/2016	It is possible to spread invasive species during winter construction. Please discuss this in RR3 and in App. K of RR3.	The Applicant will address this comment prior to issuance of the Draft Environmental Impact Statement (DEIS).
USFWS	9/26/2016	Please replace "white clover" with "white sweet clover" or include a scientific name for the less well-recognized white clover.	Section 3.3.7.1.8 has been revised per this comment.
USFWS	9/26/2016	Should include a discussion on possibility of rat spills from vessels and their potential impacts to migratory birds.	Rats are discussed in Resource Report No. 3, Section 3.4.5 Furbearers and Small Mammals and Section 3.4.10.1.6.4 Furbearers and Small Mammals, and Section 3.4.10.1.6.4 Birds.

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USFWS	9/26/2016	The Service recommends that all land disturbing activities be conducted outside of the migratory bird nesting season. Land disturbing activities include land clearing (as mentioned in this section), but also includes activities such as placing fill, stockpiling, mowing, brush hogging, hydro axing, etc.	Comment acknowledged. See Sections 3.4.10 and 3.4.10.2.1.1 of Resource Report No.3, and the Draft Avian Protection Plan (Appendix E). As a general matter, the Applicant will conduct land disturbing activities outside the nesting window. Exceptions will be brought to the USFWS for review and concurrence on the activity to be conducted.
USFWS	9/26/2016	Once disturbed Arctic Coastal Plain wetlands are difficult to restore. It can take upwards of 30 years or more to achieve some level of restoration. In addition, wetland restoration on the ACP does not result in the same type of wetland originally impacted. In addition, restoration of wetlands on the Arctic Coastal Plain after trenching likely is not possible due to subsidence and ponding. Temporal as well as functional loss should be addressed when assessing the impact of wetland loss associated with the proposed LNG pipeline. Wetland disturbance on the ACP would be best avoided by elevating the pipeline. In addition, harvesting tundra sod on the ACP where practicable, such as at mine site developments, would decrease temporal loss and increase wetland restoration success. Mitigation banks, and in lieu fees result in net loss of wetlands and as such should be considered after permittee-responsible restoration. Even though restoration of wetlands on the ACP is a slow process and may not result in the same type of wetland pre-disturbance, at least some level of functionality is restored.	Comment acknowledged. Refer to the ASAP USACE application report: ASAP Belowground Pipeline Mode: Selection, Construction, Operation, and Maintenance on Alaska's North Slope. July 12, 2016.
USFWS	9/26/2016	Clearing and Grading; 2nd paragraph: This section mentioned organic material may be segregated in upland areas. This is inconsistent with information in RR2, where this practice does not differentiate between wetlands and uplands. In RR2 it also states that this is a construction procedure that will occur except in given situations. We recommend the organic soil layer be salvaged to the greatest extent practicable, including during winter construction, throughout the entire project footprint to be used in reclamation work as this material will greatly enhance restoration efforts.	See revised text in Section 3.3.7.2.1.1 in Resource Report No. 3. Resource Report No.1, Appendix M further describes how topsoil segregation will take place.
USFWS	9/26/2016	The PTTL is proposed to be elevated on VSMs except for river crossings. We suggest the PTTL pipeline be elevated on VSMs over all river crossings to avoid likely bank thawing and erosion due to trenching (which will resulting in permanent damage to rivers and associated wetlands). The associated erosion will be extremely expensive to mitigate and likely will extend for the life of the project.	Please see Appendix E of Resource Report No. 1 that discusses the design alternatives considered for the crossing of rivers on the Point Thomson Gas Transmission Line (PTTL).

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USFWS	9/26/2016	First paragraph: The statement about the tundra mat not being removed for pipeline construction is confusing. The Plan describes winter construction on the tundra, where blasting of the trench will occur. How is this not removing the tundra mat? Additionally, reliance upon arctic conditions to prevent the establishment of invasive species is no longer a valid argument. As the climate changes and becomes warmer more invasive species encroach into the Arctic Coastal Plain region of the State. This portion of the state deserves equal treatment regarding invasive species prevention and control.	The mat will not be cut, removed and set aside for placement on top of the trench after backfilling. The trench line will be excavated and blasting may be required to break up permafrost areas to assist with trenching. More information is available in Appendix M of Resource Report 1
USFWS	9/26/2016	Suggest adding arctic fox, red fox, shrews, and voles to the first paragraph.. Also, there is no mention of red fox in this section. Red fox have become more abundant on the Arctic Coastal Plain over the past 20 years.	See revised text concerning foxes, shrews, and voles in Section 3.4.2.1 of Resource Report No.3.
USFWS	9/26/2016	Second paragraph – the USFWS final ESA listing decision on Pacific walrus will be made in September 2017.	See revised text in Section 3.4.2.2.5.
USFWS	9/26/2016	Please include a description of Hannah Shoal Walrus Use Area in the Chukchi Sea	See revised text in Section 3.4.2.2.5 of Resource Report No. 3 and Figure 17 in the Biological Assessment (Appendix C).
USFWS	9/26/2016	Bird Resources: The ecoregions mentioned in the introduction (Alaska Range Transition, Intermontane Boreal, and Arctic Tundra) do not correspond to the ecoregions described in Section 3.3.1 or in Figure 3.3.1-1. These three (larger-scale) ecoregions are, however, shown on Figure 3.2.1- 1. Additionally, the ecoregions discussed in the text following this brief introduction are a mix of these three larger and several finer-scale ecoregions. For example, “Cook Inlet Basin Ecoregion Birds”, the first sub header discussed, is a different level of ecoregion than “Arctic Tundra Ecoregion”, which is the second sub header. There should be consistency in how ecoregion levels are used throughout the Bird Resource section.	Text revised so uses of ecoregions and ecoregion levels are consistent throughout Resource Report No. 3 as described in Section 3.3.1.
USFWS	9/26/2016	The carry-over sentence from pg. 3-227 should mention nesting passerines (in addition to nesting raptors) are more prevalent in the Brooks Range Foothills and Brooks Range Ecoregions. This section also should acknowledge common ravens only have become year-round species on the Arctic Coastal Plain with the addition of infrastructure that gives them perching, roosting, and nesting platforms as well as a year-round source of food.	See revised text in Section 3.4.6.2.1.
USFWS	9/26/2016	Arctic Tundra Ecoregion Birds: Please be careful with use of the term “resident” bird, since “resident” implies non-migratory and/or implies state-managed species. Only birds that fall strictly under state jurisdiction (in this case, the ptarmigan species) should have this term applied here. (But note, it is ok to leave the term “resident” in the	Subject text in Section 3.4.6.2.1 (Arctic Tundra Ecoregion Birds) of Resource Report No. 3 has been revised in response to this comment.

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		status column of Table 3.4.6-1.) Although they may be present year-round in the Arctic, common ravens, snowy owls, and gyrfalcons are considered migratory birds. Therefore suggest rewording to something like: Two resident birds and three migratory birds may have a year-round presence in this ecoregion.	
USFWS	9/26/2016	Please include citations for the important bird habitats discussed in this and other sections. These citations also should be incorporated into the reference list for the Bird Resources section.	Text has been added to Sections 3.4.6.2.1.1, 3.4.6.2.2.1, and 3.4.6.2.3.1 indicating what bird habitats were considered important and providing citations/references. References for bird habitats are listed at the end of Table 3.4.6-1 Arctic Tundra Ecoregion Birds Potentially Occurring in the Project Area.
USFWS	9/26/2016	Gray-headed chickadee should be included in this table, as their distribution includes the Brooks Range. BLM also has a list of sensitive species that should be incorporated into this table and tables for the other ecoregions. Table 3.4.6-1 does not seem to fit well into this section on Important Bird Habitats. Consider moving to Section 3.4.6.2.1 or placing this table in an App. (perhaps within the Avian Protection Plan, since that document is incorporated in the EIS) and just referencing it. This comment applies to tables listing bird species for the other ecoregions as well.	Gray-headed chickadee has been added to Table 3.4.6-1. The BLM list is considered in Table 3.5.2-2 and accompanying text. Table 3.4.6-1 was not moved because it is associated with the previous Sections 3.4.6.2.1 (Arctic Tundra Ecoregion Birds). There was a page break issues; no change.
USFWS	9/26/2016	The Northeast Arctic Coastal Plain Important Bird Area shown on this figure is not discussed in the preceding text, but due to proximity to the project it should be added to the text. Are the Zones of Restricted Activity shown on this map relevant to the bird resources? If so, please explain why in the preceding text. If not, suggest removing from this map. Each of the ecoregions discussed in the text should be shown on this figure. The Beaufort Coastal Plain Ecoregion is not shown at present, for example. This comment applies to other figures created for other areas.	See revised text on the Important Bird Area (IBA) and zones of restricted activity in Section 3.4.6.2.1.1.
USFWS	9/26/2016	Please note the BLM 1998 reference is outdated. The 2012 Final IAP/EIS is the most current plan, and it replaced the 1998 plan. In general anywhere the 1998 citation is used should be updated, however, please check for accuracy of the reference before updating. The habitat and species description in the 2012 document are accurate and a good example for this RR . However the NPR-A does not immediately border the proposed gas line corridor, and references for the Prudhoe Bay area itself should be used in this RR .	References to the BLM Integrated Action Plan (IAP) have been updated in Sections 3.2.3, 3.2.4.2, and 3.4.6.1.2.
USFWS	9/26/2016	The focus on common to abundant breeders, representative species, and their important habitats in this section is appreciated. We suggest mentioning birds of conservation concern or special status that are using this ecoregion to this	Special status and conservation bird species are indicated in Tables 3.5.2-2 and 3.5.2-4; in the interest of space they are not repeated in Section 3.4.6.2.1.2 but

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		section. Second paragraph: References for determining representative species are outdated. We suggest using more recent references. In addition we suggest adding brant to this list, particularly since they are discussed later in text. Owls also should be discussed in this section. Third paragraph: Please provide a citation for the first sentence, discussing the most intensively used habitats on the Beaufort Coastal Plain. Also, please emphasize that passerines using the Sagavanirktok River corridor have limited distribution in the Beaufort Coastal Plain Ecoregion because this type of riparian shrub habitat has limited distribution. In addition, coastal lagoons and estuaries should be included in this paragraph as important areas receiving high bird (e.g., waterfowl, shorebird) use. Fourth paragraph: Not necessary to include the yellow-billed loon in this paragraph. They should be moved to the next paragraph and treated like the other loons (i.e. discuss their habitat preferences). Sixth paragraph: provide a citation for the first paragraph (60% of the tundra swans in Alaska…)	text has been added referring the reader to the aforementioned tables. Discussion of owls and brant have been added as has a citation regarding the relative use of habitats. A citation has been added to the statement regarding loons.
USFWS	9/26/2016	Please label the Yukon Flats West IBA correctly. Yukon Flats NWR is a bigger area around this IBA; and that label should be moved so that both are reflected here. The same applies to Minto Flats State Game Refuge and the Minto Flats IBA.	See revised Figure 3.4.6-2.
USFWS	9/26/2016	Third paragraph: The ducks listed here belong to different feeding guilds, and they are not all equally likely to be using food resources associated with emergent vegetation in aquatic habitats. Consider grouping ducks into dabbling, diving, and sea ducks in order to better understand their important habitats and food needs. Fourth paragraph: Note that long-tailed ducks molt in nearshore lagoons as well. Last paragraph: According to work on shorebirds by a WCS camp operating in Prudhoe Bay, red- necked phalarope should be added to the list of most common breeding shorebirds. See Bentzen & Robards (2014) at: https://www.fws.gov/alaska/mbsp/mbm/shorebirds/pdf/ASG%20Summaries_2014.pdf Liebezeit and Zack (2010) may also be a good reference: http://www.north-slope.org/assets/images/uploads/2010%20Ikpikpuk%20Report%20WCS.pdf	Ducks have now been discussed by feeding guild in Section 3.4.6.2.1.2 Beaufort Coastal Plain Ecoregion Birds. The information regarding long-tailed ducks and red-necked phalaropes has also been added to the section.
USFWS	9/26/2016	This section should be structured similarly to the preceding section. For example, please discuss representative species for the Brooks Foothills Ecoregion, then discuss important habitats for birds in this ecoregion, then discuss specific species. Suggest mentioning which birds of conservation concern are found in this ecoregion. First paragraph: Please provide a citation for the first sentence. Shorebirds are missing from this list of birds nesting in the Brooks Foothills Ecoregion.	See revised and restructured Section 3.4.6.2.1.3. Citations, shorebirds, and owls have been added.

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		A different suite of species may be commonly found here than are found in the coastal plain habitats. Owls are also missing from this discussion.	
USFWS	9/26/2016	This section should be structured similarly to 3.4.6.2.1.2. For example, please discuss representative species for the Brooks Range Ecoregion, then discuss important habitats for birds in this ecoregion, then discuss specific species. Suggest mentioning which birds of conservation concern are found in this ecoregion. Second paragraph: Please provide citations for birds common to the area. Please add “owls” to the last sentence.	See revised and restructured Section 3.4.6.2.1.4, with added citation, and owls added to the referenced sentence.
USFWS	9/26/2016	Please refer to Figure 3.4.6-2 in the first sentence of this introductory paragraph.	Section 3.4.6.2.2 has been revised with a figure reference.
USFWS	9/26/2016	The important waterfowl breeding and staging areas listed in this section should be moved into the discussion of important habitats in section 3.4.6.2.2.1.	The text discussing waterfowl breeding and staging areas has been moved to Section 3.4.6.2.2.1.
USFWS	9/26/2016	Second paragraph: The Yukon Flats NWR contains the Yukon Flats West IBA, which should be mentioned and discussed here. Additionally, the term “landbirds” is not used in any tables or other general descriptions of bird taxa. It should not be introduced here for the first time, so please replace with terms that match birds described in Table 3.4.6-2 (or reorganize Table 3.4.6-2 and similar tables to include this category of bird).Third paragraph: Minto Flats State Game Refuge is also a designated IBA. This should be mentioned and discussed here. Additionally, 1992 is fairly outdated for statements about bird populations (a lot can change in 25 years, and the distribution of swans in Alaska has definitely changed somewhat).See if this citation can be replaced with an updated reference. If not, please modify sentence to say, “has sustained one of the largest…”	Mention of the Yukon Flats West IBA and that Minto Flats State Game Refuge IBA have been added to Section 3.4.6.2.2.1 Important Bird Habitats in the Intermontane Boreal Ecoregion. The "landbird" term was introduced in Section 3.4.6 has been added to Table 3.4.6-1, Table 3.4.6-2, and Table 3.4.6-3. The bird population citation has been updated from 1992 as requested.
USFWS	9/26/2016	The Kobuk Ridges and Valleys Ecoregion should be shown on the immediately preceding figure (3.4.6-2), rather than refer to a figure several sections back in this RR. Please include a citation for the statement that there are few birds supported by habitats in this ecoregion. Since so few species are expected here, please discuss those that are found here (i.e. list the raptor species). To the extent possible, this section should be structured similarly to 3.4.6.2.1.2. For example, please discuss representative species (any shorebirds? Which raptors?) and important habitat types for birds in this ecoregion, then discuss specific species.	Figure 3.4.6-2 has been revised and Section 3.4.6.2.2.2 has been revised and restructured. Birds of conservation concern and special status are noted if present.
USFWS	9/26/2016	To the extent possible, this section should be structured similarly to 3.4.6.2.1.2. For example, please discuss representative species (any shorebirds or owls? Which raptors?) and important	See revised Section 3.4.6.2.2.3. Birds of conservation

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		habitat types for birds in this ecoregion, then discuss specific species. Suggest mentioning which birds of conservation concern are found in this ecoregion.	concern table 3.5.3-3 was also referenced.
USFWS	9/26/2016	Seems that some geese and swans, as well as common raven, should be included on the list of species found in the Tanana-Kuskokwim Ecoregion. Also sandhill cranes (which are a waterbird) should be included in the list of "principal waterbirds". The list does not seem comprehensive; suggest looking for additional references to determine which geese and ducks should be included here. To the extent possible, this section should be structured similarly to 3.4.6.2.1.2. For example, please discuss representative species (any shorebirds? Raptors?) and important habitat types for birds in this ecoregion, then discuss specific species. Suggest mentioning which birds of conservation concern are found in this ecoregion.	See revised and restructured Section 3.4.6.2.2.5. The list of principle waterbirds has been updated and Table 3.5.3-3 is referenced.
USFWS	9/26/2016	Suggest structuring the introductory section here similarly to 3.4.6.2.1.	See revised and restructured Section 3.4.6.2.3.
USFWS	9/26/2016	The introduction to IBAs should be included the first time IBAs are mentioned, not in the last ecoregion listed in this RR . The discussion of individual IBAs in this section is what we would like to see for all preceding sections.	Section 3.4.6.2.3.1 has been revised as requested. The definition and introduction of IBAs has been moved to Section 3.4.6 and individual IBAs are discussed in each of the ecoregions following Section 3.4.6.
USFWS	9/26/2016	First full paragraph: "Northern phalaropes" is an outdated species name. Please update to red-necked phalarope. Please include citations for this paragraph.	The species name has been updated.
USFWS	9/26/2016	Characterizing the Alaska Range Ecoregion as, "steep mountains covered with glaciers… Vegetation is sparse…," is not quite accurate. There are many habitats included in this ecoregion that are important to birds breeding in or migrating through the area. Please work on text that reflects the habitats important to birds; this is especially important because many of these lower-elevation habitats will be traversed by the proposed project. To the extent possible, this section should be structured similarly to 3.4.6.2.1.2. For example, please discuss representative species (any waterfowl? Owls?) and important habitat types for birds in this ecoregion, then discuss specific species. Suggest mentioning which birds of conservation concern are found in this ecoregion.	Section 3.4.6.2.3.2 has been revised with additional text.
USFWS	9/26/2016	Please consider changing this section header to be, "Raptors and Owls," or, "Birds of Prey." Alternatively, keep any owl-specific information in the preceding section (3.4.6.2), as BGEPA does not apply to owls, and raptor nest surveys are unlikely to include owl nests in data collected. This section could be called, "Cliff- and Tree-nesting Raptors," as these are the birds you're likely to find	The title of Section 3.4.6.3 has been revised to Birds of Prey.

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		in raptor nest surveys. If choosing this latter approach, please remove all information about owls and small, cavity- or ground-nesting raptor species. Most of the information in this second paragraph is overkill for this sort of document. Suggest summarizing this to say: "Raptor nest data has been collected along portions of the proposed project, periodically during the past 30+ years, by resource agencies and/or by previous project proponents in the general vicinity of the Alaska LNG Project. This historic data gives a good indication of habitats raptors may be using along the pipeline route, and of areas where raptor nests may be in high concentration." Citations are appropriate, but the rest of the text dilutes the point. Include basic information on habitat use by raptors, and especially nesting patterns (e.g. discuss active versus inactive nests). Last paragraph: Please make it clear that bald eagles more commonly nest in large trees, which explains their more common distribution south of the Alaska Range.	
USFWS	9/26/2016	As stated in previous comments from the Service regarding raptor surveys, surveys are important to identify raptor nest locations, as well as other eagle use areas (e.g. communal roosts, important foraging areas). We support a shorter than normal survey distance (of 0.5 mile) only where Alaska LNG project activities are unlikely to result in construction of permanent structures (e.g. pump stations, storage yards), permanent habitat loss, long term disturbance, or eagle nest take. However, in areas of relatively high golden eagle nesting densities (e.g. Atigun Pass, Glitter Gulch, Alaska Range), and where aforementioned impacts are likely, we recommend increasing the survey distance to 2.0 miles on each side of the project boundary. This survey distance of 2.0 miles on each side of the project boundary, if timed appropriately, is adequate for quantifying: (1) numbers of eagles within the activity area; (2) use of the project area by eagles; (3) potential nest take; (4) potential eagle take(including disturbance and habitat loss); (5) cumulative effects; and (6) to help identify potential avoidance and minimization measures (e.g. opportunities to site away from important eagle use areas).	Surveys were conducted per USFWS-recommended survey methods; see methods description in reports for raptor surveys in Appendix M (Wildlife Survey Reports) of Resource Report No. 3. The referenced 0.5 mile dimension was the limits of the GIS analysis, and Table 3.4.6-6 footnotes were revised to clarify this.
USFWS	9/26/2016	The table discussing Construction Impacts and Mitigation for Wildlife associated with the project should mention the Avian Protection Plan as mitigation. Please add a bullet point for both activities listed under "Birds" that states, "Best Management Practices identified in the Avian Protection Plan (APP) will be followed to the maximum extent practicable. When the APP cannot be followed, the SSHE Advisors [or whoever is deemed appropriate by the author] shall be contacted, and they will consult the USFWS as needed."	See the revised Table 3.4.10-1.

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USFWS	9/26/2016	Over 900 shorebirds are estimated to be displaced from nesting habitats in the Beaufort Coastal Plain ecoregion by the proposed Mainline construction, passerines numbering in the thousands are estimated to be displaced from nesting habitats in many of the ecoregions, and over 1000 seabirds are estimated to be displaced from nesting habitats in the Cook Inlet Basin ecoregion. We assume most birds would find suitable, alternative sites in which to construct future nests and/or raise broods. However, displacement could represent more than a minor impact on some species, if this assumption is incorrect. The Service encourages AK LNG to make adjustments to the Project footprint whenever possible to avoid those habitats/vegetation types that are considered limited, special, or sensitive in the vicinity of the Mainline corridor, as well as those areas known to have high concentrations of particular taxa during nesting or other critical life history stages. For example, as noted in previous comments from the Service, the proposed location of the GTP is in habitats that are used for brood-rearing and fall staging by several species of waterfowl. The habitat is fairly unique, being adjacent to the shore of Prudhoe Bay yet far inland from the outer coast. While the use of existing infrastructure wherever possible would reduce long-term impacts to the habitat, AK LNG indicated that no existing pads are available to co-locate the facilities that comprise the GTP. Is it possible to separate any of these facilities to reduce impacts to the habitat? It should be a priority to minimize permanent impacts, such as mine sites and reservoirs, as much as possible; and new gravel infrastructure should also be minimized. These comments apply to all ecoregions traversed by the Mainline.	The Project ROW and associated facilities were sited in areas that avoid temporary and permanent impact to sensitive habitats and would use existing mine sites and reservoirs to the extent practicable. For more information on siting criteria and analysis refer to Resource Report No. 10, Section 10.1.6 Avoiding and Reducing Environmental and Social Impacts, 10.3.2.2 Siting Methodology (Liquefaction Facility), Section 10.4.2.1 Routing Considerations (Mainline),Table 10.4.3-1 Comparison of the Cook Inlet Area Pipeline (Mainline) Alternatives, Section 10.5.3.1 GTP Site Selection.
USFWS	9/26/2016	Open trenches are not just a hazard to young waterfowl. They would be considered a hazard to any flightless birds.	Comment acknowledged; see revised Section 3.4.10.2.1.1.
USFWS	9/26/2016	Raptors nesting more than 0.5 miles from active blasting locations could be subject to disturbance, but we don't have a good indication of safe distance. In particular, we do not know how well golden eagles may tolerate this type of disturbance, but they are known to be an extremely sensitive species. Blasting plans for areas with known raptor nests (including nests >0.5 miles, up to 2 miles, from the blasting site) should be discussed on a site by site basis with the Service. We recommend as a Best Management Practice, blasting should take place prior to the start of breeding season. For raptors, this is significantly earlier than for other bird species. Please consult current Service guidelines. This comment applies to any other sections that discuss blasting near raptor nesting sites (for both Construction and Operation).	Comment acknowledged. Section 3.4.10.2.1.1 has been revised to indicate some birds may be affected by blasting at distances >0.5 mile. The Applicant would work with the USFWS once final material sites are identified and pre-construction surveys indicate where raptors may be nesting in proximity to those sites.

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USFWS	9/26/2016	Please add owls to the list of birds that are often killed by vehicular collisions. Also note that birds of prey and scavengers may be especially vulnerable because they feed on other road-killed wildlife. This comment applies to any other sections that discuss vehicular (air and land) impacts on wildlife (for both Construction and Operation). Birds should receive some discussion under vessel traffic. Birds in the nearshore, offshore, and along the coast are vulnerable to disturbance and potential fuel spills from vessel traffic, as well as to the spread of invasive organisms (including rats, not just aquatics). Additionally, birds may be attracted to lights on vessels, especially during periods of low visibility associated with darkness or inclement weather. This is a significant cause of injury and/or mortality to some groups of birds, including seabirds, passerines, and large-bodied waterfowl that regularly fly to and from or along the coast. This comment applies to any other sections that discuss vessel impacts on wildlife (for both Construction and Operation).	Owls were added to the list in Section 3.4.10.2.1.1 Mainline, Traffic (Land and Air), Wildlife. Section 3.4.10.1.6.4 discusses vessel traffic impacts including impacts from invasive organisms and rats. Section 3.4.10.1.7.4 states a Wildlife Avoidance and Interaction Plan would be implemented to reduce potential collision mortality. Section 3.4.11.1.2.5 Birds also discusses bird collisions with vessels and states. Table 3.4.10-1 states vessel, motor vehicle, and aircraft procedures would be implemented to reduce the potential for collisions with birds would be adopted.
USFWS	9/26/2016	Access to human garbage can also inflate populations of predators, such as ravens and fox, which can have a significant impact on reproductive success of nesting birds, and consequently on bird populations. See also language used for this section in 3.4.10.2.1.2, which may be included here. This comment applies to any other sections that discuss waste management and impacts to wildlife (for both Construction and Operation).	See revised text in Sections 3.4.10.2.1.1 and 3.4.10.2.1.2. Section 3.2.7.1.8 also discusses potential impacts to wildlife from waste.
USFWS	9/26/2016	This table is specific to geese and trumpeter swans, so the title should not be, “Bird Habitats within 1 Mile of Pipeline Construction Camps.” Many other birds can be found using habitats in this area, and those birds and their important habitats are not represented here. We are not sure why geese and swans are the focus here and in similar tables throughout the discussion of impacts (for both Construction and Operation), as these birds are not more abundant, more sensitive, or of greater conservation importance than many other birds that would be impacted by the proposed project. Please make it clear why they are highlighted here and elsewhere throughout the impacts discussion, and change all table titles/expand discussions as appropriate.	The table title has been revised. The Applicant does not have comparable data for other bird species, but other birds species are considered, e.g., Table 3.4.10-13.
USFWS	9/26/2016	Suggest changing second sentence under Traffic (Land and Air), wildlife to: “Low-level flights over nesting birds can be disruptive, especially to colonial-nesting waterfowl and seabirds.” A similar change should be made in other relevant sections in the Construction and Operation impacts discussions.	Section 3.4.10.2.1.1 has been revised as suggested.

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USFWS	9/26/2016	Potential effects of spills should be minor and short-term if spills are on land and small. However if spills come into contact with the marine environment, they will be harder to contain and clean up, and impacts could be significant. Please discuss spills, including large spills, in the marine environment (or reference another section where this is discussed). This comment applies to similar sections throughout this impact discussion (both Construction and Operation), if there is a marine nexus. Sensitive Wildlife Habitat Areas should include areas that could be impacted by this segment of the Project. Since fuel would be transported to and temporarily stored at Badami, this includes at least the Beaufort Sea Nearshore IBA and possibly also the Northeast Arctic Coastal Plain IBA. This comment, modified as necessary, applies to similar sections throughout this impact discussion (for both Construction and Operation).	In Section 3.4.10.2.1.2 PBTL and PTTL, the Spills text has been revised to include discussion of impacts from spills to marine environments, including the Northeast Arctic Coastal Plain IBA and Beaufort Sea Nearshore IBA, that could occur during fuel transfers or storage at Badami during PTTL construction. A discussion of spill impacts to wildlife and marine mammals is also provided in preceding Section 3.4.10.1.10 Spills and the Spill Prevention, Control, and Countermeasure (SPCC) Plan (Appendix M in Resource Report No. 2).
USFWS	9/26/2016	This table acknowledges that material sites would be located within two Important Bird Areas. Material sites represent a substantial loss of habitat and are a source of ongoing disturbance. The Service requests AK LNG consider alternate sources for material whenever practicable, so as to protect the important bird resources these IBAs host.	Preferred and alternate material sites are shown in Resource Report No. 6. Comments to specific material site use are welcome knowing that approximately 100 sites are required to build the Project.
USFWS	9/26/2016	While breeding habitat may not be limiting in the Beaufort Coastal Plain ecoregion, some habitats are much more limited than others. For species that rely on limited habitats for breeding or other critical life stages, loss of these habitats for construction of the GTP and associated infrastructure (or other project components, including in other ecoregions) could have a significant negative impact. The Service encourages AK LNG to avoid impacting these important, unique habitats (for example, dry, upland habitat types and Arctophila ponds and lakes in the Beaufort Coastal Plain ecoregion) to the maximum extent possible.	Comment noted: Alternative sites were considered for the Gas Treatment Plant (GTP). Selection of the GTP location, and the evaluation of alternative sites, are discussed in Section 10.5 in Resource Report No. 10. The current proposed location is preferred for a number of safety, engineering, regulatory, and environmental reasons. The Applicant would consult with the USFWS on types of mitigation measures that could be implemented to avoid impacts to these important unique habitats and would incorporate them into the Draft Aviation Protection Plan (Appendix E of Resource Report No. 3).
USFWS	9/26/2016	Tidal marsh habitats are used by brood-rearing and molting brant and other waterbirds for forage. Please add italicized words.	The text was removed because this statement was included in discussion of dredge disposal at West Dock, which is no longer proposed.
USFWS	9/26/2016	Mitigation for Vessel Traffic should include BMPs that address lighting on board vessels docked at West Dock or anchored offshore, so as to reduce	Marine Vessels at West Dock will be operating in summer during constant daylight, or near to it, so

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		avian collision risk. See previous lighting recommendations in RR 1-related comments.	the collision risk for birds and the efficacy of lighting on a vessel is low.
USFWS	9/26/2016	The USFWS (2012) lighting guidelines cited for mitigation for Facility Operation are not included in the reference list for RR 3. Please provide the reference so that we can ensure the project is using appropriate guidance for lighting design and operation.	See revised citations, and references.
USFWS	9/26/2016	Again, Sensitive Wildlife Habitat Areas should include areas that could be impacted by this segment of the Project. This includes at least the Beaufort Sea Nearshore IBA and possibly also the Northeast Arctic Coastal Plain IBA.	See the revised text in Section 3.4.11.2.1.2 . The Beaufort Sea Nearshore IBA and the Northeast Arctic Coastal Plain IBA have been added to Table 3.4.9-4. The Northeast Arctic Coastal Plain IBA is located more than 20 miles from theProject footprint (Table 3.4.9-4).
USFWS	9/26/2016	Sounds from equipment could affect waterfowl and other bird taxa within the zone of disturbance. Again, it is not clear why only waterfowl and trumpeter swans are the focus of this discussion and associated tables.	Trumpeter swans are the focus of this table because the Alaska Department of Fish and Game (ADF&G) lists the trumpeter swan as one of the Species of Greatest Conservation Need; BLM lists the trumpeter swan as an Alaska BLM Sensitive Species. Information was available for the trumpeter swan and geese/ducks. This information is not available for other species, therefore not added to the table.
USFWS	9/26/2016	Regarding the sentence that spans these two pg.s: Please note that we worry about birds in addition to eiders; and further, the location of the GTP and its elevated structures poses collision risk for breeding birds that make local movements from nest and brood-rearing sites to foraging sites, not just migrating birds. Therefore, the location of the GTP may reduce risk to birds migrating offshore. However the location is still considered coastal, and there remains a risk for local breeders and migrating birds, especially in periods of low visibility and inclement weather. This comment also applies to the section discussing flare stacks. We recommend placing flare stacks and lighted, elevated infrastructure (e.g. towers) as far from the coast as possible. We appreciate recognition that lighting (especially on raised towers and structures), guy wires, and overhead lines pose collision risk to birds. See the new FAA guidelines for lighting (12/04/15: http://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_70_7460-1L_.pdf) and the Service guidelines for communication towers (attached) and incorporate any additional recommendations from these reference documents into project design. Also include applicable guidelines as	Alternative sites were considered for the GTP. Selection of the GTP location, and the evaluation of alternative sites, are discussed in Section 10.5 in Resource Report No. 10. The proposed location is preferred for a number of safety, engineering, regulatory, and environmental reasons. It was identified early in GTP plot development that a northerly flare location from the GTP would be preferred because of the direction of prevailing winds. The flares have been located in a manner that minimizes radiant heat impacts on the facilities and minimizes potential downwind personnel exposure resulting from the prevailing wind direction. The location north of the GTP also eliminates the need to cross an existing road and pipeline to the south with flare lines.

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		BMPs and discuss these in the effects sections of this RR (this section and other relevant sections). Include those as references RR 3.	Mitigation measures and best management practices (BMPs) would be used to reduce collision risk. The new Federal Aviation Administration (FAA) guidelines and the USFWS guidelines have been reviewed, incorporated into the Avian Protection Plan where applicable and feasible, and have been cited. The incorporated guidelines are identified as mitigation measures where appropriate (e.g., Table 3.4.10.22 and in the impact analyses in Sections 3.4.10.2.2 and 3.4.11.2.2 in Resource Report No. 3).
USFWS	9/26/2016	There are waterfowl brood-rearing habitats near the GTP, in addition to the nesting habitats. These Arctophila waterbodies are considered a limited habitat type on the North Slope. Disturbance and displacement of nesting and brood-rearing birds due to noise and other sources of impact could represent more than a minor effect for some species, if suitable alternative habitat is not available.	Alternative sites were considered for the GTP. Selection of the GTP location, and the evaluation of alternative sites, are discussed in Section 10.5 in Resource Report No. 10. The proposed location is preferred for a number of safety, engineering, regulatory, and environmental reasons. The Applicant would consult with the USFWS on types of mitigation measures that could be implemented to avoid impacts to these important unique habitats and would incorporate them into the Draft Aviation Protection Plan (Appendix E of Resource Report No. 3).
USFWS	9/26/2016	Snow management – …"piles of snow on the edges of pads would delay access to wetlands for nesting birds." This would be a problem if snow was stored on the tundra. The Service recommends snow storage, as a result of on-pad snow plowing, occur only on pads. No snow should be stored directly on the tundra. On tundra snow storage will remove potential habitat for nesting birds, impact (delay) tundra plant growth, and impact the tundra with excess gravel from the pad.	The text in Section 3.4.11.2.2 has been clarified.
USFWS	9/26/2016	Designated critical habitat for the polar bear was reinstated by the 9th Circuit Court of Appeals on Feb 29, 2016	See Table 3.5.1-1 and Section 3.5.1.2.2 of Resource Report No.3.
USFWS	9/26/2016	Infrastructure and human activity do not necessarily make polar bear habitat unsuitable for denning, or discourage polar bears from attempting to den. Polar bears occasionally den very near human activity or even on industry infrastructure (e.g., During the denning seasons of 2000 to 2002, two active dens were located within approximately 0.4 km and 0.8 km of remediation activities on	The text in Section 3.5.1.2.2 has been revised.

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		Flaxman Island with no observed impact to the polar bears (Smith et al. 2007), in spring 2006, a female with two cubs emerged from a den 400 m from an active construction site river crossing, and in spring 2009, a female with two cubs emerged from a den within 100 m of an active ice road with heavy traffic and quickly abandoned the site).	
USFWS	9/26/2016	Please describe marine routes for vessel traffic with respect to listed and candidate species, and designated critical habitat. For example, would vessels need to enter designated critical habitat for spectacled eiders in Ledyard Bay, or the Hannah Shoal Walrus Use Area? Also add Pacific Walrus.	Figures and text have been updated to show that Ledyard Bay would be avoided. Ledyard Bay and the Hannah Shoal Walrus Use Areas are indicated on Biological Assessment figures such as Figure 17 (Walrus/Hanna Shoal) and Figure 21 (Spectacled Eider/Ledyard Bay) and potential for impact is discussed in the Biological Assessment.
USFWS	9/26/2016	With regard to spectacled eiders, please describe what is meant by “visual (colors) bird deterrents” and “implement nest-structure program in approved locations to deter nesting ”	Table 3.5.3-1 text has been removed to avoid confusion. The Applicant would consult with the USFWS on specific mitigation measures for inclusion into the Draft Avian Protection Plan (Appendix E in Resource Report No. 3).
USFWS	9/26/2016	Same comment as above regarding Alaska-breeding Steller’s eiders	Table 3.5.3-1 text has been removed to avoid confusion. The Applicant would consult with the USFWS on specific mitigation measures for inclusion into the Draft Avian Protection Plan (Appendix E in Resource Report No. 3).
USFWS	9/26/2016	List species presented in Table 3.5.3-2 in appropriate sections of 3.4. For example, the bird species listed in Table 3.5.3-2 should be included in Table 3.4.6-1. This comment also applies to Table 3.5.3-3. The columns in Tables 3.5.3-2 and 3.5.3-3 are a clear, concise way of preventing information. Since the tables have a good deal of overlap, consider combining them and using footnotes to denote whether they are BLM or USFWS species of concern. The ecoregions listed in Tables 3.5.3-2 and 3.5.3-3 do not seem to match the ecoregions discussed in 3.4 (and particularly in 3.4.6 for bird species). Please be consistent with treatment of ecoregions throughout this RR .	Table 3.5.3-2 is all BLM Sensitive and Watch List species and Table 3.4.6-1 lists only those found in the Arctic Tundra Ecoregion, so the lists should not be the same. Birds in Table 3.5.3-2 that are found in the Arctic Tundra Ecoregion are in Table 3.4.6-1. The tables have been cross-checked and fixed where warranted. Tables 3.5.3-2 and 3.5.3-3 have not been combined. The ecoregions listed in Tables 3.5.3-2 and 3.5.3-3 are those listed in Section 3.4.1; however, some revisions have been made throughout the document for consistency. Sometimes Level 2

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			ecoregions are named and sometimes Level 3.
USFWS	9/26/2016	The Service would appreciate an opportunity to review the PTU Bird Strike Avoidance and Lighting Plan before it is finalized.	Comment acknowledged.
USFWS	9/26/2016	Please remove owls from the list of birds that would depredate nests of other birds. Measures to reduce potential injury or mortality to birds would follow BMPs appropriate for the North Slope. Please reference where these BMPs are listed.	See revised Section 3.6.1.2.3.3; owls were removed from the list , and a reference added the Draft Avian Protection Plan in Appendix E of Resource Report No. 3 for the BMPs.
USFWS	9/26/2016	Measures to reduce potential injury or mortality to birds would follow BMPs appropriate for the North Slope. Please reference where these BMPs are listed.	A reference to the Draft Avian Protection Plan (Appendix E of Resource Report No. 3) has been added to Section 3.6.1.2.3.3.
USFWS	9/26/2016	"FERC, the action agency, has appointed the Project entity as its non-federal representative for purposes of carrying out informal consultation under the ESA." Is there written documentation of FERC's designation in the project record? Please define "Project entity." Because the proposed Project is likely to adversely affect listed species, formal (not informal) section 7 consultation will be required.	The Project entity will be AGDC in the FERC application. 18 CFR 380.13(b)(1) and the Memorandum of Understanding (MOU) signed between all federal agencies and FERC on their lead for conducting National Environmental Policy Act (NEPA) reviews under Section 3 of the Natural Gas Act (NGA) allows them to delegate the applicant as the non-federal representative. Letters to this effect initiating consultation with the National Marine Fisheries Service (NMFS) and the U.S. Forest Service (USFS) on October 27, 2014, are referenced in Appendix D of Resource Report No.1.
USFWS	9/26/2016	Designated critical habitat for the polar bear was reinstated by the 9th Circuit Court of Appeals on Feb 29, 2016	See text in Section 3.15.3 of the Biological Assessment (Appendix C of Resource Report No.3).
USFWS	9/26/2016	Please include Hanna Shoal Walrus Use Area on the Project Action Area in Figure 1.	See revised Figure 1 in the Biological Assessment (Appendix C of Resource Report No. 3)
USFWS	9/26/2016	"Should site preparation and/or construction activities occur during the summer on the tundra prior to July 31…" the summer nesting season on the North Slope begins on June 1 and typically runs through July 31" Suggested phrasing: Should site preparation and/or construction activities occur on the tundra between June 1 and July 31… Also, no protocol is identified in the event a nest is discovered, and the Service no longer recommends nest searches as an appropriate conservation measure.	See revised bullets in Section 2.10.4 of the Biological Assessment (Appendix C of Resource Report No. 3).
USFWS	9/26/2016	Updated polar bear abundance and trend data are available. Regarding the CBS polar bear stock: It has been difficult to obtain a reliable population estimate for this stock due to the vast and inaccessible nature of the habitat, movement of	The new information in this comment and other data will be incorporated into Section 3.12 of the Biological Assessment

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		bears across international boundaries, logistical constraints, and budget limitations (Amstrup and DeMaster 1988; Garner et al. 1992; Garner et al. 1998; Evans et al. 2003). However, the most recent estimate of the CS stock was approximately 2,000 animals, based on extrapolation of aerial den surveys (Lunn et al. 2002; USFWS 2010; Wiig et al. 2015). The current status and trend of the CS stock are considered unknown due to a lack of data. Regarding SBS polar bear stock: most recent estimate of SBS stock, which used an open population mark/recapture analysis, estimated a population size of approximately 900 bears in 2010 (90% C.I. 606-1,212; Bromaghin et al. 2015), down from a previous estimate of 1,526 bears (95% CI = 1,211; 1,841) in 2006 (Regehr et al. 2006). Available trend data suggests this stock has experienced varying periods of stability and decline over the past few decades. Little or no growth was observed during the 1990s (Amstrup et al. 2001). An overall population decline rate of 3% per year was reported from 2001-2005 (Hunter et al. 2007). Regehr et al. (2006, 2009) reported declining survival and recruitment from 2004 through 2006, which were years when summer and fall sea ice were reduced (NSIDC 2014). This led to a 25-50% decline in abundance, which was hypothesized to result from unfavorable ice conditions that limited access to prey, and possibly, low prey abundance (Bromaghin et al. 2015). For reasons not understood, survival of adults and cubs began to improve in 2007 (Bromaghin et al. 2015), which was a record low year for September sea ice (NSIDC 2007). Abundance was comparatively stable between 2008 and 2010.	(Resource Report No. 3, Appendix C).
USFWS	9/26/2016	Designated critical habitat for the polar bear has should be considered reinstated.	See text in Section 3.15.3 of the Biological Assessment (Appendix C of Resource Report No.3).
USFWS	9/26/2016	The text under the Subsistence heading for spectacled eiders discusses harvest of polar bears	Sections 4.1.4 and 4.2.3 contain no text regarding polar bears in the spectacled eider subsections.
USFWS	9/26/2016	Assuming and average density of 0.103 pairs/mi^2, loss of 6,616 acres would potentially represent nesting habitat for about one nesting pair….over what time period? 1 year? Has this estimate been extrapolated for the duration of field life?	Section 4.2.2.1 text has been revised to indicate that these impacts are annual for the duration the gravel pads are in existence.
USFWS	9/26/2016	The AMBCC reports an annual harvest of 0-392 (not 40-400), spectacled eiders per year on the North Slope. Most years, 0 harvested spectacled eiders are reported. Furthermore, harvest report data should be viewed with a degree of skepticism because their reliability is affected by a number of unquantifiable biases. Identified biases include sampling flaws or measurement error such as targeting unrepresentative households or villages, inaccurate recall by survey respondents, reluctance to report illegally-taken species,	Section 4.2.3.1 in the Biological Assessment (Appendix C of Resource Report No. 3) has been revised to indicate annual harvests vary from 0 to 392 with 0 occurring most years, and that harvest numbers are unreliable.

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		mischaracterization of fishing by-catch as hunting harvest, lack of detection of unrecovered killed or crippled birds, and errors in data collection (Huntington 2009, Omelak et al. 2009, Naves 2009a, USFWS 2010). Additionally, for rare species, survey coverage may not be adequate to detect harvest since it occurs at low levels, particularly in large villages. Further, the available harvest survey data contain considerable evidence of misidentification among species.	
USFWS	9/26/2016	Section 5.14.3 acknowledges that polar bears would be affected by expansion of the PTU but does not address how these impacts would affect polar bears or what measures would be taken to avoid or reduce impacts (e.g., limiting expansion of the PTU to the south and avoiding expansion to the east or west of the existing pad to facilitate less hindered movement of polar bears along their natural coastline travel corridor). The Service recognizes these are non-jurisdictional facilities, but for the proposed Project, expansion of the PTU would be unnecessary and therefore potential changes to these facilities should be addressed as interrelated and interdependent effects.	Potential effects of PTU expansion are addressed in Section 5.16.3 of the Biological Assessment (Appendix C of Resource Report No. 3).
USFWS	9/26/2016	The Service appreciates that communication towers would be designed without guy wires, and facility lighting would be downward shielded to reduce collision risk for migratory birds	Comment acknowledged.
USFWS	9/26/2016	The Service appreciates the Applicant's commitment to avoid use of overhead power lines.	Comment acknowledged.
USFWS	9/26/2016	How were the figures representing the estimated # of birds effected by construction and operations reached? Eider density*footprint? Do these estimates include the duration of field life (e.g., extrapolated over 30 or more years) or do they only represent a single season of construction and operations?	Table 19 has been revised to indicate these are annual impacts, and footnoted to indicate estimation method.
USFWS	9/26/2016	Section 5.18.3 acknowledges that spectacled eiders would be affected by expansion of the PTU but does not indicate to what degree these impacts would affect spectacled eiders. The Service recognizes these are non-jurisdictional facilities, however, but for the proposed Project, expansion of the PTU would be unnecessary and therefore potential changes to these facilities should be addressed as interrelated and interdependent effects.	Comment acknowledged. The Applicant has provided the information available from the Point Thomson Unit (PTU) and the operators of that Unit would be submitting permits associated with their expansion that will be reviewed by agencies at that time.
USFWS	9/26/2016	Section 5.18.5.2 This section states that vessel traffic associated with the project would not travel through, and would have no effect on, designated spectacled eider critical habitat, although Figure 1 indicates vessel traffic would transit through the Ledyard Bay Critical Habitat Unit (pg. 16).	Figures in the Biological Assessment (Appendix C of the Resource Report No. 3) have been revised to indicate the vessel route through the Chukchi Sea would avoid the critical habitat at Ledyard Bay.
USFWS	9/26/2016	Overall: The purpose of an APP is to delineate a program designed to reduce risks to birds, resulting	The Avian Protection Plan is a draft document to initiate

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		from interactions with facilities during construction and operation. Some of the ways facilities may impact birds are: noise and visual disturbance, habitat degradation and loss, habitat fragmentation, destruction of nests and/or eggs and young, collision risk (leading to injuries and fatalities), predator attraction (and predator population enhancement). These impact categories should be kept in mind. The overall goal of an APP is to reduce bird fatalities, provide mitigation for fatalities, and incorporate measures to reduce overall impacts (including to bird habitats). The APP as currently written is missing some key points, such as a discussion of impacts to bird habitats. It could be argued that impacts to habitat over the long-term could be more significant to bird populations than loss of one reproductive season. In revising this draft APP, pay particular attention to those impacts that may have long-term effects on productivity of a given bird population. We suggest the following sections may be a better way to more clearly organize this document: (1) overview of the regulatory framework relevant to migratory birds and listed species; (2) brief Project description; (3) summary of Project-specific bird issues (i.e. What aspects of the Project will birds interact with? What are the anticipated impacts before avoidance and minimization [list/discuss both lethal and non-lethal impacts]? How will important avian habitats be impacted?); (4) proposed avoidance and minimization measures incorporated into Project design, construction, and operations phases (for disturbance, fatalities, impacts to habitat, paying attention to longer- term); (5) discussion of a plan for post-construction mortality monitoring and reporting; (6) proposed mitigation for fatalities; and (7) outline of an adaptive management framework to evaluate and address potential, unanticipated impacts from the proposed project. As stated in our previous comment letter, the Service would be happy to work with the Applicant and FERC to produce a complete APP.	consultation by providing pertinent information for assessing impacts to avian species and designing and implementing mitigation measures. The Applicant has incorporated the suggested format, key elements, and categories and will continue to consult with USFWS and other subject matter experts until a final Avian Protection Plan has been drafted.
USFWS	9/26/2016	Please include habitat loss or degradation, release of petroleum products in the marine or coastal environment, overhead lines, guywires, and attraction of predators through improper waste handling or creation of denning/nesting/perching sites as concerns for migratory birds.	See revised text in Section 2.1.
USFWS	9/26/2016	The Service does not yet offer permits for incidental take of migratory birds. Please modify the last sentence of the second paragraph on this pg. to say, “An incidental take permit may be pursued with the USFWS prior to final permitting and construction of the Project, when regulations to authorize such take under the MBTA, and a process for permitting such take, are finalized.” An incidental take permit will require mitigation for said	The USFWS has issued a notice indicating it is interest in developing incidental take for Migratory Bird Treaty Act (MBTA) species and the Applicant would monitor the development of any rule-making in the context of the Project schedule.

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		take, which underlines the importance of discussing mitigation options with the Service (and including those in this document).	
USFWS	9/26/2016	Please modify list element (3) to be, “bird carcass handling, collection, and disposal.” Note, a permit is also needed to handle and transport injured birds.	See revised text in Section 4.1.
USFWS	9/26/2016	This list of risks to birds is not complete. Be comprehensive in the stated risks, even if some of these risks have already been mitigated through project design (e.g. guy wires or overhead lines). This is AK LNG’s chance to showcase what the Project is doing to be “bird-friendly”. Consider the categories of impact listed in the previous comment (comment for overall App.), and also pay attention to the long-term impacts to important habitats (which represents a risk of long-term reduction in productivity). Where risks have already been eliminated or minimized, through site or design elements, or BMPs, this can then be explained in relevant sections. For example, please include habitat conversion or degradation (both temporary and long-term) and temporary construction lighting as construction “activities” that have been identified as potential project risks to birds; list overhead lines, guywires, lighting on docked or anchored marine barges and vessels, and attraction of predators as potential risks for migratory birds at project facilities. Operations risks are not listed here. Please include a list for risks to birds from Project operation, including release of petroleum products in the marine/coastal environment and noise associated with the GTP. Helicopter overflights are another source of operations risks, as they have potential to disturb birds regularly over the life of the Project. If borrow sources will be used for maintenance as well as construction, or be left open for other users, these are also sources of longer-term disturbance that should be recognized and mitigated for.	See revised text in Section 4.3.1.
USFWS	9/26/2016	As previously stated, some disturbances (e.g. blasting) could disturb eagles well outside of the Project footprint. As requested in previous discussions with the Service, please identify raptor nests within 2 miles of the proposed Project, in those areas with high eagle use/nest density or in areas with a permanent facility or long-term disturbance. Section 4.3.2.2 should be updated accordingly. To which geographic area of Alaska do the dates for bald eagle nesting (given in Table 5) apply? Please provide this information, with the caveat that bald eagle nesting periods vary by latitude.	Surveys were conducted per USFWS-recommended survey methods; see methods description in reports for raptor surveys in Appendix M (Wildlife Survey Reports) of Resource Report No. 3. The referenced 0.5 mile dimension was the limits of the GIS analysis, and Table 3.4.6-6 footnotes were revised to clarify this.. Table 4 in Appendix E does identify nests out to a distance of 2 miles as indicated in footnote b. Table 5 has been revised to show the different nesting periods for specific geographic areas in Alaska.

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USFWS	9/26/2016	Table 4.3.2.3, discussing trumpeter swans, may not be necessary. This species does not have a special status compared to other migratory bird species, and therefore surveys for this species are not required. If there is a reason for including this specific information for trumpeter swans (but not tundra swans or other birds), please be explicit.	ADF&G lists the trumpeter swan as one of the Species of Greatest Conservation Need; BLM lists the trumpeter swan as an Alaska BLM Sensitive Species. This is indicated in the table footnotes.
USFWS	9/26/2016	The two bullet points listed under 4.3.3 Operations Risks are not actually operations risks. These read more like Best Management Practices that would be undertaken to reduce risk. This section should describe ongoing risks to birds as a result of operations activities (e.g. collisions from light attraction, noise disturbance, helicopter flights).	Section 4.3.3 has been deleted and text regarding operational risks has been added to Section 4.3.1 of the Draft Avian Protection Plan (Appendix E of Resource Report No. 3).
USFWS	9/26/2016	Please modify the first bullet point to say, "Apply the most current USFWS timing window guidelines…" adding the italicized words. Please update Table 8 to reflect the current recommended periods to avoid ground disturbing activities. The updated periods are included in an email attachment.	Bullet points in Section 4.4.1 and Table 8 have been revised.
USFWS	9/26/2016	Please check that the lighting recommendations in Table 9 follow the most recent FAA guidance. Please include additional Service recommendations for facility lighting (provided in previous comments).	Section 4.4.1 of the Draft Avian Protection Plan (Appendix E of Resource Report No. 3) has been updated referencing the most recent FAA guidance on towers and tower lighting.
USFWS	9/26/2016	Please consider retitling this section as, "Best Management Practices," or something else that shows AK LNG is committing to these proposed measures as methods for avoiding and minimizing Project impacts. Make the introductory statement for this section reflective of this commitment (this is not just what the Service recommends, but what AK LNG will do). This same comment applies to the titles and intros for 4.4.2.1 and 4.4.2.2.	The title of Section 4.4.2 has been changed from Recommendations to Mitigation Measures, and the introductory text has been modified to indicate that these are measures that would be implemented.
USFWS	9/26/2016	As previously stated in this matrix and in prior communications from the Service, although AK LNG and the Service agreed that a survey distance of 0.5 miles could be used along some of the pipeline, this is not the recommended survey distance for raptor nests for the entire length of the pipeline. There are areas where survey distance should be expanded to 2.0 miles on either side of the ROW/facilities footprint.	Surveys were conducted per USFWS-recommended survey methods; see methods description in reports for raptor surveys in Appendix M (Wildlife Survey Reports) of Resource Report No. 3. The referenced 0.5 mile dimension was the limits of the GIS analysis, and Table 3.4.6-6 footnotes were revised to clarify this.
USFWS	9/26/2016	The source for the information for Table 10 should be cited. Assuming this is from USFWS 2007, please note that guidance applies to bald eagles only. National buffer guidance for golden eagles is not available, and recommended distances should be discussed with the Region 7 Migratory Bird Management Program Raptor Biologist. Likewise, the information in Table 11 is not specific to Alaska,	The USFWS source has been added to Table 10. The buffer distances would be updated after consultation with a Region 7 Migratory Bird Management Program Raptor Biologist. Table 11 has been revised to indicate it is not specific to Alaska,

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		and AK LNG should discuss recommendations with the Region 7 Raptor Biologist.	and would be updated after consultation with a Region 7 Migratory Bird Management Program Raptor Biologist.
USFWS	9/26/2016	This is an appropriate place to discuss mitigation proposed for the Project. This mitigation component, a key element of an APP, is currently missing from the draft presented in App. E.	The Avian Protection Plan is a draft document to initiate consultation by providing pertinent information for assessing impacts to avian species and designing and implementing mitigation measures. The Applicant has incorporated the suggested format, key elements, and categories and will continue to consult with USFWS and other subject matter experts until a final Avian Protection Plan has been drafted.
USFWS	9/26/2016	The Service would like an opportunity to review and comment on the results of AK LNG's annual reviews of the APP. We may be able to offer suggestions that would enhance the protectiveness of this plan.	Table 11 has been revised to indicate it is not specific to Alaska, and would be updated after consultation with a Region 7 Migratory Bird Management Program Raptor Biologist.
USFWS	9/26/2016	The Service would like an opportunity to review and/or help develop proposed Best Management Practices (related to the MBTA and BGEPA) before they are considered final.	Comment acknowledged. The Applicant has consulted with the Service on BMPs for the final draft of the Avian Protection Plan and would continue to consult as required on the Avian Protection Plan during Project construction and operation phases as requested (Appendix E, Resource Report No. 3).
USFWS	9/26/2016	We appreciate the development of this App. to address invasive species concerns and offer the following additional comments for App. K. The document lists a lot of non-native weeds; many are invasive, and many are not. Implementing costly prevention and control measures on low ranking species such as lamb's quarters (rank 37), while this would be a valuable practice in very pristine areas, it may become onerous when low-ranking common weeds are included in prevention and control measures. We have concerns this may result in less overall management for invasive species. To minimize becoming overwhelmed with controlling every invasive species in the project area, we suggest using a ranking floor that can be used to differentiate between species that trigger action and those that do not. We suggest a ranking floor between 60 and 70, to focus implementing prevention and control measures for any species that ranks higher than 60, for example. Exceptions to this cut off (ranking floor) could include cleaning equipment, which should be required for all project	See revised text in Section 4.1 of Appendix K of Resource Report No. 3.

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		operations. (Graziano, G. 1 September 2016. Pers. Comm.)	
USFWS	9/26/2016	Please address plans to prevent spread of invasives during winter construction.	The Applicant will address this comment prior to issuance of the Draft Environmental Impact Statement (DEIS).
USFWS	9/26/2016	3rd Bullet: In addition to others areas in Alaska, invasives can also be transported from other states	See revised bullet in Section 3.1 of Appendix K.
USFWS	9/26/2016	White sweet clover also can impair riparian areas/floodplains.	Comment acknowledged. See revised text in Section 3.2 of Appendix K.
USFWS	9/26/2016	Cleaning stations should be monitored and treated to prevent spread from the cleaning station into other areas of the project.	Comment acknowledged. See revised text bullet in Section 3.3 of Appendix K.
USFWS	9/26/2016	Last paragraph. A monitoring program should be established. Long-term monitoring is critical especially for long linear projects that cross previously undisturbed areas.	See Section 3.3 of Appendix K and Section 2.4 of the Restoration Plan (Appendix P of Resource Report No. 3).
USFWS	9/26/2016	Add aircraft to this list as helipads can be a vector.	See revised text in Section 4.2.1 of Appendix K.
USFWS	9/26/2016	Contractors should also be trained on equipment cleaning as plant parts can get trapped in tiny spaces on equipment. The University of Alaska at Fairbanks Cooperative Extension Service recently released a free online training titled, “Controlling Invasive Plants in Alaska”. This may be a good training for the Project and its contractors and can be found at: https://weedcontrol.community.uaf.edu/	Thank you for your comment and information. See Section 8.0 of Appendix K.
USFWS	9/26/2016	Removing the top 6 inches at an infested site, and then replacing it back on site is an acceptable practice, however some species will warrant disposal of the soil, and still others in certain situations may require more depth to remove rhizomes. For example, removing the top 6 inches might be ineffective for some older material sites that are infested with white sweet clover. Undoubtedly, treatment applications will vary and should be in accordance with inspector recommendations. (Graziano, G. 1 September 2016. Pers. Comm.)	See revised text in Appendix K Section 4.2.3...
USFWS	9/26/2016	Inspections of these sites for invasive weeds should follow the weed free gravel inspection standards: http://plants.alaska.gov/invasives/weed-free-gravel.htm . Ideally, and according to the standards, these inspections are done by someone without a financial interest in the gravel material to be used.	The Applicant will address this comment prior to issuance of the Draft Environmental Impact Statement (DEIS).
USFWS	9/26/2016	"Seed mixtures used to revegetate exposed soils could contain noxious/invasive plant seeds. However, mixtures have a maximum allowable weed seed limit." Noxious is a legal term. Presently, there is a species on the Alaska Noxious Weed Seed List labeled as prohibited which has no	Comment acknowledged. The comment will be addressed during finalization of the invasive species plan.

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		maximum allowable tolerance. (Graziano, G. 1 September 2016. Pers. Comm.)	
USFWS	9/26/2016	We appreciate recognition of state regulations for a rat spill response plan. Please also recognize it is the Project's responsibility to communicate with harbor masters (West Dock and Cook Inlet for this project) and other receiving facilities to ensure their abilities to effectively deal with a rat spill.	Comment acknowledged. The comment will be addressed during finalization of the invasive species plan.
USFWS	9/26/2016	Last paragraph: App. A of which RR?	The text refers to Appendix A of the Noxious / Invasive Plant and Animal Control Plan (Appendix K of Resource Report No. 3). Text has been clarified..
USFWS	9/26/2016	The University of Alaska at Fairbanks Cooperative Extension Service recently released a free online training titled, "Controlling Invasive Plants in Alaska". This may be a good training for the Project and its contractors and can be found at: https://weedcontrol.community.uaf.edu/	Comment acknowledged. See Section 8.0 of Appendix K.
USFWS	9/26/2016	This document seems to refer to an older iteration of the Project. Please update the text to reflect that the data was collected for the Alaska Pipeline Project but is now being used to inform the current AK LNG Project, as proposed in the 2016 RR s. Also note that it appears this report in its entirety is repeated again later in the App. (twice at least). We reviewed and commented on the first appearance of this information. Please apply these comments as appropriate to the most recent version of the Raptor Report (2015?).	Comment acknowledged; however, these are historical reports and no changes have been made. The excess report has been removed.
USFWS	9/26/2016	Owls are birds of prey, but they are not technically raptors. Please change the title of section 1.1.3 and other language to be, "raptors and owls," or, "birds of prey."	Comment acknowledged. "Raptor" is not a scientific term and is defined variously to include owls and vultures. The referenced report is a historical report that should not be altered in response to your comment.
USFWS	9/26/2016	Table 1-1: The information presented in the Nesting Habitat column is really more information about the Nest Site and Use. This information should be retained, but consider providing a third column with information that indicates species' breeding range (in Alaska) and habitat requirements (e.g. bald eagles will be found nesting near large bodies of water, including lakes, rivers, and oceans).	Comment acknowledged; however, these are historical reports and no changes have been made.
USFWS	9/26/2016	Note that the period of sensitivity is based around the breeding season, which varies by species and latitude (in addition to factors such as nest site and weather). However, the Service identifies the main nesting period of raptors as March 1 to Aug 31 for the entire state. We also note that owls may be nesting up to two months earlier. Please indicate that raptors may be affected by noise and visual disturbance during both construction and operation. Include noise from the GTP or	Comment acknowledged; however, these are historical reports and no changes have been made to the reports. For impacts to nesting birds, see bird subsections under Section 3.4.10 of Resource Report No. 3.

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		compressor stations as a potential source of disturbance. Peregrine falcons nesting in remote locations tend to be more sensitive to human disturbance than what? Peregrines in non-remote locations?	
USFWS	9/26/2016	Protection of habitats important to migratory birds is a component of Migratory Bird Treaty Act (MBTA). MBTA implements the Convention for Protection of Migratory Birds of 1916 (among others), which imposes an obligation on U.S. to conserve both migratory birds and their habitats. Habitats upon which migratory birds depend are also afforded explicit protection under Executive Order 13186 which compels each agency to, "(1) support conservation intent of migratory bird conventions by integrating bird conservation principles, measures, and practices into agency activities and by avoiding or minimizing, to the extent practicable, adverse impacts on migratory bird resources [defined as migratory birds and the habitats on which they depend] when conducting agency actions; (2) restore and enhance the habitat of migratory birds, as practicable; and (3) prevent or abate pollution or detrimental alteration of the environment for the benefit of migratory birds, as practicable." (Migratory bird resources means) The Service considers access to suitable nesting habitat is a possible limiting factor for populations of cliff-nesting raptors. Therefore, loss of a nest site (e.g. directly, due to Project footprint, or indirectly, due to disturbance) has potential to impact long-term productivity of a breeding pair and/or a population. The Service expects that impacts to important bird habitats, including degradation or destruction, will be identified and analyzed. We would like to see impacts to nesting habitats of cliff- nesting raptors minimized and avoided to the maximum extent practicable. Habitat restoration or enhancement may be a component of the mitigation identified as appropriate for the Project's Avian Protection Plan.	Comment acknowledged. The pipeline route avoids steep elevation changes (cliffs). There are no anticipated physical impacts to cliffs suitable for nesting raptors. Per the MOU on migratory birds between the USFWS and FERC, FERC must engage in consultation with USFWS and must direct applicants to jointly develop mitigation measures with the USFWS.
USFWS	9/26/2016	The USFWS Birds of Conservation Concern lists the peregrine falcon for BCRs 3 and 4. This should be discussed somewhere in section 1.1.4, since both BLM and State of Alaska lists are discussed.	Comment acknowledged. However, these are historical reports and no changes have been made to them. Bird Conservation Regions (BCRs) (and peregrine falcons) are discussed in Section 3.5.2 and Table 3.5.2-4 in Resource Report No. 3.
USFWS	9/26/2016	The use of visual buffers (e.g. taking advantage of local topography) and consolidating the zone of disturbance (e.g. requiring helicopters to travel strictly within the pipeline right-of-way, including during return flights after routine inspections) may be other ways to minimize disturbance to raptors. Best Management Practices should apply to operations, as well as construction, especially	Comment acknowledged. The Applicant would consult with the USFWS through the Environmental Impact Statement (EIS) period to complete the development of mitigation measures and BMPs.

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		because impacts resulting from operations may have a longer-term effect.	
USFWS	9/26/2016	The buffers discussed here were developed for bald eagles. Golden eagles are generally thought to be more sensitive to disturbance than bald eagles. Buffers appropriate for minimizing disturbance to golden eagles should be identified through discussions with the Region 7 Migratory Bird Management Program Raptor Biologist.	The Applicant will consult with the Region 7 migratory bird specialist and will update the APP accordingly.
USFWS	9/26/2016	The 535 raptor nests identified within the APP study corridor represent historical nesting sites. These nests indicate likely habitat in which contemporary nests of raptors may be found, but this information is not considered adequate for identifying opportunities to avoid and minimize take of raptors and their nests. It therefore need to be supplemented with current survey information, conducted according to protocols identified in discussions with the Service; and this contemporary information would need to inform Project design and siting, so as to avoid and minimize impacts to raptor nests, before the Service would consider an application for an eagle take permit. Therefore, Section 3.0 needs to be updated to reflect the historical nature of the data being discussed here. Additionally it should be noted that for some species, number of nests do not equate to number of territories/breeding pairs that would be affected by construction. For example, as previously mentioned, a golden eagle pair may have one active nest and multiple alternative nests within a single territory.	Comment acknowledged. However, the reports in Appendix M are historical reports, and will not be changed. There are three raptor survey reports in Appendix M (2011, 2012, and 2015). The 2011 and 2012 reports are reviews. The 2015 reports are actual aerial surveys along the route. Section 3.4.6.3 of Resource Report No. 3 discusses the occurrences of raptor nests along the pipeline route and has been revised to reflect what is historical and what is survey data. The Applicant would consult with USFWS prior to applying for an eagle take permit.
USFWS	9/26/2016	Although it is stated construction of the mainline would not directly result in loss of known eagle nests, disturbance to a nesting pair as a result of construction or operations is also considered take.	Comment acknowledged. No change was made to the Appendix M reports because those are historical reports. Nest locations have been reviewed with respect to construction season and proximity and potential impacts are addressed in Resource Report No. 3.
USFWS	9/26/2016	The Service agrees that surveys should be conducted prior to construction, to provide detailed, up-to-date raptor nest location data. These surveys should follow protocols developed in discussions with the Service. If raptor nests are discovered that would be directly impacted by the proposed Project, AK LNG should make every practicable effort to site Project components away from nests. For example, can the construction yard area at Mile Post 244 (Sheet 013 in App. M) be moved away from the hawk nest, if it is still present in this location (same with the construction yard near the eagle nest at MP 448 (Sheet 024)? Similarly, we would suggest that alternate routes that would bring the pipeline into closer proximity to nests (e.g. the hawk nest at MP 291 on Sheet 016) be	Nest locations would be reviewed with respect to construction seasons to determine potential for impacts. Some nests would not be impacted because work would be completed in the winter. The Applicant would consult with the USFWS through the EIS period.

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		eliminated from consideration, unless doing so would result in more severe impacts. (We understand the Project has been refined since these 2012 maps; however, the same principals apply to the current iteration of the Project routing/siting.) What is the planned timeline for consulting with the Service on the development of a Migratory Bird Conservation Plan?	
USFWS	9/26/2016	The Service would appreciate the opportunity to review the Restoration Plan prior to the public review period.	A draft plan (Appendix P of Resource Report No. 3) has been prepared that will be reviewed with agencies.
FERC	11/16/2016	The following commitments were made by AKLNG in resource report as information to be provided or pending in response to previous comments made by FERC or other agencies. If the information will not be included in the application as indicated by Alaska LNG, provide a schedule for when it will be filed with FERC or provided to the requesting agency as applicable.	See responses to subparts a-o of this comment below.
FERC	11/16/2016	a. Vessel fuel capacities and analysis.	The Applicant will address this comment prior to issuance of the Draft Environmental Impact Statement (DEIS).
FERC	11/16/2016	b. Describe the facility lighting at the Gas Treatment Plant (GTP), Liquefied Natural Gas (LNG) Plant, and other aboveground facilities during construction and operation. As appropriate in Resource Report 3, discuss the existing conditions and the impact of facility lighting.	Appendix O of Resource Report No. 8 provides a preliminary lighting plan. Detailed plans would be prepared prior to construction.
FERC	11/16/2016	c. Determine life stages and seasonality of invasive species present in the Project area. Indicate the temperatures in which these invasive species can survive. Include descriptions of each invasive species that occur and map(s) of occurrences in the vicinity of the Project area. (Agency Comments and Requests for Information Concerning Project Description table, page 3 xxxix; section 3.2.5, tables 3.2.5-1 and 3.2.5-2, page 3- 27)	See available information on temperatures in Table 3.2.6-1 and in subsections of Section 3.2.6.1. Ranges are provided in Figure 3.2.6-1.
FERC	11/16/2016	d. Describe information on overwintering habitats (e.g., buildings that may be proximate to Project activities) of little brown myotis in Alaska available from the Alaska Department of Fish and Game (ADF&G) and the Alaska Bat Monitoring Program. (Agency Comments and Requests for Information Concerning Project Description table, page 3-x1vi; section 3.4.4.1, paragraph 27, page 3-104)	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process
FERC	11/16/2016	e. Complete tables 3.1.3-1 and 3.1.3-2.	Tables 3.2.3-1 and 3.1.3-2 in Resource Report No. 3 have been updated. Also see Appendix D in Resource Report No. 1.
FERC	11/16/2016	f. Updates on the streams crossed by the Project that contain fish and their seasonal distribution.	Additional surveys are not planned, no updates are required.
FERC	11/16/2016	g. Include sediment sampling and analysis results, including site-specific sediment sampling and	See revised text in Section 3.2.7.1.5 of Resource Report and

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		analysis results, and the potential impacts based on these results.	sample analyses in Appendix Q of Resource Report No. 2.
FERC	11/16/2016	h. Vessel Strike Analysis and Whale Strike Risk Analysis.	A vessel strike analysis is attached to Appendix C (Biological Assessment) to Resource Report No. 3.
FERC	11/16/2016	i. Incorporation of the ADF&G's updated Wildlife Action Plan.	See Section 3.5.2.3.1.2 of Resource Report No. 3.
FERC	11/16/2016	j. Appendix B – Project Vegetation Resources.	Mapping of vegetative resources is provided in Appendix B. Field study reports are provided as an appendix to Resource Report No. 2 (combined with wetland delineation reports).
FERC	11/16/2016	k. Appendix J – Wildlife Avoidance and Interaction Plan.	This Plan will be an outline until permitting is completed with appropriate regulatory agencies. Alaska LNG will address this comment after the FEIS (Final Environmental Impact Statement) but prior to construction start
FERC	11/16/2016	l. Appendix N – Marine Mammal Mitigation and Monitoring Plan.	A complete and detailed Marine Mammal Mitigation and Monitoring Plan would be submitted with applications to NMFS and the USFWS for Incidental Take Authorizations. It would be finalized with issuance of the authorizations because agencies may add permit conditions.
FERC	11/16/2016	m. Appendix O – Subsistence Plan of Cooperation.	This Plan will be an outlined until permitting is completed with appropriate regulatory Alaska LNG will address this comment after the FEIS (Final Environmental Impact Statement) but prior to construction start agencies.
FERC	11/16/2016	n. Appendix P – Project Restoration Plan.	The Draft Restoration Plan is provided in Appendix P of Resource Report No. 3.
FERC	11/16/2016	o. Appendix Q - Vegetation Study Reports.	Vegetation field reports were combined with wetland delineation reports; please see Resource Report No. 2
FERC	11/16/2016	Include correspondence with ADF&G regarding coordination of activity impacts and recommended mitigation measures for Game Management Units.	This will be provided after permitting.
FERC	11/16/2016	Clarify whether operational impacts are also included in totals for construction impacts in all tables.	Operational totals are tallied separately.
FERC	11/16/2016	Include website links to and/or copies of all citations used in Resource Report 3.	Alaska LNG will address this comment prior to the initiation of

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			the EIS (Environmental Impact Statement) process
FERC	11/16/2016	Use most recent, available information for data sources. For example, confirm that there is not newer data from ADF&G for the following:	The Project has attempted to find and utilize the most recent information available in the public domain.
FERC	11/16/2016	a. brown bear habitat;	See above
FERC	11/16/2016	b. caribou habitat;	See above
FERC	11/16/2016	c. Dall sheep habitat;	See above
FERC	11/16/2016	d. moose habitat; and	See above
FERC	11/16/2016	e. muskoxen habitat.	See above
FERC	11/16/2016	Clearly identify the Project design life and individual component/phase/pertinent activity durations within the introductory Project Description section.	The Project introduction in each Resource Report is a summarized version of the detailed Project description found in Resource Report No. 1. The design life is coincident with the Department of Energy license term of 30 years.
FERC	11/16/2016	Elaborate on the intensity of impacts on assessed resources, particularly with regards to the definitions of duration (temporary, short-term, and long-term) (section 3.1-2, page 3-5). Include a section on direct habitat losses associated with the footprint of all in-water infrastructure. Additionally, all impacts associated with infrastructure located above water should be discussed, including lighting and shading effects, behavioral effects, and contamination/spill risks from activities occurring above water.	The Applicant will address this comment prior to issuance of the Draft Environmental Impact Statement (DEIS).
FERC	11/16/2016	Include a discussion on the seasonal migrations of fish species that occur between small tributaries that freeze to the bottom (and indicate where these occur) and adjacent lakes, rivers, etc. for overwintering. Add, as appropriate, to the species summaries provided in table 3.2-1.	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process
FERC	11/16/2016	Provide clarification for table 3.2-1 as indicated below.	See responses below.
FERC	11/16/2016	a. The table is named "Non-Anadromous Freshwater Fish Occurring within the Project Area"; however, anadromous species are also included.	See revised text in Section 3.2 and footnotes to Table 3.2-1.
FERC	11/16/2016	b. Include a separate column that clearly indicates life history strategy. If life history strategies were not included due to lack of Project interaction with the anadromous life form, include a discussion on how it was confirmed that these strategies are not affected by Project components.	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process
FERC	11/16/2016	Include the basis for including or excluding species-related information in table 3.2-1.	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process
FERC	11/16/2016	Section 3.2.2 states that the "fisheries discussion are based primarily on river drainages within these ecoregions and the Project area is defined generally throughout this report to describe the	Alaska LNG will address this comment prior to the initiation of

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		regions and watersheds within which Project components would be constructed." Clearly describe the primary differences between these ecoregions with respect to fisheries. For example, North Slope watercourses/waterbodies have unique considerations; most watercourses/waterbodies freeze to the bottom during winter unless they are deep (greater than 3 meters deep).	the EIS (Environmental Impact Statement) process
FERC	11/16/2016	Footnote "a" within table 3.2-2 defines species that "may occur as anadromous and resident populations within the same drainage system." Currently, only least cisco, rainbow trout, and Dolly Varden are shown to fall under this definition. Include an explanation as to why species such as lake trout, broad whitefish, humpback whitefish, longfin smelt, ninespine stickleback, etc. have not been included under this definition when they can all exhibit an anadromous life history strategy. Some of these species were indicated as being anadromous in tables 3.2-1 and 3.2.1-1; thus, consistency should be maintained throughout all documents.	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process
FERC	11/16/2016	Elaborate on what is meant by "sufficient flow" in the following statement: "To date, most streams crossed by the Project that appear to have sufficient flow to support fish and those that do not have documented fish presence information have been surveyed for fish and habitats by the Project."	See revised text in section 3.2.1
FERC	11/16/2016	Section 3.2.1 states "The most sensitive period for North Slope fish occurs during winter when the majority of rivers and ponds freeze solid. Locations deep enough to maintain unfrozen water with adequate dissolved oxygen levels for fish overwintering are most sensitive to perturbation. Riverine overwintering pools are most sensitive, and typically contain the highest densities of fish when compared to ponds and lakes used for overwintering." Given that waterbodies may freeze to the bottom, include a discussion on inward and outward migration patterns that characterize the early and late phases of the open-water season.	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process
FERC	11/16/2016	Update table 3.2.1-1 to include all new information from the 2016 Waters Important to Anadromous Fishes, by reviewing the Atlas to the Catalog of Waters Important for the Spawning, Rearing, or Migration of Anadromous Fishes and the Catalog of Waters Important for the Spawning, Rearing, or Migration of Anadromous Fishes (Atlas and Catalog).	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process
FERC	11/16/2016	Summarize in tabular format the subsistence, commercial, sport, and personal use fisheries discussed in the text.	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process

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FERC	11/16/2016	Include more recent reference and information regarding fish species and stocks present in North Slope Alaskan Region.	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process
FERC	11/16/2016	Include more recent reference and information regarding salmon dynamics on the Susitna River.	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process
FERC	11/16/2016	Include representative sockeye salmon spawning timing for Project areas. Furthermore, it should be indicated whether kokanee (i.e., landlocked Sockeye salmon) are present in the Project area.	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process
FERC	11/16/2016	Indicate the number of water crossings intersected by Project infrastructure with emphasis on salmon stocks of concern.	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process
FERC	11/16/2016	Describe migration periodicity for species migrating between overwintering habitat and spawning/rearing habitat.	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process
FERC	11/16/2016	Include a life history periodicity table and habitat preference to summarize available information on marine fish species not included in the Essential Fish Habitat Assessment. This will facilitate the assessment of potential interactions between Project activities/infrastructure and species.	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process
FERC	11/16/2016	Include a list of fish sizes that include “small.”	There is no language in Section 3.2.4.1 for small fish. Fish species are listed. The term small fish in Section 3.2.4.2.7 has been defined.
FERC	11/16/2016	Include the number of habitat areas of particular concern that are included within the Project area or that have the potential for being affected by Project-related activities.	There are no designated Habitat Areas of Particular Concern (HAPCs) in the Project area. See text on this matter in Sections 3.2.5.1 and 3.2.5.2 in Resource Report No. 3.
FERC	11/16/2016	Include a description of how flow would be affected during water withdrawal from the waterbodies used as water sources for construction of the Mainline and Point Thomson Gas Transmission Line (PTTL).	Please see Water Use Plan in Resource Report No. 2. Water use permitting will be completed prior to construction. In the permitting process, ADF&G and/or ADNR will dictate the water volume and withdrawal rates to protect water rights and fish populations.
FERC	11/16/2016	Include a description of how seasonality would affect different crossing methods. Provide clarification that individual species requirements are considered during development/application of best management practices (BMPs) (i.e., no spawning gravels at site of isolation cuts).	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process
FERC	11/16/2016	Include the following in table 3.2.5-1:	See responses to subparts below:

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FERC	11/16/2016	a. a cross reference to the appropriate section where the reader can find a description of each of the four waterbody crossing methods; and	See revised text in section 3.2.5
FERC	11/16/2016	b. anticipated losses (temporary and permanent) of proposed crossing structures including riparian habitat.	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process
FERC	11/16/2016	Table 3.2.5-2 includes “Milepost” within a column heading, however no mileposts are included. Provided milepost data where relevant.	See revised Table 3.2.5-2.
FERC	11/16/2016	Expand table 3.2.5-3 to include all waterbodies potentially affected by Project infrastructure.	The information is provided by NOAA Fisheries into regional management areas, other waterbodies are not included in the Salmon FMP.
FERC	11/16/2016	Include a column in table 3.2.5-2 that describes the type of marine benthic habitat that would be lost (e.g., soft sediment, boulder patch, algal bed, etc.).	See revised (column added) Table 3.2.5-2.
FERC	11/16/2016	Section 3.2.5.1.1 states “There are no cataloged anadromous waters in the immediate vicinity of the Liquefaction Facility (Johnson and Litchfield, 2015c).” Define “immediate vicinity.” Discuss the potential for sediment and other material to reach anadromous waters from construction of the facility or use of access roads for construction and what measures would be implemented to avoid or minimize those potential impacts.	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process
FERC	11/16/2016	Include a subsection within Resource Report 3 for marine invertebrate zooplankton and ichthyoplankton. This section would most appropriately be found in-between section 3.2.5 Essential Fish Habitat and section 3.2.6 Aquatic Nuisance and Nonindigenous Animals. In addition to the information already included in Resource Report 3 on marine plankton, this new section should:	New subsections have been added to Sections 3.2.4.1 and 3.2.4.2, discussing zooplankton and the lack of data, recent studies on populations, and low abundance in the Project area due to physical environment.
FERC	11/16/2016	a. describe the existing plankton resources in the complete study area;	See above comment.
FERC	11/16/2016	b. assess adverse impacts directly on marine plankton;	Discussion of assessment of Project impacts on marine invertebrates, zooplankton and ichthyoplankton populations from marine dredging, pile driving, vessel activity, spills, hydrostatic testing, has been added to the Liquefaction Facility and GTP Associated Infrastructure subsections in Section 3.2.7 Potential Construction Impacts and Mitigation and Section 3.2.8 Potential Operational Impacts and Mitigation Measures.
FERC	11/16/2016	c. describe mitigation measures to address these impacts on marine plankton; and	No specific measures are proposed for potential impacts to marine plankton.

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FERC	11/16/2016	d. include a Project impact assessment for marine invertebrate zooplankton and ichthyoplankton populations for the Liquefaction Facility and the GTP Facility. Specifically address the estimated mortality from construction and operations activities in absolute terms and in context of the standing populations. These activities include, but are not limited to, dredging/sediment plumes, fuel leaks/spills, LNG spills, and vessel cooling water uptake. Also, discuss the introduction or spread of aquatic nuisance species related to both the Liquefaction facility and Interdependent Project Facilities.	Discussion of assessment of Project impacts on marine invertebrates, zooplankton and ichthyoplankton populations from marine dredging, pile driving, vessel activity, spills, hydrostatic testing, has been added to the Liquefaction Facility and GTP Associated Infrastructure subsections in Section 3.2.7 Potential Construction Impacts and Mitigation and Section 3.2.8 Potential Operational Impacts and Mitigation Measures. Aquatic nuisance species including zooplankton are addressed in Section 3.2.7.2.3.2 Aquatic Nuisance Species and Nonindigenous Animals and in Section 5.0 of Appendix K – Noxious/Invasive Plant and Animal Control Plan of Resource Report No. 3.
FERC	11/16/2016	Include more recent reference and information for arctic cod densities in Prudhoe Bay.	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process
FERC	11/16/2016	Include descriptions of the marine and aquatic benthic habitats (e.g., substrate; biological communities; infaunal, epifaunal, mobile, sessile, invertebrates and algae) in appendix D, as they relate to essential fish habitat (EFH) and utilization of that benthic habitat by each EFH designated species that will be affected both in the North Slope and Cook Inlet regions. For example, in appendix D, section 3.1.1.1, include more descriptions of the benthic habitat utilized by each live stage of Chinook Salmon. Make reference to the EFH Assessment in appendix D in the main body of the resource report.	Additional information on the use of benthic habitats within EFH has been added to Sections 3.1.1 and 3.1.3 of the EFH Assessment (Appendix D).
FERC	11/16/2016	Indicate all life stages of chum and pink salmon expected to interact with proposed dock modifications.	Juvenile and adult life stages would be present around the dock modifications.
FERC	11/16/2016	Section 3.2.5.2.2 states that there are 65 streams crossed by the Mainline containing EFH; however, appendix H only lists 62 waterbodies as containing EFH. Clarify this apparent discrepancy.	Section 3.2.5.2 and Appendix Ha have ben revised.
FERC	11/16/2016	Table 3.2.6-1 indicates Atlantic salmon are not present in the Project area while table 3.2.3-2 indicates that Atlantic salmon are present in the Project area. Clarify this apparent this discrepancy.	See text in Section 3.2.6.1.
FERC	11/16/2016	For sections describing marine fouling and epibenthic macroinvertebrates (Tunicates and Sea Squirts) describe how temperature plays a role in	Temperature ranges for tunicates and sea squirts are in Table 3.2.6-1, and life histories are summarized in Sections 3.2.6.1,

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		the success of each nuisance species to have an impact in the Project area.	3.2.6.1.5, 3.2.6.1.7, 3.2.6.1.8, and 3.2.6.1.9.
FERC	11/16/2016	Include a matrix table that summarizes species life stages, life history periodicity, and relevant habitat requirements (inclusion of limiting, sensitive, and critical and/or sensitive habitats) with the various construction components (and their timing) and all facilities to aid in assessing impacts associated with the Project.	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process
FERC	11/16/2016	Include a discussion in all subsections of 3.2.7 dealing with the marine environment of impacts on, and mitigation measures for, the marine benthic habitat, which is an important component of EFH (food sources, spawning grounds, and substrate). This includes consideration of bottom type, epibenthic and infaunal organisms (algae and invertebrates), and mobile and sessile organisms. Reference the EFH Assessment in appendix D in the main body of the resource report.	Additional discussion of potential impacts to benthic habitats have been added to Section 3.2.7.1 under Dredging and Pile Driving and in Section 3.2.7.2.2.2 (GTP Associated Infrastructure), including references to Appendix D (EFH Assessment).
FERC	11/16/2016	Describe how and when Project representatives would coordinate with ADF&G to develop and implement appropriate mitigation measures for impacts on fisheries from construction and operation activities.	See revised text in section 3.2.7.
FERC	11/16/2016	Include seasonal timing of plankton blooms in Cook Inlet. This is required to determine the level of impact on zooplankton and phytoplankton due to hydrostatic testing at the Liquefaction Facility.	See revised Section 3.2.4.1.6,discussing marine phytoplankton/zooplankton in Cook Inlet.
FERC	11/16/2016	In the sentence “Construction of the Project would include activities within and proximate to freshwater resident and anadromous fish habitat and temporary impacts to small amounts of benthic habitat in Cook Inlet and Prudhoe Bay,” provide a quantity rather than using the language "small amounts," which is considered relative	The submerged shoreline of both upper and lower Cook Inlet represent potential habitat for freshwater resident and anadromous fish species. The acreage of potential impact resulting from this Project is extremely small with respect to the entirety of available habitat. There is no designated or special habitat identified in Cook Inlet.
FERC	11/16/2016	Include an expanded discussion of potential impacts in section 3.2.7. The list currently included does not provide enough information to evaluate whether the most suitable mitigation measures have been selected for identified potential effects.	An expanded discussion of impacts to fish and fish habitat is included in Appendix D – Essential Fish Habitat (EFH) Assessment Report in Resource Report No. 3. Section 5.0 in Appendix D discusses potential effects to EFH and EFH species, and Section 6.0 discusses mitigation measures.
FERC	11/16/2016	Section 3.2.7 states that “Numerous construction mitigation plans for each of these components have been developed and would reduce the potential for direct mortality of fish.” Include a list of relevant and specific mitigation measures.	Table 3.2.7-1 lists relevant and specific mitigation that would be implemented.
FERC	11/16/2016	Section 3.2.7 states that “Blockages to fish movements into wintering areas could have minor to moderate affects; however, most streams	Alaska LNG will address this comment prior to the initiation of

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		crossed by the Mainline are small and likely provide rearing habitat for small portions of the drainage's fish, including EFH species." Include supporting data and/or references for this statement and quantify what is considered "small." Stream habitat should not be ignored, particularly in sub-arctic/arctic systems where these habitats can only be used during the open-water season.	the EIS (Environmental Impact Statement) process
FERC	11/16/2016	Table 3.2.7-2 footnote "a" indicates "These measures would be used where practical." Include an explanation on what is meant by "practical."	These are proposed general mitigation measures, the permitting process with ADF&G will determine which are used and where, which in turn determines what is "practical".
FERC	11/16/2016	Define what is meant by "no major freshwater waterbodies or streams on the Liquefaction Facility Site" (i.e., include definitions such as that done in section 3.2.7.2.1.1 on what constitutes the different stream characterizations, etc.).	See revised Section 3.2.7.1.1.1.
FERC	11/16/2016	Include confirmation if any biota have been tested for contaminants in areas to be dredged or within the vicinity of those areas.	See revised Section 3.2.7.1.5.
FERC	11/16/2016	Section 3.2.7.1.2 states "Dredging would result in a temporary loss of invertebrates within the dredged area." Include a list of those macroinvertebrate and macroalgae species that would be lost, including sessile and mobile benthic organisms (e.g., large crab species).	Invertebrates in Cook Inlet that may be lost during dredge/dredge disposal are listed in Table 3.4.8-1, 3.4.8-2, and 3.4.8-3; see revised Section 3.4.10.1.2.6 for impacts. See revised Sections 3.3.6 and 3.3.6.1 regarding macroalgae.
FERC	11/16/2016	Include a description of impacts of suspended sediments on macroinvertebrate and macroalgae species.	Section 3.2.7.1.2.1 discusses impacts to marine fish and EFH from increased turbidity from dredge and dredge disposal. Suspended sediments (turbidity) and impacts to aquatic invertebrates are discussed in Section 3.4.10.1.3.6. See text for revisions that include more detail. Because there are no marine algal beds present in the Liquefaction Facility footprint, there is no description of impacts. The nearest macroalgal bed from West Dock is located 13 miles away at Boulder Patch, and is not expected to be impacted by suspended sediments because dredging (if needed at all) would be very minor"
FERC	11/16/2016	Define the various dredge disposal methods that are being considered as these entail very different approaches for baseline data collection, including sediment transport modeling, types of effects, mitigation measures, regulatory processes, etc.	Different dredge disposal methods are outlined in Resource Report No. 10.

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FERC	11/16/2016	Section 3.2.1.2 states “the effects would be limited to the period during and immediately following dredging.” Indicate the duration of dredging activities and the number and type of seasons in which work may occur.	The Applicant will address this comment prior to issuance of the Draft Environmental Impact Statement (DEIS).
FERC	11/16/2016	Elaborate on the proposed approach for managing the risks of dredged materials exceeding threshold levels.	The Applicant will address this comment prior to issuance of the Draft Environmental Impact Statement (DEIS).
FERC	11/16/2016	Section 3.2.7.1.2 states that “The additional, temporary mobilization of sediment because of dredging is not anticipated to have a significant impact to any fish or invertebrate population in the area.” Describe significant impacts in relation to the resource in addition to providing the supporting evidence that no significant impact on any fish or invertebrate population would occur	The submerged shoreline of both upper and lower Cook Inlet represents potential habitat for freshwater resident and anadromous fish species. The acreage of potential impact resulting from this Project is extremely small with respect to the entirety of available habitat. There is no designated or special habitat identified in Cook Inlet.
FERC	11/16/2016	Include detail regarding the Seattle Dredged Material Management Program (COE, 2014) requirements for:	See revised text concerning the Guidance Manual in Section 3.2.7.1.5 of Resource Report No. 3 and R.
FERC	11/16/2016	a. sediment testing;	See revised text concerning the Guidance Manual in Section 3.2.7.1.5 of Resource Report No. 3 and Appendix R.
FERC	11/16/2016	b. disposal to be incorporated in dredging protocol; and	See revised text concerning the Guidance Manual in Section 3.2.7.1.5 of Resource Report No. 3 and AppendixR.
FERC	11/16/2016	c. dredge disposal site management and monitoring plan details.	See revised text concerning the Guidance Manual in Section 3.2.7.1.5 of Resource Report No. 3 and Appendix R.
FERC	11/16/2016	Section 3.2.7.1.2.1 states “the proposed dredged area for the MOF is a small percentage of the total EFH in Cook Inlet.” Define the relative proportion of available and similar habitat being affected within the EFH (i.e., a like for like comparison), particularly if sensitive or limiting habitats are being affected from proposed works.	The submerged shoreline of both upper and lower Cook Inlet represents potential habitat for freshwater resident and anadromous fish species. The acreage of potential impact resulting from this Project is extremely small with respect to the entirety of available habitat. There is no designated or special habitat identified in Cook Inlet.
FERC	11/16/2016	With regards to impact on capelin spawning, section 3.2.7.1.2.1 states “any such effects would be minor given that the placement area would represent a tiny fraction of available capelin spawning habitat in Cook Inlet, and would be short-term.” Define "tiny fraction" and expand on affected area relative to available spawning habitat	The submerged shoreline of both upper and lower Cook Inlet represents potential habitat for freshwater resident and anadromous fish species. The acreage of potential impact resulting from this Project is extremely small with respect to the entirety of available habitat. There

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		area, and whether the impact is occurring in a high density spawning area.	is no designated or special habitat identified in Cook Inlet.
FERC	11/16/2016	Expand the current discussion of pile driving mitigation measures to include the possibility of active monitoring during all activities using hydrophones installed in water and use of bubble curtains. Indicate the total number of piles and the total duration of time over which pile driving may occur as it may cover numerous life history stages of fish, even if restricted to only a few months.	The Applicant will address this comment prior to issuance of the Draft Environmental Impact Statement (DEIS).
FERC	11/16/2016	Include a discussion of the potential impacts of pile driving on commercially important crab species.	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process.
FERC	11/16/2016	Include a discussion specific to anchor, anchor able sweep, and mooring scour in both marine regions (Cook Inlet and Prudhoe Bay) and how that relates to benthic habitat impacts (e.g., infaunal and epifaunal organisms). (sections 3.2.7.1.5, 3.2.7.2.2, 3.2.8.1.2, 3.4.10.1.6.6, and 3.4.11.1.2.7)	Pipelay vessels have not been selected and anchor patterns therefore have yet to be developed. Text discussing the potential effects of anchor scar and cable sweep on benthos and benthic habitat has been inserted in Sections 3.2.7.2.1.1 (Pipelines/Mainline) under Offshore Trenching and Pipelay. General discussion of potential effects of anchoring construction vessels has been added to Section 3.2.7.1.1.3 (Liquefaction Facility/Foundation Construction and Section 3.2.7.2.2.2 (GTP Associate Infrastructure) under Vessel Activity and referenced in Sections 3.4.10.1.6.6. No changes were made to Sections 3.2.8.1.2 (Operational Impacts/Liquefaction Facility/Vessel Activity) or 3.4.11.1.2.7 because the LNG carriers (LNGCs) would be moored at dock, not anchored.
FERC	11/16/2016	Include additional information and references regarding the life history and temperature range of sea squirts and tunicates (fouling organisms).	Temperature ranges for tunicates and sea squirts are in Table 3.2.6-1 and life histories are summarized in Sections 3.2.6.1, 3.2.6.1.5, 3.2.6.1.7, 3.2.6.1.8, and 3.2.6.1.9.
FERC	11/16/2016	Section 3.2.7.1.6.1 states "there would be no long-term effects from seawater intake on fish and fish habitat, including EFH and EFH species". Include information on intake design and location, whether it would be a floating structure or located along the seafloor, and what design considerations would be taken into account to minimize impacts on fish, invertebrate eggs, and larvae (based on data indicating organism densities at different depths).	Currently there are no designs for any intake structures. Such designs will not be available until a later stage of the Project. The assessment was based on the type of habitat (sand/clay/gravel) and EFH (salmon) found in the upper Cook Inlet, volumes of seawater to be used, and the oceanographic conditions (high energy, extreme tides and tidal

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			flushing). Additional text has been added to this section for clarity.
FERC	11/16/2016	Section 3.2.7.1.6.1 states "overall volume is miniscule when compared to the entire region." Include specifics on the calculations used to make this determination. Expand the current discussion to include information on the density of capelin spawning locations relative to the seawater intake location.	It is a relative comparison of the size of the disposal area (1,200 acres) to the entire size of Cook Inlet benthic habitat (over 38,000 square miles). Alaska LNG will address density of capelin spawning locations relative to seawater intake locations prior to the initiation of the EIS process.
FERC	11/16/2016	Include a discussion on the impacts and mitigation measures in the event that a "large" spill occurs in the marine environment. Indicate the total volume of hydrocarbon products that could be released into the environment and the impact should these volumes be released.	As noted in Resource Report No. 1, Appendix C, the potential for large spills and the workplan for response will be addressed in a Spill Prevention, Control and Countermeasure (SPCC) Plan, to be developed prior to construction.
FERC	11/16/2016	Section 3.2.7.2.1.1 states "Based on these criteria (including the PTTL), approximately 554 minor (many of which are ephemeral drainages or seasonal high water channels), 84 intermediate, and 14 major waterbody crossings would be constructed (appendix H in Resource Report 2);" however, the current list of crossings provided in appendix H is incomplete. Provide clarification on this apparent discrepancy.	Appendix H of Resource Report lists all 612 waterbody crossings/
FERC	11/16/2016	Include information on how many of the fish bearing streams in table 3.2.7-2 are anticipated to be frozen during construction, an assessment of the affected areas for spawning habitat, particularly for those streams known to provide Arctic grayling spawning, rearing, and migration habitat during the open-water (ice-free) season. Of those waterbodies actively sampled or inspected, demonstrate that suitable effort was made to capture fish and that fish sampling was conducted during suitable sampling periods conducive to fish capture. Furthermore, clearly indicate what approach would be taken to determine crossing methods when no baseline information is available.	See revised text regarding the number of streams expected to be frozen in Section 3.2.7.3.1. 1..
FERC	11/16/2016	Section 3.2.7.2.1.1 states "Construction impacts to fish and fish habitat are not anticipated from this mode of construction, as fish will not be present. This method of construction could be employed at all classes of waterbody provided the crossing is dry." While most streams freeze at most northern latitudes of Alaska, this does not mean that fish habitat would not be affected from trench excavation and other construction activities unless baseline site conditions are fully rehabilitated. Given the proposed rehabilitation measures, revise this discussion to include potential construction impacts.	See revised text in Section 3.2.7.3.1.1.
FERC	11/16/2016	Section 3.2.7.2.1.1 refers to "Appendix H, tables 1 and 2"; however, only one table was included in appendix H. Clarify if a second table will be	There is only a single table in Appendix H of Resource Report

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		included in appendix H as part of the FERC application or update the text as needed.	No. 3. References in the text have been revised.
FERC	11/16/2016	Section 3.2.7.2.1.1 states “Cataloging of fish overwintering areas along the alignment generally has not occurred. Most streams crossed would not have viable fish overwintering areas, but some would. Documentation of adequate under-ice water volume of high enough quality to overwinter fish would be needed to fully assess impacts and would include information to ensure adequate mitigation methods are employed.” Include a schedule and an approach on when this documentation would occur.	The Applicant has no plans to conduct overwintering fish surveys.
FERC	11/16/2016	In section 3.2.7.2.1.1 include a discussion on the risk of inadvertent returns, and what baseline data is available for each watercourse where trenchless methods are proposed to ensure that the potential loss of productivity and spawning habitat may be quantified and appropriate mitigation measures be developed.	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process
FERC	11/16/2016	Section 3.2.7.2.1.1 states “Numerous floodplain material sites would either be developed or continue to be developed to provide the additional material needed.” Indicate what testing has been done on these proposed site materials to ensure that rock materials are "clean" (i.e., free of metal leaching or acid rock drainage potential). Include a discussion on the potential impacts from the removal of floodplain material sites, including any sites associated with eskers.	See revised text in section 3.2.7.3.1.1 under Material Source Development.
FERC	11/16/2016	Indicate what baseline data will be collected to ensure that BMPs associated with blasting near waterbodies may be followed.	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process
FERC	11/16/2016	Summarize how many and what type of waterbodies and species are present in proximity to proposed blasting areas. Add a column to appendix H to indicate if blasting would be required at any of these waterbody crossings.	Alaska LNG will address this comment prior to the issuance of the DEIS (Draft Environmental Impact Statement).
FERC	11/16/2016	Section 3.2.7.2.1.2 states "The Shaviovik and East Channel Sagavanirktok rivers both contain identified pink salmon spawning habitat in the vicinity of the pipeline crossing. However, the crossings of the Kadleroshilik and Shaviovik rivers occur near enough to the coast that fish use during winter would likely be low, and the crossing may be dry/frozen." Include references and data to support the statement that fish use "would likely be low.”	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process
FERC	11/16/2016	Include reasoning on why fish habitat is considered absent during the winter when it would be available during the open-water season (i.e., fish habitat does not disappear during winter, rather it is not used over that season but should still be available come spring).	Text in Section 3.2.7.2.1.2 has been revised in response to this comment.
FERC	11/16/2016	Section 3.2.7.2.1.5 states “Adequate flow rates to protect aquatic life would be maintained during	Please see Water Use Plan in Resource Report No. 2. Water

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		intake from freshwater sources and water withdrawal rates would be monitored to avoid significant impacts on stream flow or downstream resources. With these measures in place, any effects on fisheries and aquatic resources would be minor and short-term.” Given the large quantity of water required for the Project, indicate the required data needs, approach, and proposed data collection timeline that would be used to test flow rates in order to ensure that impacts are avoided or minimized, and to support effects conclusions.	use permitting will be completed prior to construction. In the permitting process, ADF&G and/or ADNR will dictate the water volume and withdrawal rates to protect water rights and fish populations.
FERC	11/16/2016	Elaborate on what data was used to support statements such as “Blockages to fish moving into wintering areas could have minor to moderate affects; however, most drainages crossed by the Mainline are small systems that likely provide rearing habitat for only small overall components of a drainage’s population of fish and rearing EFH species.” Quantify the definition of "small" in this statement and include a discussion on the importance of "small systems.”	The statement was based on a review of construction methods, fish use of the stream and known permitting requirements. Post permitting, applicant commits to using intake rates per ADFG and ADNR permitting requirements. See revised text in section 3.2.7.3.1.5
FERC	11/16/2016	Section 3.2.7.2.2.1 states “Construction of the GTP pad is not anticipated to have any adverse effects on fish or fish habitats, including EFH and EFH species.” Include additional information on this conclusion, including specifying the closest waterbody and EFH from the GTP.	See revised text in Section 3.2.7.3.2.1.
FERC	11/16/2016	To properly assess potential effects associated with water extraction, baseline data is required not only on waterbodies directly affected, but also on waterbodies located downstream of such waterbodies. Include the percentage of water being removed from the entire waterbody volume. Include a discussion on the potential impacts on downstream flows from high quantities of water removal. Include data to support any conclusions and impacts associated with water withdrawal.	See the Water Use Plan (Appendix K of Resource Report No. 2) for details on projected water use, and information on water sources (Attachments B and C).
FERC	11/16/2016	Section 3.2.7.2.2.1 states "The river intake structures would comply with ADF&G and federal regulations to protect fish. With these mitigation measures implemented, any effects of fisheries and aquatic resources would be minor and short-term." Include a list of the regulations referenced in the statement and include baseline data that has been or is intended to be collected to support assessment conclusions. Include information on how long it would take for the proposed reservoir to be filled with water.	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process.
FERC	11/16/2016	Section 3.2.7.2.2.2 states “However, initial dredging at West dock would be conducted during the winter, minimizing impacts to fish since there are fewer individuals and species present near the shorefast ice in.” Describe and include if impacts on marine invertebrates (living in, under, or on the ice) would also be minimized during the winter.	There is no longer any dredging at West Dock.

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FERC	11/16/2016	With regards to the quality and quantity of permanent habitat losses associated with the construction of the West Dock area, include information on available baseline studies to support the importance (or lack thereof) of these areas.	There is no longer any dredging at West Dock.
FERC	11/16/2016	Describe the mortality that is expected to occur to the benthic community (e.g., invertebrates and algae) from the filling in of 28 acres of marine habitat, and address which mobile invertebrates are more vulnerable to these activities. Make reference to the EFH Assessment in appendix D in the main body of the resource report.	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process.
FERC	11/16/2016	Describe impacts of pile driving on mobile benthic invertebrates. (e.g., large crabs)	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process.
FERC	11/16/2016	Provide ichthyoplankton survey results collected in the vicinity of the planned operational impact locations including survey data and summary results by species, life stage, depth strata, and month/season.	No ichthyoplankton tows were conducted in the proposed Marine Terminal area by the Project. Ichthyoplankton data is scarce to nonexistent in Upper Cook Inlet. Results of previous sampling studies reported low abundance and diversity in comparison to Lower Cook Inlet. Information of the most recent zooplankton (including ichthyoplankton) tow surveys and previous tow surveys conducted near the Project area were added to Section 3.2.4.1.6, Section 3.2.8.1.2.1 Marine Fisheries and EFH and Section 3.4.8.1 Liquefaction Facility.
FERC	11/16/2016	a. Describe intake designs and operations including volume, velocity, duration, depth, and screen mesh size for intake structures on LNG carriers. Quantify impact of these water intakes on ichthyoplankton, by season, including EFH species, and commercial and recreational fish and shellfish. Specify the planned and potential measures to minimize possible impacts of water intake on biological resources.	The Applicant will address this comment prior to issuance of the Draft Environmental Impact Statement (DEIS).
FERC	11/16/2016	b. Report the ichthyoplankton densities, potential annual entrainment, and standing crop by species and life stage for water intakes. Present results in absolute numbers as well as Age 1 equivalents. Identify any mitigation measures that Alaska LNG proposes to minimize impacts on ichthyoplankton.	See response above. No mitigation measures are proposed. Impacts would be minor based on reported low abundance and diversity of zooplankton populations in the Project area.
FERC	11/16/2016	Include the following information regarding entrainment of aquatic species.	See responses to subparts of this FERC response (351) comment below. Entrainment of aquatic species is discussed in Section 3.2.8.1.2.1 Marine Fisheries and EFH

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FERC	11/16/2016	a. Size characteristics for plankton directly affected by seawater intake entrainment due to mesh size, duration, seasonal timing, and intake rate. Clarify in the first sentence of paragraph 2 that plankton (phytoplankton and zooplankton) could be included in entrainment.	The first sentence of the second paragraph of Section 3.2.8.1.2.1 has been revised. Section 3.2.8.1.2.1 Marine Fisheries and EFH discusses estimated LNGC seawater intake rates; specific screen intake design, mesh size, and seasonal timing of LNGC calling at the Marine Terminal is not available at this time.
FERC	11/16/2016	b. Quantify the impact of water intakes during construction (e.g., hydrostatic testing, vessel ballast water management, cooling water) and operations (e.g., vessel ballast, cooling water) on ichthyoplankton. Specify the planned and potential mitigation measures to minimize impacts on ichthyoplankton provided by state and federal agencies and include evidence of those consultations. Include the fish screen sizes that would be used for the above activities.	The Applicant will address this comment prior to issuance of the Draft Environmental Impact Statement (DEIS).
FERC	11/16/2016	c. Specific measures that would be taken to ensure that fish entrainment is minimized or avoided. Include information on which small fish stages and life stages are most susceptible and in which season(s).	The Applicant will address this comment prior to issuance of the Draft Environmental Impact Statement (DEIS).
FERC	11/16/2016	Section 3.2.8.1.1.3 states “Surface drainage and oily water from process areas would be collected for wastewater treatment. The discharge location of all wastewater effluent streams would be an outfall to Cook Inlet that complies with the APDES individual permit requirements.” Include a discussion on what baseline information, modelling, etc. has been done to ensure that compliance with Alaska Pollutant Discharge Elimination System requirements can be met.	The Applicant will address this comment prior to issuance of the Draft Environmental Impact Statement (DEIS).
FERC	11/16/2016	Section 3.2.8.1.2.1 states “Because fish are mobile organisms, only behavioral effects would be expected to occur during operations.” However, behavioral effects may have indirect effects on growth, reproduction, etc. Elaborate and expand upon both direct and indirect effects, and include information on duration of sounds, even if intermittent, and how this may impact fish over the entire duration of the Project. Include the baseline information that exists and indicate what long term monitoring data would be collected to ensure effects predictions are accurate over the long term.	The Applicant will address this comment prior to issuance of the Draft Environmental Impact Statement (DEIS).
FERC	11/16/2016	Section 3.2.8.1.2.1 states “Impacts to fisheries resources are expected to be minor given the small scale of the LNGCs’ intakes when compared to the entire area of Cook Inlet.” Include information to support this statement. For example, although the area of Cook Inlet is larger than the "small scale of the LNGCs’ intakes," include a discussion as to how much similar habitat is available, how important is the area being affected relative to the	The Applicant will address this comment prior to issuance of the Draft Environmental Impact Statement (DEIS).

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		rest of Cook Inlet, and the abundance of the species that would be affected.	
FERC	11/16/2016	Include more recent references and information for water temperatures in Cook Inlet.	Comment acknowledged.
FERC	11/16/2016	Section 3.2.8.2.1.1 describes the potential thermal effects of the buried pipeline on waterbodies and associated fisheries.	The Applicant is conducting additional evaluation of the thermal impact of the pipeline to adjacent soil. The Applicant will address this comment in the summer of 2017.
FERC	11/16/2016	It is unclear from the information provided what the actual impact from thermal effects may be on waterbodies. Further describe anticipated flow impacts for the various watercourses and the available baseline data in order to support the effects assessment. Indicate whether data is available to assess effects on fisheries productivity given the link between fish bioenergetics and temperature.	Evaluation of the thermal impact of the pipeline to adjacent soil is underway. Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process
FERC	11/16/2016	Reference to table 1 in appendix D in this location in the text is incorrect because it does not identify "Mainline stream crossings with identified overwintering habitats in anadromous Pacific salmon spawning areas." Include the correct reference or update table 1 in appendix D accordingly.	The correct reference is Table A-1 in Appendix D (EFH Assessment). See revised text in Section 3.2.8.2.1.1 in Resource Report No. 3.
FERC	11/16/2016	Elaborate on what is meant by "consistent" in the following statement: "Barriers to fish passage during operation of the Mainline are not anticipated to be a consistent effect of the Project, post-construction."	See revised text in Section 3.2.8.2.1.1 Barriers to Fish Passage.
FERC	11/16/2016	Include specific mitigation measures that would be implemented to minimize or avoid all potential barriers from developing in waterbodies.	The Water Use Plan is Appendix K of RR2 and mitigation measures in Section 3.2.7 of Resource Report No. 3.
FERC	11/16/2016	Provide estimates of water withdrawal impacts on water flows downstream using estimated flow rates at the time of withdrawal based on U.S. Geological Survey stream gauge data or other available or collected data.	The Water Use Plan is Appendix L of RR2
FERC	11/16/2016	Section 3.2.8.2.2.1 states "Potential effects to resident and anadromous fish using the Putuligayuk River would be minimal." Elaborate on available baseline information (e.g., proportion of flow that would be removed at any one time) that provides support to this statement or the approach that would be followed to ensure validity of this statement.	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process
FERC	11/16/2016	An expanded vessel dock is being constructed at the GTP; however, it is indicated that "Routine vessel activity is not anticipated for operation of the GTP. Most materials, supplies, and personnel would use ground or air transportation." Resource Report 1 (section 1.5.2.4, page 1-168) indicates: "The majority of the GTP facility would consist of	There is no planned use of West Dock during operations.

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		modules transported to the site via seagoing vessel and then transported from the dock to the site using SPMTs. It is expected that the modules would be delivered during four summer sealift seasons." Resource Report 1 section 1.6 does not include a section on Operations and Maintenance of the GTP regarding seagoing vessels. Verify that no seagoing vessel traffic would occur during operation of the GTP.	
FERC	11/16/2016	Section 3.2.8.2.2.2 states "Post-construction maintenance dredging of the approach channel and turning basin are not anticipated." Include additional support and justification for this statement.	See above
FERC	11/16/2016	The appendix H table should be updated to include the information below.	See responses to subparts a-d below.
FERC	11/16/2016	a. A statement under note "b" indicating fish species not expected to be present in waters potentially affected by the Project (e.g., Arctic char, based on information in section 3.2)	The citation provided is the Anadromous Waters Catalogue and the information provided by the State. The species potentially present in the Project area are listed in footnote "b".
FERC	11/16/2016	b. A note that provides explanation on all of the "0 feet" widths included in the table. Additionally, include sources on how these widths were determined.	A footnote to that effect has been added to Appendix H of Resource Report No. 3.
FERC	11/16/2016	c. All other species at all fish-bearing crossings to ensure the selection of the most suitable mitigation measures are adopted. Additionally, the specific type of habitat that may be affected by Project infrastructure should also be indicated, and known critical or limiting habitats should be identified for each water crossing. Ideally, the distance to such habitats should also be included such that appropriate actions may be taken should work occur outside of least risk windows.	The ADFG are the experts on these streams and surrounding areas and will provide the most suitable mitigation for each crossing location. These areas have been studied for TAPS and other projects in the past. There is no limiting habitat at the crossings.
FERC	11/16/2016	d. General location of crossings (e.g., North Slope) since construction windows and potential effects may differ depending on selected method.	Crossing locations are provided in fisheries mapping in Appendix A of RR 3 and may be cross referenced by mileposts provided in Appendix H of Resource Report No. 3.
FERC	11/16/2016	Describe annual precipitation in section 3.3.1 for each ecoregion crossed and how it influences vegetation communities.	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process
FERC	11/16/2016	Describe how permafrost influences hydrology and the vegetative community (i.e., what happens if permafrost is thawed). For each ecoregion in which it occurs, include a range of the depth of the permafrost.	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process
FERC	11/16/2016	Describe the role and importance of biological soil (cryptogamic) crusts in the Project's ecoregions, particularly tundra environments. Include the formation process for biological crust and how long recovery could take if bryophyte or lichen	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process

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		communities are damaged. (sections 3.3.1.2.1 to 3.3.1.2.3, pages 3-112 to 3-113)	
FERC	11/16/2016	Describe the extent of noxious/invasive plant infestations associated with existing utility and road rights-of-way in Alaska as described by Nawrocki et al., 2011.	See revised text in Section 3.3.3.
FERC	11/16/2016	Include clarification on invasive and non-native plants.	See below.
FERC	11/16/2016	a. Describe the role of disturbed soil from construction activities as a potential vector to spread invasive and non-native plants, including disturbed ground along the pipeline right-of-way, access roads, and new facilities.	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process
FERC	11/16/2016	b. Describe the role of non-native landscape plants as a potential vector (e.g., purple loosestrife). Based on input from the Alaska Division of Agriculture and other relevant agencies, identify revegetation seed mixes.	See revised text in Section 3.3.3.
FERC	11/16/2016	Identify the data source for table 3.3.3-1. If derived from field surveys describe the dates, locations, and methods to collect the data. Include the information identified below regarding forest pests and diseases.	See revised footnote to Table 3.3.3-1. The source is a clearinghouse for data from numerous sources 1901-2016.
FERC	11/16/2016	a. List references and explain how forest pests and diseases are spread through vegetation removal. Explain how importing and moving live plant material is the primary pathway for forest pests and diseases as referenced by Graham and Heutte, 2014. (section 3.3.4, page 3-123)	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process
FERC	11/16/2016	b. Describe forest damage increases in recent years (include the data from 2012 and 2013 that was included in the first draft of Resource Report 3), and determine if this is a trend, cyclical, or otherwise of concern.	The older data has been added back to Table 3.3.4-1. The USFS reference document used for this section cautions against over-analysis due to limitations in the data, but some evaluation was added to the text.
FERC	11/16/2016	c. State who will inspect local plant material for forest pests and disease. Describe this mitigation measure in the impact discussions throughout section 3.3.7 for each component of the Project.	The Applicant would hire Environmental Inspectors to oversee Informing and training construction personnel regarding noxious weed and invasive species identification and the protocols to prevent or control the spread of invasive species. Environmental Inspectors would be employed during construction to monitor and provide oversight and implementation of the Noxious and Invasive Plant and Animal Control Plan.
FERC	11/16/2016	Briefly describe the methods and findings of the survey used as source data for table 3.3.4-1, which provides updated acreages for total affected area of forest insect and disease (section 3.3.4, page 123). Describe how public concerns about	See updated text in Section 3.3.4 in Resource Report No. 3 describing methods and findings used to create Table 3.3.4-1. A note was added referring the

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		culturally important plants will be addressed and include a cross reference to Resource Report 4 for more information, if applicable. Identify any rare plants and those that are considered culturally important in table 3.3.5-1.	reader to Appendix C of Resource Report No. 5 for information on the importance/harvest of plants. Rare plants are identified in Section 3.3.5.3.
FERC	11/16/2016	Include additional discussion on plant associations of concern and rare plants where they could be affected, including the extent and nature of impacts.	Sections 3.3.7.1.10, 3.3.7.2.1.1, 3.3.7.2.1.2, 3.3.7.2.1.3, 3.3.7.2.1.4, 3.3.7.2.2.1, and 3.3.7.2.2.2 of Resource Report No. 3 have been revised with additional analysis of potential impacts to rare plants and plant communities of concern.
FERC	11/16/2016	a. Confirm that the plant associations in table 3.3.5-2 occur in the Project area, as stated in the title. If so, add columns to the table to include the closest Project facility and the distance to the plant association. If the plant association is crossed by the Mainline, include a milepost range of the crossing.	Table 3.3.5-2 lists plant associations found within arctic tidal marshes. The presence of these plant associations in the arctic tidal marsh within the Project area has not been confirmed. Text to that effect has been added to Section 3.3.5.2.2, 3.3.7.2.2.1, and 3.7.2.2.2 and the title to Table 3.3.5-2 has been modified.
FERC	11/16/2016	b. Describe the potential impacts on the tidal marsh/mud flats, including which plant associations of concern would be affected and to what extent (e.g., acreage and percent loss of the total area).	See revised text in Section 3.3.7.2.2.2 in regards to impacts to tidal marsh/mud flats in or near West Dock.
FERC	11/16/2016	c. Describe whether the habitat would be suitable for Vahl's alkaligrass and Poa sublanata, how far away occurrences have been found, the impact on the species if affected, and whether the Bureau of Land Management (BLM) would require mitigation measures to offset losses.	The nearest locations of recorded occurrences to the Project footprint are identified in Table 3.3.5-3 and shown on Figure 3.3.7-1. With occurrences greater than 0.25 mile, no effects would be expected as indicated in Section 3.3.7.2.2.1. Text regarding habitats occupied by Vahl's alkali grass and possibility of occurrence in or near the Project footprint has been added to Sections 3.3.7.2.1.4
FERC	11/16/2016	Identify agency regulations or requirements pertaining to rare plant species on state and BLM land. Explain the difference and importance of BLM Sensitive and BLM Watch List plants (section 3.3.5.3, page 3-129). Additionally, add an assessment of potential impacts on these species.	See added text in Section 3.3.5.3 for definitions and regulations. Potential Project impacts are evaluated in Sections 3.3.7.1.10, 3.3.7.2.1.1, 3.3.7.2.1.2, 3.3.7.2.1.3, 3.3.7.2.1.4, 3.3.7.2.2.1,3.3.7.2.2.2, 3.3.8.2.1.1, 3.8.2.1.2, 3.3.8.2.1.3, 3.3.8.2.1.1, and 3.5.3.2.
FERC	11/16/2016	Include a footnote in table 3.3.5-3 to clarify whether "Distance to Nearest Facility" and "Distance to Pipeline" pertains to documented occurrences of the species. Additionally, this table should include distance to access roads.	A footnote has been added to Table 3.3.5-3 for clarification.

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FERC	11/16/2016	Include a paragraph in section 3.3.1 describing nearshore habitat(s) in addition to the terrestrial ecoregions to clarify typical vegetation to be found in the nearshore environments in the area.	See revised text in Sections 3.3.1 and 3.6.
FERC	11/16/2016	a. Describe Alaska's marine vegetation resources including submerged aquatic vegetation as well as algae (e.g., eelgrass beds [eelgrass is listed as a component of marine aquatic herbaceous cover type in appendix Q, and is documented as occurring in the Arctic Tundra Ecoregion]).	See revised text in Sections 3.3.6 and 3.3.6.1 for information on submerged aquatic and clarifying that there are no known algal or submerged aquatic vegetation in the Liquefaction Facility footprint.
FERC	11/16/2016	b. Describe where marine vegetation typically occurs (distance from shore, depths, substrates needed, etc.), their importance to the marine environment, and potential impacts on these resources.	See Revised Table 3.3.6-1. See revised text in Resource Report No. 3 Sections 3.3.7.1.11, 3.3.7.2.1.1, 3.3.7.2.1.4, 3.3.7.2.2.2, 3.3.8.1.6, 3.3.8.2.1.1, and 3.3.8.2.2.2 for potential impacts.
FERC	11/16/2016	c. Identify the distance to the nearest documented algal and submerged aquatic vegetation from the Liquefaction Facility and other marine facilities	See revised text in Sections 3.3.6.1 and 3.3.6.2.1 in Resource Report No. 3.
FERC	11/16/2016	Estimate the amount of time it would take for vegetation in the different ecoregions to re-establish. Describe revegetation obstacles, examples of failures and successes across BLM lands, restrictions on reseeding/planting times, and any specialized seeding techniques needed in this region.	Section 2.3 of Appendix P - Draft Restoration Plan of Resource Report No. 3 addresses performance standards and performance periods for each ecoregion. Section 2.4 of Appendix P includes an Adaptive Management plan that allows for changes in approach to revegetation depending on success/failure rates. Section 1.2 of Appendix P details the history of restoration practices that are relevant to Alaskan ecosystems. Section 1.2.3 of Appendix P describes restrictions on reseeding/planting times, and any specialized seeding techniques needed in this region.
FERC	11/16/2016	Define temporary and permanent impacts as they relate to this Project, and describe in detail the impact analysis for each component of the Project.	Temporary and permanent are defined in Section 3.1.2 of Resource Report No. 3.
FERC	11/16/2016	a. List what would cause permanent alteration to vegetation (e.g., permanent access roads, camps, gravel pad in right-of-way, and dredged basin).	In this assessment, construction impacts are by definition not permanent and operation impacts are considered permanent (see Section 3.2.1). The additional examples were added to Sections 3.3.7 and 3.3.8.
FERC	11/16/2016	b. Describe how construction and operation activities would impact vegetation.	Resource Report No. 3 Sections 3.3.7 and 3.3.8 describe the impacts to vegetation from construction and operation of the Project respectively. Some text has been added to subsections (Clearing and Grading,

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			Hydrostatic Testing, Access Roads, Spills) within these sections to make it more apparent how vegetation would be affected.
FERC	11/16/2016	c. Identify the number of years long-term impacts would likely last.	Effects determination terminology is defined in Resource Report No. 3, Section 3.1.2. "Long-term" is defined as 5 to 30 years.
FERC	11/16/2016	Describe in detail why clearing vegetation in the winter would minimize impacts.	The text in Resource Report No. 3, Sections 3.3.7 has been modified with new text indicating that winter clearing would have less impact because the ground would be frozen, and there would be less disturbance to the root mat in addition to the plants being in a dormant state.
FERC	11/16/2016	Clarify the items identified below in table 3.3.7-1.	See below
FERC	11/16/2016	a. Include any measures that would mitigate increases in soil temperature.	No mitigation is planned at this time.
FERC	11/16/2016	b. Identify where topsoil segregation would be implemented for trenching and backfill.	See Appendix M of Resource Report No. 1.
FERC	11/16/2016	c. Include the Timber Removal Plan in mitigation measures.	Alaska LNG will address this comment after the FEIS (Final Environmental Impact Statement) but prior to construction start
FERC	11/16/2016	d. Include dredging to the "Activity" column, along with potential impacts and mitigation.	The impacts refer to terrestrial vegetation.
FERC	11/16/2016	Confirm that table 3.3.7-2 includes impacts from road construction and improvements. Include a footnote explaining what Project components are included in the acreages. "Barren-unvegetated" area acreages are not needed and can be removed from table. Conversely, the 52-acre area that would be dredged should be included in table 3.3.7-2. Confirm whether the construction camp and dredge disposal area would be restored or would be permanent.	Yes, it includes road construction and improvements. The footnote at the bottom of the table indicates that the acreages are based upon all categories provided in Table 1.4-1. Restoration will be based on landowner requirements.
FERC	11/16/2016	For the Liquefaction Facility impacts, add percentages for open low scrub and graminoid communities and mixed forest. Add impact acreages of algal and submerged aquatic vegetation communities and include an analysis regarding the change in depth of dredged areas, and whether the new depths/substrate would be able to support vegetation.	Alaska LNG will address this comment prior to the issuance of the DEIS (Draft Environmental Impact Statement)
FERC	11/16/2016	Clarify if algal beds or submerged aquatic vegetation occur in the intertidal zone as stated in section 3.3.6.1. If so, include an analysis of impacts on the algae communities.	See revised text in Section 3.3.6.1 clarifying that algal beds or other submerged aquatic vegetation are not found in the Liquefaction Facility footprint.
FERC	11/16/2016	Include the following information related to access roads:	See below

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FERC	11/16/2016	a. the acres of impact from permanent access road construction/improvement and temporary access roads;	See revised text in Section 3.3.7.1 of Resource Report No. 3.
FERC	11/16/2016	b. whether temporary access roads would be restored to preexisting conditions; and	Roads will be restored to landowner requirements; see Section 1.3.4.2 of Resource Report No. 1.
FERC	11/16/2016	c. acres of impact on vegetation from soil compaction and loss of soil structure to construct the access roads.	The vegetation compaction footprint is the same footprint as road itself, but soil structure not lost.
FERC	11/16/2016	Include the information identified below relative to invasive plants.	See responses to parts a-d of this comment below.
FERC	11/16/2016	a. Describe how ground disturbance is a potential vector to spread invasive plants.	Section 3.3.7.1.8 has been revised in response to this comment; also Appendix K - Invasives Plan of Resource Report No. 3 addresses transportation pathways (Section 3.1) for invasive species.
FERC	11/16/2016	b. Include a reference to the Restoration Plan to support why reestablishing native or desirable vegetation would reduce the potential spread of invasive species.	See added text in Resource Report No. 3 Section 3.3.7.1.8 for an added reference to the Draft Restoration Plan (Appendix P of Resource Report No. 3).
FERC	11/16/2016	c. Describe the relative prevalence of invasive species in the Project area.	The numbers of occurrences of invasive plants is provided by facility in Table 3.3.3-1 in Resource Report No. 3 and Table 1 in the Noxious/Invasive Plant and Animal Control Plan (Appendix K of Resource Report No. 3). A general statement about prevalence has been added to the text.
FERC	11/16/2016	d. Include example(s) of marine plant or algal species that are potential invasives to the area.	Text has been added regarding invasive marine plants to Resource Report No. 3 Section 3.3.3 and its Appendix K.
FERC	11/16/2016	Include a discussion as to how the risk of spreading forest pests and diseases would be mitigated.	See Appendix K of Resource Report No. 3
FERC	11/16/2016	Clarify if surveys for plant communities of conservation concern have been completed at the Liquefaction Facility.	Section 3.3.7.1.10 has been clarified. Surveys expressly for plant communities of conservation concern have not been undertaken, but vegetative and wetland mapping crews mapped species if found during surveys.
FERC	11/16/2016	Include the following impact assessments:	See below
FERC	11/16/2016	a. acreage of right-of-way maintenance as a long-term impact in discussion of impacts: include right-of-way maintenance widths (i.e., 100 feet maintained as non-forested vegetation in uplands and 10-foot-wide corridor centered over the pipeline as herbaceous vegetation in wetlands);	ROW widths are discussed in Appendix G of RR1.

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FERC	11/16/2016	b. acreage of soil compaction and loss of soil structure as impact on vegetation from vehicle movement;	See revised text in Section 3.3.7.2.1.1.
FERC	11/16/2016	c. description of how melting permafrost would impact vegetation; and	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process
FERC	11/16/2016	d. clarification about whether impacts on sensitive vegetation communities or rare plants are anticipated.	Section 3.3.7.2.1.1 Mainline Sensitive Vegetation Types or Communities has been clarified with respect to the assessment of potential impacts to rare or sensitive vegetation.
FERC	11/16/2016	Describe methods for tundra vegetation recovery in disturbed soils. Include the following:	See responses to the subparts a-e below.
FERC	11/16/2016	a. estimated time to recovery, typical success/failure rates of revegetation efforts in these areas, and any impacts to biological soil crust;	Past efforts at restoration and what has worked and what has not are reviewed in the Draft Restoration Plan (Appendix P in Resource Report No. 3)
FERC	11/16/2016	b. clarification of whether the 5- to 20-year recovery time includes tundra ecoregions;	Section 3.3.7.2.1.1 of Resource Report No. 3 has been revised under Clearing and Grading.
FERC	11/16/2016	c. description of the potential short- and long-term effects from thaw permafrost and change to the hydrology (e.g., length of time for permafrost and preexisting conditions to reestablish);	See the Restoration Plan (Appendix P of Resource Report No. 3).
FERC	11/16/2016	d. clarification of which sensitive plant species are intolerant of disturbance; and	See Table 1: Summary of Restoration Options in the Arctic and Subarctic and Their Potential for use in the Project in Appendix P – Draft Restoration Plan of Resource Report No. 3.
FERC	11/16/2016	e. context for impacts on vegetation (e.g., affected acreage relative to surrounding vegetation).	This section addresses impacts to types of vegetation that are common in the respective regions. Any vegetation types or plant communities that are known to be rare or sensitive are discussed in the subsection on Sensitive Vegetation Types or Communities.
FERC	11/16/2016	In section 3.3.7.2.1.1, identify which of the rare plant species are culturally important.	Culturally important plants are discussed in Resource Report No. 5 Appendix D – Subsistence Impacts Analysis.
FERC	11/16/2016	Include the information identified below for the impact analysis for the Prudhoe Bay Gas Transmission Line (PBTL) and PTTL.	See below
FERC	11/16/2016	a. Describe affected acreages as was done in previous sections (e.g., Mainline).	As this is winter construction, there is no impact from working off an ice pad. The VSM impacts are reported in RR 02, Table 2.4.2-2, and in the CWA 404 Application

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FERC	11/16/2016	b. Describe these impacts consistently with previous impact discussions (e.g., Mainline impacts).	As this is winter construction, there is no impact from working off an ice pad. The VSM impacts are reported in RR 02, Table 2.4.2-2, and in the CWA 404 Application, just as the mainline impacts are reported.
FERC	11/16/2016	c. Organize impact discussions in each section consistently.	Comment acknowledged.
FERC	11/16/2016	d. Clarify potential impacts such as delayed phenology from late snowmelt at the PBTL and PTTL.	Alaska LNG will address this comment prior to the issuance of the DEIS (Draft Environmental Impact Statement)
FERC	11/16/2016	e. Describe thermokarst and how it could impact surrounding permafrost.	These pipelines are elevated and will not contribute to or cause thermokarsting.
FERC	11/16/2016	f. Include a discussion of invasive plants.	See revised text in Section 3.3.7.2.1.2.
FERC	11/16/2016	g. Clarify what the “Water” category includes in table 3.3.7-4.	The table was updated to change categories, water was changed to "unvegetated," and a footnote was added to clarify what unvegetated means.
FERC	11/16/2016	Clarify whether or not surveys are recommended or required by the Alaska Department of Natural Resources (ADNR) and include agency consultations and proposed minimization measures for sensitive species listed in table 3.3.5-3 that could occur along the Project facilities.	Mitigation measures will be developed to meet ADNR approval for all potential rare and sensitive species that could be encountered along the Project facilities.
FERC	11/16/2016	Include the information identified below for the impact analysis for the GTP.	See below
FERC	11/16/2016	a. Describe sensitive vegetation types or communities that could be affected.	The referenced page 3-160 was within Section 3.7.2.2.1, which addresses the GTP Facility; however, the referenced Section 3.3.7.2.1.4 addresses Pipeline Associate Infrastructure. Both have Sensitive Vegetation Types or Communities subsections. Both have been revised per this comment.
FERC	11/16/2016	b. Clarify that Pioneer Camp impacts listed in table 3.3.7-8 would be temporary.	The table footnote has been revised. The pioneer camp will be temporary, based on available space in or around Deadhorse.
FERC	11/16/2016	c. Describe the long-term effects of suitable habitat for submerged aquatic vegetation in dredged areas.	Per Section 3.3.7.1.1 of Resource Report No. 3, there is no marine vegetation in the dredge or dredge disposal area, and therefore no impact. Section 3.3.6.1 describes marine vegetation species present in and around the Liquefaction Facility footprint.

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FERC	11/16/2016	Include the information identified below for the GTP-associated infrastructure.	See below.
FERC	11/16/2016	a. Describe the impact of converting forest to scrub and/or herbaceous vegetation communities within the maintained right-of-way.	See revised text in Section 3.3.8.2.1.1 of Resource Report No. 3 that describes the impact of converting forest to shrub/herbaceous vegetation.
FERC	11/16/2016	b. Describe the proximity of the PTTL's operational right-of-way with existing pipelines and identify the total combined rights-of-way widths.	See colocation information in Appendix N of Resource Report No.1 and revised text in Section 3.3.8.2.1.2 in Resource Report No. 3.
FERC	11/16/2016	c. Clarify that buffer widths around facilities are included in affected acreages.	Buffer widths are not included around the facilities; the direct impacts are represented.
FERC	11/16/2016	Include a general discussion of the Beaufort Sea and Cook Inlet marine environments.	Completed.
FERC	11/16/2016	Update marine mammal sections to reflect National Oceanographic and Atmospheric Administration National Marine Fisheries Service (NMFS) recently released final acoustic guidance (August 3, 2016).	See Section 3.4.10.1.2.1 of Resource Report No. 3, Section 6.0 of Appendix F (Draft MMPA Assessment Report) and the Draft Petition for Incidental Take Regulations (ITR) (AGDC, 2017) of Resource Report No. 3. These exposure estimates as detailed in Appendix F and Draft ITR follow the NMFS guidance. These results have also been added or considered to Sections 3.4.10.1.2.1, 3.4.10.1.3.1, 3.4.10.1.4.1, and 3.4.10.2.2.2 of Resource Report No. 3.
FERC	11/16/2016	Include a habitat description in table 3.4.2-1 for the bearded seal and Pacific walrus.	See changed text in Table 3.4.2-1. These species are addressed in Section 3.5.
FERC	11/16/2016	Include discussions of humpback whale and gray whale within the text of section 3.4.2 similar to those included for other species in table 3.4.2-1.	See added footnote in Table 3.4.2-1, explaining that these species are covered under threatened and endangered subpopulations in Section 3.5.1.
FERC	11/16/2016	Humpback whales are listed in table 3.4.2-1 as potentially being affected by LNG carriers; however, they are not included in the text. Update the text or table accordingly.	Impacts to humpback whales by vessels are discussed in the Biological Assessment (Appendix C of Resource Report No. 3). See added text in Section 3.4.2.1 regarding impacts to humpbacks by LNGCs.
FERC	11/16/2016	Page 3-183 states "Killer whales have been implicated as causing significant mortality for both northern sea otters and Cook Inlet beluga whales" and page 3 184 states "There have been anecdotal reports of killer whales feeding on belugas in upper Cook Inlet...but potential for occurrences of killer whales in the area remains low." Explain this apparent discrepancy and	See the revised text in Section 3.4.2.1.3 of Resource Report No. 3.

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		confirm population sizes of killer whales in Cook Inlet in recent history.	
FERC	11/16/2016	Section 3.4.2.1.4 states "of the six dead minke whales reported, one was determined to be the result of a vessel strike." Include the dates associated with the dead minke whales. Include a discussion of the potential increase in minke whale strikes due to increased vessel traffic from the Project.	Information added to Section 3.4.2.1.4
FERC	11/16/2016	Include the following information for harbor seal, spotted seal, bearded seal, and walrus haulouts:	See responses below to parts a-d of this comment.
FERC	11/16/2016	a. Include locations of known harbor seal haulout or rookery locations within the Project area in the text and include in figure 3.4.2-1.	Figure 3G-8 in Appendix G of Resource Report No. 3 indicates locations of known haulout and rookery locations.
FERC	11/16/2016	b. Revise figure 3.4.2-2 to include spotted seal haulout areas (Oarklock Island, Piasuk River, and Colville River delta).	Locations of known haulouts have been added to Figure 3G-12 in Appendix G of Resource Report No. 3.
FERC	11/16/2016	c. Update section 3.4.2.2.4 (and appendix G figures) to include locations of known bearded seal haulouts within the Project area.	None are known. See the Biological Assessment (Appendix C of Resource Report No. 3) for details on bearded seal behavior. Bearded seal haulout ranges have been added to the Figure 3G-7 in Appendix G of Resource Report No. 3.
FERC	11/16/2016	d. Update section 3.4.2.25 (and appendix G figures) to include locations of known pacific walrus shoreline haulouts in Prudhoe Bay.	There are no known Pacific walrus haulout locations in or near Prudhoe Bay; see the Biological Assessment (Appendix C of Resource Report No. 3).
FERC	11/16/2016	Address the potential overlap of hunting seasons and construction on game species and what the impacts and mitigation measures would be from construction.	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process
FERC	11/16/2016	Include a description of the range of the brown lemming within the Project area.	See revised text in Section 3.4.5.2.4.
FERC	11/16/2016	Update section 3.4.6.2.1 to include information on gyrfalcon use of Arctic Tundra Ecoregion and observations in the Project area.	See added text in Section 3.4.6.2.1. that includes gyrfalcons' use of the Arctic Tundra Ecoregion.
FERC	11/16/2016	Update the ecoregion descriptions provided in section 3.4.6 to consistently address flyways.	Ecoregions have been updated and flyways have been added to Section 3.4.6 of Resource Report No. 3.
FERC	11/16/2016	Update the Brooks Range Ecoregion description to list examples of raptors present within the ecoregion.	Raptors present in the Brooks Range Ecoregion have been added to Section 3.4.6.2.1.4 of Resource Report No. 3.
FERC	11/16/2016	Update figure 3.3.1-1 to include the Intermontane Boreal Ecoregion as it is described in the specific ecoregion section and the specific waterbodies	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process Alaska LNG

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		listed in the text description of the ecoregion in 3.4.6.2.2.	will address this comment prior to the initiation of the EIS process
FERC	11/16/2016	Include a definition, for "Zones of Restricted Activity" as shown in the legend for figure 3.4.6-1. Update section 3.4.6 to include a discussion of how these zones apply to avian resources.	See revised text in section 3.4.6.2.1.1
FERC	11/16/2016	Section 3.4.6.2.2 states "Of these, the upper Kantishna River and Salchaket Slough and tributaries occur in the closest proximity to the Project area. " Include distances of these waterbodies to Project facilities, including mileposts if applicable.	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process
FERC	11/16/2016	Include the distance of the Yukon Flats National Wildlife Refuge (NWR) to the nearest Project facility.	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process
FERC	11/16/2016	Include the distance of Minto Flats State Game Refuge to the nearest Project facility.	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process
FERC	11/16/2016	Update the section 3.4.6.2.2.1 discussion to include additional information on the "highest-quality waterfowl habitats" within the Minto Flats Important Bird Area (IBA), including specifying if the habitat is used for nesting or foraging.	Discussion has been added to Section 3.4.6.2.2.1 of Resource Report No. 3 to include additional information on the highest-quality waterfowl habitats.
FERC	11/16/2016	Update references of "Steller's eider" to "Alaska-breeding Steller's eider" as the latter is listed threatened.	This is defined in Section 3.5.1.1.12, so therefore it should be attributed to the rest of the document where Steller's eider is referenced. We have added "Alaska-breeding" where its particularly important.
FERC	11/16/2016	Include the typical terrestrial invertebrate species that occur in each ecoregion.	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process
FERC	11/16/2016	Include a detailed description (with references) of the benthic habitat(s) within Cook Inlet where dredging and construction activities would occur. A listing of individual species present is provided, but more detail about the benthic habitat as a whole is needed.	See added text in Section 3.4.8.1 of Resource Report No. 3.
FERC	11/16/2016	a. Include sediment types and the type of invertebrate community those substrates support (e.g., epifaunal hard bottom habitat, soft sediment infaunal habitat, intertidal and subtidal).	See added text in Section 3.4.8.1 of Resource Report No. 3.
FERC	11/16/2016	b. Include maps classifying intertidal and subtidal habitats.	As referenced in Section 3.4.8.1, the National Oceanic and Atmospheric Administration (NOAA) Shorezone Mapping of intertidal areas has been added to Appendix B-1 (mapbooks of Vegetation Resources Mainline Topographic and Aerial Mapping) of Resource Report No. 3.

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FERC	11/16/2016	c. Address the abundance and role of larger mobile macroinvertebrates (e.g., king crab) that may be of commercial or subsistence value.	See revised text in Sections 3.2.4 and 3.4.8.1 in Resource Report No. 3.
FERC	11/16/2016	Include the following information regarding the benthic environment and benthic species:	Responses to subparts a-d are provided below.
FERC	11/16/2016	a. Update section 3.4.8.1 to address commercial fisheries for infaunal littleneck clam and razor clam, and recreational fisheries for littleneck clam, razor clam, and butter clam.	Information on commercial fisheries for invertebrates has been added to Section 3.2.4 and discussion of potential impacts has been added to Section 3.4.8.1 of Resource Report No. 3.
FERC	11/16/2016	b. Address commercial fisheries for epifaunal benthic organisms such as tanner crab, snow crab, and red king crab (currently closed), and recreational fisheries for tanner crab and Dungeness crab.	Information on commercial fisheries for invertebrates has been added to Section 3.2.4 and discussion of potential impacts has been added to Section 3.4.8.1 of Resource Report No. 3.
FERC	11/16/2016	c. Address the importance of the benthic habitat as part of the overall marine ecosystem in the Cook Inlet.	See added text in Section 3.4.8.2.2 regarding Cook Inlet's epifaunal species and their role in the coastal ecosystems.
FERC	11/16/2016	i. Describe how larger predators and marine mammals (e.g., sea otters, beluga whale) forage on macroinvertebrates (e.g., crab, urchins) and utilize the benthic habitat. If these details are covered in other sections of Resource Report 3, make reference to those sections.	Text has been added to various sections (based on species) of the MMPA Assessment (Appendix F of Resource Report No. 3).
FERC	11/16/2016	ii. Address the role infauna plays in the coastal ecosystem (prey species, nutrient cycling).	See added text in Section 3.4.8.1 regarding the role infauna plays in coastal ecosystems.
FERC	11/16/2016	iii. Address the role epifaunal species (e.g., sessile inverts, sponges, ascidians, barnacles, a few occurrences of cold-water corals in lower Cook Inlet, and larger mobile crustaceans such as king crab) plays in the coastal ecosystem.	See added text in Section See Section 3.4.8.1 regarding Cook Inlet's epifaunal species and their role in the coastal ecosystems.
FERC	11/16/2016	d. Include a timeframe for invertebrates to recolonize habitats after disturbance from dredging. Include supporting references for the identified timeframe.	See Section 3.4.8.1.
FERC	11/16/2016	Include life history information in tabular format for marine invertebrate species that occur in the Project area such as life stage present, lifespan, seasonal presence, dispersal behavior, and habitat. Include size and estimated density data for each species/genus/family.	A table has been added to Section 3.4.8 describing each species of invertebrates found in Tables 3.4.8-1 and 3.4.8-2.
FERC	11/16/2016	Include a more detailed and referenced description of the marine benthic habitat types of Prudhoe Bay where dredging and construction activities would occur (e.g., Dredge Channel, Turning Basin, and Dock Head 2 Expansion). Description should include:	See responses to subparts below.
FERC	11/16/2016	a. typical associations between substrate and benthic macroalgae species;	See added text in Section 3.4.8.2 about typical associations

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			between substrate and benthic macroalgae species.
FERC	11/16/2016	b. additional detail about sediment types (e.g., grain size, composition) and the type of invertebrate community those substrates support (e.g., epifaunal hard bottom habitat, boulder patch, soft sediment infaunal habitat, intertidal and subtidal);	See added text in Section 3.4.8.2 about sediment types and communities they support.
FERC	11/16/2016	c. a listing of individual species abundance for infaunal invertebrates is provided but more detail about the benthic habitat as a whole, and as part of the Arctic coastal ecosystem is needed; and	See added text in Section 3.4.8.2 about the Arctic coastal ecosystem.
FERC	11/16/2016	d. discussion on the abundance and role of larger mobile macroinvertebrates (e.g., snow crab) that may be of commercial or subsistence value.	See revised text in Sections 3.2.4.1.5, 3.2.4.1.6, and 3.4.8.1 in Resource Report No. 3.
FERC	11/16/2016	Update figure 3.4.8-1 to include standard error bars for characterizing seasonal changes in meroplankton abundance.	Standard errors were unavailable for these data.
FERC	11/16/2016	Provide a review of known epifaunal species from survey data and literature (e.g., echinoderms, mollusks, a few occurrences of cold-water corals, and larger mobile crustaceans such as snow crab) and address the role epifauna plays in the coastal ecosystem of Prudhoe Bay (prey species, structure/habitat formation).	See Section 3.4.8.2.1 for added text regarding the role of epifaunal species in the coastal ecosystem of Prudhoe Bay.
FERC	11/16/2016	Include details about seasonal nutrient cycling, benthic production, benthic-pelagic coupling, and ice-edge communities. Use and include recent citations.	See Section 3.4.8.2.1 for revised text that includes discussion on seasonal nutrient cycling, benthic production, benthic-pelagic coupling, and ice-edge communities.
FERC	11/16/2016	Include detailed maps of the Toolik Lake Research Natural Area and the Galbraith Lake Areas of Critical Environmental Concern, including the known Dall sheep lambing areas and expected movement corridors in relation to the Mainline corridor.	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process
FERC	11/16/2016	Update figure 3.4.9-2 to include the Kenai NWR, Denali State Park, Goose Bay State Game Refuge, Anchorage Coastal Wildlife Refuge, and Willow Mountain Critical Habitat Area.	See revised Figure 3.4.9-2.
FERC	11/16/2016	161. Include a noise impact analysis of construction and operation for each of the following large terrestrial mammal species and their associated sensitive habitat areas: (section 3.4.10 and 3.4.11) a. Dall sheep, mineral licks, and sensitive seasonal use areas; b. caribou, calving areas, insect relief habitat, and sensitive seasonal use areas; c. muskox, calving areas, and sensitive seasonal use areas; d. wood bison and sensitive seasonal use areas; e. polar bear, sensitive seasonal use areas, denning areas, and sea ice; f. brown bear and sensitive seasonal use areas; g. black bear and sensitive seasonal use areas; and h. moose, sensitive seasonal use areas, calving,	See revised Sections 3.4.10 and 3.4.11.

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		and rutting areas. The analysis should include the following:	
FERC	11/16/2016	a. A review of available weighted noise sensitivity ranges for each species. If species-specific information is not available, identify species that have similar physiology to support the assumption that sensitivities to noise could be equivalent. Include the threshold distances for injury and disturbance for each species.	Where information was available, noise sensitivities for species have been provided in Section 3.4.4.
FERC	11/16/2016	b. Identification of the areas where construction and operational noise from the Project have the potential to cause injury or disturbance to the large terrestrial mammal species within their sensitive habitat areas. Include a map set with isopleths associated with the sensitive wildlife and/or habitats and the associated activities.	Analysis of potential effects of noise on wildlife has been added to Section 3.4.10 (construction noise) and 3.4.11 (operations noise).
FERC	11/16/2016	c. A detailed noise mitigation plan (including but not limited to site selection, timing restrictions, gradual noise start-up, use of temporary barriers/mufflers, etc.) that would minimize or avoid impacts on large terrestrial mammals in their sensitive habitat areas.	Alaska LNG will address this comment prior to the issuance of the DEIS (Draft Environmental Impact Statement)
FERC	11/16/2016	Include any conservation and mitigation measures for wildlife, developed in consultation with the state and federal agencies, and include evidence of those consultations.	Alaska LNG will address this comment prior to the issuance of the DEIS (Draft Environmental Impact Statement)
FERC	11/16/2016	Instead of providing the total acreage for both temporary and permanent impacts (e.g., 70,000 acres) during construction, include a breakdown of temporary versus permanent impacts and reference the relevant table where these acres of impact can be found.	Table 1.4-1 in Resource Report No. 1 provides a detailed breakdown of the Project footprint.
FERC	11/16/2016	Update table 3.4.10-1 with the information identified below.	See below.
FERC	11/16/2016	a. Update the table to include mitigation measures for noise impacts.	Mitigation measures for noise impacts are not planned at this time.
FERC	11/16/2016	b. Address human interactions and impacts on wildlife movements (daily and seasonally) as potential impacts and include mitigation measures for those potential impacts.	Wildlife distribution and sensitive wildlife areas are identified in Resource Report No. 3. The Applicant is and will continue to work with the jurisdictional agencies on development of mitigation measures for specific life phases, movement and habitat protection. These measures would be implemented during pre-construction, construction, and operational phases of the Project. A good example of this is the Zones of Restricted Activity developed by BLM under the ROW grant for TAPS.
FERC	11/16/2016	Include additional discussion in the text of section 3.4.10 for the mitigation measures to avoid or reduce potential effects of construction on wildlife.	Section 3.4.10 provides a complete discussion of wildlife

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			mitigation measures proposed at this time.
FERC	11/16/2016	a. How timing is being used as a mitigation measure to avoid or reduce potential effects of general construction on marine mammals.	The text in Table 3.4.10-2 has been modified so it is more clear where and when timing is used as a mitigation measure. The text has also been added to Section 3.4.10.2.2 GTP Infrastructure/Pad and Dock Construction describing the use of timing to minimize effects on marine mammals.
FERC	11/16/2016	b. How BMPs are being used to reduce impacts on critical habitat at waterbody crossings.	Critical habitat as defined by the ESA is not found at any waterbody crossings.
FERC	11/16/2016	c. A mitigation measure for clearing, grubbing, and grading activities was listed as “to the extent practicable, limit vegetation removal to the winter.” Clarify in text where vegetation will not be cleared in winter and what the potential impacts and mitigation measures would be.	The timing cannot be predicted until closer to construction, as it will depend on several factors, such as weather and land agreements. There are areas outside of winter when clearing would be acceptable.
FERC	11/16/2016	d. A mitigation measure for blasting was listed as “clear areas of wildlife prior to blasting as practicable.” How this would be implemented was not included in the text and does not appear to be addressed in the table of contents for the Wildlife Avoidance and Interaction Plan.	See revisions to Table 3.4.10-1.
FERC	11/16/2016	e. A mitigation measure for trenching and backfilling was listed as “reduce construction traffic, both motor vehicle and aircraft.” Clarify how traffic for trenching and backfilling will be reduced.	See revised text in table 3.4.10-1
FERC	11/16/2016	f. A mitigation measure for contractor yards and camps was listed as “where required, provide wildlife monitors...” Include discussion of locations or circumstances where monitors would be employed in the Wildlife Avoidance and Interaction Plan.	See revisions to Table 3.4.10-1.
FERC	11/16/2016	g. Table 3.4.10-1 is footnoted with “These measures will be used where practical.” In subsequent text descriptions in section 3.4.10, include details of circumstances, specific cases or locations, or situations where mitigation measures as outlined may not be practical, what impacts on resources would be without implementation of these mitigation measures, and if alternative mitigation measures would be implemented.	The Applicant has identified measures to mitigate construction impacts to wildlife (Table 3.4.10-1). The Project's proposed mitigation measures for each activity are subject to approval from the state and federal resource agencies in the permitting process, including the landowners via the state and federal ROW agreements.
FERC	11/16/2016	Section 3.4.10.1.1.2 states (in reference to the Liquefaction Facility) that “it is unlikely that bears den in the area” and then goes on to include “hibernating bears in dens” as one of the greatest potential for large mammal injury or mortality. Resolve this discrepancy (section 3.4.10.1.1.2, page 3-288). Include a discussion of impacts on	See revisions to Section 3.4.10.1.1.2.

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		mammals burrowed under snow in winter that may be crushed by vegetation removal equipment.	
FERC	11/16/2016	Discuss impacts on mammals in the context of the timing of construction activities and sensitive life history stages of species that may occur in the Liquefaction Facility Project area.	The Liquefaction facility site location is within a zoned industrial area surrounded by residential communities. Timing restrictions for terrestrial mammals are not required at this time. Marine mammals are addressed in the MMPA Assessment found in Appendix F.
FERC	11/16/2016	Construction of the heavy haul road would include cutting through the bluff, which may result in the removal of nesting habitat for swallows. Update the text to include a discussion of the potential impact on these birds if activities occur during the nesting season.	See revised Section 3.4.10.1.1.4.
FERC	11/16/2016	Describe impacts in terms of permanent loss of habitat and in the context of wood frog populations in the area.	See below.
FERC	11/16/2016	a. Address the potential for wood frogs to occur in the natural pond on the Liquefaction Facility site.	No wood frog habitat would be lost within the Liquefaction Facility site.
FERC	11/16/2016	b. Describe temporary impacts on wood frogs as a result of construction of the Liquefaction Facility.	See above.
FERC	11/16/2016	c. Include a discussion of any mitigation measures that would be used to avoid or minimize these impacts.	No mitigation is required as there are no impacts at the Liquefaction Facility site.
FERC	11/16/2016	d. Include an estimate of the threshold distances for injury and disturbance for wood frogs.	An estimate of the threshold distances for injury and disturbance for wood frogs is not necessary, as there are no impacts to wood frogs at the Liquefaction Facility site.
FERC	11/16/2016	Address and include an analysis of vessels as a source of noise and impacts on marine mammals at the marine terminal.	An analysis of vessel noise is provided in Sections 5.1.3.2 and 6.5.4 of the MMPA Assessment (Appendix F of Resource Report No. 3). Summary text from that analysis has been added to Section 3.4.10.1.2.1 of Resource Report No. 3.
FERC	11/16/2016	Quantify the "small area" of foraging habitat that would be eliminated due to dock construction.	Refer to revised text in Section 3.4.10.1.2.4 quantifying the small area by percentage of acres of foraging habitat that would be eliminated due to MOF dock construction
FERC	11/16/2016	Address impacts on wildlife from the creation of predator perches.	Dock construction at the Liquefaction Facility could create perch sites for eagles and gulls. The perches could be used for resting or searching for prey. During construction of the marine infrastructure, perch site use would be expected to be minimal

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			due to noise and activity from equipment and people. During operations, perch use could increase due to reduced noise and activity compared to construction. Impacts to wildlife from the potential increase in perch sites from dock creation would be expected to be minimal due to the numerous existing natural perch sites surrounding the marine facilities.
FERC	11/16/2016	Describe direct impacts on aquatic invertebrates from in-water construction and include proposed minimization measures.	Impacts to invertebrates from dredge and disposal in Cook Inlet are included in Section 3.4.10.1.3.6 and 3.4.10.1.2.6. No mitigation measures are proposed for aquatic invertebrates at this time.
FERC	11/16/2016	Include the following information related to impacts on the marine environment associated with the installation and removal of the Material Offloading Facility (MOF) in the Cook Inlet.	See below
FERC	11/16/2016	a. Describe how the habitats would be altered, how much biomass would be removed, and how much time it would take for these areas to recover.	See revised text in Section 3.4.10.1.2.6.
FERC	11/16/2016	b. Address if sheet piling and other temporary structures used at the MOF would be covered with antifouling paint/coatings.	It is not planned to coat temporary structures with antifouling paint/coatings. The materials will be removed after construction.
FERC	11/16/2016	c. After removal of the structures, describe if sediment would be spread around or moved into the marine environment. Describe how the intertidal and subtidal habitat would be altered.	Those types of details would not be known until after the Final EIS (FEIS) and before construction.
FERC	11/16/2016	Include information source(s) for the statement "...it is unlikely that dredging and dredge disposal would exceed background water turbidity more than 200 feet from these activities." Include the basis for this distance and determination.	See revisions to Section 3.3.7.1.11 in Resource Report No. 3.
FERC	11/16/2016	Describe impacts from construction activities on killer whales, harbor porpoises, and northern sea otters occur in Cook Inlet.	Impacts to marine mammals like killer whales, harbor porpoise, and sea otters are included in Sections 6.0. 7.2.5 and 7.2.3 of the MMPA Assessment (Appendix F of Resource Report No. 3).
FERC	11/16/2016	Current information regarding sea otter presence in the Project area is unclear. Include agency correspondence confirming presence or probable absence from the Project area, including potential for occurrence in vessel travel routes and dredge disposal locations.	See revised Section 3.4.2 of Resource Report No. 3 and in the MMPA Assessment (Appendix F).
FERC	11/16/2016	Include a timeframe for invertebrates to recolonize habitats after disturbance from dredging. Include supporting references for the identified timeframe.	A discussion of recolonization timeframes has been included with the additional impacts analysis of

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			invertebrate species in Section 3.4.10.1.3.6
FERC	11/16/2016	Discuss how seasonal fluctuations of turbidity and the timing of construction in Cook Inlet and dredging activities may impact aquatic invertebrates.	See revised Section 3.4.10.1.3.6
FERC	11/16/2016	Address impacts and minimization measures on epifauna and macroinvertebrates such as urchins, snails, and mobile crabs	Impacts to invertebrates from dredge and disposal are included in Section 3.4.10.1.3.6. No mitigation measures are proposed at this time.
FERC	11/16/2016	Include the distance from the eastern shore of Cook Inlet (with spring concentration and nesting concentrations of waterfowl) to the nearest Project facilities. Include potential impacts on shoreline habitats near the Liquefaction Facility from construction activities.	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process
FERC	11/16/2016	Discuss any comments on bird habitats potentially affected by the Project. Describe how impacts on bird habitats would be minimized and what specific measures Alaska LNG would commit to implementing (e.g., construction outside of the nesting season, measures in the migratory bird plan).	Text discussing the potential effects of pile-driving on birds has been added to Resource Report No. 3, Section 3.4.10.1.4.3.
FERC	11/16/2016	Include background information for how the numbers of marine mammals (e.g., harbor porpoises, killer whales, and harbor seals) that would be affected by noise were calculated.	An overview of the methods used to calculate exposures is provided in Resource Report No. 3, Section 3.4.10.1.2.1 and Table 3.4.10-4, but the details are provided in Section 6 of the MMPA Report (Resource Report No. 3, Appendix F) and the Draft Petition for Incidental Take Regulations (AGDC, 2017) The reader is referred to Appendix F in Resource Report No. 3, Section 3.4.10.1.2.1. Table 3.4.10-4 has been footnoted to direct the reader to Appendix F. The reader is now referred to Table 3.4.10-4 in the subject Vessel Traffic subsection under Section 3.4.10.2.1.1. Exposures are calculated as the known density of animals x area ensonified by the vessel x the number of docking events.
FERC	11/16/2016	Include minimization measures for potential entrainment of aquatic invertebrates.	See Appendix K Section 5.1.2 Ballast Water for measures for reducing spread of aquatic invasives, and see Section 3.4.10.1.6.6 of Resource Report No. 3.
FERC	11/16/2016	Include current estimates of bird mortality from air traffic and justify how increased air traffic would not increase bird strikes.	See Section 3.4.10.1.7.4 for added discussion on aircraft strikes.

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FERC	11/16/2016	Explain under what circumstances that the measures in appendix J (Wildlife Avoidance and Interaction Plan) would be impractical to apply, and what alternative mitigation measures would be implemented.	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process
FERC	11/16/2016	Describe whether any idling rules (time limits or locations) or workspace and parking locations would be implemented near known locations of wood frogs to reduce potential impacts from vehicle exhaust.	There are no wood frogs on the Liquefaction Facility site, and there are no idling rules planned.
FERC	11/16/2016	Sections 3.4.10.1.10.1 and 3.4.10.1.10.2 list spills and leaks as potential impacts on marine mammals and large and small mammals.	See responses to subparts below.
FERC	11/16/2016	a. Include mitigation measures for spills on wildlife.	See the Project SPCC Plan located in Appendix N of Resource Report No. 2.
FERC	11/16/2016	b. Identify specific measures or procedures to identify spills and leaks in time to not cause injury to birds	See the Project SPCC Plan located in Appendix N of Resource Report No. 2.
FERC	11/16/2016	c. Describe mitigation measures for spills that would be implemented in winter to minimize impacts on resident birds.	Mitigation measures for spills are covered in the Project SPCC Plan located in Appendix N of Resource Report No. 2.
FERC	11/16/2016	i. Describe the mitigation measures proposed to protect birds and nesting/resting habitat in the event of a spill year-round.	Mitigation measures for spills are covered in the Project SPCC Plan located in Appendix N of Resource Report No. 2.
FERC	11/16/2016	ii. Include documentation of any consultation with state and federal agencies regarding these impacts and reference any plans that have been created.	AGDC will meet with agencies on this subject, document meetings in Resource Report No. 1, Appendix D, and reference the results in Resource Report No.3, Section 3.4.10.1.10.3.
FERC	11/16/2016	Discuss mitigation measures including workspace setbacks for wetlands that may reduce impacts from spills on amphibians.	Resource Report No. 2, Appendix N, provides the set back requirements for construction across waterbodies and wetlands.
FERC	11/16/2016	Clarify if there would be a separate Spill Prevention, Control, and Countermeasures Plan for the Liquefaction Facility than that included in appendix M.	Each contractor would prepare an SPCC Plan for its respective work responsibility, so there would be one for each facility and pipeline spread following the outline provided in the SPCC Plan in Appendix M. This has been clarified in Section 3.4.10.1.10.
FERC	11/16/2016	Describe mitigation measures for potential impacts of spills on amphibians and terrestrial and aquatic invertebrates.	See revised text in section 3.4.10.1.10.4. and 3.4.10.1.10.5
FERC	11/16/2016	Clarify if the proposed permanent gravel fill has been included in the permanent operational impacts in table.	Yes gravel pads are included in the permanent operational impacts. See Table 1.4-1 for total land impact acreages and table

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			3.3.7-7 for vegetation affected by Mainline access roads.
FERC	11/16/2016	Include maps depicting these habitat areas within the Project area:	See below
FERC	11/16/2016	a. brown bear habitat summarized in table 3.4.10-6	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process
FERC	11/16/2016	b. caribou habitat summarized in table 3.4.10-7	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process
FERC	11/16/2016	c. Dall sheep habitat summarized in table 3.4.10-8	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process
FERC	11/16/2016	d. moose habitat summarized in table 3.4.10-9; and	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process
FERC	11/16/2016	e. muskoxen habitat summarized in table 3.4.10-10.	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process
FERC	11/16/2016	Discuss impacts on marine mammals and mitigation measures for the shore approaches that would be constructed for the Cook Inlet crossing as described in section 1.5.2.3.7 of Resource Report 1.	Impacts to marine mammals during construction on the shore approaches is discussed in Resource Report No. 3 Appendix F – MMPA Assessment Report. Mitigation Measures would be included in a draft Marine Mammal Mitigation Plan that would be prepared and submitted to NMFS and the USFWS with applications for Incidental Harassment Authorizations. Appendix N – Marine Mammal Mitigation Plan would be finalized in the course of the permitting process.
FERC	11/16/2016	Discuss wetland fill impacts (loss and/or conversion) and mitigation measures from gravel fill on terrestrial mammals, birds, amphibians, and invertebrates.	See revised text in Section 3.4.10.2.1.1, Site Preparation, Large and Small Mammals, Section 3.4.10.2.1.1, Site Preparation, Birds, Section 3.4.10.2.1.1, Site Preparation, Amphibians, and 3.4.10.2.1.1, Site Preparation, Terrestrial and Aquatic Invertebrates:
FERC	11/16/2016	Discuss the potential for vehicle collisions from site preparation activities and identify any mitigation measures that would be implemented for large and small mammals.	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process.

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FERC	11/16/2016	Alaska LNG states that vegetation clearing would typically occur in winter. The Draft Avian Protection Plan states that consultation would occur with U.S. Fish and Wildlife Service (FWS) if construction is proposed during the migratory bird nesting season. Include a list of locations where clearing would not occur during the winter (i.e., within the migratory bird nesting season) and specific minimization measures that would be implemented in those locations.	Alaska LNG will address this comment after the FEIS (Final Environmental Impact Statement) but prior to construction start
FERC	11/16/2016	Clarify if vegetation would be actively planted and describe mitigation or restoration measures that would be implemented for impacts on avian nesting habitat.	At this time there are no plans to actively revegetate avian nesting habitat. Seasonal timing would be used when possible. See Appendix P of Resource Report No. 3 Draft Restoration Plan for mitigation measures and restoration measures. Impacts to avian habitats are described in Section 3.4.10.
FERC	11/16/2016	Include documentation of agency correspondence regarding wildlife movement and protection during construction of the Mainline and other facilities.	Alaska LNG will address this comment prior to the issuance of the DEIS (Draft Environmental Impact Statement)
FERC	11/16/2016	Section 3.4.10.2.1.1 states that “occasionally large and small mammals can enter or fall into the trench and become trapped.” Describe the mitigation measures that would be implemented to minimize the potential for wildlife to become trapped in open trenches.	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process.
FERC	11/16/2016	Include the locations and timing for which large mammals would be affected by construction, what those impacts would be for a particular construction season, and any mitigation measures that would be implemented.	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process.
FERC	11/16/2016	Discuss impacts on birds that nest on barren, cleared areas and any impacts that could occur to them from post-clearing construction activities (vegetation could be cleared 1 to 3 years ahead of other construction activities). Include minimization measures that would reduce impacts to nesting birds that could be present prior to construction.	Text has been added to Section 3.4.10.2.1.1 Mainline under Trenching, which discusses the potential for impacts to birds that nest on such cleared/barren areas.
FERC	11/16/2016	Include minimization measures for reducing the rate of reed canary grass colonization following construction.	Reed canary grass is an invasive plant and Mitigation measures for all invasive species are included in the Invasive Plant and Animal Control Plan (Appendix K of Resource Report No. 3). Reed canary grass is not known to occur in Alaska and no special measures are planned for this species.
FERC	11/16/2016	Discuss additional noise generated from trenchless crossing methods, including what the increase in noise level at each of the four waterbody crossings listed would be above baseline, impacts on different species groups (i.e., large and small	Noise data and analysis are contained in RR9.

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		mammals, birds, amphibians), potential sensitive habitat for particular species that could be affected by the noise, and any mitigation measures that would be implemented to reduce impacts from noise.	
FERC	11/16/2016	Describe if blasting types, and therefore potential impacts and mitigation measures, would be different for blasting in the trench and blasting in material sites.	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process.
FERC	11/16/2016	Describe the locations where blasting would occur where the noise and vibration could attenuate to the marine environment. Describe impacts on marine mammals and mitigation measures that would be implemented.	No blasting would occur near Cook Inlet or Prudhoe Bay/Beaufort Sea, therefore marine mammals would not be impacted and mitigation measures are not required. Text has been added to Section 3.4.10.2.1.1. Details about blasting and locations can be found in Resource Report No. 6, Appendix B – Blasting Plan.
FERC	11/16/2016	Include agency correspondence regarding recommended mitigation measures for marine mammals and large and small terrestrial mammals for blasting activities.	No blasting would occur near Cook Inlet or Prudhoe Bay/Beaufort Sea, therefore marine mammals would not be impacted and mitigation measures are not required.
FERC	11/16/2016	Define “short time period” for blasting as described in the Birds and Amphibians sections.	The time for the explosives to detonate.
FERC	11/16/2016	Provide an approximate distance or radius that the blast zone would impact, and how far noise that could be potentially harmful to birds and other wildlife would travel.	The Project would follow the National Bald Eagle Management Guidelines of no blasting within 0.5 mile of an active bald eagle’s nest. This would be a conservative distance to apply for other animals, as eagles are protected under the BGEPA, and MBTA and are in a sensitive state when stationary and nesting. In most other situations, animals (birds or wildlife) could be in the range of hearing the blasting but are moving through the area and not invested in a specific location like a nesting bird.
FERC	11/16/2016	Describe direct impacts from blasting on wood frogs during hibernation.	Wood frogs allow up to 2/3 of their body water to freeze during their overwintering period and aren't moving in this state. As an overwintering strategy, they elevate their intracellular solute concentrations and utilize ice nucleating proteins, evacuating water from their cells into the extracellular space and allowing it to freeze while protecting their cells. In this state, any wood frogs

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			nearby blasting areas would remain torpid, unable to overcome the physiological challenge of being partially frozen (many have noted that their skin feels "crunchy" due to the frozen water in the interstitial space) until the temperature rises in spring. If it is early or late in the overwintering period and they are thawed, but still torpid, it is because it is still relatively cold out; as ectothermic vertebrates, they would not have a metabolism that is elevated enough to be moving around much in response to disturbance. These frogs burrow into a pit into the ground in the fall and allow themselves to be covered by leaf litter and remain there until spring.
FERC	11/16/2016	Section 3.4.10.2.1.1 states "Potential impacts to invertebrate communities from blasting are expected to be temporary and minor." Address how much mortality of commercially important macroinvertebrates (e.g., crabs) is expected from blasting.	Blasting is not expected to be conducted in Cook Inlet but it is possible. Section 3.4.10.2.1.1 of Resource Report No. 3 has been revised in response to this comment.
FERC	11/16/2016	Include discussion of rail impacts on wildlife.	The increase in train activity expected during Project construction could increase wildlife mortality; in particular moose. Mortality numbers from train collisions are collected by ADFG and heavy winter snow fall drives moose to the railroad for ease of access. During low snow years, moose mortality from train collisions is substantially reduced.
FERC	11/16/2016	Describe how a 0.8 collision increase per mile was determined. Include the rate of traffic increase per year that relates to an increase in collisions of 0.8 collisions per mile and relate it to the increase in traffic for the Project. Include the estimate of additional collisions for the Project based on this data.	The collision factor comes from an ADOT&PF study, citation is found in the text.
FERC	11/16/2016	Describe maintenance that would be done to improve visibility as a mitigation measure for wildlife collisions.	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process.
FERC	11/16/2016	Section 3.4.10.2.1.1 refers to table 3.4.10-B; however, no table is included with this name in Resource Report 3. Include this missing table or correct the text.	The table reference has been fixed.
FERC	11/16/2016	Describe impacts on marine mammals from vessel traffic and include minimization measures for these impacts.	Section 3.4.10.2.1.1 has been revised; see Section 3.4.10.1.6.1 for additional impact assessment.

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			Impacts to marine mammals from vessel traffic are also discussed in the MMPA Assessment (Appendix F of Resource Report No. 3).
FERC	11/16/2016	Quantify the potential impacts of vessel strikes on non-listed species within the text of Resource Report 3.	A vessel strike analysis is provided as Attachment A to the Biological Assessment (Appendix C of Resource Report No. 3). It addresses listed and non-listed cetaceans, and to a lesser extent pinnipeds and sea otters.
FERC	11/16/2016	Describe impacts on wildlife (marine mammals, large and small mammals, and birds) from increased human presence over multiple seasons (e.g., altered behavior, migrations, movement, death, and habituation).	Text has been added to Section 3.4.10.2.1.1 under Site Preparation in response to this comment.
FERC	11/16/2016	a. Specifically address the long term nature of worker camps (up to 8 years) and multiple years of construction in one area and impacts on wildlife from human presence and disturbance.	Most camps are used for one or two seasons. See revised text in Section 3.4.10.2.1.2.
FERC	11/16/2016	b. Include BMPs or mitigation measures that would be implemented to reduce impacts on foxes attracted to on-ice activities.	Fox are not necessarily attracted to on ice activities. They are attracted to areas where they can burrow or den, or where they can get an easy meal. Mitigation for small mammals is included in the Wildlife Avoidance Plan
FERC	11/16/2016	Specify how construction waste has the potential to increase the total area of habitat affected by construction. Include an estimate of acres.	Disposal area footprint has been addressed in this application.
FERC	11/16/2016	Include correspondence with agencies regarding construction activities in Sensitive Wildlife Habitat Areas. Based on these consultations, describe impacts on these areas as well as BMPs or mitigation measure that would be used to reduce those impacts. (section 3.4.10.2.1.1, page 3-336; section 3.4.10.2.1.3, page 3-343; section 3.4.10.2.2.1, page 3-353; section 3.4.10.2.2.2, page 3 360)	Meetings will be held with BLM, ADF&G, and ADNR. Meeting minutes should be presented in Resource Report No. 1, Appendix D, and summarized in Resource Report No. 3, Section 3.4.10.2.1.1 Mainline/Sensitive Wildlife Habitat Areas.
FERC	11/16/2016	Define and describe the potential impact listed as “phenology from late snowmelt.”	Alaska LNG will address this comment prior to the issuance of the DEIS (Draft Environmental Impact Statement)
FERC	11/16/2016	Include any BMPs or erosion control measures that would be used to reduce impacts on invertebrates from construction.	There are none that would be applied to reduce impacts to invertebrates (mosquitoes, flies, worms, bugs).
FERC	11/16/2016	Define which infrastructure is included in the calculations of habitat impacts presented in Section 3.4.10.2.1.3.	The associated infrastructure is identified in Section 3.1 of Resource Report 3 and itemized in Table 1.4-1 in Resource Report No. 1.
FERC	11/16/2016	Clarify if all of the material site impacts on aquatic features would be permanently affected and what the mitigation measures would be.	See revised text in Section 3.4.10.2.1.3 of Resource Report No. 3.

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FERC	11/16/2016	Describe the specific site preparation activities that would impact large and small mammals.	The GTP would be located within existing oilfield infrastructure and near the CGF. Construction would start in winter and compaction of material would occur in the summer. Large and small mammals should not be impacted beyond what is mentioned in resource report.
FERC	11/16/2016	Quantify and describe permanent loss or temporary impacts on habitats and mitigation measures for terrestrial and aquatic invertebrates.	Section 3.4.10.2.2.1 addresses the potential impacts associated with construction of the GTP facility onshore; Section 3.4.10.2.2.2 for offshore impacts from GTP Infrastructure.
FERC	11/16/2016	Address the magnitude of loss of benthic habitat, the mortality of invertebrate species (e.g., which species would be affected), how the habitat would be altered, and how long would it take to recolonize.	Species and abundance of invertebrates in dredge disposal areas are described in Table 3.4.8-1 and Table 3.4.8-2. Habitat alterations and effects on aquatic invertebrates is included in Sections 3.4.10.1.2.6 and 3.4.10.1.3.6, 3.4.10.2.2.2. Acreages of benthic habitat that will be altered will be provided in Tables 3.4.10-2 and 3.4.10-22.
FERC	11/16/2016	Describe impacts from and mitigation measures for helicopter traffic and helicopter pads during construction and operations.	Helicopters will only land on project footprint areas already defined, not on new sites. Impacts are addressed in respective sections where the Project footprint is discussed. Mitigation is also addressed in those sections.
FERC	11/16/2016	Describe potential for noise impacts from pumps on wildlife.	Section 3.4.10.2.2.1 addresses the potential impacts associated with construction of the GTP facility. The Applicant is unsure to which pumps the commenter is referring.
FERC	11/16/2016	Describe potential impacts from chemical spills and how they may or may not be different from fuel and other spills.	Spill impacts are addressed in Section 3.4.10.1.10; it includes both fuel and hazardous materials.
FERC	11/16/2016	Update the IBA figures to include the boundaries of the Prudhoe Bay Oilfield.	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process
FERC	11/16/2016	Describe flare impacts on birds and any BMPs or mitigation measures for impacts from flaring at the GTP.	See Section 3.4.11.2.2 for impacts to birds. Due to the infrequency of flaring (only during emergencies) and the height of the stack, there is no proposed mitigation.
FERC	11/16/2016	Include acreages of aquatic/marine habitats affected by the infrastructure associated with the GTP.	Acreage of marine habitats that would be affected are identified in Section 3.4.10.2.2.2 in several places. Acreage of aquatic

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			habitats are itemized in Table 3.4.10-22.
FERC	11/16/2016	Describe impacts on marine mammals, terrestrial mammals, and birds from pad and dock construction.	Dredging is no longer proposed for the berthing basin; very minor dredging is possible at the barge bridge location. Mitigation measures and noise impacts from dredging at both the barge bridge at West Dock and the Marine Terminal in Cook Inlet are summarized in Appendix F (MMPA Assessment) of Resource Report No. 3. (See Sections 5.1, 5.2, 6.5.)
FERC	11/16/2016	Describe noise impacts on marine mammals from dredging activities and mitigation measures.	Dredging is no longer proposed at West Dock; no changes were made in response to this comment.
FERC	11/16/2016	Quantify the amount of spotted seal foraging habitat that would be affected by dredging and/or dredge disposal.	Dredging is no longer proposed at West Dock; no changes were made in response to this comment.
FERC	11/16/2016	Describe the timing of dredge disposal activities and nesting bird activity at the sites, what those impacts would be, and proposed mitigation measures or BMPs that would be implemented. Describe any benefits to wildlife from dredge material disposal.	Dredging is no longer proposed at West Dock; no changes were made in response to this comment.
FERC	11/16/2016	Regarding the statement "Bottomfast ice can extend to 10 feet below the surface of the water and it prohibits overwintering of most benthic species, resulting in a population that is dependent on recolonizing the area during ice-free periods (MMS 1990)."	See responses to subparts below.
FERC	11/16/2016	a. specify which benthic species recolonize in the ice-free season;	Additional information from the literature regarding benthic recolonization in the Beaufort Sea has been inserted in Section 3.4.8.2 GTP Associated Infrastructure under Terrestrial and Aquatic Invertebrates.
FERC	11/16/2016	b. describe this seasonal cycle in more detail with respect to Project activities; and	Additional information from the literature regarding infauna in the Beaufort Sea has been inserted in Section 3.4.8.2.
FERC	11/16/2016	c. address which marine benthic invertebrates, specifically infaunal, are present during the ice season, regardless of the presence of bottomfast ice.	Additional information from the literature regarding infauna in the Beaufort Sea has been inserted in Section 3.4.8.2.
FERC	11/16/2016	Marine mammal species and vessel trips vary between the GTP and Liquefaction Facility; include a discussion of vessel impacts specific to Beaufort Sea species.	Some new analysis has been added to Section 3.4.10.2.2.2. For listed species in the Beaufort Sea, potential effects from vessel traffic is discussed in Section 5 of Appendix C (Biological Assessment) to Resource Report

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			No. 3. Text has been added to Section 3.4.10.1.1.1 under Vessel Activity/Marine Mammals. Discussions for Threatened and Endangered species in Appendix C (Biological Assessment) are now summarized in this section along with additional analysis for non-listed species of marine mammals.
FERC	11/16/2016	Include noise disturbance as a potential impact from facility operation and include mitigation measures for these impacts in table 3.4.11-1.	Noise from Liquefaction Facility operations has been added to Table 3.4.11-1
FERC	11/16/2016	Regarding table 3.4.11-1	See responses to subparts of this comment below.
FERC	11/16/2016	a. include any BMPs or mitigation measures to reduce impacts from vessel traffic and strikes; and	See mitigation discussions in Section 11 in the MMPA (Appendix F of Resource Report No. 3) discusses mitigation measures in detail. A Vessel Strike Analysis is located in Attachment A to the Biological Assessment (Appendix C of Resource Report No. 3) and summarized in Section 5.3 of the MMPA Assessment.
FERC	11/16/2016	b. include a summary of impacts and mitigation for terrestrial and aquatic invertebrates, amphibians, and sensitive habitat areas.	Terrestrial and aquatic inverts, amphibians, and sensitive habitat areas do not belong in this table because there are no mitigations planned for impacts to them during operations. See individual sections for details.
FERC	11/16/2016	Confirm if a Wildlife Avoidance and Interaction Plan will be developed for operational activities.	Yes; see revised text in Table 3.4.11-1.
FERC	11/16/2016	Describe the specific impacts from flares and pollutants on birds in stormwater ponds, as discussed in section 3.4.11.1.3, page 3-363. What quantities of oils would be expected to discharge into the ponds? Would the trajectory of ground flares actually intercept air space over the ponds?	This information will be available after the FEIS and before construction.
FERC	11/16/2016	Include an example of an anti-perching design structure and include a diagram of the structure. Reference the Avian Protection Plan in this section. Further, the Avian Protection Plan (appendix E) lists this design in one instance (section 4.5, page 37) but does not provide additional detail.	Alaska LNG will address this comment after the FEIS (Final Environmental Impact Statement) but prior to construction start
FERC	11/16/2016	Include mitigation measures for noise impacts on sea otters and Stellar sea lions from vessel traffic.	No mitigation measures are planned for potential disturbance effects on sea otters and sea lions from vessel noise during operations.
FERC	11/16/2016	Describe potential impacts from vessel wake damage to coastal habitats used by birds.	See revised Section 3.4.11.1.2.5 of Resource Report No. 3. Additional discussion is found

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			in Section 3.4.10.1.6.4 (Birds under Vessel Activity).
FERC	11/16/2016	Include an estimate of the vessel groundings per year within Cook Inlet, and describe how grounding and associated spills may increase with the additional vessel activity for operations activities.	Alaska LNG will address this comment prior to the issuance of the DEIS (Draft Environmental Impact Statement)
FERC	11/16/2016	Regarding air traffic for construction and operation activities:	See below
FERC	11/16/2016	a. discuss the potential for pipeline surveillance flight paths to occur over pinniped haulouts;	No regular vessel activity or noise impacts are anticipated for operational maintenance of the offshore portion of the pipeline.
FERC	11/16/2016	b. quantify the anticipated amount of land and air traffic required for operation, what impacts on wildlife those activities would have, and any BMPs or mitigation measures that would be implemented; and	Alaska LNG will address this comment after the FEIS (Final Environmental Impact Statement) but prior to construction start
FERC	11/16/2016	c. describe why air traffic would not have any impacts on marine mammals. Include a discussion of helicopter traffic.	Discussion of impacts of aircraft on marine mammals during operations is found in Section 3.4.11.2.1.1, which has been revised with additional analysis.
FERC	11/16/2016	Include additional detail on the expected frequency of vessel activity and noise impacts from maintenance of marine sections on marine mammals.	This is addressed in the MMPA assessment found in Appendix F.
FERC	11/16/2016	Include a discussion of impacts and mitigation measures on the Beaufort Sea IBA from operations activities.	See revised text in Section 3.4.10.2.1.2 under Sensitive Wildlife Habitat Areas.
FERC	11/16/2016	Discuss noise levels at the liquefaction facility that might interfere with bird communication, including an estimate of the threshold sound level at which this could occur. Describe mitigation measures for facility noise impacts on birds	See Section 3.4.11.1.1.3.
FERC	11/16/2016	Include discussion of impacts and mitigation measures for impacts on sensitive waterfowl habitats and IBAs.	Discussion of impacts and mitigations to IBAs has been added to Sections 3.4.10.2.1.1 and 3.4.10.2.1.3
FERC	11/16/2016	Include any mitigation measures that would be implemented to reduce impacts from operations and facilities on caribou sensitive areas.	There are no sensitive areas for caribou in the GTP area. Mitigation measures are provided in Sections 3.4.10 and 3.4.11 in Resource Report No. 3 and will be in Appendix J-Wildlife Avoidance and Interaction Plan (Appendix J of Resource Report No.3) when finalized.
FERC	11/16/2016	Describe what avian surveys would be conducted in the GTP work areas. Specifically, include further information to support "Snow piled in the lake basin could reduce the quality of this habitat for spectacled eiders, although spectacled eiders are not expected to nest close to granular pads."	No avian surveys are planned on the North Slope at this time. Potential disturbance to nesting spectacled or Steller's eiders would be reduced by completing most construction activities during winter. Should site preparation and/or construction activities occur

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		Explain whether spectacled eider nesting habitat would be surveyed in this area.	on the tundra between June 1 and July 31 or later the appropriate USFWS Field Office would be contacted for instructions on how to avoid or minimize the potential loss of the active nest.
FERC	11/16/2016	Include a discussion of Steller sea lion Western Distinct Population Segment and spectacled eider critical habitats. This discussion should describe the primary constituent elements and any potential impacts on them resulting from construction and operation of the Project.	Steller sea lion critical habitat is discussed in Sections 3.12.3, 5.13.4.1, and 6.12.2 in Resource Report No. 3, Appendix C (Biological Assessment): primary constituent elements (PCEs) have not been identified by the agency. The findings are reiterated in Table 3.5.3-1 of Resource Report No. 3 but are not discussed further in Resource Report No. 3 to limit redundancy and because there would be no effect. Steller's eider critical habitat is discussed in Sections 5.21.5.1 and 6.20.2 of the Biological Assessment (Appendix C): PCEs are identified in Section 3.20.3 and 6.17.2. The findings are reiterated in Table 3.5.3-1 of Resource Report No. 3 but are not discussed further to limit redundancy and because there would be no effect.
FERC	11/16/2016	Address the potential for the southeast Alaska stock of sea otters to occur in the Project area in the text of section 3.5.1.1.10.	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process
FERC	11/16/2016	Include the forage species for the short-tailed albatross, Steller's eider, and wood bison. (section 3.5.1.1.11, page 3-398; section 3.5.1.1.12, page 3-398; section 3.5.1.2.3, page 3-408)	Information on forage species has been added to the respective subsections within Section 3 of the Biological Assessment (Appendix C of Resource Report No. 3).
FERC	11/16/2016	Include the state listed species that occur in the Project area, including the LNG carrier routes.	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process
FERC	11/16/2016	Include information on BLM Sensitive and Watch List plant species potentially affected by the Project. Also, include any regulations or requirements pertaining to these species.	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process
FERC	11/16/2016	Add marine vegetation mapping data for Cook Inlet to appendix B, if available (e.g., Nearshore Biophysical Habitat Mapping: Alaska ShoreZone Program at http://www.kenaifishpartnership.org/wp-content/uploads/2012/10/web_Saupe.pdf).	Shorezone mapping of vegetation has been added to Sheets 157 and 162 in the mapbook in Appendix B-1 of Resource Report No. 3. This data is one dimensional, just a line along the coast, not polygonal like the rest of the vegetation mapping.
FERC	11/16/2016	Include Pacific walrus, ringed seal, and bearded seal in the Biological Assessment due to their potential for listing before the Project is complete.	These species have now been addressed in the Biological Assessment (Appendix C of

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			Resource Report No. 3). See Sections 3.10, 3.11, 3.13, and others.
FERC	11/16/2016	Edit figure colors used for resources shown as they are difficult to determine what resource is being depicted. Suggest removing eider information as it is included in a standalone figure. Steller sea lion critical habitat is not visible.	See revised Figure 1 in the Biological Assessment; Steller sea lion critical habitat was also shown on standalone Figures 13 and 14.
FERC	11/16/2016	Summarize U.S. regulations for ballast water discharges as it relates to listed species.	U.S. regulations for ballast water discharges were summarized in Section 3.4.10.1.6 of Resource Report No. 3 and have now been summarized in Section 2.1.1.2 of the Biological Assessment (Appendix C of Resource Report No. 3).
FERC	11/16/2016	Include the MOF at Beluga in the Project description and subsequent species impacts and mitigation measures sections.	A description of the Mainline MOF is found in Resource Report No. 1, Section1.3.1.2 Marine Terminal. This Resource Report addresses impacts of construction and use of this facility.
FERC	11/16/2016	Describe any mitigation measures for ice dependent species (polar bear, ringed seal).	All measures are included in Section 2.10.3.
FERC	11/16/2016	Include aircraft in section 2.10.5.	Appendix C Section 2.10.5 has been updated to include Vehicles and Aircraft
FERC	11/16/2016	Describe how conducting ice road closure drills is a mitigation measure for wildlife.	This mitigation measure has been deleted; see revised Section 2.10.5.
FERC	11/16/2016	Describe Federal Aviation Administration requirements for communication towers as they relate to wildlife.	Appendix C Section 2.10.6 refers to Appendix E - FAA requirements for communication towers
FERC	11/16/2016	Include the Polar Bear and Pacific Walrus Avoidance and Interaction Plan in Appendix J.	A Polar Bear and Pacific Walrus Avoidance and Interaction Plan has not yet been fully developed. It would be prepared and submitted with an application to USFWS for a Letter of Authorization prior to construction.
FERC	11/16/2016	Quantify the action area limits or boundaries and include a figure for the action area limits associated with the Mainline.	The Mainline Action Area is indicated in Figure 1 (note added to the legend) of the figure and noted in Section 2.11. Total areas of the Action Areas have been noted in Section 2.11. All portions of the Mainline that have the potential for listed species occurrence are encompassed within the Prudhoe Bay and Cook Inlet portions of the Action Area (see Figures 5 and 6).
FERC	11/16/2016	Include the following information regarding vessel and wildlife interactions:	ee responses to subparts of this comment below.

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FERC	11/16/2016	a. Include a figure of gray whale migration routes with respect to Project facilities and anticipated vessel traffic.	Such a figure already exists as Figure 3G-21 in Appendix G of Resource Report No. 3. No changes made.
FERC	11/16/2016	b. Include a detailed analysis for right whales since vessels travel through critical habitat.	As planned, vessels do not travel through right whale critical habitat. No changes made to the document.
FERC	11/16/2016	Include the 20-nautical-mile buffer on figure 14. Critical habitat is in the legend of figures 13 and 14, but is not visible on maps.	The 20-nautical-mile buffer has been added to Figure 14.
FERC	11/16/2016	Clarify if and where surveys for active polar bear dens would be conducted prior to construction activities.	Text in Sections 2.10 (conservation measures) and 5.16.1.6.2 (direct effects on polar bears) has been revised to clarify when and where such surveys would be conducted.
FERC	11/16/2016	Include the timeline for when reintroduction of the wood bison to Minto Flats is planned, and if it coincides with the Project construction timeline, include a discussion of impacts and documentation of coordination with the FWS regarding the potential for impacts and any proposed mitigation measures.	The agencies have no plan for reintroduction to Minto Flats; see revised Section 3.16.2.
FERC	11/16/2016	Describe migration patterns between the Arctic and Cook Inlet areas (e.g., is migration overland or along coastal areas).	Text has been added to Section 3.20.2 describing what is known of the migration routes of Steller's eiders.
FERC	11/16/2016	Species listed and discussed in each of the portions of the action area (Nearshore Beaufort Sea, Arctic Coastal Plain, and Cook Inlet Basin) do not match the table provided in Resource Report 3.	The structure and content of the BA was developed in consultation with USFWS, NMFS and FERC. The Project was not required to describe species by segments within the Project area.
FERC	11/16/2016	Discuss disturbances to spectacled eiders and the types, nature of activity, and vessel disturbances related to life history stage. Include the frequency of eider collisions from reference	See revised text in Section 4.1.2.1 of the Biological Assessment (Appendix C of Resource Report No. 3).
FERC	11/16/2016	Include baseline noise levels underwater in Cook Inlet.	Ambient sound levels in Cook Inlet were discussed in Section 4.3.1.2 of the Biological Assessment (Appendix C of Resource Report No. 3) and in the MMPA Assessment (Appendix F).
FERC	11/16/2016	Include descriptions of species-specific measures that would be implemented to mitigate specific Project-related impacts. Include a conservation measures subsection for each species and activity (appendix C, section 5.1). Include a list of projects that would be considered under cumulative effects for each Action Area region (i.e., Beaufort Sea, Cook Inlet).	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process. Most such measures would have benefits for a number of species. A table will be added to Section 2.10 to indicate which mitigation measures would apply to which species.

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			Text will be added to Section 5.2 of Appendix C indicating what projects were considered in the cumulative effects analysis.
FERC	11/16/2016	Include noise sources and levels of exposure and their impacts on Cook Inlet belugas from construction and docking activities.	Sound source levels and radii to thresholds were provided in Table 13 in the Biological Assessment (Appendix C of Resource Report No. 3). More details are provided in Section 6.0 of the MMPA Assessment (Appendix F of Resource Report No. 3).
FERC	11/16/2016	Include the missing data in table 13.	Table has been completed.
FERC	11/16/2016	Clarify what level constitutes a “loud sound” that would trigger PSO to stop activity.	PSOs monitor the esonification area around construction activities for marine mammals and will stop activity based on marine mammal presence, not noise levels.
FERC	11/16/2016	Include a discussion of impacts on marine mammals from:	See responses to subparts of this comment below.
FERC	11/16/2016	a. dredging, physical impacts;	Additional quantification of the physical effects of dredging has been added to Section 9.1 of the MMPA Assessment (Appendix F of Resource Report No. 3).
FERC	11/16/2016	b. vessel strikes;	See the vessel strike analysis in Attachment A of the Biological Assessment (Appendix C of Resource Report No. 3), which is summarized in Section 5.3 of the MMPA Assessment (Appendix F).
FERC	11/16/2016	c. fuel releases; and	See revised text on impacts of possible petroleum spills on marine mammals in Section 5.4 of the MMPA Assessment (Appendix F of Resource Report No. 3)
FERC	11/16/2016	d. pipeline anchors in Cook Inlet.	See revised discussion regarding anchoring of the pipelay vessel in Section 1.1.2 and Section 9.1 of the MMPA Assessment (Appendix F of Resource Report No. 3).
FERC	11/16/2016	Include evidence of consultation with NMFS as indicated below.	See responses to subparts of this comment below.
FERC	11/16/2016	a. Incidental Take Authorization application needs.	The Applicant has begun consultation. In a September 15, 2016, meeting between NMFS and the Applicant regarding potential application for incidental take regulations, NMFS confirmed the sound sources that should be covered under an incidental take authorization.
FERC	11/16/2016	b. “NMFS does not regulate vessel traffic under MMPA”; also clarify this statement in terms of what	This text has been altered to be more clear. NMFS uses this

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		regulatory authority NMFS has in terms of marine mammals and vessel strikes.	phraseology. They do not regulate incidental harassment of marine mammals from normal vessel traffic; Incidental Harassment Authorizations are not issued for vessel traffic but the proposed action (construction of facilities and operation of facilities) in Cook Inlet.
FERC	11/16/2016	c. Confirmation that NMFS does not require thruster noise to be quantified in an MMPA assessment.	As stated in Section 5.1.3.2 of the MMPA Assessment (Appendix F of Resource Report No. 3) vessel thrusters do need to be quantified and are in the document See Appendix D of Resource Report No. 1 for records of a Project meeting with NMFS during which sound sources were identified.
FERC	11/16/2016	d. “NMFS does not consider transiting vessel sound to rise to the level of ‘take’.”	This statement is referenced as a personal communication with S. Guan of NMFS. It was also made clear in September 15, 2015, Project meeting with NMFS (see Resource Report No. 1 Appendix D) in which they detailed what sound sources should be evaluated.
FERC	11/16/2016	e. NMFS recommendations for noise modeling.	See revised text in Section 5.1.5 per results of a September 15, 2015, meeting between NMFS and the Applicant regarding potential application for Draft Incidental Take Regulations for construction of the Project. (AGDC, 2017) and Appendix D of Resource Report No. 1.
FERC	11/16/2016	f. NMFS recommendations for determining polar bear densities in summer for purposes of airborne noise impacts and take calculations.	NMFS does not manage polar bears, USFWS does. Requests for Letters of Authorization from USFWS do not require density estimates.
FERC	11/16/2016	Designated critical habitat has been reinstated for the polar bear. Include discussion of critical habitat in the Project area and any impacts on designated critical habitat.	See revised text in Sections 9.2 and 12.2 of the MMPA Assessment (Appendix F of Resource Report No. 3).
FERC	11/16/2016	Include a discussion of impacts on seals and otters at the surface of the water from airborne sounds.	See revised Section 5.1.8 in the MMPA Assessment (Appendix F of Resource Report No. 3).
FERC	11/16/2016	Include the source for criterion used in table 18 and explanation of how determination of exceedance was made.	See footnotes to Table 18.
FERC	11/16/2016	Include helicopters in the discussion of overflight noise impacts.	The term aircraft in the discussion in Section 5.1.8 (Aircraft Overflight Noise) of the MMPA Assessment (Appendix F of Resource Report

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			No. 3) includes helicopters. Some text has been added to the section to make this point clear. Further analysis was deemed to not be warranted as overflights would be kept above 1,500 feet except for landings and take-offs.
FERC	11/16/2016	Include data on sea otter densities in Cook Inlet.	There are no reliable published density estimates for northern sea otters in Cook Inlet. An estimate from monitoring studies has been added to Table 24 of the MMPA Assessment (Appendix F of Resource Report No. 3) and properly footnoted.
FERC	11/16/2016	Include the Noxious Weed Act and Plant Protection Act under the federal regulations.	The Noxious weed act and Plant protection act has been included in Section 1.3.1
FERC	11/16/2016	Include Title 3 of the Alaska Statutes regarding protection of agriculture under state requirements and list other regulations regarding noxious and invasive plants as appropriate	Additional State Statutes has been added into section 1.3.2
FERC	11/16/2016	Throughout the appendix, state which applicable/appropriate agencies would be consulted for invasives (e.g., ADNR, Alaska Division of Agriculture, ADF&G (e.g., appendix K, section 1.3.3, page 7; section 2.1.1, page 8)	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process
FERC	11/16/2016	Include whether the BLM has any other regulations or requirements for invasives on BLM land.	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process
FERC	11/16/2016	Define who the "Project Entity" is in section 2.1.1.	Defined in Resource Report No. 1, first page, Alaska LNG (the Applicant) is the entity that will build and operate the facilities.
FERC	11/16/2016	Update section 2.1.1.1 to clarify that the environmental inspector (EI) would be responsible for ensuring equipment is clean and free of weeds before entering the construction zone and exiting weed infested areas.	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process
FERC	11/16/2016	Update the following for existing noxious weed infestations:	See below
FERC	11/16/2016	a. work and travel in existing noxious weed infestations would be avoided to the extent practicable	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process
FERC	11/16/2016	b. that excavated soil with a previous weed infestation would be cleared and stockpiled separately from topsoil;	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process
FERC	11/16/2016	c. add details to the third bullet, including when cleaning stations might be deemed necessary; and	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process

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FERC	11/16/2016	d. add that all field vehicles and construction equipment would be cleaned prior to leaving weed infested areas to the third bullet.	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process
FERC	11/16/2016	Although not included under the Alaska aquatic nuisance species plan high priority threat species list, there are numerous species of phytoplankton and zooplankton at risk for introduction to Alaskan waters through ballast water and hull fouling. Examples include (Bythotrephes longimanus, Cercopagis pengoi, Mnemiopsis leidyi, Tortanus dextrilobatus, Pseudodiaptomus inopinus). Include a cursory review of the planktonic aquatic nuisance species potentially introduced through ballast waters.	Appendix K Section 5.1.1 and 5.1.2 includes a list of mitigation measures the State requires.
FERC	11/16/2016	State who would determine whether a monitoring program might be established, when this would be determined, and how it would be developed or documented and by whom.	BLM and ADNR through the State ROW Lease and ROW Grant agreements would initiate the discussion on the required monitoring program and the implementation of any requirements.
FERC	11/16/2016	Add a column for the total number of occurrences per species to table 1 in section 3.3.	Information was not collected during field surveys.
FERC	11/16/2016	Clarify what is meant by field weed wash stations may be set up on site "…until the topsoil or grading has been completed." Seed and other propagules could remain in the ground in and around the infested area even after control measures are applied. Review and revise as needed, including reasoning for supporting wash station use.	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process
FERC	11/16/2016	Add detail on when continued revegetation efforts after the first several grow seasons would be carried out, including whether revegetation would continue until a specific coverage of desirable vegetation is achieved, whether monitoring would occur, whether this would apply to all areas or as requested by landowners, etc.	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process
FERC	11/16/2016	Clarify whether plants and seeds would be taken to a disposal facility or actually destroyed.	Alaska LNG will destroy the noxious material removed.
FERC	11/16/2016	Section 3.3.1 (Herbicide Treatment Methods) referenced in section 4.3 should be Section 4.3.1.	Herbicide Treatment Methods is in Section 4.3.1
FERC	11/16/2016	Add invasive marine plant/algal species of concern to table 2 (e.g., Codium fragile).	See revised text in Section 3.2 in the Noxious and Invasive Plants and Animal Control Plan (Appendix K of Resource Report No. 3). Table 2 is a list of animal species.
FERC	11/16/2016	Dall sheep survey data were collected in 2011 for the Alaska Pipeline Project (APP). Include information on the coverage of this survey relative to the proposed Alaska LNG Project, and agency correspondence to how long this survey data is valid.	The reference in Section 4 of Appendix K has been revised.

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FERC	11/16/2016	Include information on how long the 2015 raptor surveys are valid and details of agency correspondence.	Documents in Appendix M of Resource Report No. 3 are historical reports and are not updated. The surveys were flown per USFWS recommendations. They are valid for a year. They will be flown annually during construction.
FERC	11/16/2016	Appendix M includes Dall sheep and raptor survey reports. Include information on other wildlife species surveys that occur within the Project area.	These are historical reports for species specific surveys. Other species are identified in Section 3.4 of Resource Report No. 3.
FERC	11/16/2016	In figure 1-1, define the white area in the map.	White areas are marine waters of Cook Inlet and Beaufort Sea; no changes were made to the historical document.
FERC	11/16/2016	Include similar mean annual precipitation, temperature, and frost-free days for all sub-ecoregions as done in section 1.3.2, Intermontane Boreal.	Alaska LNG will address this comment prior to the initiation of the EIS (Environmental Impact Statement) process
FERC	11/16/2016	State the number of field plots surveyed in each sub-ecoregion. Also, section 3.1 states that all 30 Viereck cover types occur in the study area. Clarify whether all 30 cover types were field verified and if not, how many (and which ones) were field verified.	The referenced 2015 Vegetation Study Report (Appendix Q of Resource Report No. 3) is a historical report and should not be changed. The Project footprint has changed since the 2015 report was prepared. The data in Section 3.3 (Table 3.3.2-1) are the numbers on which should be relied. All 30 types are located within the study (survey) area but only 24 of them were verified with data/observation points. Types IIIB3, IIIC1, IIIC2, IIID1, IIID2, and IIID3 were not, but represented very small acreages within the study area. The number of data points in each ecoregion have been added to Resource Report No. 3 as footnotes to Table 3.3.2-1.
FERC	11/16/2016	Revise the titles of tables 3.1 and 3.2 to clarify what Viereck cover type levels are included.	Tables 3-1 and 3-2 are in the 2015 Vegetation Study Report, which is a historical report, and therefore should not be changed. That said, the reader can see what cover types are included. Table 3-1 provides totals by Level 1 cover types as indicted in text above the table. Table 3-2 describes the cover types at Levels II and III. Sometimes the lower level cover types were combined in the study mapping due to heterogeneity. The final cover types for all map polygons are provided in Tables 3-3, 3-4, and 3-5, in which the reader

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Agency Comments and Requests for Information Concerning Fish, Wildlife, and Vegetation Resources

Agency	Date	Comment	Response/Resource Report Location
			can see where some cover types were combined for some polygons.
FERC	11/16/2016	Clarify whether rare and sensitive plant species and invasive plant species were found during field surveys, and if so, state the number of documented occurrences, and refer to the section where they're listed. If not listed, add a list of these species to appendix Q.	Surveys were not conducted for rare, sensitive, or invasive plants. If they were observed during the vegetation studies they would have been recorded as indicated in Section 2.3 of the 2015 Vegetation Study Report (in Appendix Q of Resource Report No. 3). The referenced report is a historical document and should not be altered, however, a statement regarding these findings has been added to Section 3.3.5.3 of Resource Report No. 3.
FERC	11/16/2016	Clarify that the references to appendices are for appendices of appendix Q (e.g., "Vegetation Field Study Protocols" as appendix A).	Those are stand alone historical survey reports.

Resource Report No. 3 Public Comments			
Date	**Individual/ Organization**	**Comment**	**Response/Resource Report Location**
9/29/2016		DRR No. 3 Page 3-49 Table 3.2.5-2 – Marine Essential Fish Habitat Occurring in the Project Area. Table Notes 2 at the bottom list GOA Groundfish FMP. The list does not include Pacific Halibut. It should be noted that this fish has been found in the Project area (Nikiski - at both the Liquification plant and the Boulder Point/Suneva Lake landing for the pipeline) in recent years. Commercial shore salmon fisheries have encountered increased halibut catch in their nets.	Comment acknowledged. The presence of halibut in the Cook Inlet is noted. The Groundfish FMP does not cover Pacific halibut and there is no EFH for halibut in the Cook Inlet area.
9/29/2016	Keith, Scott	DRR No. 3 Page 3-83 Offshore Trenching and Pipelay – The third paragraph of this section discusses sound effects from bow thrusters. “Sound from bow thruster operations during mainline pipelay across Cook Inlet could potentially affect fish” (and marine mammals). It discusses Sound Pressure Levels (SPL's) that exceed the NMFS at a distance of 2.31 miles from the source. I was under the impression that the preferred method for pipeline installation in the Inlet was by laybarge with anchors and tugs. Will vessels with bow thrusters be operated in the near shore vicinity of Beluga and Nikiski where the pipeline enters and leaves the Inlet? Will this activity be only during sub-sea and near-shore pipeline installation? Will bow thruster type vessels be utilized when shipping materials via barge to Beluga Landing (Table 5.4.2-7 Estimated use of Mainline MOF or Beluga Landing During Project Construction on Page 5-177 indicates more than 400 barge landings)?	The referenced distance is for behavioral effects on marine mammals. Any effects on fish would occur over a much smaller area. Use of a pipelay vessel and tugs is the expected methods for pipelay in the Cook Inlet.
9/29/2016	Keith, Scott	If bow thrusters are routinely used – there must be established a much larger buffer area around the construction area to protect the fish and marine mammals from acoustic harm. In addition if these bow thruster vessels are utilized for barge movements, then a 6 year impact to local fisheries and mammals would result. The Beluga area is proximal to a Critical Beluga whale habitat. It will be very important to assess whether the noise is transmitted to this sensitive area.	Assessment of potential effects form noise associated with bow thrusters is found in Section 6 of the MMPA Assessment and in the Draft ITR Petition (AGDC, 2017)).
9/29/2016	Keith, Scott	DRR No. 3 Page 3-83 Hydrostatic Testing – Will the hydrostatic testing of the sub-sea portions of the mainline will be done with Cook Inlet seawater or freshwater? Well the answer to this can be found in DRR No. 1 Page 1-168. Please put a link in Page 3-83 to the offshore hydrostatic testing procedure on page 1-168. What will be the corrosion mitigation for the pipe interior? This is not detailed in either this section or in the offshore Section No. 1. Please expand with details about the type of corrosion inhibitor, methods to apply the inhibitor and disposal methods.	Cook Inlet seawater is the currently intended source of hydrostatic test water for the offshore portion of the pipeline. The reference has been added to the text.
9/29/2016	Keith, Scott	DRR No. 3 Page 3-368 3.4.11.2.1.1 Marine Mammals. “Operation of the marine sections of the Mainline through Upper Cook Inlet wild have limited effect on marine mammals.” This section discusses overflights and vessel activity and their effect on mammals. It lacks detail on the impacts of construction activities. The expected Operations and Maintenance activities on the sub-sea portions of the pipeline should be listed and their possible effects discussed.	There are few activities associated with a subsea pipeline. These are addressed in Section 3.4.11.2.1.1. See Section 3.4.10 for assessment of construction impacts. Additional analysis is found in the Biological Assessment (Appendix C), MMPA Assessment (Appendix F), and the Draft ITR Petition (AGDC, 2017).
9/29/2016		DRR No. 3 Page 3-295 Table 3.4.10-4 Marine Mammals that May Be Exposed to Sound Exceeding NMFS Thresholds. It is clear that Pile	The comment is acknowledged. Marine

Resource Report No. 3
Public Comments

Date	Individual/ Organization	Comment	Response/Resource Report Location
		Driving presents the biggest acoustic problem for marine mammals in the area. Mitigation of the effects of this sound source on marine mammals is very important. The timing of this construction activity may need to be adjusted if marine animals are in the vicinity. This are indications that the Nikiski shoreline near East Forelands and the Nikiski Docks area may be part of the seasonal range for Cook Inlet Beluga whales and other mammals. If the distance at which the sound exceeds the NMFS threshold (120db) is 2.17 miles then a larger buffer area must be established to watch for marine mammals. When Belugas or other marine mammals are in this area Pile Driving should be stopped.	mammal mitigation measures are described in RR3, Appendix N: Draft Marine Mammal Mitigation and Monitoring Plan.
9/29/2016	Keith, Scott	DRR No. 3 Page 3-376 & 377 Table 3.4.11-5 Wildlife Habitat within 1 mile of Mainline Block Valves - several of the items are marked (West) these include MP 718.74, 748.18, 763.83, 792.42, 796.23, 800.03. What does the (West) signify? The West route option? It is not clear.	Yes, that is correct. Please see the revised Table 3.4.11-5.
9/29/2016	Keith, Scott	DRR No. 3 Page 3-421 Table 3.5.3-1 Marine Mammals – NMFS. Beluga whales are discussed. In the column Proposed Mitigation makes the statement: "Typical mitigation measures could include: Placing marine mammal monitors (protected species observers PSO's) on marine structures/docks, avoiding construction activities furring sensitive mammal periods/seasons..." I believe the statement should be more descriptive of the proposed mitigation measures to protect Beluga whales. The statement should read "Typical mitigation measures shall include:" In my opinion – details about the protection afforded to this species is one of the most important issues that the LNG project must provide in this FERC application.	Comment acknowledged. See detailed analyses in the Biological Assessment (Appendix C), MMPA Assessment (Appendix F), and Draft ITR Petition (AGDC, 2017). Mitigation measures would be refined in the permitting process associated with the Petition.
9/29/2016	Keith, Scott	DRR No. 3 Page 3-324 Discusses Trenching (Onshore and Offshore) – This section discusses the effect of the trenching on Marine Mammals. This is another section where the protection provided to marine mammals is critical. It is important to pledge to avoid trenching that cause displacement of marine mammals and injury especially adjacent to critical habitat for endangered species. Parts of Appendix N should be referenced in this section.	Comment acknowledged. See detailed analyses in the Biological Assessment (Appendix C), MMPA Assessment (Appendix F), and Draft ITR Petition (AGDC, 2017)

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APPENDIX H Project Table of Fish Stream Crossings
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APPENDIX M Project Wildlife Survey Reports (Privileged and Confidential)
APPENDIX N Draft *Marine Mammal Mitigation and Monitoring Plan*
APPENDIX O Subsistence Plan of Cooperation (To be filed with FERC Application)
APPENDIX P Draft *Restoration Plan*
APPENDIX Q Project Vegetation Field Study Reports
APPENDIX R USACE Seattle District, Dredged Material Evaluation and Disposal Procedures – User Manual (August 2016).

ACRONYMS AND ABBREVIATIONS

ACRONYM	DEFINITION
μPa	MicroPascal
AAC	Alaska Administrative Code
ACEC	Area of Critical Environmental Concern
ACP	Arctic Coastal Plain physiographic region
ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish and Game
ADNR	Alaska Department of Natural Resources
ADOT&PF	Alaska Department of Transportation and Public Facilities
AFFI	Alaska Freshwater Fish Inventory
AGDC	Alaska Gasline Development Corporation
AGI	Apex Gas Injection
AKNHP	Alaska National Heritage Program
ANS	Aquatic Nuisance Species
ANSTF	Aquatic Nuisance Species Task Force
ANWR	Arctic National Wildlife Refuge
APDES	Alaska Pollutant Discharge Elimination System
APP	Alaska Pipeline Project
Applicant	Alaska Gasline Development Corporation (AGDC)
APSC	Alyeska Pipeline Service Company
AR	Alaska Range
AR	Alaska Range Transition
ARRC	Alaska Railroad Corporation
AS	Alaska Statute
AT	Arctic tundra
ATWS	additional temporary workspace
AWC	Anadromous Water Catalog
BA	Biological Assessment
BB	Beringia Boreal
BBS	Breeding Bird Survey
BCC	Birds of Conservation Concern
BCP	Beaufort Coastal Plain Ecoregion
BCR	Bird Conservation Region
BF	Brooks Range Foothills
BGEPA	Bald and Golden Eagle Protection Act
BLM	Bureau of Land Management
BMP	best management practice
BpS	biophysical setting
BR	Brooks Range
C.F.R.	Code of Federal Regulations
CAH	Central Arctic Herd
Catalog	The Catalog of Waters Important for Spawning, Rearing or Migration of Anadromous Fishes
CDFW	California Department of Fish and Wildlife
CGF	Central Gas Facility within the Prudhoe Bay Unit

ACRONYM	DEFINITION
CHA	Critical Habitat Area
CI	Cook Inlet
CIAA	Cook Inlet Aquaculture Association
CIRCAC	Cook Inlet Regional Citizens Advisory Council
CNF	United States Department of Agriculture, Chugach National Forest
CPR	continuous plankton recorder
CV	coefficient of variation
dB	decibel
dBA	A-weighted decibels
DBH	diameter at breast height
dB_{rms}	decibels root mean square
DH	Dock Head
DHCMA	Dalton Highway Corridor Management Area
DHHS	Alaska Department of Health and Human Services
DMLW	Alaska Department of Natural Resources, Division of Mining, Land, & Water
DMMP	Dredged Material Management Program
DNPP	Denali National Park and Preserve
DOER	Dredging Operations and Environmental Research
DPS	distinct population segment
EEZ	economic exclusion zone
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EMALL	ExxonMobil Alaska LNG LLC
ENP	Eastern North Pacific
EPA	United States Environmental Protection Agency
EPT	Ephemeroptera, Plecoptera, Trichoptera
ERDC	United States Army Engineering Research and Development Center
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
FEIS	Final Environmental Impact Statement
FERC	Federal Energy Regulatory Commission
FLIR	forward looking infrared
FLPMA	Federal Land Policy Management Act
FMC	Fisheries Management Council
FMP	Fishery Management Plan
FWCA	Fish and Wildlife Conservation Act
GC1	Gas Gathering Center No. 1
GHX-1	Gas Handling Expansion Phase 1
GIS	geographic information system
GMU	Game Management Unit
GOA	Gulf of Alaska
GTP	Gas Treatment Plant
HAPC	Habitat Areas of Particular Concern
HDD	horizontal directional drilling
HH	Hodanza Hills

ACRONYM	DEFINITION
HIP	Harvest Information Program
HLV	heavy lift vessel
Hz	hertz
IAP	Integrated Action Plan
IBA	Important Bird Area
IHA	Incidental Harassment Authorization
IPS	Initial Production System
IUCN	International Union for Conservation of Nature
IWC	International Whaling Commission
KABATA	Knik Arm Bridge and Toll Authority
KL	Kenai Lowlands
KM	Kenai Mountains
KRV	Kubuk Ridges and Valleys
LAA	may affect, likely to adversely affect.
LNG	Liquefied Natural Gas
LNGC	liquefied natural gas carrier
LOA	Letter of Authorization
LOD	Limit of Disturbance
MBTA	Migratory Bird Treaty Act
MHHW	mean higher high water
MHW	mean high water
MLBV	Mainline block valve
MLLW	mean lower low water
MMPA	Marine Mammal Protection Act
MMS	Minerals Management Service (now reorganized as the Bureau of Ocean Energy Management)
MOF	Material Offloading Facility
MOU	Memorandum of Understanding
MP	milepost
MSA	Magnuson-Stevens Fishery Conservation and Management Act
NAS	Nonindigenous Aquatic Species
N/A	not applicable
NCS	no closed season
ND	no critical habitat designated
NEP	non-essential experimental population
NEPA	National Environmental Policy Act
NIP	non-native invasive plant
NLAA	may affect, not likely to adversely affect
NLAM	not likely to adversely modify
NLJ	not likely to jeopardize continued existence
NMFS	National Oceanic and Atmospheric Administration, National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOS	no open season
NP	North Pacific
NPFMC	North Pacific Fisheries Management Council
NPR-A	National Petroleum Reserve – Alaska

ACRONYM	DEFINITION
NSB	North Slope Borough
NTFP	non-timber forest products
NRG	Natural Resource Group (now Environmental Resources Management [ERM])
NWR	National Wildlife Refuge
OC	open-cut
ONA	Outstanding Natural Area
OPMP	Alaska Department of Natural Resources, Office of Project Management and Permitting
PAH	polycyclic aromatic hydrocarbons
PBTL	Prudhoe Bay Gas Transmission Line
PBU	Prudhoe Bay Unit
PCE	Primary constituent elements
PCH	Porcupine Caribou Herd
PLF	Product Loading Facility
POA	Port of Anchorage
Project	Alaska LNG Project
PSO	Protected Species Observer
PTS	Permanent Threshold Shift
PTTL	Point Thomson Gas Transmission Line
PTU	Point Thomson Unit
RM	Ray Mountains
rms	root mean square
RNA	Research Natural Area
SAIC	Science Applications International Corporation
SE	standard error
SEL	sound exposure level
SFP	Special Forest Products
SGR	State Game Refuge
SHPO	Alaska Department of Natural Resources, Division of Parks and Outdoor Recreation, State Historic Preservation Office
SPCC	Spill Prevention, Control, and Countermeasure
SPCS	Alaska Department of Natural Resources, Division of Oil and Gas, State Pipeline Coordinator’s Section
SPL	Sound Pressure Level
SPLASH	Structure of Populations, Levels of Abundance and Status of Humpbacks
SSFP	Management of Sustainable Salmon Fisheries Policy
SWPPP	Stormwater Pollution Prevention Plan
TAPS	Trans-Alaska Pipeline System
TBD	to be determined
TCH	Teshekpuk Caribou Herd
TKL	Tanana-Kuskokwim Lowlands
TTS	Temporary Threshold Shift
UIC	Underground Injection Control
ULSD	Ultra-low sulfur diesel
U.S.	United States
USACE	United States Army Corps of Engineers
USCG	United States Coast Guard

ACRONYM	DEFINITION
USDOI	United States Department of the Interior
USFS	United States Department of Agriculture, Forest Service
USFWS	United States Department of the Interior, Fish and Wildlife Service
USGS	United States Department of the Interior, Geological Survey
VAR	variable
VSM	vertical support member
WAH	West Arctic Herd
WAP	Wildlife Action Plan
WH	White Hills
WM	White Mountains
WNP	Western North Pacific
YTU	Yukon-Tanana Uplands
ZOI	zone of influence

3.0 RESOURCE REPORT NO. 3 – FISH, WILDLIFE, AND VEGETATION RESOURCES

This Resource Report analyzes the potential biological resource impacts from the construction and operation of the Alaska LNG Project (Project), including direct and indirect effects, effects of non-jurisdictional activities and connected actions, and cumulative impacts. In addition to the areas in which the Project and associated facilities would be constructed, areas that may be directly or indirectly affected by the Project and that are analyzed in this Resource Report include:

- Crossing locations of the proposed facilities across upland habitats, wetlands, and waterbodies, as well as the distance sediment plumes could travel;
- The in-water area of disturbance in Cook Inlet from dredging, marine facility construction, and sediment disposal could cause noise and sediment plumes to travel;
- The in-water area of disturbance in Prudhoe Bay from West Dock and Dock Head 4 (DH 4) construction and placement of granular fill could cause noise and sediment plums to travel; The in-water potential dispersion of construction fuel supplies or vessel groundings and fuel leaks;
- The potential dispersion of liquefied natural gas (LNG) leaks or spills; and
- The transit routes of construction and operational support vessels and LNG carriers (LNGCs) from the Liquefaction Facility through Cook Inlet or West Dock through Prudhoe Bay out to the seaward limits of the Exclusive Economic Zone (EEZ) offshore of Alaska.

3.1 PROJECT DESCRIPTION

The Alaska Gasline Development Corporation (Applicant) plans to construct one integrated liquefied natural gas (LNG) Project (Project) with interdependent facilities for the purpose of liquefying supplies of natural gas from Alaska, in particular from the Point Thomson Unit (PTU) and Prudhoe Bay Unit (PBU) production fields on the Alaska North Slope (North Slope), for export in foreign commerce and for in-state deliveries of natural gas.

The Natural Gas Act (NGA), 15 U.S.C. § 717a(11) (2006), and Federal Energy Regulatory Commission (FERC) regulations, 18 Code of Federal Regulations (C.F.R.) § 153.2(d) (2014), define "LNG terminal" to include "all natural gas facilities located onshore or in State waters that are used to receive, unload, load, store, transport, gasify, liquefy, or process natural gas that is ... exported to a foreign country from the United States." With respect to this Project, the "LNG Terminal" includes the following: a liquefaction facility (Liquefaction Facility) in Southcentral Alaska; an approximately 807-mile gas pipeline (Mainline); a gas treatment plant (GTP) within the PBU on the North Slope; an approximately 63-mile gas transmission line connecting the GTP to the PTU gas production facility (PTU Gas Transmission Line or PTTL); and an approximately 1-mile gas transmission line connecting the GTP to the PBU gas production facility (PBU Gas Transmission Line or PBTL). All of these facilities are essential to export natural gas in foreign commerce and will have a nominal design life of 30 years.

These components are shown in Resource Report No. 1, Figure 1.1-1, as well as the maps found in Appendices A and B of Resource Report No. 1. Their proposed basis for design is described as follows.

The new Liquefaction Facility would be constructed on the eastern shore of Cook Inlet just south of the existing Agrium fertilizer plant on the Kenai Peninsula, approximately 3 miles southwest of Nikiski and 8.5 miles north of Kenai. The Liquefaction Facility would include the structures, equipment, underlying access rights, and all other associated systems for final processing and liquefaction of natural gas, as well as storage and loading of LNG, including terminal facilities and auxiliary marine vessels used to support Marine Terminal operations (excluding LNG carriers [LNGCs]). The Liquefaction Facility would include three liquefaction trains combining to process up to approximately 20 million metric tons per annum (MMTPA) of LNG. Two 240,000-cubic-meter tanks would be constructed to store the LNG. The Liquefaction Facility would be capable of accommodating two LNGCs. The size of LNGCs that the Liquefaction Facility would accommodate would range between 125,000–216,000-cubic-meter vessels.

In addition to the Liquefaction Facility, the LNG Terminal would include the following interdependent facilities:

- Mainline: A new 42-inch-diameter natural gas pipeline approximately 807 miles in length would extend from the Liquefaction Facility to the GTP in the PBU, including the structures, equipment, and all other associated systems. The proposed design anticipates up to eight compressor stations; one standalone heater station, one heater station collocated with a compressor station, and six cooling stations associated with six of the compressor stations; four meter stations; 30 Mainline block valves (MLBVs); one pig launcher facility at the GTP meter station, one pig receiver facility at the Nikiski meter station, and combined pig launcher and receiver facilities at each of the compressor stations; and associated infrastructure facilities.

  Associated infrastructure facilities would include additional temporary workspace (ATWS), access roads, helipads, construction camps, pipe storage areas, material extraction sites, and material disposal sites.

  Along the Mainline route, there would be at least five gas interconnection points to allow for future in-state deliveries of natural gas. The approximate locations of three of the gas interconnection points have been tentatively identified as follows: milepost (MP) 441 to serve Fairbanks, MP 763 to serve the Matanuska-Susitna Valley and Anchorage, and MP 807 to serve the Kenai Peninsula. The size and location of the other interconnection points are unknown at this time. None of the potential third-party facilities used to condition, if required, or move natural gas away from these gas interconnection points are part of the Project. Potential third-party facilities are addressed in the Cumulative Impacts analysis found in Appendix L of Resource Report No. 1;

- GTP: A new GTP and associated facilities in the PBU would receive natural gas from the PBU Gas Transmission Line and the PTU Gas Transmission Line. The GTP would treat/process the natural gas for delivery into the Mainline. There would be custody transfer, verification, and process metering between the GTP and PBU for fuel gas, propane makeup, and byproducts. All of these would be on the GTP or PBU pads;

- PBU Gas Transmission Line: A new 60-inch natural gas transmission line would extend approximately 1 mile from the outlet flange of the PBU gas production facility to the inlet flange of the GTP. The PBU Gas Transmission Line would include one meter station on the GTP pad; and

- PTU Gas Transmission Line: A new 32-inch natural gas transmission line would extend approximately 63 miles from the outlet flange of the PTU gas production facility to the inlet flange of the GTP. The PTU Gas Transmission Line would include one meter station on the GTP pad, four MLBVs, and pig launcher and receiver facilities—one each at the PTU and GTP pads.

Existing State of Alaska transportation infrastructure would be used during the construction of these new facilities including ports, airports, roads, railroads, and airstrips (potentially including previously abandoned airstrips). A preliminary assessment of potential new infrastructure and modifications or additions to these existing in-state facilities is provided in Resource Report No. 1, Appendix L. The Liquefaction Facility, Mainline, and GTP would require the construction of modules that may or may not take place at existing or new manufacturing facilities in the United States.

Draft Resource Report No. 1, Appendix A, contains maps of the Project footprint. Appendices B and E of Resource Report No. 1 depict the footprint, plot plans of the aboveground facilities, and typical layout of aboveground facilities.

Outside the scope of the Project, but in support of or related to the Project, additional facilities or expansion/modification of existing facilities would be needed to be constructed. These other projects may include:

- Modifications/new facilities at the PTU (PTU Expansion project);
- Modifications/new facilities at the PBU (PBU Major Gas Sales [MGS] project); and
- Relocation of the Kenai Spur Highway.

3.1.1 Purpose of Resource Report

As required by 18 Code of Federal Regulations (C.F.R.) § 380.12, Resource Report No. 3 has been prepared in support of the Project's future application under Section 3 of the NGA to construct and operate the Project facilities. The purpose of this Resource Report is as follows:

- Describe the existing fish, wildlife, and vegetation resources in the Project area;

- Assess the potential adverse effects to these resources resulting from Project construction and operation; and

- Identify mitigation measures to avoid or minimize potential adverse effects to fish, wildlife, and vegetation resources in the Project area.

The Federal Energy Regulatory Commission (FERC) has designated the Project as its non-federal representative in the Endangered Species Act (ESA) process. A draft Biological Assessment (BA) has been prepared under Section 7(c) of the ESA of 1973 as amended (PL 93-205; 16 U.S.C. §§ 1531-1544) to address listed species and their critical habitat that may be present in the Project area. The draft BA is attached as Appendix C of this Resource Report.

A draft Essential Fish Habitat (EFH) Assessment Report has been prepared to identify federally listed EFH that potentially occurs in the vicinity of the Project and to evaluate potential Project adverse effects to EFH pursuant to the Magnuson-Stevens Fishery Conservation and Management Act (MSA) and 18 C.F.R. Part 380.12(e)(6). The draft EFH Assessment is attached as Appendix D. An assessment of impacts to marine mammals is provided in Appendix F.

Other appendices attached to this Resource Report include the following:

- Appendix A – Project Fisheries Mapping (provided under separate cover);
- Appendix B – Project Vegetation Resources (provided under separate cover);
- Appendix C –*Biological Assessment (BA) Report*;
- Appendix D –*Essential Fish Habitat (EFH) Assessment Report*;
- Appendix E – *Draft Avian Protection Plan*;
- Appendix F –*Marine Mammal Protection Act (MMPA) Assessment Report*;
- Appendix G – Marine Mammal Distribution Mapping;
- Appendix H – Table of Fish Stream Crossings;
- Appendix I –Raptor Nest Mapping (provided as Privileged and Confidential under separate cover);
- Appendix J – *Wildlife Avoidance and Interaction Plan* (includes *North Slope Activities: Polar Bear and Pacific Walrus Avoidance and Interaction Plan*);
- Appendix K – *Noxious and Invasive Plant and Animal Control Plan*;
- Appendix L – Project Fisheries Survey Reports;
- Appendix M – Wildlife Survey Reports (Raptor Survey Report provided as Privileged and Confidential under separate cover);
- Appendix N – *Draft Marine Mammal Mitigation and Monitoring Plan*;
- Appendix O –*Subsistence Plan of Cooperation for the Arctic OCS*;
- Appendix P – *Draft Restoration Plan*;
- Appendix Q – *Vegetation Field Study Report*;
- Appendix R – *USACE Seattle District, Dredged Material Evaluation and Disposal Procedures – User Manual (Manual (August 2016).*

The data for this Resource Report were compiled based on the best scientific and commercial data available, including but not limited to:

- Pre-front-end engineering design (pre-FEED) and proposed construction plans;
- United States Geological Survey (USGS) topographic maps;
- National landcover maps;
- Recent aerial photography (2012–2015);
- Project field survey data and survey reports of prior projects;
- Scientific literature;
- Recent environmental impact statements (EISs) and permits issued in Alaska for projects in the Project area;
- Other proposed LNG project environmental reports filed on the FERC Docket;
- Comments, data, and feedback from FERC and other federal, state, and local agencies;
- Geographic information system (GIS) data from federal and state agencies; and
- Scoping comments received from stakeholders, including tribes, local communities, and other interested parties.

3.1.2 Effect Determination Terminology

The following definitions were used when assessing the duration, significance, and outcome of potential effects related to the Project:

- <u>Duration</u>**:** ***Temporary*** effects are those that could occur only during a specific phase of the Project, such as during construction or installation activities. ***Short-term effects*** could continue up to five years. ***Long-term*** effects are those that would require more than five years to recover. ***Permanent*** effects could occur as a result of any activity that modified a resource to the extent that it would not return to preconstruction conditions during the 30-year life of the Project.

- <u>Significance</u>: ***Minor*** effects are those that could be perceptible, but are of very low intensity and may be too small to measure. ***Significant*** effects are those that, in their context, and due to their intensity, have the potential to result in a substantial adverse change in the physical, biological, or human environment.

- <u>Outcome:</u> A ***positive*** effect may cause positive outcomes to the natural or human environment. In turn, an ***adverse*** effect may cause unfavorable or undesirable outcomes to the natural or human environment. ***Direct effects*** are "caused by the action and occur at the same time and place" (40

C.F.R. 1508.8). ***Indirect effects*** are "caused by an action and are later in time or farther removed in distance but are still reasonably foreseeable. Indirect impacts may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems" (40 C.F.R. 1508.8). Indirect impacts are caused by the Project, but do not occur at the same time or place as the direct impacts.

The evaluation of threatened and endangered species in this Resource Report and the Biological Assessment attached in Appendix C are based on the standards and definitions in the ESA, its implementing regulations, and resource agency guidance, and are based on the best scientific and commercial data available.

3.1.3 Agency and Organization Consultations

This section describes consultations that have been conducted to date with agencies and other parties interested in the Project. Additional consultations will be conducted as Project details are refined in the pre-FEED process that is currently underway.

3.1.3.1 Federal Agencies

Discussions were held with multiple federal agencies regarding various Project details. Table 3.1.3-1 includes meetings and correspondence where discussions regarding fish, wildlife, and vegetation were raised.

A list of the required federal permits for the Project is provided in Resource Report No. 1, Appendix C. A preliminary summary of public, agency, and stakeholder engagement is provided in Resource Report No. 1, Appendix D.

TABLE 3.1.3-1

Summary of Consultations with Federal Agencies

Date Contacted	Contact	Summary
5/16/2013	Bureau of Land Management (BLM)	Discussion of 2013 field studies scope, submittal of draft SF299 form, and discussion of reimbursable services agreement
6/4/2013	BLM	Delivery and review of Casual Use Notification
12/10/2013	BLM	Discussion regarding 2014 field study scope and submittal of reimbursable services agreement amendment letter
2/26/2014	BLM National Park Service (NPS) U.S. Environmental Protection Agency (EPA) U.S. Army Corps of Engineers (USACE) U.S. Coast Guard (USCG) U.S. Fish and Wildlife Service (USFWS)	Summer field season kickoff presentation
3/4/2014	BLM USFWS	Discussion regarding 2014 summer field season activities

TABLE 3.1.3-1

Summary of Consultations with Federal Agencies

Date Contacted	Contact	Summary
4/9/2014	National Marine Fisheries Service (NMFS) USACE	Discussion regarding further metocean studies and geotechnical and geophysical (G&G) studies permitting
5/28/2014	USFWS	Discussion regarding authorizations required for preliminary studies to support the Gas Treatment Plant (GTP)
5/28/2014	USACE	Letter to USACE – Wetlands Determination Protocol
5/29/2014	EPA USACE	Discussion regarding authorizations required for preliminary studies to support the GTP
5/30/2014	NMFS	Discussion regarding authorizations required for preliminary studies to support the GTP
6/12/2014	USACE	Discussion regarding Wetlands Assessment Protocol and data
8/13/2014	USACE	Letter to USACE – Review of Wetland Studies Data Gathered by the Alaska Pipeline Project (APP) and the Alaska LNG Project
9/2/2014	USACE	Discussion of previously submitted wetlands data
10/1/2014	USACE	Discussion regarding permitting and Pre-File activities
10/1/2014	USFWS	Discussion regarding permitting and Pre-File activities
10/1/2014	NMFS	Discussion regarding permitting and Pre-File activities
10/8/2014	NMFS	Discussion regarding permitting and Pre-File activities
10/22/2014	NMFS	Discuss notification letter to National Oceanic and Atmospheric Administration (NOAA) for USACE NWP5, POA-2013-610
10/22/2014	USACE EPA NMFS	Discussion regarding North Slope Test Trench permitting
10/27/2014	NMFS	Letter to NMFS – Initiation of Informal Section 7 consultation – Request for information regarding federally threatened or endangered species or critical habitat that may occur within Project footprint
10/27/2014	NMFS	Letter to NMFS – Initiation of Informal Section 7 consultation – Request for information regarding federally threatened or endangered species or critical habitat that may occur within Project footprint
10/27/2014	USFWS	Letter to USFWS – Initiation of Informal Section 7 consultation – Request for information regarding federally threatened or endangered species or critical habitat that may occur within Project footprint
11/13/2014	USFWS	Industry collaboration meeting to discuss polar bear den surveys on the North Slope
1/16/2015	NMFS	ESA and EFH Consultation Processes for GTP and Cook Inlet Geophysical & Geotechnical Field Programs

TABLE 3.1.3-1

Summary of Consultations with Federal Agencies

Date Contacted	Contact	Summary
1/30/2015	USACE	Email from USACE – Response to Review of Wetland Studies Data Gathered by APP and the Alaska LNG Project
2/10/2015	Federal Energy Regulatory Commission (FERC) NMFS NPS USACE USCG U.S. Department of Energy – Office of Fossil Energy USFWS U.S. Department of the Interior (DOI) EPA	Project Agency Web Mapper and SharePoint Overview
2/26/2015	FERC Natural Resources Group (NRG)	ESA Consultation for Field Study Incidental Harassment Authorization application
3/16/2015 - 3/18/2015	BLM FERC NRG NMFS Pipeline and Hazardous Materials Safety Administration (PHMSA) USACE USCG USDOI USEPA USFWS NPS	FERC and Agency First Draft Resource Report Workshops
4/6/2015	USFWS	Review Avian Raptor Protocols with USFWS
4/15/2015	NMFS	Review of Final NMFS Comments and Updates to Cook Inlet G&G Incidental Harassment Authorization (IHA) Application
4/21/2015	BLM FERC USFWS NPS	Federal Land Managers Air Quality Meeting
4/22/2015	USFWS	USFWS Review of Raptor Survey Protocols
4/24/2015	NMFS	Review Project BA Outline with NMFS
5/12/2015	NPS Department of Revenue EPA USFWS USACE BLM FERC	Multi-Agency Pipeline Routing Workshop

TABLE 3.1.3-1

Summary of Consultations with Federal Agencies

Date Contacted	Contact	Summary
	NRG	
5/14/2015	USACE EPA USFWS	USACE Aquatic Site Assessment Guidance
5/20/2015	NMFS	Review of the Draft Biological Assessment for Section 7 ESA Consultation – Cook Inlet Geotechnical & Geophysical Program
5/20/2015	USACE EPA USFWS	Email to USACE, USFWS, EPA – Wetlands Determination Protocol Notification
5/21/2015	NMFS	IHA Application Status Update
5/26/2015	USFWS	Alaska LNG Project USFWS Section 7 Consultation Initiation
6/4/2014	USACE USFWS	G&G Survey Kenai Peninsula Borough (KPB) Permits Pre-application Meeting
6/5/2015	NMFS	Cook Inlet G&G IHA Application – Schedule Alignment
6/8/2015	NRG	Letter to NRG – EIS Summer Field Season Field Protocols
6/24/2015	USACE DOI EPA USFWS	Multi-Agency Pipeline Construction Execution Workshop
6/25/2015	USFWS FERC NRG NOAA	Multi-Agency Waterbody Crossings Workshop
6/25/2015	NPS BLM U.S. Department of Agriculture, Chugach National Forest (CNF) USFWS	Letter to NPS, BLM, CNF (Deyna Kuntzch) – Alaska LNG Air Quality Modelling Approach for Federal Conservation Units
7/1/2015	NMFS	Meeting with NMFS Regarding Support for Beluga Whale Research
7/1/2015	NMFS	Review of NMFS questions on Alaska LNG Cook Inlet G&G BA
7/8/2015	USACE	Letter from USACE – Wetlands Determination Protocol
7/9/2015	NMFS	Review of Project Representative's Questions on Proposed IHA Posted in Federal Register
7/17/2015	BLM	Letter from BLM – Comments to Air Quality Modeling Approach for Federal Conservation Units
7/22/2015	NMFS	Follow-up NMFS Questions on Alaska LNG IHA/BA

TABLE 3.1.3-1

Summary of Consultations with Federal Agencies

Date Contacted	Contact	Summary
7/23/2015	NMFS	Review of IHA Take Calculations (Daily Method)
7/24/2015	NPS	Letter from NPS – Comments to Air Quality Modeling Approach for Federal Conservation Units
7/27/2015	USACE	Letter to USACE – Response to Wetland Delineation and Functional Assessment Protocol
7/29/2015	NPS	Letter to NPS – Visual/Aesthetics Study Work Plan
7/29/2015	USFWS	Letter to USFWS – Visual/Aesthetics Study Work Plan
7/30/2015	CNF	Letter from CNF – Comments to Air Quality Modeling Approach for Federal Conservation Units
7/31/2015	EPA	Letter to USEPA – Alaska LNG Air Quality Modeling Approach for Federal Conservation Units
8/3/2015	FERC	Letter to FERC – Wetland Protocol Validation Study
8/7/2015	BLM USFWS NPS	Alaska LNG Visual Aesthetics Study Work Plan
8/10/2015	USFWS	Letter to USFWS – Bald Eagle Nest Monitoring in Nikiski Alaska for G&G Program
8/12/2015	FERC NMFS USACE USCG EPA FWS	GTP Footprint Review Workshop
8/12/2015	EPA	Letter from EPA – Alaska LNG Air Quality Modeling Approach for Federal Conservation Unit
8/19/2015	FERC NMFS USACE USFWS	Cook Inlet Routing and Construction Review
9/2/2015	FERC NMFS USACE USCG USFWS	Liquefaction Facility (LNG Plant and Marine Terminal) Footprint Review
9/3/2015	FERC NMFS USACE USCG EPA USFWS	Marine Dredging Workshop
9/9/2015 and 9/10/2015	FERC	Review of proposed modifications to Wetland and Waterbody Crossing Procedures (Procedures) with FERC

TABLE 3.1.3-1

Summary of Consultations with Federal Agencies

Date Contacted	Contact	Summary
10/16/2015	NMFS	ESA Section 7 Consultation for 2016 IHA Application
10/22/2015	NMFS	Review 2016 Cook Inlet IHA Application
4/27/2016	USFWS	Bald and Golden Eagle Protection Act Permitting Requirements
6/30/2016	NMFS	2016–2017 Incidental Harassment Authorization Status Update; Determine NMFS Status for Issuing Incidental Harassment Authorization
8/3/2016	NMFS Office of Protected Resources	Cook Inlet Incidental Take Regulations Pre-Application Meeting
8/17/2016	NMFS	Draft 2 Biological Assessment
8/22/2016	USFWS	Draft 2 Biological Assessment
8/24/2016	NMFS Office of Protected Resources	Construction and Execution of Cook Inlet Pipeline in the Susitna Delta Exclusion Zone
8/26/2016	BLM, Alaska State Office	Resource Reports, ROW Grant Application, Reimbursable Agreement
8/29/2016	USACE	Project Overview, Document Review Update, and Permitting
9/15/2016	NMFS Office of Protected Resources	Acoustic Modeling Methodologies

3.1.3.2 Alaska State and Local Government Agencies

Discussions were held with multiple State of Alaska and local agencies, as well as private corporation representatives, regarding Project details. Table 3.1.2-2 includes meetings and correspondence where discussions of fish, wildlife, and vegetation resources were raised.

A list of required state permits for the Project, as well as a summary of public, agency, and stakeholder engagement , is provided in Resource Report No. 1, Appendix D.

TABLE 3.1.3-2

Summary of Consultations with Alaska State and Local Government Agencies

Date Contacted	Contact	Summary
12/10/2013	State Pipeline Coordinator's Section (SPCS)	Discussion regarding 2014 field study scope and submittal of reimbursable services agreement amendment letter
7/3/2014	Alaska Department of Fish and Game (ADF&G)	Email from ADF&G – Concurrence on Fish Protocols for Summer Field Season
8/13/2014	ADF&G	Letter to ADF&G – Review of Fish Studies Data Gathered by the APP and the Alaska LNG Project
10/23/2013	ADF&G Alaska Department of Health & Social Services (DHSS) SPCS	Discussion regarding work scope for subsistence and health impact studies

TABLE 3.1.3-2

Summary of Consultations with Alaska State and Local Government Agencies

Date Contacted	Contact	Summary
2/25/2014	Alaska Department of Environmental Conservation (ADEC) SPCS	Discussion regarding 2014 summer field season activities
2/27/2014	ADF&G Alaska Department of Natural Resources (ADNR) Alaska Railroad Corporation (ARRC) SPCS	Pipeline right-of-way (ROW) workshop with state and federal regulators
3/4/2014	ADEC ADF&G Alaska Department of Transportation and Public Facilities (ADOT&PF) SPCS	Discussion regarding 2014 summer field season activities
5/29/2014	ADEC ADF&G ADOT&PF ADNR Office of Project Management and Permitting (OPMP) SPCS	Discussion regarding authorizations necessary for 2014 summer field season activities
6/4/2014	ADF&G ADNR KPB River Center	Geotechnical & Geophysical Survey KPB Permits Pre-application Meeting
6/4/2014	KPB	Discussion regarding 2014 field activities
6/11/2014	ADF&G ADNR OPMP SPCS	Discussion regarding fish stream and lakes investigation survey protocols and data
6/12/2014	Alaska Gasline Development Corporation SPCS	Joint discussion regarding state park lands permitting
8/28/2014	ADF&G	Discussion regarding fisheries data
10/22/2014	ADF&G SPCS	Discussion regarding GTP water reservoir design
10/22/2014	ADEC ADNR	Discussion regarding North Slope Test Trench permitting
2/10/2015	ADOT&PF North Slope Gas Commercialization Permitting Coordination Team	Alaska LNG Project Agency Web Mapper and SharePoint Overview
2/12/2015	ADF&G KPB North Slope Gas Commercialization Permitting Coordination Team USACE USFWS	2015 Nikiski and Cook Inlet Area G&G Programs
3/16/2015 - 3/18/2015	ADEC ADF&G	FERC and Agency First Draft Resource Report Workshops

TABLE 3.1.3-2

Summary of Consultations with Alaska State and Local Government Agencies

Date Contacted	Contact	Summary
	ADNR ADOT&PF State Historic Preservation Office (SHPO) SPCS	
4/12/2015	ADF&G	ADF&G Wildlife Training for G&G Survey Team
5/12/2015	Alaska Department of Health and Human Services (ADHHS) ADNR Alaska Department of Revenue (DOR) ADOT&PF ADF&G SPCS ADEC North Slope Borough (NSB) SHPO Denali Borough KPB ADNR Division of Geological & Geophysical Surveys	Multi-Agency Pipeline Routing Workshop
5/13/2015	ADF&G	Waterbody Crossing Review
6/24/2015	ADEC ADF&G ADNR ADOT&PF NSB SPCS	Multi-Agency Pipeline Construction Execution Workshop
6/25/2015	SPCS ADHHS	Multi-Agency Waterbody Crossings Workshop
8/12/2015	ADF&G ADNR NSB SPCS	GTP Footprint Review Workshop
8/19/2015	ADF&G ADNR KPB Matanuska-Susitna Borough	Cook Inlet Routing and Construction Review
9/2/2015	ADF&G ADNR ADOT&PF KPB	Liquefaction Facility (LNG Plant and Marine Terminal) Footprint Review
11/12/2015	ADF&G	ADF&G Soldotna – Commercial Fishing Schedules
12/11/2015	ADNR	IHA and Subsistence Discussion, Resource Report Schedules
3/31/2016	Alaska House of Representatives – Mike Chenault's office Alaska State Senate City of Kenai City of Soldotna	Mobilization of 2016 Marine Field Work

TABLE 3.1.3-2

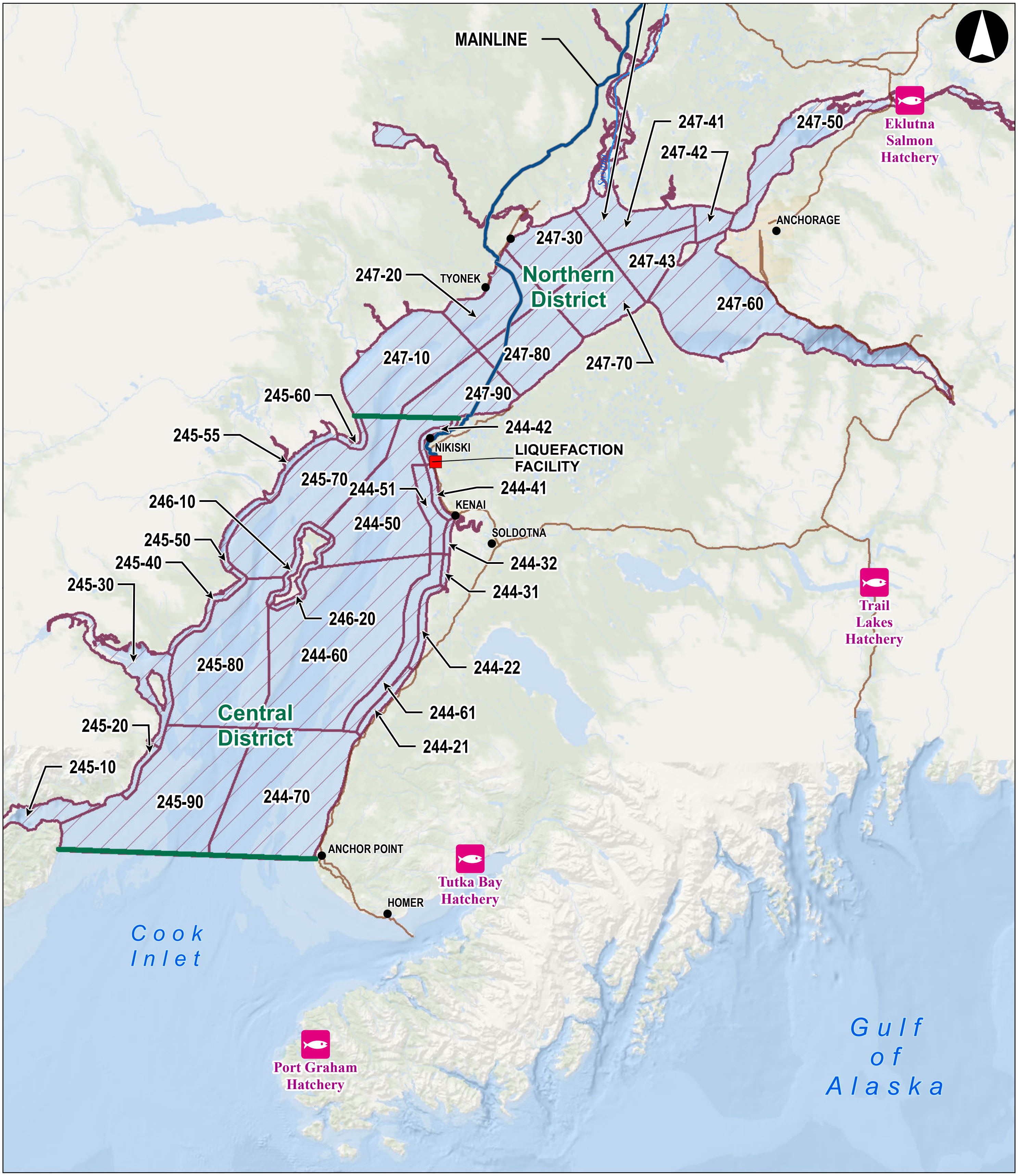
Summary of Consultations with Alaska State and Local Government Agencies

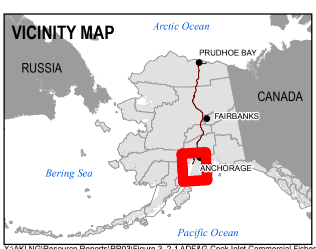
Date Contacted	Contact	Summary
	House of Representatives Kenai Peninsula Borough (KPB)	
3/31/2016	ADF&G	Mobilization of 2016 Marine Field Work
4/27/2016	United States Fish and Wildlife Service (USFWS)	Bald and Golden Eagle Protection Act Permitting Requirements
5/19/2016	Kenaitze Indian Tribe	Project Update on Summer Field Activities, Workforce Development and IHA

3.2 FISHERIES AND AQUATIC RESOURCES

Fisheries and aquatic resources in Alaska include subsistence, commercial, sport, personal use, aquatic shellfish farms, and hatcheries. Most commercial fisheries in Alaska occur in marine or estuarine waters, with the exception of the Kuskokwim and the Yukon in-river commercial salmon fisheries. Commercial fisheries are not currently authorized in the Arctic Management Area (North Pacific Fisheries Management Council [NPFMC], 2009). Sport, subsistence, and personal use fisheries may occur in fresh or marine waters. Aquatic shellfish farms occur in coastal areas. Commercial and state-run hatcheries are used primarily to support salmon fisheries (commercial, sport, and personal use). There are currently no aquatic farms or hatcheries operating within the Project area in Upper Cook Inlet north of Anchor Point; (see Figure 3.2-1). The Cook Inlet Aquaculture Association (CIAA) is based in Kenai, approximately 10 miles from Nikiski. This organization engages in salmon enhancement work throughout the Cook Inlet region, and its remote release sites support salmon enhancement projects throughout the Cook Inlet drainage. Hatcheries are located at Trail Lakes north of Seward, Eklutna on the Knik Arm northeast of Anchorage, and Tutka Bay Lagoon and Port Graham on Kachemak Bay at the southern end of the Kenai Peninsula (Figure 3.2-2).

Commercial fisheries in Cook Inlet include: Pacific salmon, halibut, groundfish, shellfish, smelt, and herring. Groundfish, principally Pacific cod and sable fish, are harvested using jigs, pots, or longline gear; while commercial halibut are harvested using longline gear. The Upper Cook Inlet commercial salmon fishery uses set and drift gillnets. Within the Project area, the primary commercial fisheries are the Upper Cook Inlet set gillnet fishery near the Mainline route across Cook Inlet and near the Marine Terminal, and the Upper Cook Inlet drift gillnet fishery near the Marine Terminal and shipping lanes. These fisheries intercept all five Pacific salmon migration routes, primarily from the Kenai and Susitna rivers.





LEGEND

- Fish Hatcheries
- Project Facility
- Alaska Place Names
- Alaska LNG Rev C2 Route
- Major Highways
- Major Rivers
- Commercial Fisheries Statistical Areas

0 5 10 20 Miles

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ADF&G COOK INLET COMMERCIAL FISHERIES DISTRICTS

FIGURE 3.2-1

ALASKA LNG

X:\AKLNG\Resource Reports\RR03\Figure 3_2-1 ADF&G Cook Inlet Commercial Fisheries Districts.mxd

Sport fishing is significant throughout Cook Inlet and Interior Alaska, with fisheries for salmon, halibut, rockfish, lingcod, and Pacific cod. The most highly sought fish are halibut as well as Chinook, sockeye, and coho salmon. The Kenai and Susitna rivers support the bulk of freshwater salmon fishing in Cook Inlet. Harvesting of shellfish such as shrimp, tanner, Dungeness, and king crabs; razor clams; and other hardshell clams occurs south of the Project area in Cook Inlet. Personal use is a regulatory category of fishery defined as the taking, fishing for, or possession of finfish, shellfish, or other fishery resources by Alaska residents for personal use and not for sale or barter, with gill or dipnet, seine, fish wheel, long line, or other means. Personal use fisheries for salmon, eulachon, herring, shrimp, crab, and clams occur in Cook Inlet. The most significant personal use fisheries near the Project area are Kenai River and Kasilof River dipnet salmon fisheries.

Primary information sources used to compile descriptions of fish habitat and usage include documents from the Alaska Department of Fish and Game (ADF&G, 1985, 1986a, b; Johnson and Litchfield, 2015a, b, c), Bureau of Land Management (BLM, 1987a, b), Alyeska Pipeline Service Company (APSC, 1993, 2002), APSC Fish Stream Database (APSC, undated), and R2 Resource Consultants (2013). The APSC database includes information on fish species in many of the streams along the pipeline corridor north of Livengood. A general list of non-anadromous freshwater fish (includes some species that can occur as anadromous or non-anadromous) that could be present in waters that may be affected by the Project is provided in Table 3.2-1, and by drainage in Table 3.2-2. A discussion of EFH in the Project area is provided in Appendix D, Essential Fish Habitat Assessment, and a list of the fish present within the proposed Project stream crossings is provided in Appendix H, Table of Fish Stream Crossings. Many fish species are widely distributed throughout Alaska and within the Project footprint. Because changes in biotic conditions across Alaska are reflected and previously described based on ecoregions, this discussion is organized by ecoregions. Where possible, specific fisheries and aquatic resources associated with the Liquefaction Facility and Interdependent Project Facilities are described. In keeping with the presentation throughout the remainder of this Resource Report, the fisheries discussion is based primarily on river basin drainages located within the 32 Alaska “unified ecoregions” as delineated by Nowacki et al. (2001) and based on a unified interagency effort to delineate ecoregion boundaries in Alaska (ADF&G, 2006). These larger (Level-1) ecoregions are further delineated into smaller ecoregion groups. The Project crosses parts of the following Level-1 ecoregions Arctic Tundra, Beringia Boreal, and Coast Mountains Boreal. and the following smaller or sub-ecoregions located within these larger (Level-1) ecoregions: Beaufort Coastal Plain, Brooks Foothills, and Brooks Range (Arctic Tundra Ecoregion); Kobuk Ridges and Valleys, Ray Mountains Yukon-Tanana Uplands, and Tanana-Kuskokwim Lowlands (Beringia Boreal Ecoregion); and the Alaska Range, and Cook Inlet Basin (Coast Mountains Boreal Ecoregion).

The Alaska North Slope is roughly equivalent to the Beaufort Coastal Plain Ecoregion ; Interior is roughly equivalent to the Beringia Boreal Ecoregion; and Southcentral is roughly equivalent to the Cook Inlet Basin Ecoregion.

Fisheries discussions are based primarily on river drainages within these ecoregions and the Project area is defined generally throughout this report to describe the regions and watersheds within which Project components would be constructed. A primary difference is that the headwaters and portions of the Chandalar-Christian Rivers and Koyukuk River drainages originate in the Arctic Tundra Ecoregion and some headwaters and portions of the Tanana River drainage originate in the Beringia Boreal Ecoregion.

TABLE 3.2-1

Non-Anadromous Freshwater Fish Occurring within the Project Area

Species		Region			
Common Name	**Scientific Name**	**North Slope**	**Interior Alaska**	**Southcentral Alaska**	**Life History and Distribution**
Alaska blackfish	*Dallia pectoralis*	X	X	Introduced	Resident. Distributed throughout central Alaska lowlands, including Yukon and Tanana River systems and drainages from the Colville River west on the North Slope. These resident fish occur in wetlands and ponds with abundant vegetation, vegetated streams, rivers, and lakes. Typically migrate to deeper areas of rivers and larger lakes before freezing in winter.
Alaskan Brook Lamprey	*Lethenteron alaskense*			X	Resident. Alaskan brook lamprey is a separate species from the American brook lamprey (*L. alaskense*). It is located in a few areas of Alaska, including on the Alaska and Kenai peninsulas, in the Chatanika and Chena rivers. It is a nonparasitic, resident freshwater species that grows to be 5 to 7 inches as an adult. It spawns in spring and summer in shallow areas of streams and sometimes lakes.
Arctic char	*Salvelinus alpinus*	X	X	X	Resident. Freshwater. Found in lakes along the northern foothills of the Brooks Range, also in a few scattered coastal plain lakes west of the Colville River, in lakes on the Kenai Peninsula, and in a small area of Interior Alaska near Denali National Park and Preserve (DNPP).
Arctic grayling	*Thymallus arcticus*	X	X	X	Resident. Freshwater. Widespread in lakes, rivers, and streams throughout most of Alaska. Spawns in spring during and immediately following breakup. Migrates between spawning and feeding areas in the spring and overwintering areas in deeper portions of lakes and rivers during the winter.
Broad whitefish	*Coregonus nasus*	X	X		Anadromous and resident forms. Occurs mostly in rivers, but sometimes in lakes. On the North Slope and in the Yukon River, broad whitefish are an important subsistence harvest resource. Spawning and overwintering populations exist in the Sagavanirktok River and Yukon River drainages, and in drainages from the Colville River west to the Meade River.
Burbot	*Lota*	X	X	X	Resident. Freshwater. A valuable subsistence and recreational fish that occupies most large rivers and many lakes throughout Alaska. Burbot spawn under the ice in late winter.

TABLE 3.2-1

Non-Anadromous Freshwater Fish Occurring within the Project Area

Species		**Region**			
Common Name	**Scientific Name**	**North Slope**	**Interior Alaska**	**Southcentral Alaska**	**Life History and Distribution**
Dolly Varden [a]	*Salvelinus malma*	X	X	X	Anadromous and resident populations occur in the Project area. Locally abundant in all coastal waters of Alaska. Dolly Varden spawn in streams, usually from mid-August to November. One of Alaska's more important and sought-after sport fish, also an important subsistence resource on the North Slope.
Humpback whitefish[b]	*Coregonus pidschian*	X	X	X	Anadromous and resident forms. Distributed throughout drainages of the North Slope from the Colville River westward, in Interior streams north of the Alaska Range, as well as in the Copper and Susitna rivers, Bristol Bay drainages, and isolated river systems farther south. Upstream migration starts during the summer and fall and spawning occurs in the upper reaches of rivers in October, usually over a gravel bottom. Important as a subsistence and commercial resource.
Lake chub	*Couesius plumbeus*		X		Resident. Freshwater. Prefers cooler waters of lakes, streams, and rivers. Spawns during summer when water temperatures are greater than 50 degrees Fahrenheit (°F), sometimes migrating to tributary streams.
Lake trout	*Salvelinus namaycush*	X	X	X	Resident. Freshwater. Alaska's largest freshwater fish. Inhabits deeper lakes along the central and western Arctic Coastal Plain, as well as waters in the Brooks Range and Alaska Range. Also occurs in Interior lakes, including Summit Lake and Paxson Lake. Spawning occurs over clean, rocky lake bottoms from September through November.
Longnose sucker	*Catostomus*	X	X	X	Resident. Widely distributed in clear, cold streams and rivers of Alaska, occasionally entering brackish waters in the Arctic region. Spawns during late spring and early summer.
Ninespine stickleback	*Pungitius*	X	X	X	Resident, freshwater. Mostly occurs in lakes, ponds, slow-moving streams, and estuaries containing emergent vegetation. Spawns in freshwater during summer months.
Northern pike	*Esox lucius*	X	X	Introduced	Occurs in a wide variety of habitats, including rivers and lakes. Spawns after ice melts in late spring or early summer. Mostly occurs in freshwater, but occasionally enters brackish water. Widely distributed in the Yukon River drainage in Alaska and in drainages west of the Colville River on the North Slope. Introduced into the Susitna drainage in Cook Inlet.
Pond smelt	*Hypomesus olidus*			X	Resident, freshwater species that occupies lakes and streams. Spawns between April and June.

TABLE 3.2-1

Non-Anadromous Freshwater Fish Occurring within the Project Area

Species		Region			
Common Name	**Scientific Name**	**North Slope**	**Interior Alaska**	**Southcentral Alaska**	**Life History and Distribution**
Pygmy whitefish	*Prosopium coulteri*			X	Resident. Occurs in some lakes of southwestern Alaska. Spawning occurs in autumn or early winter in lakes or streams.
Rainbow trout [a]	*Oncorhynchus mykiss*		X	X	Anadromous (steelhead) and resident forms. Found in the Susitna River and other northern Cook Inlet drainages and associated lakes. Spawning is from mid-April through early June.
Round whitefish	*Prosopium cylindraceum*	X	X	X	Resident. Freshwater. Widely distributed in shallow water along the pipeline corridor. Spawning occurs along lake and stream shorelines in autumn over gravel shoals of lakes or at river mouths.
Slimy sculpin	*Cottus cognatus*	X	X	X	Resident. Freshwater. Most widespread sculpin in Alaska and the only sculpin in Interior Alaska. Occupies streams and lakes.
Threespine stickleback [a]	*Gasterosteus aculeatus*	X	X	X	Anadromous and resident populations are present. Numerous in Cook Inlet drainages but extend north into Beaufort Sea drainages.

Sources: ADF&G (1985, 1986a, b, 2014a-c); BLM (1987a, b); APSC (1993, 2002); Hebert and Wearing-Wilde (2002); Armstrong (1996); Moulton (1997); R2 Resource Consultants (2013).

[a] May occur as anadromous and resident populations within the same drainage system.

[b] Humpback whitefish complex as described here may also include lake whitefish (*Coregonus clupeaformis*) and Alaska whitefish (*C. nelsonii*) (Brown, 2006).

TABLE 3.2-2

Non-Anadromous Freshwater Fish Occurring within the Project Area by Drainage Basins

	Major Drainage Basins[b]									
	North Slope Arctic Tundra Ecoregion [d]		Interior Beringia Boreal Ecoregion				Southcentral Coast Mountains Boreal Ecoregion			
Non-Anadromous Fish	**Prudhoe Bay**	**Colville River[c]**	**Chandalar-Christian Rivers**	**Koyukuk River**	**Beaver Creek - Yukon River**	**Tanana River**	**Susitna River**	**West Cook Inlet**	**Kenai Peninsula**	**Knik Arm**
Alaska blackfish		X			X	X				I
Alaskan brook lamprey						X			X	
Arctic char	X	X	X	X	X	X			X	
Arctic grayling	X	X	X	X	X	X	X	X	I	X
Broad whitefish	X	X	X	X	X	X				
Burbot	X	X	X	X	X	X	X	X	X	X

TABLE 3.2-2

Non-Anadromous Freshwater Fish Occurring within the Project Area by Drainage Basins

	Major Drainage Basins[b]									
	North Slope Arctic Tundra Ecoregion [d]		Interior Beringia Boreal Ecoregion				Southcentral Coast Mountains Boreal Ecoregion			
Non-Anadromous Fish	**Prudhoe Bay**	**Colville River[c]**	**Chandalar-Christian Rivers**	**Koyukuk River**	**Beaver Creek - Yukon River**	**Tanana River**	**Susitna River**	**West Cook Inlet**	**Kenai Peninsula**	**Knik Arm**
Dolly Varden[a]	X	X	X	X	X	X	X	X	X	X
Humpback whitefish		X		X	X	X	X			
Inconnu/Sheefish				X	X	X				
Lake chub			X	X	X	X				
Lake trout	X	X	X	X	X	X	X	X	X	X
Least cisco[a]	X	X	X	X	X	X				
Longfin smelt								X	X	
Longnose sucker	X	X	X	X	X	X	X	X	X	X
Ninespine stickleback	X	X	X	X	X	X	X	X	X	X
Northern pike	X	X	X	X	X	X	I	I	I	I
Pond smelt	X	X					X	X	X	X
Pygmy whitefish					X					
Rainbow trout[a]						S	X	X	X/S	X
Round whitefish	X	X	X	X	X	X	X	X	X	X
Slimy sculpin	X	X	X	X	X	X	X	X	X	X
Alaska blackfish								X		

Sources: ADF&G 2014a, b, c.

[a] May occur as anadromous and resident populations within the same drainage system.

[b] No streams in the Eastern Arctic Basin would be affected by the Project.

[c] The Mainline would cross through a small portion of the Colville Basin in the Brooks Range Foothills.

[d] Catalog and Atlas Arctic Management Region are equivalent to the North Slope.

3.2.1 Coldwater Anadromous Fisheries

Alaska Statute (AS) 16.05.871(a) requires ADF&G to specify those waters important for spawning, rearing, or migration of anadromous fish. The Catalog of Waters Important for Spawning, Rearing or Migration of Anadromous Fishes (Catalog) and its companion Atlas are adopted by reference in the Alaska Administrative Code (AAC) at 5 AAC 95.011(a) to identify such waters. The Catalog and Atlas are divided into six volumes corresponding to Alaska's six fish and game resource management regions. The volumes that encompass Project-associated areas are for the Arctic (Johnson and Litchfield, 2015a), Interior (Johnson and Litchfield, 2015b), and Southcentral regions (Johnson and Litchfield, 2015c). The Catalog lists waterbodies documented as used by anadromous fish. It also lists USGS quadrangle map, latitude, longitude, and legal description of the mouth and upper known extent of anadromous fish use for each specified waterbody. The Atlas is a spatial representation of the catalogs with topographic maps that show locations of specified anadromous fish bearing waters, fish using these waters, and to the extent known, fish life history phases that use each water by location (Johnson and Litchfield, 2015a, b, c). Not all streams in Alaska have been thoroughly surveyed; thus, streams that are not designated as anadromous fish streams in the Catalog may still contain, or be used by, anadromous fish. To date, most streams crossed by the Project that appear to have sufficient flow (enough water to support flow dependent aquatic organisms) to support fish and those that do not have documented fish presence information have been surveyed for fish and habitats by the Project. Additional streams will be surveyed in 2016 and in future field seasons of the Project. A list of anadromous fish species expected to be present in waters that may be affected by the Project is provided in Table 3.2.1-1. Life histories of these species are discussed in Section 3.2.1.3. in detail in Appendix D, EFH Assessment.

Fisheries surveys conducted by the Project are reported in Appendix L by year. Together with the ADF&G information, presence or absence of fish is summarized in the mapbooks presented in Appendix A. Project data is used by ADF&G to update the Catalog of Waters Important for Spawning, Rearing or Migration of Anadromous Fishes.

TABLE 3.2.1-1

Coldwater Anadromous Fish Occurring in the Project Area by Drainage

Anadromous Fish	**Scientific Name**	**Major Drainage Basins[b]**									
		North Slope/ Arctic Tundra Ecoregion [d]		**Interior Beringia Boreal Ecoregion**				**Southcentral Coast Mountains Boreal Ecoregion**			
		Prudhoe Bay	**Colville River[c]**	**Chandalar-Christian Rivers**	**Koyukuk River**	**Beaver Creek - Yukon River**	**Tanana River**	**Susitna River**	**West Cook Inlet**	**Kenai Peninsula**	**Knik Arm**
Arctic cisco	*Coregonus autumnalis*	X	X								
Arctic lamprey	*Lethenteron camtschaticum*	X	X	X		X	X	X	X	X	X
Bering cisco	*Coregonus laurettae*	X	X			X		X	X		X
Broad whitefish[a]	*Coregonus nasus*	X	X	X	X	X	X				
Chinook salmon	*Oncorhynchus tshawytscha*			X	X	X	X	X	X	X	X
Chum salmon	*Oncorhynchus keta*	X	X	X	X	X	X	X	X	X	X
Coho salmon	*Oncorhynchus kisutch*				X	X	X	X	X	X	X
Dolly Varden[a]	*Salvelinus malma*	X	X	X	X	X	X	X	X	X	X
Eulachon	*Thaleichthys pacificus*							X	X	X	
Humpback whitefish	*Coregonus pidschian*	X	X					X			
Inconnu (sheefish)	*Stenodus nelma*				X	X	X				

TABLE 3.2.1-1

Coldwater Anadromous Fish Occurring in the Project Area by Drainage

Anadromous Fish	Scientific Name	Major Drainage Basins[b]									
		North Slope/ Arctic Tundra Ecoregion[d]		Interior Beringia Boreal Ecoregion				Southcentral Coast Mountains Boreal Ecoregion			
		Prudhoe Bay	Colville River[c]	Chandalar-Christian Rivers	Koyukuk River	Beaver Creek - Yukon River	Tanana River	Susitna River	West Cook Inlet	Kenai Peninsula	Knik Arm
Least cisco	*Coregonus sardinella*	X	X	X	X	X	X				
Longfin smelt	*Spirinchus thaleichthys*								X		
Pacific lamprey	*Entosphenus tridentatus*							X	X	X	X
Pink salmon	*Oncorhynchus gorbuscha*	X	X					X	X	X	X
Rainbow smelt	*Osmerus mordax*	X	X								
Sockeye salmon	*Oncorhynchus nerka*							X	X	X	X
Steelhead[a]	*Oncorhynchus mykiss*							X	X	X	X
Threespine stickleback	*Gasterosteus aculeatus*	X	X						X		

Sources: ADF&G 2014a, b, c.

[a] May occur as anadromous and resident populations within the same drainage system.

[b] The Project footprint would affect no streams in the Eastern Arctic Basin.

[c] The Mainline would cross through a small portion of the Colville Basin in the Brooks Range Foothills.

[d] Catalog and Atlas Arctic Management Region are equivalent to the North Slope.

Whether specific fish species listed in Table 3.2.1-1 are likely to be present depends on the final location of the Project footprint and seasonality of construction. Fish streams that would be crossed by the Project are identified in Appendix A and seasonal distribution is discussed in Section 3.2.3. This information will be updated in the FERC application.

3.2.1.1 Liquefaction Facility

3.2.1.1.1 Cook Inlet Basin Ecoregion

The Liquefaction Facility would be located within the Kenai Peninsula drainage in the Cook Inlet Basin Ecoregion (Figure 3.2.1-1). Around 26 species of fish occur across this region (Table 3.2-1 and Table 3.2.1-1). All five species of Pacific salmon use rivers or streams on the northern Kenai Peninsula for migration, spawning, and rearing and are found in the drainage, with sockeye, coho, and Chinook salmon being dominant (ADF&G, 1985). Other anadromous species within the Kenai Peninsula drainage include Dolly Varden, steelhead, eulachon, longfin smelt, Arctic and Pacific lamprey, Bering cisco, and threespine stickleback. There are no cataloged anadromous waters in the immediate vicinity of the proposed Liquefaction Facility. The mouth of the Kenai River (244-30-10010) is located about 9.5 miles south of the Liquefaction Facility (Johnson and Litchfield, 2015c). Parsons Lake (247-90-10030-0030) and the upper reaches of Bishop Creek (247-90-10030), east of the Liquefaction Facility, support coho salmon, sockeye salmon, and Dolly Varden (Johnson and Litchfield, 2015c). Bishop Creek drains to the northeast into Upper Cook Inlet on the north side of the East Forelands (Johnson and Litchfield, 2015c). A brief synopsis of the five Pacific salmon is provided in Section 3.2.1.4 below.

3.2.1.2 Interdependent Project Facilities

3.2.1.2.1 Beaufort Coastal Plain Ecoregion

The Project area within the North Slope is located in the Beaufort Coastal Plain Ecoregion and runs west from Point Thomson to the Gas Treatment Plant (GTP) immediately west of the Putuligayuk River near Prudhoe Bay, then south along or near the Sagavanirktok River and its side channels and tributaries (Figure 3.2.1-1). The Mainline corridor also crosses the headwaters of the Kuparuk River. Twenty-four species of fish have been reported in the North Slope region, with the most common anadromous species being Dolly Varden, broad whitefish, and Arctic cisco. The presence of chum salmon, least cisco, and humpback whitefish is less common or incidental and those species do not represent large spawning stocks (Craig, 1984).

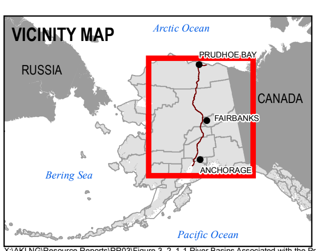
Compared with other in-state sport fisheries, effort and harvest is low in the portions of rivers and streams near the Project area. Dolly Varden (both anadromous and resident populations), is the species most often targeted by anglers, although some fishing for pink salmon occurs in the Sagavanirktok River when they are abundant. No subsistence or commercial fisheries have been identified along the Sagavanirktok River itself, although juvenile Arctic cisco that overwinter in the lower reaches and delta of the river may eventually be recruited to stocks harvested by subsistence fisheries in the Colville River. In addition, some anadromous Dolly Varden from the Sagavanirktok River may be taken in subsistence fisheries along the coast during summer (Craig, 1989). Fish habitats within streams have different sensitivities to disturbance at different locations at different times of year. Generally, fish habitats are most sensitive if and when they support fish spawning or overwintering.

The GTP is located next to the Putuligayuk River, which is classified as an anadromous fish stream in its lower reaches because of its use by Arctic cisco, broad whitefish, and least cisco during summer. After leaving the GTP, the Mainline corridor parallels the Sagavanirktok River, crossing numerous side channels. The river and smaller channels are classified as anadromous fish habitat along this entire length, primarily because of the presence of anadromous Dolly Varden. Side channels also contain broad whitefish and are therefore most sensitive during the May-to-October open-water season. The main channel of the Sagavanirktok River is sensitive year-round because it provides rearing and overwintering areas for many fish species. The main river is most sensitive from August through October because of anadromous Dolly Varden migration and spawning.

Many streams within the Mainline corridor north of Oksrukuyik Creek are sensitive from May to October because they provide summer foraging habitat for a number of species.

Although the portion of the Kuparuk River near the Mainline corridor is not designated as anadromous fish habitat, designated anadromous fish habitats occur farther downstream (Johnson and Litchfield, 2015a). In addition, the Mainline corridor crosses the Atigun River and several streams that enter Tee Lake, which provide overwintering habitat for some species and are sensitive from November through December.

The most sensitive period for North Slope fish occurs during winter when the majority of rivers and ponds freeze solid. Locations deep enough to maintain unfrozen water with adequate dissolved oxygen levels for fish overwintering are most sensitive to perturbation. Riverine overwintering pools are most sensitive, and typically contain the highest densities of fish when compared to ponds and lakes used for overwintering.



LEGEND

- Project Facility
- Existing Facility
- Alaska Place Names
- Alaska LNG Rev C2 Route
- Major Highways
- Major Rivers
- River Basins

Ecoregions

- Arctic Tundra
- Intermontane Boreal
- Alaska Range Transition

0 50 100 Miles

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RIVER BASINS ASSOCIATED WITH THE PROJECT

FIGURE 3.2.1-1

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X:\AKLNG\Resource Reports\RR03\Figure 3_2_1-1 River Basins Associated with the Project.mxd

3.2.1.2.2 Beringia Boreal Ecoregion

After crossing Atigun Pass in the Brooks Range, the Mainline corridor enters Interior Alaska or the Beringia Boreal Ecoregion. Within this ecoregion, the corridor crosses or runs along several major streams and rivers, most of which are in the Yukon River drainage. At least 26 species of fish occur in the Yukon River drainage, with the most important being anadromous and resident Dolly Varden, and chum, coho, and Chinook salmon.

South of the Brooks Range, the Mainline corridor follows the course of the Dietrich River and the Middle Fork of the Koyukuk River. Although none of the waterbodies within the Dietrich River system are classified as anadromous, the Dietrich flows into the Middle Fork of the Koyukuk River, which is classified as an anadromous fish stream. The Middle Fork of the Koyukuk River and several of its tributaries support stocks of resident Dolly Varden, and anadromous chum and Chinook salmon. The Middle Fork of the Koyukuk River contains very sensitive rearing habitat year-round, and most of the tributaries, side channels, and sloughs associated with it are sensitive from April through October.

The Mainline corridor, south of the Dietrich River and the Middle Fork of the Koyukuk River, crosses several streams that provide habitat for chum and/or Chinook salmon, including Minnie Creek, Marion Creek, the South Fork of the Koyukuk River, Jim River, Douglas Creek, Prospect Creek, and the Yukon River. Fish habitat in these streams and associated side channels are very sensitive throughout the year. Although few anadromous fish streams exist between Prospect Creek and the Yukon River, Bonanza Creek and Fish Creek empty into the South Fork of the Koyukuk River, which is an anadromous fish stream. Chum salmon occur in Bonanza Creek downstream from the Mainline corridor crossing, and the Kanuti River provides anadromous-fish habitat near its mouth.

Few anadromous fish streams occur along the Mainline corridor between the Yukon and the West Fork of the Tolovana rivers; chum salmon have been reported in Hess Creek and the Tolovana River (Appendix A). Most streams in this area support Arctic grayling and numerous other species, including whitefishes, slimy sculpin, longnose sucker, northern pike, and burbot. These waterbodies are most sensitive from May through October. The Tolovana River supports anadromous fish about 25 miles downstream of the Mainline corridor (Johnson and Litchfield, 2015b).

South of the Tolovana River, the Mainline corridor diverges from the Trans-Alaska Pipeline System (TAPS) corridor and information on fish distribution and habitat use is less detailed. The Chatanika, Tanana and Nenana rivers are all anadromous fish streams supporting populations of Chinook, coho, and chum salmon. June Creek supports coho and chum salmon, while Panguingue Creek contains coho salmon.

3.2.1.2.3 Cook Inlet Basin Ecoregion

South of the Alaska Range, the Mainline corridor crosses Cook Inlet Basin Ecoregion streams and rivers primarily within the Susitna River drainage (Figure 3.2.1-1). Approximately 26 species of fish occur within this region (Table 3.2-1 and Table 3.2.1-1). All five species of Pacific salmon are found in the drainages, with sockeye, coho, and Chinook salmon being dominant (ADF&G, 1985). From the Chulitna River south to Cook Inlet, most of the streams support spawning and/or rearing by one or more of the salmon species. The Susitna River is a major producer of sockeye, Chinook, coho, and chum salmon in the Cook Inlet region. Other anadromous species within the drainage include Dolly Varden, Bering cisco, humpback whitefish, eulachon, and longfin smelt.

All five Pacific salmon use streams along the Mainline corridor for migration, spawning, and rearing. A brief synopsis of each species within the Project area is provided in Section 3.2.1.3.

3.2.1.3 Salmon Species

Pacific salmon are considered the most sensitive anadromous fish that may be influenced by the Project because of their use of a wide variety of aquatic habitats during all seasons and because of their importance to subsistence, commercial, and sport fisheries throughout the State of Alaska.

3.2.1.3.1 Chinook Salmon

Chinook salmon (*Oncorhynchus tshawytscha*) spawn in rivers throughout Interior and Southcentral Alaska, including the Yukon River and its tributaries, and the Susitna, Little Susitna, Beluga, Theodore, and Chuit rivers in Upper Cook Inlet. Females may deposit 2,000 to 17,000 eggs in redds. Chinook fry hatch in spring and most juvenile Chinook remain in freshwater until the following spring when they begin to move toward marine habitats.

In the Cook Inlet region, Chinook juveniles normally leave freshwater and enter marine waters during the summer of their second or third year. Information from the Susitna River indicates Chinook salmon leave that system as both age-0 and age-1 fish (Roth and Stratton, 1985). Age-0 outmigrants leave the system from mid-June to late August at lengths of 1.7 to 3.0 inches (43–75 millimeters), while age-1 smolts leave the river from late May to mid-June at 3.1 to 3.5 inches (80–89 millimeters). Chinook smolts feed on plankton and insects in freshwater. After migrating to sea, young Chinook salmon initially feed in shallow nearshore areas along the coast. As they grow, they gradually move offshore and into deeper water. Chinook remain within the coastal area throughout their marine phase. Prey initially include a variety of marine plankton, including copepods, amphipods, euphausiids, and small fish. With increasing size, fish become the dominant food item, with Pacific herring (*Clupea pallasii*) and Pacific sandlance (*Ammodytes hexapterus*), as well as squid and crustaceans, providing a high percent of the diet. Chinook salmon enter tributaries on the western side of the Susitna River in May and June, continuing until August, with peak recreational harvests occurring at the mouth of Alexander Creek during the first week of June, and at the mouth of the Deshka River during mid-June (Ivey and Sweet, 2004). Catches from commercial setnets along the western side of northern Cook Inlet, between 2001 and 2005, indicate that 90 percent of the catch occurs between May 25 and June 18.

Moulton (1997) captured juvenile Chinook salmon smolts along the northwestern shore of Upper Cook Inlet in the Susitna, Tyonek, and Trading Bay regions. Catch rates peaked in mid-June and mid-July, and no Chinook smolts were caught in September. Chinook smolts captured in June were primarily age-1, while those captured in July were ages-0 and -1. Small numbers of age-2 and -3 juvenile Chinook were also caught. In Knik Arm, Chinook salmon comprised 25.6 percent of all juvenile salmon captured from April to July 2005 (Houghton et al., 2005a). Peak abundance occurred in June and no significant difference in the catch per unit effort occurred among stations throughout the Knik Arm. In April, most of the Chinook were age-0 fish from 1.2 to 1.6 inches in length. Beginning in May, fish greater than 2.4 inches dominated the catch, many of which appeared to be of hatchery origin. Multiple cohorts were also present in tow net samples collected in May. Chinook smolt abundance declined in Knik Arm in mid- to late summer.

3.2.1.3.2 Sockeye Salmon

Sockeye salmon (*Oncorhynchus nerka*) is an important commercial, sport, and subsistence fish throughout Cook Inlet, with major runs to the Kenai, Susitna, and other rivers in the region. Sockeye typically spawn in lakes or rivers associated with lake systems, although they can occur in river systems without lakes. Female sockeye salmon deposit 2,000 to 4,500 eggs in redds. When lakes are available, sockeye fry may spend one to three years in freshwater before entering the ocean. In systems without lakes, sockeye generally spend less time in freshwater (ADF&G, 2014a). Some sockeye salmon populations are landlocked (e.g., kokanee) and spend their entire life in freshwater.

Adult sockeye salmon are present from June to October in Upper Cook Inlet waters (ADF&G, 2014a) with a historic peak return to the southern boundary of Upper Cook Inlet marine waters around July 15 (Shields and Willette, 2005). Approximately 50 percent of Susitna River sockeye are thought to be produced in the Yentna River tributary (Ivey and Sweet, 2004). Catches from commercial setnets along the western side of northern Cook Inlet between 2001 and 2005 indicate that 90 percent of the catch occurs between July 1 and 31, although they are present from early June into early August.

Juvenile sockeye salmon were caught in Upper Cook Inlet in June and July, but in limited numbers (Moulton, 1997). During June, juvenile sockeye were caught throughout the study area in Upper Cook Inlet; in July, they were caught mostly in the eastern and middle portions of Moulton's (1997) study area. Age-1 (one winter in freshwater) was dominant in the June tows, but ages-0 and -1 were caught in equal numbers in July. No juvenile sockeye salmon were caught in September.

Sockeye juveniles normally leave freshwater and enter marine waters during the summer of their second or third year. In the Susitna River, sockeye were observed to leave the system at age-0 and -1 (Roth and Stratton, 1985). Age-0 sockeye outmigrated from the Susitna River in mid-May to late August at lengths of 1.6 to 2.1 inches (40–53 millimeters). Age-1 sockeye from the Susitna River show a more typical outmigration, with 90 percent outmigrating from mid-May to mid-June at lengths of 2.8 to 3.1 inches (71–78 millimeters) in 1984 and 3.14 inches (80 millimeters) in 1985.

In Knik Arm in 2004, juvenile sockeye were the most frequently caught salmon during beach seining from July to November (Houghton et al., 2005a, b). Catches peaked in August 2004. In 2005, juvenile sockeye catches were low in April and May, peaked in June, and continued in July. Based on length measurements, two cohorts of sockeye (ages-0 and -1) were present in Knik Arm during both years. Juvenile sockeye in Knik Arm appeared to have substantial body growth from July through September 2004.

3.2.1.3.3 Coho Salmon

Coho salmon (*Oncorhynchus kisutch*) is a popular commercial and sport fish, occurring in most river systems within Cook Inlet. Coho salmon spawn in many types of freshwater habitats and are known to migrate up the Yukon River to the Alaska/Canada border. Adult coho salmon return to spawn later than other species and may be found in spawning streams from July through November. The timing of spawning runs may vary depending on environmental conditions and barriers in small headwater streams in which they often spawn. Females deposit 2,000 to 4,500 eggs into redds.

Juvenile coho salmon usually rear from one to three winters in freshwater (ADF&G, 2014a) before moving into marine waters. Juvenile coho salmon can establish winter territories in freshwater pools and lakes, and may move between brackish estuarine water during spring and summer for feeding and move back to freshwater in fall (ADF&G, 2014a).

Adult coho salmon are well represented throughout Upper Cook Inlet with runs beginning in July and continuing into October. The peak of the run in the west-side Susitna area, an early-run stock, is generally in the last week of July (Ivey and Sweet, 2004). The Little Susitna River has proven to be a good indicator of coho run strength throughout the region, and the Susitna River drainage supports the largest coho stock in Upper Cook Inlet. The greatest recreational harvest of coho salmon generally occurs in the Knik and Eastside Susitna Management Units, followed closely by the Westside Susitna Unit (Ivey and Sweet, 2004). Lake Creek is the greatest contributor to sport fish catches in the Westside Unit. Catches from commercial setnets along the western side of northern Cook Inlet between 2001 and 2005 indicate that 90 percent of the catch occurs between July 12 and August 15, although they are present from early July into late August.

Juvenile coho in northern Cook Inlet streams spend from one to three years in the freshwater streams. In the Susitna and Little Susitna rivers, most of the returning adults have spent either one or two summers in freshwater, migrating out as smolts the following summer. Neither age group appears to be consistently dominant (ADF&G, 1983; Barrett et al., 1984, 1985; Bartlett, 1992; Waltemyer, 1991). Migration of smolts out of the Susitna River to marine waters occurs from mid-May to September. Age 0 smolts left the river in late July through August in both 1984 and 1985. In 1984, ages-1 and -2 showed a similar outmigration pattern, while in 1985, the older smolts outmigrated in June and early July. Age-1 smolts left at lengths of 3.3 to 4.4 inches (85–113 millimeters) in 1984 and 89–108 millimeters in 1985, while age-2 smolts were 4.9 to 5.6 inches (126–141 millimeters) in 1984 and averaged 132 millimeters in 1985. Upon entry into the marine waters, coho tend to remain near shorelines where they feed on planktonic crustaceans, pink and chum salmon fry, and juveniles and larvae of other fish. As they grow, they move into deeper, offshore waters and are eventually distributed across the North Pacific Ocean and into the Bering Sea. As the coho grow, their diet shifts to larger pelagic prey.

In Knik Arm, juvenile coho salmon was the second-most-abundant juvenile salmon species captured in beach seines in 2004, and the most abundant species in 2005 (Houghton et al., 2005a). Coho salmon smolts were captured as early as April and were present in Knik Arm into late November. In both 2004 and 2005, catches of juvenile coho peaked in July, but continued into August. In 2005, coho salmon were distributed throughout Knik Arm, but were more abundant on the western side (Houghton et al., 2005a). Several cohorts were present throughout the study period and a relatively high frequency of 4–5.5-inch (101–140-millimeter) coho captured in June 2005 may have resulted from the smolt release from Ship Creek hatcheries. Houghton et al. (2005a) reported that adult coho comprised 0.9 percent of the total beach seine catch and that most adult coho were captured in July with smaller numbers in August. In northern Cook Inlet, catch rates of juvenile coho salmon were highest in mid-June and mid-July, and the greatest numbers were caught near the Susitna River delta (Moulton, 1997). Juvenile coho were the only salmon caught in September.

3.2.1.3.4 Pink Salmon

Pink salmon (*Oncorhynchus nerka*) are the smallest of the Pacific salmon, with a maximum length of 30 inches and weight of 14 pounds (Mecklenburg et al., 2002). Adult pink salmon return to rivers and streams throughout Upper Cook Inlet. They are harvested in commercial and subsistence fisheries, but usually in the course of effort directed at other species. Females may deposit as many as 1,500 to 2,000 eggs in a redd in freshwater or occasionally in intertidal areas. The eggs hatch during winter and the developing fish, or alevins, remain in the gravel using their yolk sacs for nourishment. Fry emerge from the gravel in late winter or early spring and immediately move downstream to marine waters.

In the ocean, juvenile pink salmon smolt feed on plankton and larval fish, and may reach 4 to 6 inches in length by their first winter. They spend the next year in the open ocean, returning the following fall to spawn in their natal streams. This life cycle of the Pacific salmon is generally the shortest (two years from hatching to spawning).

Because pink salmon spawn at 2 years of age, two separate lines of unrelated fish develop in alternating odd- and even-year cycles. In some locations one line may be dominant over the other in abundance. In the Cook Inlet region, larger pink salmon runs occur during even years.

Adult pink salmon probably feed relatively little in Cook Inlet because they are close to entering their natal stream. Based on the diets of juvenile pinks in Prince William Sound and the northern Gulf of Alaska, pink salmon are known to feed on a mixture of gastropods, cladocerans, copepods, and bivalves early on, ranging to larger prey such as pteropods, larvaceans, amphipods, and euphausiids later in summer (Bolt and Haldorson, 2003).

Adult pink salmon return to Upper Cook Inlet from early July to mid-August, with Westside Susitna drainages having peak runs in July. Upper Cook Inlet pink salmon runs are even-year dominated, with the 2000 and 2002 returns being characterized as strong or very strong, as opposed to diminished returns since the mid-1980s. However, harvest levels of pink salmon have been low, owing to restrictions in place to ensure sockeye salmon escapement. Pink salmon returns in 2004 were deemed average to above average (Fox and Shields, 2005). Catches from commercial setnets along the western side of northern Cook Inlet between 2001 and 2005 indicate that the adult return timing is quite similar to that of sockeye salmon, with 90 percent of the catch occurring between July 1 and 31, although they are present from mid-June into early August.

Pink salmon emerge from gravel substrate in April and May, and immediately migrate downstream to the estuary. The time spent in freshwater varies, depending on the distance the juveniles must travel, and average stream velocities they encounter along the way. Freshwater residence of a few hours to a few days is typical. Feeding does not normally occur during this downstream migration. During 1985, pink salmon left the Susitna River throughout June, with the outmigration essentially finished by the first week in July (Roth et al., 1986). Outmigrating pink salmon averaged 1.5 inches (37 millimeters), with a maximum of 1.9 inches (48 millimeters).

Juvenile pink salmon were the most abundant salmon reported by Moulton (1997) during tow net sampling in Upper Cook Inlet in June and July of 1993, comprising 16.5 percent of the total catch. Pink salmon were caught in 92 percent of the tows in June, comprising approximately 25 percent of the total catch. Pink salmon numbers decreased in July, when they occurred in only 70 percent of the tows. Pink salmon were abundant throughout the study area from the East and West Forelands to Fire Island near Anchorage, but were most abundant in mid-June near the mouth of the Susitna River. However, a large number of pink salmon were also caught in a single mid-channel tow in mid-July in the eastern portion of the study area.

Houghton et al. (2005a) did not capture any pink salmon smolt in Knik Arm during beach seine sampling in 2004, although few were expected. The larger even-year pink runs in Cook Inlet produce a larger number of odd-year outmigrants, and the numbers of pink salmon smolt expected in even years are much lower. In 2005, Houghton et al. (2005a) captured 33 pink salmon by beach seine, which corresponded to 1.9 percent of all juvenile salmonids. Most pink salmon were captured in May and were young-of-the-year outmigrants between 1.2 to 1.6 inches in length. Houghton et al. (2005a) also captured pink salmon smolt during tow net sampling in Knik Arm. Pink salmon smolt were most abundant in May; numbers of pink salmon smolt declined in June and July.

Pink salmon juveniles entering marine habitats begin feeding on small invertebrates, particularly calanoid and harpacticoid copepods (Cooney et al., 1981; Sturdevant et a1., 1993). Other important foods are often decapod larvae, fish larvae, invertebrate eggs, and insects (Heard, 1991). As they grow, the juveniles move away from estuaries, but usually remain close to shorelines for several weeks. In Prince William Sound, pink salmon fry enter the marine area at lengths of around 1.4 inches (35 millimeters) in late April to early May and have reached lengths of 40 to 45 millimeters by early June, depending on growing conditions (Celewycz and Wertheimer, 1993). By late summer, the juveniles have grown to a length of about 2.4 to 3.1 inches (60–80 millimeters) and they begin moving offshore. Pink salmon from northern Cook Inlet likely move to the Gulf of Alaska during the late summer and early fall.

3.2.1.3.5 Chum Salmon

Chum salmon (*Oncorhynchus keta*) in Upper Cook Inlet are most abundant in the Susitna River, although they occur in other rivers as well. Chum salmon spawn in coastal streams and intertidal areas, but may also travel great distances inland. Some chum salmon are known to migrate up the Yukon River to the Yukon Territory to spawn, a distance of over 2,000 miles. Females may lay up to 4,000 eggs.

Chum fry move toward marine waters soon after hatching, usually shortly after ice breaks up from their natal rivers. Chum may not feed before reaching saltwater, thus making marine food resources of special importance. Juvenile chum in Cook Inlet are thought to enter marine water from late May through July. By their first winter, Cook Inlet chum salmon have moved into the Gulf of Alaska and spend three to four years in the ocean before returning to natal streams (ADF&G, 2008).

Adult chum salmon are not well represented in Westside Susitna drainages of the Upper Cook Inlet. Their peak run timing is mid-July through mid-August; however, their run continues into September (ADF&G, 2008). Upper Cook Inlet chum stocks are only monitored at one location, Clearwater Creek, with an escapement index generated by peak run time aerial survey counts (Hasbrouck and Edmundson, 2005). Chum production in the Susitna River declined in the mid-1980s to the mid-1990s but a steady increase in production has been observed in Upper Cook Inlet since the mid-1990s (Fox and Shields, 2005). Catches from commercial setnets along the western side of northern Cook Inlet between 2001 and 2005 indicate that the return of adult chum salmon falls between that of sockeye and coho, with 90 percent of the catch occurring between July 8 and August 7, although they are present from early July into late August.

Juvenile chum salmon emerge from the streambed in spring and immediately begin moving downstream to the sea. The duration of this migration depends on the total distance traveled, and water velocities encountered. In most cases, the downstream migration takes a few hours to a few days. Little or no feeding occurs in streams where the downstream migration is completed in a small time after emergence. In the Susitna River, chum leave during June through early July at a size of 2.0 to 2.4 inches (42–43 millimeters). In both 1984 and 1985, chum salmon between 50 and 60 millimeters were caught in the river, which was interpreted to indicate growth prior to outmigration.

Chum salmon smolts were the second-most-abundant salmon reported by Moulton (1997) in Upper Cook Inlet and comprised 10.2 percent of the total catch. Chum salmon showed a steady increase in size through the study period with mean lengths ranging from 1.7 inches in early June to 2.3 inches in mid-July. The growth rate of chum smolt appeared to be greater in July than in June and may have been related to warmer temperatures or to a decrease in the numbers of smolt emigrating from freshwater (Moulton, 1997).

During beach seine sampling in Knik Arm, Houghton et al. (2005a) captured only five juvenile chum in 2004 and concluded that most chum had probably migrated out of the area before sampling began in late July. Sampling in 2005 began earlier than in 2004 and small numbers of juvenile chum were captured in April with significant increases in May and June. As in 2004, no chum smolts were captured with beach seines in July 2005. Chum salmon smolts were the most abundant salmon captured in tow net sampling in Knik Arm (Houghton et al., 2005a). Chum smolt were most abundant in May and numbers declined in June and July. Houghton et al. (2005a) reported that adult chum salmon composed 0.1 percent of the total beach seine catch.

Once in the estuary, juveniles form schools and normally remain close to shorelines for several months to feed and grow prior to moving onto the high seas. Salo (1991) describes chum salmon juveniles as depending on a detritus-based food web in the estuarine habitat. Fish larvae and insects were important components of juvenile chum diet in northern Cook Inlet during June, while insects became dominant in July (Moulton, 1997). Prey studies often describe harpacticoid copepods as dominant food item. By late summer, juvenile chum salmon move to offshore waters.

3.2.1.3.6 Salmon Stocks of Concern

The Alaska Board of Fisheries, in consultation with ADF&G, may designate, amend, or discontinue Salmon Stocks of Concern identified by ADF&G as required under the Management of Sustainable Salmon Fisheries Policy (SSFP) (5 AAC 39.222). Designations are based on stock status reports and recommendations from ADF&G. The SSFP defines three levels of concern (yield, management, and conservation) with yield being the lowest level of concern and conservation the highest level of concern.

Seven Chinook and one sockeye salmon stock in Cook Inlet have been designated as stocks of concern at the yield or management level (Table 3.2.1-2). Juveniles and adults from these stocks are likely to occur in marine waters in Upper Cook Inlet. The freshwaters supporting spawning for these stocks are shown in Figure 3.2.1-2.

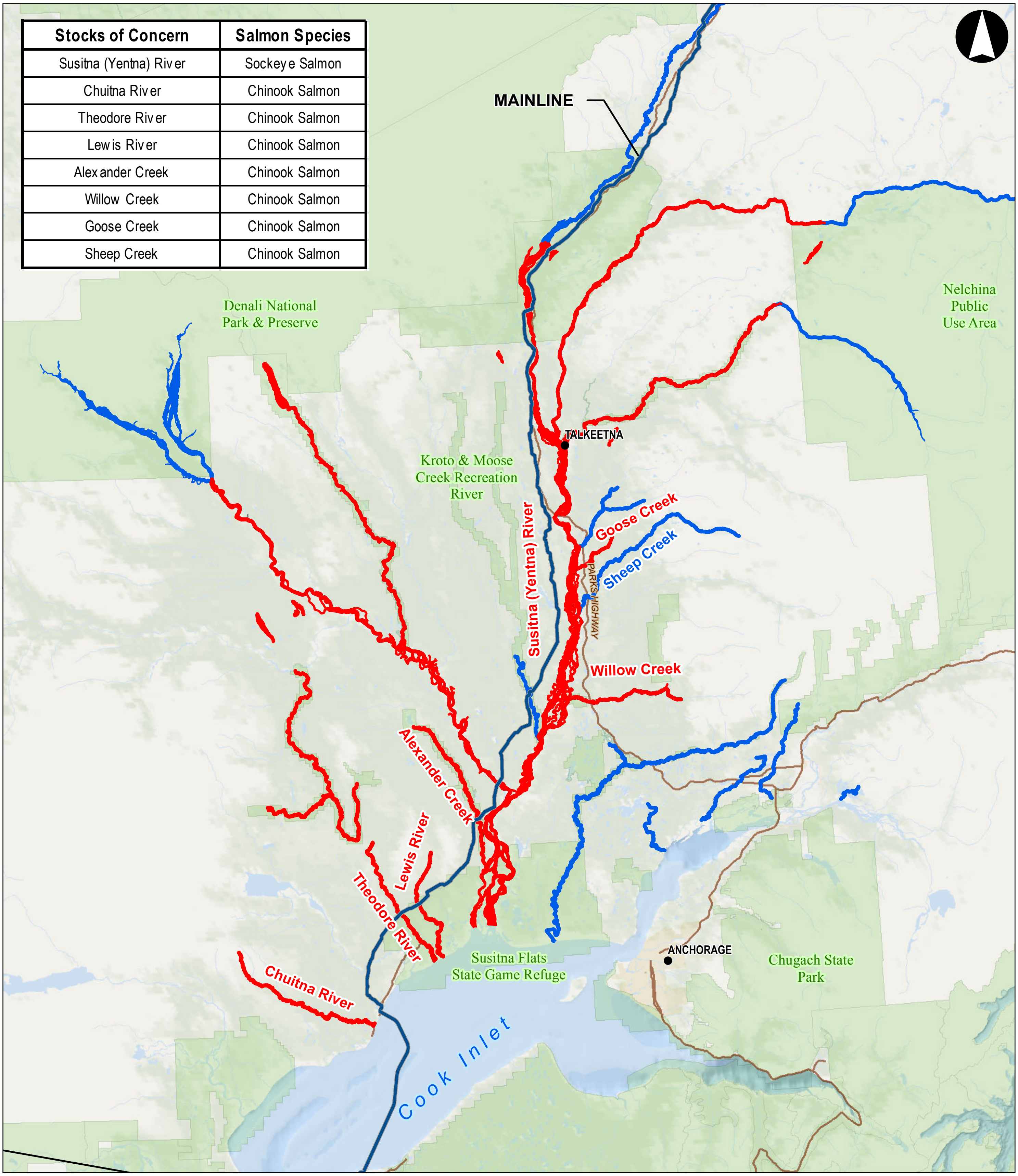
TABLE 3.2.1-2

Salmon Stocks of Concern within the Project Area

System	Common Name	Area	Year Designated	Level of Concern [a]	Year Last Reviewed
Susitna (Yentna) River	Sockeye salmon	Cook Inlet	2007	Yield	2010
Chuitna River	Chinook salmon	Cook Inlet	2010	Management	2010
Theodore River	Chinook salmon	Cook Inlet	2010	Management	2010
Lewis River	Chinook salmon	Cook Inlet	2010	Management	2010
Alexander Creek	Chinook salmon	Cook Inlet	2010	Management	2010
Willow Creek	Chinook salmon	Cook Inlet	2010	Yield	2010
Goose Creek	Chinook salmon	Cook Inlet	2010	Management	2013
Sheep Creek	Chinook salmon	Cook Inlet	2013	Management	2013

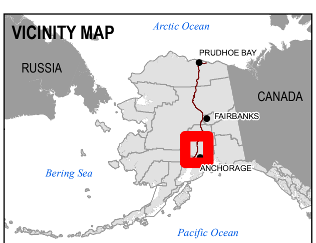
[a] Current as of March 30, 2016

Source: ADF&G 2016b



Stocks of Concern	Salmon Species
Susitna (Yentna) River	Sockeye Salmon
Chuitna River	Chinook Salmon
Theodore River	Chinook Salmon
Lewis River	Chinook Salmon
Alexander Creek	Chinook Salmon
Willow Creek	Chinook Salmon
Goose Creek	Chinook Salmon
Sheep Creek	Chinook Salmon

VICINITY MAP



LEGEND

- Alaska Place Names
- Alaska LNG Rev C2 Route
- Major Salmon Producing Waters
- Salmon Stocks of Concern
- Major Highways
- State and Federal Conservation Lands

0 5 10 20 Miles

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SALMON STOCKS OF CONCERN ASSOCIATED WITH THE PROJECT

FIGURE 3.2.1-2

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3.2.2 Coldwater Resident and Amphidromous Fish

Many freshwater resident and amphidromous fish (these would be labeled as anadromous for purposes of the Anadromous Waters Catalog) also occupy aquatic habitats within the Project area (Table 3.2.2-1). Arctic grayling are the most visible freshwater fish along the pipeline corridor, occurring in many of the small, clearwater tributaries along the entire route. Other commonly encountered freshwater species include burbot, northern pike, round whitefish, slimy sculpin, and ninespine stickleback. Arctic grayling are the fish most often targeted by anglers, with northern pike and burbot often targeted in Interior waters. Amphidromous whitefish also occur throughout much of the Project area.

TABLE 3.2.2-1

Coldwater (Non-Anadromous) Resident Fish Occurring in the Project Area by Drainage

Resident Fish	Major Drainage Basins[b]									
	North Slope Arctic Tundra Ecoregion		Interior Beringia Boreal Ecoregion				Southcentral Alaska Range Ecoregion			
	Prudhoe Bay	Colville River	Chandalar-Christian Rivers	Koyukuk River	Beaver Creek-Yukon River	Tanana River	Susitna River	West Cook Inlet	Kenai Peninsula	Knik Arm
Alaska blackfish		X			X	X				I
Alaskan brook lamprey						X			X	
Arctic char	X	X	X	X	X	X			X	
Arctic grayling	X	X	X	X	X	X	X	X	I	X
Broad whitefish[a]	X	X	X	X	X	X				
Burbot	X	X	X	X	X	X	X	X	X	X
Dolly Varden[a]	X	X	X	X	X	X	X	X	X	X
Lake chub			X	X	X	X				
Lake trout	X	X	X	X	X	X	X	X	X	X
Least cisco[a]	X	X	X	X	X	X				
Longnose sucker	X	X	X	X	X	X	X	X	X	X
Ninespine stickleback	X	X	X	X	X	X	X	X	X	X
Northern pike	X	X	X	X	X	X	I	I	I	I
Pond smelt	X	X					X	X	X	X
Pygmy whitefish					X					
Rainbow trout[a]						S	X	X	X/S	X
Round whitefish	X	X	X	X	X	X	X	X	X	X
Slimy sculpin	X	X	X	X	X	X	X	X	X	X

Sources: Mecklenburg et al., 2002

[a] May occur as anadromous and resident populations within the same drainage system.

[b] The Project footprint would affect no streams in the Eastern Arctic Basin.

I = Introduced, S = Stocked

3.2.2.1 Liquefaction Facility

Within the Kenai Peninsula drainage on the north Kenai Peninsula, fisheries for resident freshwater fish include rainbow trout, resident Dolly Varden, lake trout, and Arctic grayling (Begich and Pawluk, 2010). Rainbow trout, as with Arctic grayling, spawn in spring; thus, streams used for spawning by this species are sensitive to disturbance during the April to June spawning and incubation period. Several lakes in the Nikiski area are stocked with rainbow trout. Arctic grayling are not considered native to the Kenai Peninsula, but were stocked in several lakes and have become self-sustaining in several drainages (ADF&G, 1985). Other notable resident species in this region include round whitefish, longnose sucker, and slimy sculpin.

3.2.2.2 Interdependent Project Facilities

3.2.2.2.1 North Slope Region

Fish habitats within streams are more or less sensitive to disturbance depending on fish use and timing of that use, with sensitivity being greatest during spawning and overwintering. Within the North Slope region, the Sagavanirktok River and its side channels support Arctic grayling, ninespine stickleback, round whitefish, and slimy sculpin, which are therefore most sensitive during the May-to-October open-water season. Blackfish and ninespine sticklebacks are considered to be non-sensitive species in by ADF&G because they are ubiquitous and can withstand low dissolved oxygen levels. The ninespine stickleback has been known to survive over winter in massive concentrations in small pools of water. The main channel of the Sagavanirktok River is sensitive year-round because it provides rearing and overwintering areas for many fish species. The main river is most sensitive from May through June because of Arctic grayling spawning.

Many of the tundra streams that are crossed are most sensitive from May to October because they provide summer foraging habitat for a number of species, including Arctic grayling and resident Dolly Varden. Because of spawning by Arctic grayling, these tributaries are sensitive in the spring. As in the lower reaches, the portion of the Sagavanirktok River into which these tributaries empty is sensitive year-round for Arctic grayling, burbot, slimy sculpin, and round whitefish, and very sensitive in spring (May–June) for spawning Arctic grayling.

3.2.2.2.2 Beringia Boreal Ecoregion

Within Interior Alaska or the Beringia Boreal Ecoregion, Arctic grayling, resident Dolly Varden, burbot, and northern pike are the most noticeable freshwater species, with slimy sculpin and longnose sucker among other abundant species. Arctic grayling and slimy sculpin use the North Fork of the Chandalar River. The North Fork of the Chandalar River is sensitive during summer, from May through October, and very sensitive in spring and fall because of spawning by Arctic grayling. South of the Brooks Range, the Mainline corridor follows the course of the Dietrich River and the Middle Fork of the Koyukuk River. Resident Dolly Varden, Arctic grayling, burbot, round whitefish, longnose sucker, and slimy sculpin inhabit the Dietrich River drainage. Known overwintering areas occur intermittently along the Dietrich River and are considered sensitive year-round. The river's tributaries are sensitive during periods of open water (typically May through October). Streams along the Interior Alaska portion of the corridor that support overwintering habitat are also sensitive.

3.2.2.2.3 Cook Inlet Basin Ecoregion

Within Southcentral Alaska or the Cook Inlet Basin Ecoregion, Arctic grayling, resident Dolly Varden, and burbot are abundant within streams, and rainbow trout are also present in many tributaries of the Susitna River. Rainbow trout, like Arctic grayling, spawn in spring; thus, streams used for spawning by this species are sensitive during the April to June spawning and incubation period. Other notable resident species in this region include round whitefish, longnose sucker, and slimy sculpin.

3.2.3 Seasonal Fish Distribution

Within the Susitna River drainage, which has been extensively studied because of ongoing hydroelectric evaluations, life stages of all five Pacific salmon are present year-round (Table 3.2.3-1). Similarly, Pacific salmon within the Interior regions of the Project occur year-round but are restricted to Chinook, coho, and chum salmon. Timing of Interior salmon spawning, fry emergence, and smolt outmigration typically occurs later than in Southcentral Alaska (Table 3.2.3-2). In addition, chum salmon populations in the Interior of Alaska can have both summer and fall spawning migrations. On Alaska's North Slope, only chum and pink salmon have been identified with any consistency within the Project area. Chum and pink salmon move into spawning streams along the Beaufort Sea coast anytime between July and September, and smolt outmigrate to the ocean during or very near peak break-up flows.

However, a typical seasonal pattern for the salmon species present is as follows:

- Movement to summer feeding areas following breakup;
- Movement within feeding areas during summer, with movements sometimes extensive; and
- Late summer movement to wintering areas.

Most streams within the Project area are used only seasonally by fish. Fish distributions generally are most extensive during the open-water season when juvenile anadromous, and all age classes of resident fish, have access to major, intermediate, and minor streams throughout the Project area, including some streams with intermittent flow during only spring and highwater periods.

Fish distribution within the Project area varies by species and region. Within this basic movement pattern will be movements to spawning areas, which can be in spring (Arctic grayling, rainbow trout, eulachon), summer (Pacific salmon), fall (Dolly Varden, ciscoes, whitefish), or winter (burbot, sculpins). Table 3.2.3-3 provides general movement and habitat use periods for select coldwater resident and anadromous fish in Interior Alaska streams.

TABLE 3.2.3-1

Seasonality of Juvenile Salmon Presence in the Susitna River
Light gray indicates total duration of residence in the middle Susitna River and dark gray represents periods of peak use.

Species	Life Stage (age)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Chinook Salmon	Spawning Run												
	Incubation												
	Fry Emergence												
	Rearing (0)												
	Rearing (1)												
	Juvenile Migration (0)												
	Juvenile Migration (1)												
Sockeye Salmon	Spawning Run												
	Incubation												
	Fry Emergence												
	Rearing (0)												
	Rearing (1)												
	Juvenile Migration (0)												
	Juvenile Migration (1)												
Coho Salmon	Spawning Run												
	Incubation												
	Fry Emergence												
	Rearing (0)												
	Rearing (1)												
	Rearing (2)												
	Juvenile Migration (0)												
	Juvenile Migration (1)												
	Juvenile Migration (2)												
Chum Salmon	Spawning Run												
	Incubation												
	Fry Emergence												
	Rearing (0)												
	Juvenile Migration (0)												
Pink Salmon	Spawning Run												
	Incubation												
	Fry Emergence												
	Juvenile Migration (0)												

Source: R2 Resource Consultants (2013)

= Peak Use

= Off-peak Use

TABLE 3.2.3-3

General Coldwater Resident/Anadromous Fish Habitat Use Periodicity Chart for Selected Species in Interior Alaska Streams (Middle and Upper Yukon River Tributaries)

Species	Life Stage (age)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sheefish	Juvenile												
	Adult												
	Spawning												
	Incubation (in gravel)												
	Rearing												
Broad Whitefish	Juvenile												
	Adult												
	Spawning												
	Incubation (in gravel)												
	Rearing												
Least Cisco	Juvenile												
	Adult												
	Spawning												
	Incubation (in gravel)												
	Rearing												
Round Whitefish	Juvenile												
	Adult												
	Spawning												
	Incubation (in gravel)												
	Rearing												
Humpback Whitefish	Juvenile												
	Adult												
	Spawning												
	Incubation (in gravel)												
	Rearing												
Arctic Grayling	Juvenile												
	Adult												
	Spawning												
	Incubation (in gravel)												
	Rearing												
Northern Pike	Juvenile												
	Adult												

TABLE 3.2.3-3

General Coldwater Resident/Anadromous Fish Habitat Use Periodicity Chart for Selected Species in Interior Alaska Streams (Middle and Upper Yukon River Tributaries)

Species	**Life Stage (age)**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
	Spawning												
	Incubation (in gravel)												
	Rearing												
Burbot	Juvenile												
	Adult												
	Spawning												
	Incubation (in gravel)												
	Rearing												
Longnose Suckers	Juvenile												
	Adult												
	Spawning												
	Incubation (in gravel)												
	Rearing												
Dolly Varden	Juvenile												
	Adult												
	Spawning												
	Incubation (in gravel)												
	Rearing												

Source: R2 Resource Consultants (2013)

= Peak Use

= Off-peak Use

3.2.4 Marine Fisheries

The Alaskan coastline is highly irregular, composed of a variety of sheltered coves, bays, exposed river deltas, and mudflats. In general, the rivers that run through the low-lying coastal areas are braided and can form depositional deltas that extend into the open ocean (National Oceanic and Atmospheric Administration [NOAA], 2010). The northern Alaskan coast is also protected by several barrier islands located at various distances offshore.

3.2.4.1 Liquefaction Facility

The Liquefaction Facility is located along the east side of Central Cook Inlet on Nikiski Peninsula. Within Cook Inlet, there are numerous protected marsh bays located along the rocky shoreline. Due to its proximity to Anchorage and abundance of species, Cook Inlet is heavily used for recreational fishing. Marine fisheries within Cook Inlet include flatfish, such as halibut, flounder, and sole; rockfish; Pollock; some members of the cod family; and others. Some marine species that are normally found in deep water as adults move into shallower water to spawn.

The marine fish, zooplankton, and ichthyoplankton discussed in the following sections are some of the species that have been reported from Upper Cook Inlet, or are species that have been considered as prey for Cook Inlet beluga whales.

3.2.4.1.1 Pacific Cod

Pacific cod (*Gadus macrocephalus*) in the eastern Pacific Ocean are found from central California to the Bering Sea with unconfirmed reports to the Chukchi Sea. Pacific cod are distributed throughout Southcentral Alaska and are found primarily in benthic habitats in water depths ranging from 49 to 1,804 feet. Pacific cod was one of the most abundant species captured during sampling in Kachemak Bay (Abookire et al., 2001). Pacific cod feed on other fish, including walleye pollock (*Theragra chalcogramma*), flatfishes, Pacific sandlance, and Pacific herring, as well as on crabs and shrimp. They may reach 47 inches in length, but the average length in trawl catches is 27.5 to 29.5 inches (Mecklenburg et al., 2002). Pacific cod usually spawn in relatively deep water during the winter and move to shallower waters to feed. Males become sexually mature at age-2 and females at age-3. Breeding occurs annually and fecundity increases with increasing size of female fish. Eggs develop on the ocean floor and development is affected by temperature. Optimal temperatures for egg development are around 3.5 to 4 degrees Celsius (38.3 to 39.2 degrees Fahrenheit [°F]). Larvae are moved by ocean currents and have been found in Cook Inlet from May to July. Larvae feed on copepods and other plankton. Young Pacific cod are often found in shallow coastal waters and move to deeper water with age. Pacific cod were not reported from tow net sampling in northern Cook Inlet during 1993 (Moulton, 1997), nor from sampling by beach seine and tow net during 2004–2005 studies in Knik Arm (Houghton et al., 2005a, b).

3.2.4.1.2 Sculpins

Sculpins (family Cottidae) spawn in the winter. Some species of sculpins have internal fertilization. Eggs are typically laid in rocks, where they are guarded by males. Larvae often have diel migration (near the surface at night) and may be present year-round. Juveniles are abundant nearshore and gradually move offshore as they grow. Studies in Knik Arm caught only Pacific staghorn sculpin (*Leptocottus armatus*)

(Houghton et al., 2005a, b). Staghorn sculpin are a euryhaline species that is common in the nearshore region and ascends the lower reaches of river deltas (Hart, 1973). They typically co-occur with starry flounder.

3.2.4.1.3 Starry Flounder

Starry flounder (*Platichthys stellatus*) occur from the Beaufort and Chukchi seas to southern California and Korea. Starry flounder reach a length of 36 inches and a weight of 20 pounds. They are found on soft bottoms from intertidal areas to a depth of 1,230 feet, but are usually found in areas of less than 328 feet. In nearshore areas, they are found in estuaries and up rivers to the limit of tidal influence, as well as in marshes and coastal lakes (Mecklenburg et al., 2002). Starry flounder have been reported in small numbers in Knik Arm (Houghton et al., 2005a, b), Upper Cook Inlet (Moulton, 1997), and the Chisik Island area of Lower Cook Inlet (Fechhelm et al., 1999a; Robards et al., 1999).

3.2.4.1.4 Walleye Pollock

Walleye pollock (*Theragra chalcogramma*) is an abundant species in the Bering Sea and the Gulf of Alaska, and is also found in Cook Inlet. Pollock range from the Chukchi Sea south through the Bering Sea and Pacific Ocean to central California and Japan. Pollock reach 36 inches in length and are an important species in commercial fisheries. Walleye pollock are demersal and may occur at depths to 3,117 feet, but are also pelagic and occur in schools near the surface and in mid-water habitats (Mecklenburg et al., 2002). Small pollock feed on copepods and other zooplankton and larger pollock feed on fish. Although walleye pollock is grouped with groundfish, young pollock are the dominant forage fish consumed by larger fish, including adult pollock, and many marine bird and mammal species (Schumacher et al., 2003). Walleye pollock consistently spawn in the Shelikof Strait area and were the second-most-abundant groundfish species captured during small-mesh trawl sampling in Kachemak Bay in 2000 (Gustafson and Bechtol, 2005). Walleye pollock are scarce in the upper portions of Cook Inlet.

3.2.4.1.5 Razor Clams

Macroinvertebrates such as crabs, shrimp, butter clams, littleneck clams, and octopus that are commercially harvested in lower Cook Inlet and Katchimak Bay are not currently commercially harvested in Upper Cook Inlet. Pacific Razor clams are a highly edible, softshelled clam found on sandy beaches from California to Alaska. A large number of razor clams are found in Cook Inlet, which supports a popular sport fishery and commercial harvest areas. Commercial harvests of razor clams in Upper Cook Inlet date back to 1919. Harvests have fluctuated from no fishery to a harvest in excess 500,000 pounds, driven largely by market demand (ADF&G, 2010b). The nearest razor clam bed to the Project area is at Coho Beach in Kasilof (ADF&G, 2010b). However, due to low population levels caused by over harvesting, the east side of Cook Inlet has been closed to clamming since 2015. Currently, the West side of Cook Inlet is the only location for recreational and commercial harvests of razor clams, not in the vicinity of the Project footprint. (ADF&G, 2015k).

3.2.4.1.6 Marine Invertebrates and Zooplankton

Data on marine invertebrates and zooplankton in Upper Cook Inlet near the proposed Marine Terminal and Mainline Crossing are limited. Marine invertebrate and zooplankton populations are reportedly low in abundance and diversity except for copepods in comparison to Lower Cook Inlet (see Figure 3.2-1 for Lower and Upper Cook Inlet boundaries). A number of previous reports on marine plankton conclude that the reduced light penetration due to high suspended sediment loads and low salinity at certain times of the year combine to severely restrict survival and that the number of plankton species and that abundance increases toward Lower Cook Inlet (Pentec, 2005; USACE 1996; SAIC, 2002; Jackson, 1970; and Murphy, et. al., 1972). Timing of zooplankton blooms in Cook Inlet occurs shortly following phytoplankton blooms; phytoplankton typically peaks in May, though there are significant blooms later in the summer and fall (CIRCAC, 2017).

The most recent data on zooplankton communities southwest of the Forelands near the proposed Marine Terminal and Nikiski are discussed in Section 3.4.8.1 Liquefaction Facility. In 1993 sampling tows were conducted as part of a prey availability of juvenile salmon in the summer and fall of 1993. Sampling tows, 10 minutes in duration, were conducted in nearshore, mid-inlet, central, and northwest inlet waters over three periods: June 3–20, July 7–15, and September 8–10. Plankton samples consisted of mostly copepods and ichthyoplankton, spionid worms, mysids, and invertebrate eggs. Calanoid copepods increased from June to July in the East Channel (near Susitna River) in comparison to the zooplankton samples from Tyonek (North Foreland) and Trading Bay (West Foreland) tows. Ichthyoplankton (herring and eulachon) and surface insects peaked in early July and decreased after that (Moulton, 1997).

3.2.4.2 Interdependent Project Facilities

Prudhoe Bay is located at the Project's northern terminus and consists of largely open bays with limited barrier island protection. Prudhoe Bay abuts the Beaufort Sea, which is nominally covered by ice for approximately nine months of the year between late summer and the following July. During the summer months, ice on the Beaufort Sea will retreat from 6 to 62 miles offshore (NOAA, 2010). Due to the combination of meltwater from the sea ice and overland flow from the rivers, a stratified water column can develop with more saline waters below a layer of fresher water. As summer progresses, the waters can become less stratified and more well mixed, returning to marine conditions (URS, 1999). Although gravel makes up the substrate around the bases of several of the barrier islands, the overlying sediment covering most of Prudhoe Bay and nearby coastal waters consists primarily of fine silt and fine sand (Busdosh et al., 1985).

Fish populations of the nearshore region of the Beaufort Sea provide an important subsistence resource for local residents (Craig, 1989) and support commercial and sport harvests (BLM, 2004, 2012, 2014; Howe et al., 1998). Fish populations near existing and planned developments related to oil exploration and extraction, and the effects of these developments on fish and fish habitat, have been extensively investigated since the mid-1970s. Summaries of those studies are included in reviews and other documents, including the U.S. Army Corps of Engineers (USACE 1980, 1984), ARCO Alaska et al. (1997), BLM (2012), Truett and Johnson (2000), Daigneault and Reiser (2007), Logerwell et al. (2010), Moulton et al. (2010), Williams and Burril (2011), Fechhelm et al. (2011), and ABR, Inc. (2012).

Marine species commonly encountered in the Prudhoe Bay region of the Beaufort Sea include Arctic cod, saffron cod, Arctic flounder, and fourhorn sculpin (Fechhelm et al., 2011). Anadromous fish commonly occurring in the Beaufort Sea in the vicinity of oil production areas include Dolly Varden, Arctic cisco, least cisco, humpback whitefish, broad whitefish, and rainbow smelt. Although these anadromous species occur in the Beaufort Sea, they can include both anadromous and freshwater populations.

The marine fish discussed in the following sections are some of the species that are expected to occur in Beaufort Sea waters of the Project area.

3.2.4.2.1 Arctic Cod

As summarized in Fechhelm et al. (2011), Arctic cod (*Boreogadus saida*) have a circumpolar distribution and are ubiquitous in marine waters throughout the Beaufort Sea. Arctic cod are an important food item in the diets of marine mammals, birds, and fish, and are considered to be a primary component of the Arctic marine food chain. Arctic cod is one of the most abundant fish species collected in coastal waters and is typically associated with highly productive transition layers that separate cold marine bottom water and warm brackish surface water. The onshore movement of such layers is an important factor in coastal aggregations of fish. Arctic cod do not actively move into freshwater or low-salinity habitats. The movement of large schools into coastal areas can be dramatic and can be either short-lived or sustained. The occurrence of Arctic cod schools in any particular area is both unpredictable and ephemeral.

3.2.4.2.2 Saffron Cod

Saffron cod (*Eleginus gracilis*) are found in brackish and marine waters of the Beaufort Sea east to Bathurst Inlet in Canada (Fechhelm et al., 2011). They frequently enter rivers and may go considerable distances upstream. Saffron cod may be found both nearshore and offshore during summer. Saffron cod have been reported from studies throughout the Beaufort Sea, but it is the least abundant of the marine species that move into nearshore waters during summer. Saffron cod have been reported from studies throughout the Beaufort Sea, but it is the least abundant of the marine species that are regularly caught by fyke nets in the Prudhoe Bay region during summer.

3.2.4.2.3 Arctic Flounder

Arctic flounder (*Pleuronectes glacialis*) are typically found in shallow coastal waters during summer and are circumpolar in distribution (Fechhelm et al., 2011). They are not found offshore and they often move upriver. They are common and widely distributed along the Beaufort Sea coast during summer. Arctic flounder catch rates increased in 1990s from levels reported in the 1980s and remained elevated through the 2010s, contributing about 9 percent of the catch during 2011 fyke net sampling (Fechhelm et al., 2011).

3.2.4.2.4 Arctic Cisco

The oil exploration and extraction industry has been conducting annual fish monitoring surveys in the coastal waters of the Beaufort Sea near Prudhoe Bay over the past 30 years. Nearly all of the studies conducted in the Beaufort Sea nearshore zone in the summer found substantial numbers of large Arctic cisco (*Coregonus autumnalis*) present (Craig and Mann, 1974; Griffiths et al., 1975, 1977; West and Wiswar, 1985; Wiswar and West, 1987; Griffiths, 1983; Fruge et al., 1989; Underwood et al., 1995; Fechhelm et al., 1999b). Arctic cisco found in the Alaskan Beaufort Sea originate from spawning grounds in the Mackenzie River system of Canada (Gallaway et al., 1983, 1989). In the spring, newly hatched young-of-the-year (age-0) are flushed downriver into ice-free coastal waters adjacent to the Mackenzie Delta. Some young-of-the-year are transported west to Alaska by wind-driven coastal currents (Gallaway et al., 1983; Fechhelm and Fissel, 1988; Moulton, 1989; Fechhelm and Griffiths, 1990; Schmidt et al., 1991; Underwood et al., 1995; Colonell and Gallaway, 1997). In summers with strong and persistent eastern winds, enhanced westward transport can carry fish to the Colville River, where they take up winter residence. They continue to winter within the Colville River until the onset of sexual maturity at about age-7, at which point they migrate back to the Mackenzie River to spawn (Gallaway et al., 1983).

The meteorologically driven recruitment process plays a major role in determining the age structure of Arctic cisco populations in Alaska. Summers with strong, persistent eastern winds are associated with strong year classes in the Colville/Sagavanirktok region (Cannon et al., 1987; Moulton, 1989; Glass et al., 1990; Reub et al., 1991; LGL Alaska, 1992, 1994a; Griffiths et al., 1996). These year classes maintain a presence in the region that can be tracked as fish grow to ages harvested by the commercial and subsistence fisheries operating in the Colville River (Moulton et al., 1992; Moulton and Field, 1988, 1991, 1994; Moulton, 1994, 1995).

3.2.4.2.5 Dolly Varden

Dolly Varden (*Salvelinus malma*) are discussed under Anadromous Fish (see Section 3.2.1). Dolly Varden migrate considerable distances along the Beaufort Sea coast during summer, where extensive alongshore and open-water migrations have been reported, suggesting that they may be tolerant of marine water conditions (Fechhelm et al., 2011). They have been taken as far as 9.3 miles offshore in the Alaskan Beaufort Sea. There is dietary evidence that Dolly Varden may feed offshore among ice floes in mid- and late summer (Fechhelm et al., 2011).

3.2.4.2.6 Fourhorn Sculpin

Fourhorn sculpin (*Myoxocephalus quadricornis*) are circumpolar in distribution in brackish and moderately saline waters (Fechhelm et al., 2011). They are one of the most common fish in coastal waters of the Beaufort Sea during summer, moving offshore to overwinter when nearshore shallow waters freeze in the fall. They spawn in mid-winter, and are not found far offshore. When coastal ice dissipates in the spring they move back into coastal waters and may travel considerable distances up river (Fechhelm et al., 2011).

3.2.4.2.7 Least Cisco

Least cisco (*Coregonus sardinella*) have both migratory and freshwater resident populations in the Beaufort Coastal Plain Ecoregion and the oil exploration and extraction industry has been conducting annual fish monitoring surveys in the coastal waters of the Beaufort Sea near Prudhoe Bay over the past 30 years. Migratory populations have a discontinuous distribution in the coastal Beaufort Sea (Craig and McCart, 1974; Craig, 1984, 1989). Western populations are associated with the Colville River and smaller rivers to the west, while eastern populations are associated mainly with the Mackenzie River. The large distance between these freshwater systems apparently isolates the migratory populations from each other.

The eastward dispersal of juvenile least cisco during summer appears to be a function of wind-driven coastal currents (Fechhelm et al., 1994). Western winds in early summer (primarily July) create easterly flowing currents in Simpson Lagoon that enhance the eastward dispersal of small (<7 inches) fish. In summers of substantial western winds (about one out of every two years), large numbers of juvenile least cisco are collected in the Prudhoe Bay/Sagavanirktok Delta region (Griffiths et al., 1983; Moulton et al., 1986; LGL Alaska, 1992, 1993). In years lacking substantial July western wind events, few small least cisco reach the eastern end of Simpson Lagoon (Cannon et al., 1987; Glass et al., 1990; Reub et al., 1991; Fechhelm et al., 1994; LGL Alaska, 1994b; Griffiths et al., 1996).

3.2.4.2.8 Rainbow Smelt

Rainbow smelt (*Osmerus mordax*) are an anadromous pelagic fish found throughout the Beaufort Sea. They spawn in spring, and are known to spawn in the Colville and Chipp rivers (Fechhelm et al., 2011; Moulton et al., 2011). As with Arctic flounder, catch rates for rainbow smelt increased in the 1990s, but rainbow smelt catch rates gradually declined back to 1980s levels by the end of the decade (Fechhelm et al., 2011). They contributed approximately 1 percent of the catch during 2011 fyke net sampling (Fechhelm et al., 2011).

3.2.4.2.9 Whitefish

As with least cisco, anadromous broad whitefish (*Coregonus nasus*) and humpback whitefish (*Coregonus pidschian*) have two population centers in the Beaufort Sea region, the Colville River and westward, and the Mackenzie River drainage. Unlike the situation with least cisco and Arctic cisco, however, the Sagavanirktok River supports a spawning and overwintering population of broad whitefish. Humpback whitefish do not spawn or overwinter in the Sagavanirktok River drainage (Fechhelm et al., 2011). Like broad whitefish, humpback whitefish are intolerant of high salinities and remain in brackish nearshore waters and river deltas throughout summer (Fechhelm et al., 2011).

Broad whitefish use a variety of habitats throughout their life cycle. Spawning occurs in deep portions of large rivers in fall. In the Mackenzie River, they spawn in the lower river, just upstream of the marine influence. The anadromous population in the Colville River appears to show a similar pattern, with spawning in the main river upstream of the delta. Anadromous broad whitefish radio tagged in drainages east and west of the Colville River have been documented moving into the Colville during summer and fall. Morris et al. (2001), documented consistent movement of individual broad whitefish between habitats in Fish Creek to the west, and the Colville River. Broad whitefish radio-tagged in the Prudhoe Bay region also were documented moving to the Colville River (Morris 2000). Fish from both areas moved to locations in the Colville River near and just upstream from the Iktillik River, presumably for spawning; the fish overwintered in the same areas. However, Bendock and Burr (1986) identified a pre-spawning migration in August, but did not know if the fish were freshwater residents or part of the anadromous population.

During spring flood, subadult broad whitefish enter a variety of available habitats, including seasonally flooded lakes, lakes connected to stream systems, river channels, and coastal areas. Fish using perched lakes remain in the lake until they reach maturity, and then return to the river in the spring of the year they will spawn. Broad whitefish that do not enter perched lakes either enter the coastal region and adjacent small drainages to feed, thus assuming an anadromous pattern, or remain in the river system and feed in low-velocity channels, tapped lakes, or drainage lakes. In fall, they leave the shallow feeding areas and return to deep wintering areas in the main river or in lakes. Maturity is first reached at age 9, with most maturing at age 10 to 12 (Bendock and Burr, 1984, 1986).

3.2.4.2.10 Marine Invertebrates and Zooplankton

Data on zooplankton populations in Prudhoe Bay are limited. Studies on zooplankton conducted to provide background information for oil and gas development in Prudhoe Bay in the late 1980s reported a total of 68 categories of zooplankton identified and consisting of 48 species and 20 other categories. Three groups were identified in the nearshore Beaufort seas and in Prudhoe Bay: group one consisted of *Pseudoculunus* spp.; group two consisted of benthic copepods, polychaetes, and the amphipod *Hulirages mixius*; and the third group was composed of all other zooplankton species. Inside Prudhoe Bay, the copepod *Acartia clausi* was the dominant species followed by the *Pseudocalanus* sp. Between Prudhoe Bay and the Midway Islands, *Calanus glacialis* and *Pseudocalanus sp*. were reported as the dominant species. A more diverse community occurred in the more oceanic area outside the barrier islands including meroplanktonic larvae of decapods, polychaetes, barnacles, juvenile shrimp, and euphausids. Calanoid copepods were dominant under the ice. In the Prudhoe Bay area during the spring the cyclopoid and harpacticoid copepods, hydrozoans, amphipods, larvaceans, and larval stages of planktonic and benthic invertebrate populations increased, which was attributed to the sea ice melting and releasing zooplankton into the water column. The third group of zooplankton population reportedly declined as the sea ice melted. During the winter all of the zooplankton populations abundance and diversity declined. Calanoid copepods (*Psuedocalanus* spp.) were the dominant zooplankton population in Prudhoe Bay (Horner and Murphy, 1985).

3.2.5 Essential Fish Habitat

Pursuant to the Magnuson-Stevens Fishery Conservation and Management Act (1801 et seq.) (Magnuson-Stevens Act), FERC must consult with the National Marine Fisheries Service (NMFS) regarding the Project's anticipated impact on EFH if it concludes that the Project may adversely affect such habitat. EFH is defined as waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (50 C.F.R. Part 600). For the purposes of this definition, "waters" means aquatic areas and their associated physical, chemical, and biological properties; "substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities; "necessary" means the habitat required to support a sustainable fishery and healthy ecosystem; and "spawning, feeding, and breeding" is meant to encompass the complete life cycle of a species (50 C.F.R. Part 600). A detailed description of EFH and the potential effects of the Project on EFH are provided in Appendix D.

EFH is designated by Fisheries Management Councils (FMCs) in Fishery Management Plans (FMPs) based on best available scientific information (NMFS, 2005). The Magnuson-Stevens Act defines information levels used to describe the level of understanding. Level 1 information corresponds to distribution; Level 2 information corresponds to density or relative abundance; Level 3 information corresponds to growth, reproduction, or survival rates; and Level 4 information corresponds to production rates (NMFS, 2005). Project facilities are located within areas designated as EFH for Arctic cod and for Pacific salmon. All of the Beaufort Sea including Prudhoe Bay and the West Dock area have been designated as EFH for Arctic cod. All of Cook Inlet, Beaufort Sea (including Prudhoe Bay), and freshwater streams important for the spawning, rearing, and migration of Pacific salmon as designated by ADF&G, have been designated as EFH for all five species of Pacific salmon.

FMCs can identify Habitat Areas of Particular Concern (HAPCs) (50 C.F.R. 600.815(a)(8)) within the FMPs. A HAPC is a designation that encompasses discrete subsets of EFH that play a particularly important ecological role in the fish life cycle or that are especially sensitive, rare, or vulnerable.

The Project area crosses waterbodies that drain into the Pacific Ocean (Cook Inlet and tributaries), the Bering Sea (Yukon/Koyukuk headwaters), and Beaufort Sea (Prudhoe Bay and tributaries). The Mainline would cross 65 streams containing freshwater EFH and the Point Thomson Gas Transmission Line (PTTL) would cross three such streams. The numbers of crossings of EFH streams are provided by crossing method type in Table 3.2.5-1. Stream crossing methods are included in Resource Report No. 1 Section 1.5.2.3.4.1 Waterbody Crossings. EFH streams crossed by the pipeline have been assessed for the presence of overwintering documented spawning habitat (Appendix D, Table A-1) as determined by studies by ADF&G and information in the Catalog. A total of 56 sites that may be used for extraction of granular materials (material sites) are located within 0.25 mile of EFH streams; only 6 are within 300 feet of any freshwater EFH. Surface waterbodies that may be used as water sources for construction of the Project (Mainline and PTTL) include 32 streams with EFH.

Table A-1 in Appendix D provides a list of all known anadromous stream crossings by pipeline milepost (MP) and Appendix H in Resource Report No. 2 provides a table of all stream crossing by pipeline MP. Both of these tables were compiled using ADF&G Catalog information and Project field surveys. A depiction of the locations is provided in Appendix A mapbooks.

Project facilities located in areas designated as Marine EFH are indicated in Table 3.2.5-2. Arctic cod EFH encompasses all U.S. waters in the Beaufort Sea including the area proposed for modifications at West Dock (Table 3.2.5-2). Marine EFH for Pacific salmon encompasses all of Cook Inlet including the proposed locations for the Marine Terminal and Mainline crossing of Cook Inlet.

TABLE 3.2.5-1

Summary of Freshwater EFH Stream Crossings by Class and Construction Method

FERC Waterbody Class	Proposed Crossing Method	Freshwater EFH Stream Crossings		
		Total	**Winter Construction**	**Summer Construction**
Minor	Buried Trenchless	0	0	0
	Aerial	0	0	0
	Open/Frozen Cut	26	12	14
	Isolation Cut	12	8	4
Minor EFH Stream Crossing Total		***38***	***20***	***18***
Intermediate	Buried Trenchless	0	0	0
	Aerial	0	0	0
	Open/Frozen Cut	4	1	3
	Isolation Cut	12	7	5
Intermediate EFH Stream Crossing Total		***16***	***8***	***8***
Major	Buried Trenchless	5	0	5
	Aerial	1	1	0
	Open/Frozen Cut	5	0	0
	Isolation Cut	0	0	0
Major EFH Stream Crossing Total		***11***	***5***	***6***
Totals		**65**	**33**	**32**

TABLE 3.2.5-2

Marine Essential Fish Habitat Occurring in the Project Area

Facility/ Milepost	Waterbody Name	Fisheries Management Plan	Fish	Potential Source/Season	Habitat Loss (acres)	EFH	Benthic Habitat Type
LIQUEFACTION FACILITY							
Marine Terminal	Cook Inlet	Alaska EEZ Salmon FMP; Gulf of Alaska Groundfish FMP	Salmon[a] – marine stages Groundfish[b]; Forage fish[c]	Habitat modification Potential for Spills Ballast Water/year-round	63.6 acres temporary 18.7 acres permanent	Pacific salmon marine EFH	Unvegetated, soft-bottom, occasional cobble or boulder – See Section 3.4.8.1
PIPELINES							
Mainline/ 766-793	Cook Inlet	Alaska EEZ Salmon FMP; Gulf of Alaska Groundfish FMP	Salmon[a] – marine stages Groundfish[b]; Forage fish–egg larvae	Buried trenchless crossing, In-water construction/TBD	49 acres temporary	Pacific salmon marine EFH	Unvegetated, soft-bottom, See Section 3.4.8.2.2
GAS TREATMENT PLANT							
Associated GTP Infrastructure	Beaufort Sea	Arctic FMP Alaska EEZ Salmon FMP	Arctic cod, saffron cod Salmon[a] – marine stages	West Dock Modifications/TBD	47.3 acres temporary 31 acres permanent[d]	Arctic cod; Pacific salmon marine EFH	Unvegetated, soft-bottom, some cobble – See Section 3.4.8.2.1

Notes:

[a] **Alaska EEZ Salmon FMP**

Chinook Salmon
Chum Salmon
Coho Salmon
Pink Salmon
Sockeye Salmon

[b] **GOA Groundfish FMP**

Walleye Pollock	Dusky Rockfish
Pacific Cod	Thornyhead Rockfish
Sablefish	Atka Mackerel
Yellowfin Sole	Squids
Arrowtooth Flounder	Sculpins
Northern Rock Sole	Skates
Alaska Plaice	Sharks
Rex Sole	Octopuses
Dover Sole	Southern Rock Sole
Flathead Sole	Yelloweye Rockfish
Pacific Ocean Perch	
Northern Rockfish	
Shortraker Rockfish	
Blackspotted/Rougheye Rockfish	

[c] **Forage Fish Complex**

Osmeridae (smelt)
Myctophidae (lanternfish)
Bathylagidae (deep-sea smelt)
Ammodytidae (sand lance)
Trichodontidae (sand fish)
Pholidae (gunnels)
Stichaeidae (pricklebacks)

Gonostomatidae (bristlemouths)
Euphausiacea (krill)

[d] Dockhead 4 (DH 4) at West Dock will not be operated or maintained by the Project.

Sources: Resource Report No. 1; NPFMC, 2009, 2014; NPFMC et al., 2012

3.2.5.1 Liquefaction Facility

EFH consultation for the Cook Inlet region is expected to focus on species managed under the:

- FMP for the Salmon Fisheries in the Economic Exclusion Zone off the Coast of Alaska (Salmon FMP);
- FMP for Groundfish of the Gulf of Alaska;
- Marine .

No designated HAPCs, as defined in Section 3.2.5, are located in the Project area.

3.2.5.1.1 Salmon FMP

Both the Liquefaction Facility and Interdependent Project Facilities portions of the proposed Project would be within the jurisdiction of the FMP for the Salmon Fisheries in the EEZ of Alaska (NPFMC et al., 2012), which lists five species of Pacific salmon that could occur within the Project area: Chinook (*Oncorhynchus tshawytscha*), sockeye (*O. nerka*), coho (*O. kisutch*), chum (*O. keta*), and pink (*O. gorbuscha*) salmon.

Pacific salmon populations within the Project area are all in the West Management Area, which includes all federal waters west of Cape Suckling in the Gulf of Alaska to Demarcation Point in the Beaufort Sea; with the exception of three excluded areas in the northern Gulf of Alaska. EFH for Pacific salmon in Alaska has been designated based on Level 1 distribution information (NMFS, 2005). The Salmon FMP identifies EFH for each species' life stage and, in most cases, is based on either the general distribution of the life stage, or the general distribution of the life stage in waters identified by the ADF&G Catalog of Waters Important for the Spawning, Rearing, or Migration of Anadromous Fishes (Johnson and Litchfield, 2015a, b, c).

All five Pacific salmon use marine waters in the vicinity of the Project area near Nikiski and use rivers or streams on the northern Kenai Peninsula for migration, spawning, and rearing (Table 3.2.5-3). Most notable is the Kenai River (244-30-10010), which is located approximately 9.5 miles south of the Liquefaction Facility (Johnson and Litchfield, 2015c). The Kasilof River, another notable stream, is located 20 miles south of the Liquefaction Facility. There are no cataloged anadromous waters in the immediate vicinity of the Liquefaction Facility (Johnson and Litchfield, 2015c). Parsons Lake (247-90-10030-0030) and the upper reaches of Bishop Creek (247-90-10030), east of the Liquefaction Facility, support coho and sockeye salmon (Johnson and Litchfield, 2015c).

Designated Pacific salmon marine EFH in the Cook Inlet encompasses all of upper Cook Inlet, including the area affected by the construction and operation of the Marine Terminal. All five Pacific salmon seasonally use Cook Inlet at various life stages (Table 3.2.5-3). A brief life history synopsis of each of the five Pacific salmon is provided in Section 3.2.1.3.

TABLE 3.2.5-3

Salmon Species EFH Life Stages Present in Cook Inlet

	Freshwater		Estuarine	Marine		Freshwater
Salmon Species	**Eggs**	**Larvae and Juveniles**	**Juveniles**	**Juveniles**	**Immature and Maturing Adults**	**Adults**
Chinook	1	1	1	1	1	1
Sockeye	1	1	1	1	1	1
Coho	1	1	1	1	1	1
Chum	1	1	1	1	1	1
Pink	1	1	1	1	1	1

Source: NMFS 2015
1 = life stage with defined EFH in the Project area.

3.2.5.1.2 Groundfish FMP

Marine species expected to occur in the Project area include forage fish, such as walleye pollock, saffron cod, Pacific herring, longfin smelt, capelin, Pacific sandfish (*Trichodon trichodon*), Pacific sandlance, snake prickleback (*Lumpenus sagitta*), Pacific staghorn sculpin, and starry flounder (Moulton, 1997; Houghton et al., 2005a, b). Cook Inlet occurs within the jurisdiction of the Gulf of Alaska FMP, which supports 25 species of groundfish and nine forage fish complexes (Table 3.2.5-2). Walleye pollock and starry flounder are considered target species of the FMP for Groundfish of the Gulf of Alaska (NPFMC, 2014).

The proposed Liquefaction Facility is located along Upper Cook Inlet. Due to its proximity to Anchorage, Cook Inlet is used for both commercial and recreational fishing. Marine fisheries within Cook Inlet include flatfish such as halibut, flounder, and sole; rockfish; Pollock; some members of the cod family; and others. Some marine species that are normally found in deep water as adults move into shallower water to spawn.

The marine fish discussed in Section 3.2.4 for the Liquefaction Facility have been reported from Upper Cook Inlet, or are considered as prey for Cook Inlet beluga whales. A brief synopsis of Pacific cod, sculpins, walleye pollock, and starry flounder is provided in Section 3.2.4.1. The Liquefaction Facility inclusive of the Marine Terminal, is not located within any EFH designated by the FMP for Groundfish of the Gulf of Alaska (NPFMC, 2014).

3.2.5.2 Interdependent Project Facilities

The Prudhoe Bay and Beaufort Sea region contains EFH for Arctic cod and Pacific salmon species that are managed under the Arctic FMP and Salmon FMP, respectively.

There are no HAPCs, as defined in Section 3.2.5, proximate to any Project components except for shipping routes. The closest HAPC is more than 150 miles from the site proposed for the Mainline crossing of the Cook Inlet. Within the Gulf of Alaska FMP management area, two general HAPCs are identified: the Alaska Seamount Habitat Protection Areas and the Gulf of Alaska Coral Habitat Protection Areas. The Alaska Seamount Habitat Protection Area includes 15 seamounts, all of which are east and south of the

Aleutian Trench and the Smith Escarpment in the Gulf of Alaska, far outside of Cook Inlet and far from Nikiski and Beluga, Alaska. In addition, there are three HAPCs within the Gulf of Alaska Coral Habitat Protection Areas: Cape Ommaney, Fairweather North, and Fairweather South. All are located off the Alexander Archipelago east of Yakutat Bay, far outside Cook Inlet and far from Nikiski and Beluga, Alaska. The Salmon FMP includes the HAPCs listed and adds the Bowers Ridge and Ulm Plateau HAPC. Both HAPCs lie north of the southern arch of the Aleutian Islands and separate the Bowers and Aleutian basins of the Bering Sea. Both HAPCs are far from the Project area.

Marine Project activities in the Arctic Region occur primarily at Prudhoe Bay and include West Dock modifications, and construction/operation of the PTTL. Prudhoe Bay is located at the Project's northern terminus and consists of largely open bays with limited barrier island protection. Prudhoe Bay abuts the Beaufort Sea, which is nominally covered by ice for approximately nine months of the year between late summer and the following July. During the summer months, ice on the Beaufort Sea will retreat from 6 to 62 miles offshore (NOAA, 2010). Due to the combination of meltwater from the sea ice and overland flow from the rivers, a stratified water column can develop with more saline waters below a layer of fresher water. As summer progresses, the waters can become less stratified and more well mixed, returning to marine conditions (URS, 1999). Although gravel makes up the substrate around the bases of several of the barrier islands, the overlying sediment covering most of Prudhoe Bay and nearby coastal waters consists primarily of fine silt and fine sand (Busdosh et al., 1985). In addition, the PTTL will cross the Sagavanirktok and Shaviovik rivers, both of which support small runs of salmon.

Fish populations of the nearshore region of the Beaufort Sea provide an important subsistence resource for local residents (Craig, 1989) and support limited commercial and sport harvests (BLM, , 2004, 2012, 2014; Howe et al., 1998). Fish populations near existing and planned developments related to oil exploration and extraction, and the effects of these developments on fish and fish habitat, have been extensively investigated since the mid-1970s. Summaries of those studies are included in reviews and other documents, including USACE (1980, 1984), ARCO Alaska et al. (1997), BLM (2012), Truett and Johnson (2000), Logerwell et al. (2010), Williams and Burril (2011), and Fechhelm et al. (2011).

3.2.5.2.1 Arctic FMP

The NPFMC manages three target species: (1) Arctic cod, (2) saffron cod (*Eleginus gracilis*), and (3) snow crab (*Chionoecetes opilio*) in accordance with the FMP for the Fish Resources of the Arctic Management Area (NPFMC, 2009; 74 C.F.R. 56734). As described in the FMP, the NPFMC decided to initially prohibit commercial fishing until sufficient information is available to enable a sustainable commercial fishery to proceed.

Of these three target species, snow crab are more associated with deep water (Logerwell et al., 2010), and are not expected to be found within the Project area. Arctic cod EFH is designated based on Level 1 information for only adults and late juveniles; insufficient information is available to designate EFH for eggs, larvae, and early juveniles (NPFMC, 2009).

The general summer distribution of saffron cod and Arctic cod extends across Prudhoe Bay into the Point Thomson portion of the Project area, with saffron cod and Arctic cod being documented in summer study programs within the area (NMFS, 2005; Williams and Burril, 2011). During winter, Arctic cod are the primary species in the Prudhoe Bay region, although in low densities (Tarbox and Thorne, 1979). Brief synopses of Arctic cod and saffron cod are provided in Section 3.2.4.2.

Designated Arctic cod EFH encompasses all U.S. waters offshore of Alaska in the Beaufort and Chukchi seas. Construction and use of the West Dock modifications would occur within Arctic cod EFH. EFH for saffron cod has been designated in nearshore waters of the Chukchi Sea north to Point Barrow. There is no saffron cod EFH in the Beaufort Sea. Some vessels associated with the Project transporting equipment, supplies, and modules may transit through Chukchi Sea waters designated as EFH for saffron cod. Under the Arctic FMP, EFH designated for snow crab is restricted to waters south of Point Hope, some of which would also be traversed by Project vessels transiting to Prudhoe Bay.

3.2.5.2.2 Salmon FMP

The Salmon FMP discussed in Section 3.2.5.1 includes the Beaufort Sea. The general summer distribution of all five species of Pacific salmon extends across Prudhoe Bay into the Point Thomson portion of the Project area, with pink and chum salmon being documented in summer study programs within the area (NMFS, 2005; Williams and Burril, 2011).

Prudhoe Bay is located near the limit of salmon use in the Alaska Arctic. Chum and pink salmon are the only species of salmon with confirmed presence in the Sagavanirktok River, the primary tributary into Prudhoe Bay (Johnson and Litchfield, 2015a; Carothers et al., 2013). Both these species are likely to occur in the vicinity of the proposed dock modifications in Prudhoe Bay during their marine stages of life. Chinook salmon have been confirmed as present in Fish Creek (Johnson and Litchfield, 2015a), and are occasionally found in the Colville River (George et al., 2009), but there is no confirmed presence as far east as Prudhoe Bay. Other than anecdotal reports by local fisherman (George et al., 2009), there are no confirmed records of sockeye or coho salmon in Alaskan Beaufort Sea watersheds (Johnson and Litchfield, 2015a; Carothers et al., 2013). Chinook, sockeye, and coho salmon are therefore considered unlikely to occur within the vicinity of the proposed dock modifications in Prudhoe Bay.

The Salmon FMP has designated all waters offshore of Alaska to the seaward limits of the EEZ as EFH. This includes all of Cook Inlet where the Cook Inlet crossing of the Mainline would be installed. It also includes the Chuckhi and Beaufort seas as well as Prudhoe Bay where the West Dock modifications are proposed and where vessels transporting supplies would transit. The Mainline would cross 67 streams containing freshwater EFH and the PTTL would cross fourteen such streams.

3.2.6 Aquatic Nuisance and Nonindigenous Animals

Nonindigenous (or invasive) species can cause harm to ecological systems by upsetting natural balances and suppressing resident species. Invasive species can also upset commercial industries and subsistence and recreational fishing when they impact fisheries. To combat the spread of invasive species and limit their disturbance on Alaska's ecosystems, ADF&G has developed an *Aquatic Nuisance Species* (*ANS*) *Plan*, which focuses on nonindigenous species that have or could still be introduced into Alaskan waters. The plan was developed in 2002 to provide for interdivision and interagency coordination for the prevention and detection of the spread of invasive species (ADF&G, 2002). The approval of ADF&G's *ANS Plan* allowed for limited federal funding from the Aquatic Nuisance Species Task Force (ANSTF), which is an intergovernmental organization composed of 13 federal agency representatives and 12 ex-officio members, co-chaired by the U.S. Fish and Wildlife Service (USFWS) and NOAA.

3.2.6.1 Aquatic Nuisance Species (ANS)

ADF&G has identified several ANS of concern, identifying them as High Priority Threats. The designation as a Priority Species means that the ANS is considered a significant threat to Alaskan waters and requires immediate or continued management action to minimize the impact on existing ecosystems. A summary of ANS species that could potentially be present within the Project area is provided in Table 3.2.6-1.

In addition to the state program, the USGS established a database to track and record the presence of Nonindigenous Aquatic Species (NAS) throughout the U.S. to support the efforts of the federal ANSTF. The species listed in Table 3.2.6-2 are identified as present in Alaska, which may or may not include presence in the Project area. Some of these species occur naturally within portions of the Project area, but they may have been legally stocked or illegally introduced into portions of the Project area where they did not naturally occur. Of the nonindigenous aquatic species that have been documented as present within the Project area, American shad, northern pike, and Atlantic salmon have been illegally or accidentally introduced; rainbow trout and Arctic grayling have been legally stocked in Interior Alaska (ADF&G, 2015j) and the Kenai Peninsula (ADF&G, 2010) by ADF&G Department of Sport Fish (Table 3.2.6-2).

TABLE 3.2.6-1

Alaska ANS Plan High Priority Threat Species[a]

Type	Common Name	Scientific Name	USGS Documented Presence in Project Area[b]	Temperature Tolerance	
				Minimum Temperature	Reference
Amphibian	Pacific Chorus Frog	*Pseudacris regilla*	No	32 °F/0 °C (tadpole survival)	Brattstrom and Warren, 1955
Amphibian	Red-legged Frog	*Rana aurora*	No	39 °F/4 °C (embryonic survival)	Waye, 1999
Fish	Atlantic Salmon	*Salmo salar*	No	32 °F/0 °C	Elliott and Elliot, 2010
Fish	Brook Trout	*Salvelinus fontinalis*	No	32 °F/0 °C	Raleigh, 1982
Fish	Northern Pike	*Esox Lucius*	Yes	42 °F/5.8 °C (fry survival)	Inskip, 1982
Fish	Oscar	*Astronotus ocellatus*	No	53 °F/12 °C	Shafland and Pestrak, 1982
Crustacean	Chinese Mitten Crab	*Eriocheir sinensis*	No	39 °F/4 °C (adult) 53 °F/12 °C (larval)	Anger, 1991; Hanson and Sytsma, 2005
Crustacean	Green Crab	*Carcinus maenas*	No	32 °F/0 °C (adult) 50 °F/10 °C (larval)	WDFW, 2015b; Perry, 2015
Crustacean	Signal Crayfish	*Pacifastacus leniusculus*	No	32 °F/0 °C	Fofonoff et al., 2003; based on geographical distribution

TABLE 3.2.6-1

Alaska ANS Plan High Priority Threat Species[a]

Type	Common Name	Scientific Name	USGS Documented Presence in Project Area[b]	Temperature Tolerance	
				Minimum Temperature	Reference
Mollusk	New Zealand Mudsnail	*Potamopyrgus antipodarum*	No	35.5 °F/2 °C (adult)	Moffitt and James, 2012
Mollusk	Zebra Mussel	*Dreissema polymorpha*	No	37 °F/3 °C	Spidle et al., 1995
Mollusk	Quagga Mussel	*Dreissena rostriformis bugensis*		37 °F/3 °C	Spidle et al., 1995
Marine Invertebrate	Golden Star Tunicate	*Botryllus schlosseri*	No	30.2 °F/-1 °C	Ruiz et al., unpublished data; as cited by Fofonoff et al., 2003
Marine Invertebrate	Violet Tunicate	*Botrylloides violaceous*	No	30.9 °F/-0.6 °C	Zerebecki et al., 2011
Marine Invertebrate	Glove Leather Tunicate	*Didemnum vexillum*	No	28.4 °F/-2 °C	Bullard et al., 2007
Marine Invertebrate	Common Sea Squirt	*Ciona intestinalis*	No	37 °F/2.8 °C	Dybern, 1965
Marine Invertebrate	Pacific Transparent Sea Squirts	*Ciona savignyi*	No	29 °F/-1.7 °C	Zvyagintsev et al., 2007

Notes:

[a] Based on Appendix I of the ADF&G *ANS Plan* (ADF&G, 2002), updated with comment from Tammy Davis, ADF&G.

[b] Based on query of USGS NAS mapped occurrences: http://nas.er.usgs.gov/queries/SpSimpleSearch.aspx (USGS, 2013)

TABLE 3.2.6-2

USGS Identified Nonindigenous Aquatic Species in Alaska[a]

Type	Common Name	Scientific Name	Present in Project Area[b]
Amphibian	Northern Pacific Treefrog	*Pseudacris regilla*	No
Amphibian	Northern Red-legged Frog	*Rana aurora*	No
Amphibian	Rough-skinned Newt	*Taricha granulosa*	No
Crustacean	Signal crayfish	*Pacifastacus leniusculus*	No
Fish	Unidentified pacu	*Colossoma or Piaractus sp.*	No
Fish	Oscar	*Astronotus ocellatus*	No
Fish	American Shad	*Alosa sapidissima*	Yes (Cook Inlet)
Fish	Goldfish	*Carassius auratus*	No
Fish	Northern pike	*Esox Lucius*	Yes (Cook Inlet)
Fish	Western mosquitofish	*Gambusia affinis*	No
Fish	Rainbow trout	*Oncorhynchus mykiss*	Yes (Interior)
Fish	Atlantic salmon	*Salmo salar*	Yes (Cook Inlet)
Fish	Brook trout	*Salvelinus fontinalis*	No
Fish	Arctic grayling	*Thymallus arcticus*	Yes (Kenai Peninsula)
Fish	Alaska blackfish	*Dallia pectoralis*	Yes (Knik Arm)

Notes:

[a] Based on query of USGS website for Alaska: http://nas.er.usgs.gov/queries/SpeciesList.aspx?Group=&Sortby=1&state=AK

[b] Based on query of USGS NAS mapped occurrences: http://nas.er.usgs.gov/queries/SpSimpleSearch.aspx (USGS, 2013)

3.2.6.1.1 Chinese Mitten Crab

Chinese mitten crabs (*Eriocheir sinensis*) are medium-sized crabs (carapace up to 3 inches wide) that are identified by their hairy, mitten-like claws. They are native to Southeast Asia, ranging from southern China to the Korean Peninsula (Figure 3.2.6-1). Chinese mitten crabs were first reported in San Francisco Estuary in 1992, but rapidly spread and are now considered established in California (California Department of Fish and Wildlife [CDFW], 2015). Chinese mitten crabs are proficient burrowers and their vertical and horizontal tunnels can cause damage to dikes, levees, and stream banks. The damage can lead to increased erosion that causes the weakening and collapse of flood control and water supply systems. In addition to causing such structural damage, Chinese mitten crabs have also been known to steal bait from recreational anglers, damage commercial fishing nets, compete with native and commercially important species for food, and prey upon native species (including fish eggs). Chinese mitten crabs may transfer diseases and parasites; in Asia they are host for the human lung fluke (CDFW, 2015).

Chinese mitten crabs are catadromous, meaning they live in freshwater, but require saltwater to successfully reproduce (CDFW, 2015). The probable means of introduction to North America was by transport of larvae and small crabs in ship ballast water and within barnacle shells on vessel hulls. Once established, Chinese mitten crabs are capable of emerging from water and crossing dry land to enter new river systems. The northern extent of a potential mitten crab population is likely to be limited by low water temperature. Although adult crabs can survive under ice at 39 °F (4 °C), most otherwise suitable estuary systems in

Alaska have limited periods where temperatures are above the mortality threshold for the larval stages at greater than or equal to 53 °F (12 °C; Anger, 1991). Alaskan waters are therefore at a low risk for the establishment of reproducing populations (Hanson and Sytsma, 2005).

3.2.6.1.2 Green Crab

The globally invasive European green crab (*Carcinus maenas*) has a native range that extends along the Atlantic coasts of Europe and northern Africa from Iceland and Norway south to Mauritania (Washington Department of Fish and Wildlife [WDFW], 2015b). Introduced green crabs impact commercial fisheries by voraciously feeding on native crabs (e.g., Dungeness) and bivalves. Their ability to outcompete native species for food and structural resources, high reproductive capacity, and wide environmental tolerances allow them to fundamentally alter coastal ecosystems. Green crabs are most abundant in shallow subtidal and intertidal habitats.

AQUATIC NUISANCE RANGES

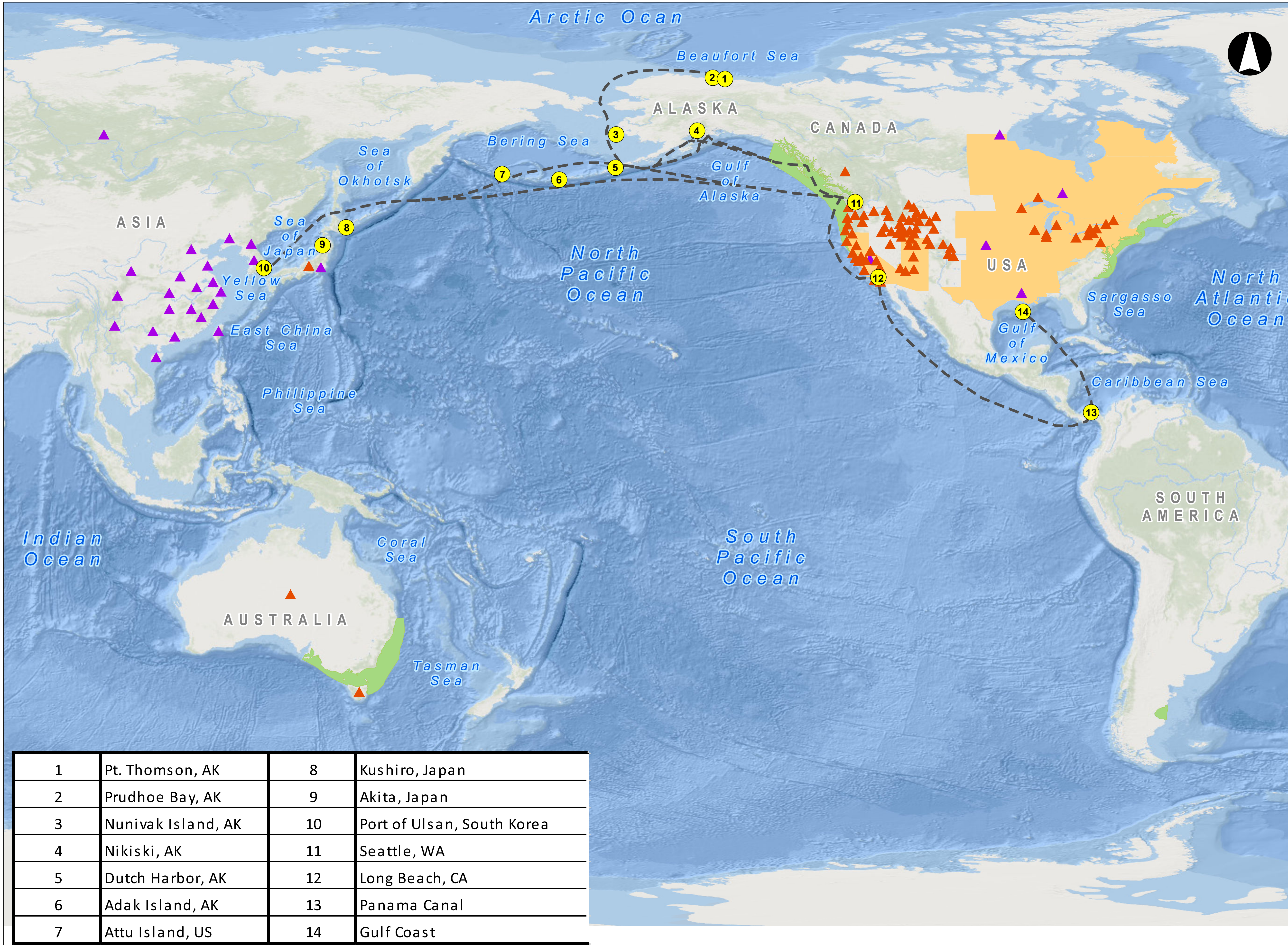
FIGURE 3.2.6-1

ALASKA LNG

LEGEND

- Potential Shipping Ports
- Chinese Mitten Crab
- New Zealand Mud Snail
- Potential Ocean Transport Routes
- Zebra and Quagga Mussels
- Green Crab

0 375 750 1,500 Miles



1	Pt. Thomson, AK	8	Kushiro, Japan
2	Prudhoe Bay, AK	9	Akita, Japan
3	Nunivak Island, AK	10	Port of Ulsan, South Korea
4	Nikiski, AK	11	Seattle, WA
5	Dutch Harbor, AK	12	Long Beach, CA
6	Adak Island, AK	13	Panama Canal
7	Attu Island, US	14	Gulf Coast

DISCLAIMER

PREPARED BY:	AGDC		
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DATE:	2017-03-03	SHEET:	1 of 1

VICINITY MAP

X:\AKLNG\Resource Reports\RR03\Figure 3_2_6-1 Aquatic Nuisance Ranges.mxd

The green crab was introduced to San Francisco in the 1980s and has spread quickly to Oregon and Washington; however, establishment of self-sustaining populations in Alaska may be restricted by environmental conditions for reproduction. Laboratory experiments indicate poor larval survivorship and development at temperatures below 50 °F (10 °C; Hines et al., 2004). Several sites within Alaska appear warm enough to support green crab populations, even if larval tolerances are more restrictive than those for adult crabs.

Green crabs are dispersed in ballast water, on ship hulls, within packing materials, on bivalves moved for aquaculture, via currents, and on vegetation (Perry, 2015). Given the possibility of ship-mediated transfer in ballast water, current data indicate that Alaska is at risk to invasion by green crabs. Port Valdez in Prince William Sound routinely receives tankers from infested West Coast ports, including Los Angeles, San Francisco Bay, and Puget Sound, and could be at particular risk (Hines et al., 2004). Water temperatures and ice conditions are colder and more extreme in Cook Inlet compared to Prince William Sound; therefore, Cook Inlet may be at a lower risk for invasion.

3.2.6.1.3 New Zealand Mudsnail

The New Zealand mudsnail (*Potamopyrgus antipodarum*) is a tiny aquatic snail (0.16 to 0.24 inches long). The mudsnail is native to rivers and lakes of New Zealand. Mudsnails are well established in Pacific coast states and are found on a wide variety of substrates and vegetation in fresh and brackish lakes, rivers, streams, and estuaries. Mudsnails have been documented in almost all western U.S. states, the Great Lakes, and, more recently, in British Columbia, Canada (Proctor et al., 2007; DFO, 2011). New Zealand mudsnails are ovoviparous and parthenogenic, and all introduced U.S. populations consist entirely of cloned females (Benson et al., 2015a). They are tolerant of turbidity, siltation, a wide range of water temperatures, and poor water quality. Adults can survive in water between 35.5 and 84.2 °F (2 and 29 °C) (Therriault et al., 2010). They can reproduce in salinities up to 15 parts per thousand (1.5 percent) and can survive short periods of time in salinities up to 35 parts per thousand (CDFW, 2015). Due to their small size and ability to cling to equipment, vegetation, and fur or feathers, mudsnails are easily transported by anglers, boaters, recreationists, and wildlife.

Once established, the mudsnail can typically be found at densities of 10,000 to 40,000 snails per square meter (Richards et al., 2004). New Zealand mudsnails frequently threaten ecosystems by outcompeting and overcrowding native mollusk species (Kerans et al., 2005; Riley et al., 2008). In addition, their voracious and indiscriminate feeding can lead to overgrazing of algae populations, thereby changing energy flows; increasing nitrogen availability through excretion; and disturbing food webs (Brown et al., 2008; Arango et al., 2009). New Zealand mudsnails have not been found in Alaska, but may be capable of surviving if introduced into estuarine or freshwater.

3.2.6.1.4 Zebra and Quagga Mussels

Zebra mussels (*Dreissena polymorpha*) and quagga mussels (*D. rostriformis bugensis*) are small freshwater bivalves native to Eurasia. They are highly adaptable to a wide range of environments, which they colonize rapidly. Dreissenid mussels were introduced to North America in the ballast water of a transatlantic vessel. Larvae (veligers) are planktonic and thus are easily transferred into and out of ballast water. Adults and juveniles are also capable of dispersing on solid ballast, vessel fouling, and can even be transported overland on vessels and cargo. Quagga mussels cannot tolerate salinities greater than 5 parts per thousand (0.5

percent) and zebra mussels in Europe have been found in estuaries with salinities up to 1 part per thousand (0.1 percent). Both species tolerate temperatures of approximately 37 to 86 °F (3 to 30 °C) (Spidle et al., 1995).

Dreissenid mussels can cause significant ecological and economic damage. They biofoul by heavily colonizing water supply pipes, break walls, buoys, beaches, harbor facilities, ship hulls, and any other available hard surface. Ecosystems may be altered as monocultures of mussels filter large volumes of water, consuming phytoplankton and disrupting food webs. A single female zebra mussel can release 30,000 to 40,000 fertilized eggs per year and zebra mussels have been found at densities of 700,000 per square meter in the Midwest (Benson et al., 2015b, 2015c). Although no zebra mussels or quagga mussels have been identified in Alaska, infested boats en route to Alaska have been intercepted at inspection stations outside of Alaska (Davis, 2015)

3.2.6.1.5 Golden Star Tunicates

Golden star tunicates (*Botryllus schlosseri*) have been identified in BioBlitz surveys from the Sitka area. Golden star tunicates have not yet been reported from Southcentral Alaskan waters. These tunicates are non-native, sessile, and benthic filter-feeders that consume plankton (ADF&G, 2015d). They are colonial, maturing after one to two months. Golden star tunicates reproduce sexually or asexually (e.g., budding) in the spring and early summer when temperatures are at least 51.8 °F (ADF&G, 2015d; Exotics Guide, 2015). They are capable of growing in large, mat-like colonies (up to 0.16 inches thick and 4 inches across) on hard or artificial substrates (ADF&G, 2015d; Exotics Guide, 2015). Hull fouling is the likely source for introducing and spread of the tunicate on the Pacific Coast (Exotics Guide, 2015). As an invasive species, they have few natural predators, and can outcompete and suffocate bivalves (ADF&G, 2015d). Their life expectancy is three to eight months (Exotics Guide, 2015). Golden star tunicates can be spread through shipping, oyster culture, and other aquaculture transfers (Fofonoff et al., 2003).

3.2.6.1.6 Violet Tunicates

Violet tunicates (*Botrylloides violaceous*) derive their name from their purple color; however, they may also be orange, yellow, red, or tan (Seagrant, 2015). These tunicates have become abundant in in Sitka and Ketchikan (Smithsonian and KBRR, Undated). They have also been recorded in Prince William Sound and Kachemak Bay (Lambert and Sanamyan, 2001; Ruiz et al., 2006). Native to Japan, they are colonial, forming flat sheets up to 1 foot in diameter or producing lobate forms (Seagrant, 2015). They are found in the intertidal zone to 164 feet, and are capable of growing on boat hulls, ropes, docks, gear, rocks, seaweeds and other organisms (Seagrant, 2015). They reproduce both sexually and asexually, and survive in temperatures from 46.4 to 77.0 °F (Seagrant, 2015). Individuals can survive temperatures as low as 31 °F (Zerebecki and Sorte, 2011). Violet tunicates can be spread through shipping, oyster culture, and other aquaculture transfers (Fofonoff et al. 2003).

3.2.6.1.7 Glove Leather Tunicates

Glove leather tunicates (*Didemnum vexillum*) are colonial and grow in low, undulating mats or long tendrils (ADF&G, 2015e). They vary in color from cream, pink, yellow or orange, and filter feed on detritus and plankton (ADF&G, 2015e; ADF&G, 2015f). Like other tunicates, glove leather tunicates are hermaphroditic and can reproduce sexually (e.g., broadcast spawning) or asexually (e.g., budding)

(ADF&G, 2015f). Under appropriate conditions, rapid growth is possible; therefore, it is necessary to de-foul gear often (ADF&G, 2015f). Food webs may be impacted since the mats are capable of smothering organisms, thereby preventing predators from finding their prey (ADF&G, 2015f). This species has been identified in Whiting Harbor, near Sitka, Alaska (Fofonoff et al., 2003). In 2010, glove leather tunicates were found in Whiting Harbor, Sitka, Alaska (Cohen et al., 2011). The species has not yet been reported from Southcentral Alaskan waters. Glove leather tunicates are probably moved between locations in ballast water as colony fragments, on fouled hulls of vessels, or possibly with infested mariculture gear or infrastructure (ADF&G, 2015f).

3.2.6.1.8 Common Sea Squirts

Common sea squirts (*Ciona intestinalis*) are solitary tunicates that are vase-shaped and clear to whitish in color (WDFW, 2015a). Their siphons have bright yellow margins and red spots on the rims (WDFW, 2015a). They feed on plankton, larvae, and suspended organic material (WDFW, 2015a). They are hermaphroditic, and reproduce sexually via broadcast spawning (WDFW, 2015a). However, because eggs and sperm mature at different times, they do not self-fertilize (WDFW, 2015a). Adults can be up to 6 inches long (WDFW, 2015a). They are found attached to manmade structures, as well as in tidal waters to over 1,000 feet (WDFW, 2015a). They aggressively compete with native species for resources (WDFW, 2015a). Common sea squirts are tolerant of near-freezing water temperatures (37 °F, as reported by Dybern, 1965) and are found at high northern latitudes in the Atlantic, having become established in Iceland and Norway. In the Pacific, this species has been reported as far north as British Columbia, Canada, but is not yet present in Alaskan waters (Fofonoff et al., 2003). Common sea squirts are most likely transmitted by fouling of ships.

3.2.6.1.9 Pacific Transparent Sea Squirts

Pacific transparent sea squirts (*Ciona savignyi*) share several characteristics with the common sea squirts. They are solitary tunicates that are tube-shaped and clear to whitish in color (WDFW, 2015a). Their siphons are rimmed with yellowish to orange flecks, and they are usually found at depths of 40–75 feet (WDFW, 2015a). They feed on plankton, larvae, and suspended organic material (WDFW, 2015a). They are hermaphroditic, and reproduce sexually via broadcast spawning (WDFW, 2015a). However, because eggs and sperm mature at different times, they do not self-fertilize (WDFW, 2015a). Adults can be up to 6 inches long (WDFW, 2015a). They attach to manmade structures and compete with native species for resources (WDFW, 2015a). Although native to the Arctic Atlantic, this sea squirt has been introduced along the Pacific Coast from Puget Sound, Washington, to southern California (Fofonoff et al., 2003). Pacific transparent sea squirts were recorded in Behm Canal in southeastern Alaska in 1903; however, no other specimens have since been collected and the record may represent a cryptic species, a very early introduction, or a relict population (Fofonoff et al. 2003). Pacific transparent sea squirts are most likely transmitted by fouling of ships.

3.2.6.1.10 American Shad

On average, American Shad are 1.64 feet in length and weigh up to 12 pounds (Fishbase, 2015). They can be found in Cook Inlet, spending most of their life at sea and returning to freshwater streams to spawn (Fishbase, 2015). Their peak run water temperature is 65.3 °F (Fishbase, 2015). Spawning can occur in water temperatures 46.4–78.8 °F, but typically occurs from 53.6–69.8 °F (Fishbase, 2015). Newly hatched larvae spend their summer in rivers, but move to the sea in the fall, where they mature (Fishbase, 2015). They occupy continental shelf and brackish waters in spring, summer, and fall when they are not spawning (Fishbase, 2015). They feed on plankton and small fish (Fishbase, 2015). Their life expectancy is up to 13 years (Fishbase, 2015).

3.2.6.1.11 Northern Pike

Northern pike (*Esox lucius*) are native to Interior Alaska waters, but have been illegally introduced into waters of Southcentral Alaska where they are damaging to salmon stocks. Northern pike vary in color from light to dark green (ADF&G, 2015b). Their bodies are elongated, and their flat snout resembles a duck bill (ADF&G, 2015b). Northern pike overwinter in large rivers that are deep and slow-moving (ADF&G, 2015b). They are sexually mature at 4 to 6 years of age, and spawning occurs in the spring when the ice melts (ADF&G, 2015b). Females deposit eggs in the grassy margins of shores, sloughs, or slow-moving streams, where they incubate for 30 days (ADF&G, 2015b). Summer feeding areas are warm and shallow (ADF&G, 2015b). Young pike feed on small crustaceans, insects, and fish, while adults consume fish, small mammals, and waterfowl (ADF&G, 2015b). Their life expectancy is 20 or more years (ADF&G, 2015b).

3.2.6.1.12 Atlantic Salmon

The preferred temperature range of Atlantic Salmon is 39.2–53.6 °F; therefore, they can be found in rivers where temperatures are above 50 °F for three months of the year, but not more than 68 °F for more than a few weeks during the summer (Fishbase, 2015). They typically spend their first two to three years in freshwater rivers before migrating to the ocean for another two to three years (NMFS, 2015d). They are sexually mature at 3 to 7 years (Fishbase, 2015). Atlantic salmon return to their natal rivers to spawn beginning in the spring, peaking in the summer, and continuing through the fall (NMFS, 2015d). Spawning occurs at 42.8 to 50 °F in gravel river areas with moderate to fast-flowing waters at depths of 1.64 to 9.84 feet (Fishbase, 2015). Eggs hatch in March or April; fry emerge six weeks later and begin feeding on plankton and small invertebrates (NMFS, 2015d). Their nursery habitat is shallow water with adequate cover and moderate to fast flow (NMFS, 2015d). Juveniles consume aquatic insects, mollusks, crustaceans, and fish; adults consume squid, shrimp, and fish (Fishbase, 2015). Their life expectancy is 4 to 6 years (Fishbase, 2015).

Salmon farming began in the Pacific Northwest in the 1970s. At the same time, Alaska considered allowing the farming of finfish; however, by 1990, it concluded that the dangers were too great to the wild system upon which Alaska depends. The farming of finfish in Alaska was banned in 1990 to protect wild stocks from the danger of disease and pollution as well as the possibility of escaped farmed fish displacing or breeding with wild fish. Alaska statutes currently prohibit any species of finfish farming in the waters of the state. Atlantic salmon often escape fish-farming net pens off the coasts of British Columbia and Washington State. When this happens, Atlantic salmon may join schools of Pacific salmon as they move into Alaska waters. Alaska's native salmon and trout could be negatively affected if escaped Atlantic salmon begin spawning in Alaskan waters (ADF&G, 2016).

3.2.6.2 Liquefaction Facility

The most notable ANS near the proposed Liquefaction Facility on the northern Kenai Peninsula is northern pike, which was illegally introduced into Derks Lake, a tributary to Soldotna Creek in the 1970s, and has spread through Soldotna Creek drainage, including East and West Mackey Lakes; Soldotna Creek; and Soldotna (Sevena) Lake and Stormy Lake in the Swanson River drainage (Begich and Pawluk, 2011). Northern pike also use the Kenai River as a migration corridor (Begich and Pawluk, 2011). Northern pike are thought to be a leading cause of the decline of rainbow trout and Dolly Varden in Soldotna Lake (Begich and Pawluk, 2011). ADF&G has used methods such as sport fishing, spear fisheries, gillnet removal, and rotenone poisoning, to remove northern pike from specific waters on the northern Kenai Peninsula (Begich and Pawluk, 2011).

Yellow perch were illegally introduced into a 14-acre lake on the northern Kenai Peninsula more than 3 miles northeast of the proposed Liquefaction Facility off Bastien Drive. This introduction resulted in an established population of yellow perch in the lake that was eradicated with rotenone in 2000 (ADF&G, 2014c).

3.2.6.3 Interdependent Project Facilities

The most notable ANS in the Project area is northern pike, which was introduced into the Susitna River drainage in the 1950s, and has spread into 70 drainages and more than 100 lakes within the Susitna basin (Rutz, 1999; Sepulveda et al., 2013). Introduced northern pike are thought to be a leading cause in the decline of salmonid species in the lower Susitna drainage and have drastically reduced the number of returning Chinook salmon adults and distribution of spawning in Alexander Creek. Pike were introduced to Alexander Lake in the late 1960s, although no harvest record of pike prior to 1985 exists (Mills, 1986). Today, pike are widespread throughout the system. Pike are hypothesized to be primary drivers of declines in multiple fish species beginning in the late 1990s including Chinook, coho, chum, and sockeye salmon, Dolly Varden, rainbow trout, and Arctic grayling (Southcentral Alaska Northern Pike Control Committee, N.D.; Rutz, 1999).

3.2.7 Potential Construction Impacts and Mitigation Measures

Construction of the Project would include activities within and proximate to freshwater resident and anadromous fish habitat (Appendix H, Table 1 and 2; Appendix A) and temporary impacts to small amounts of benthic habitat in Cook Inlet and Prudhoe Bay. The primary construction-related activities that could affect fish and fish habitat, including EFH and EFH species, include the construction of Marine Terminal and MOF facilities, pipeline waterbody crossings, associated ice road workpads, and associated equipment stream crossings; development of material sources; and water withdrawals for various components of construction, pipeline hydrostatic testing, and handling of pipeline ditch spoils. Fish habitats during winter seasons are considered absent because fish do no utilize these areas during these times. Numerous plans have been developed that identify mitigation measures that would be implemented to address the potential effects described in the following sections.

Table 3.2.7-2 outlines potential construction impacts to fish and associated mitigation measures. The Applicant would meet with ADF&G staff before permitting begins and regularly throughout the process to include the appropriate mitigation measures into the plan for the construction and operational phases of the

Project. Relevant plans, procedures, and mitigation measures are addressed by section and include, but are not limited to those listed in Table 3.2.7-1.

TABLE 3.2.7-1

Mitigation Plans and Procedures

Title	Resource Report	Appendix
Project's *Winter Construction Plan*	Resource Report No. 1	Appendix M
Site-Specific Construction Drawings: Site-specific Waterbody Crossing Plans	Resource Report No. 2	Appendix I
Stormwater Pollution Prevention Plan (SWPPP)	Resource Report No. 2	Appendix J
HDD Inadvertent Release Contingency Plan (Project-Specific HDD Contingency Plan)	Resource Report No. 2	Appendix L
Spill Prevention, Control, and Countermeasures (SPCC) Plan	Resource Report No. 2	Appendix M
Project's *Wetland and Waterbody Construction and Mitigation Procedures*	Resource Report No. 2	Appendix N
Water Use Plan	Resource Report No. 2	Appendix K
Noxious and Invasive Plant and Animal Control Plan	Resource Report No. 3	Appendix K
Draft *Project Restoration Plan*	Resource Report No. 3	Appendix P
Project *Blasting Plan*	Resource Report No. 6	Appendix B
Project's *Erosion Control, Revegetation, and Maintenance Plan*	Resource Report No. 7	Appendix A
Fire Prevention and Suppression Plan	Resource Report No. 8	Appendix G
Project Waste Management Plan	Resource Report No. 8	Appendix J
Unanticipated Contamination Discovery Plan	Resource Report No. 8	Appendix I
Fugitive Dust Control Plan	Resource Report No. 9	Appendix J

Temporary impacts to fisheries and fish habitat from Project construction could include:

- Surface water use (e.g., vessel traffic);
- Water withdrawals (e.g., hydrostatic testing, ballast water management, cooling water);
- Discharges (e.g., run-off, hydrostatic testing);
- Releases of sediment and turbidity (e.g., dredging, construction);
- Scouring;
- Habitat loss, including shoreline and in-stream cover loss and loss or sedimentation of critical spawning habitat;
- Interruption of fish spawning migrations;

- Spills of fuels, lubricants, or solvents; and
- Material source development.

Some components of construction could lead to direct fish mortality, including coldwater resident, anadromous, and EFH species. Excessive pressures from blasting in or near waterbodies could have lethal effects on fish; some blasting for right-of-way (ROW) preparation and material source (material site) development would be required. Water withdrawal during construction of ice roads and for pipeline and tank hydrostatic testing could lead to fish mortality through either direct impingement, entrainment, or entrapment of fish at water intake points or through dewatering of fish bearing habitats. Development of shallow scrape material sites within floodplains could also lead to the entrapment of fish after high water events that trap fish as water levels recede, isolating and potentially drying out the site. Pipeline construction methods that dewater some reaches of streams harboring fish at the time of construction could also lead to mortality. Numerous construction mitigation plans for each of these components have been developed and would reduce the potential for direct mortality of fish.

The potential for construction-related mortality would be short-term, not extending beyond the active period of construction at any given fish-bearing site for most potential causes. Shallow scrape granular material sites in active floodplains could have more persistent potential to cause mortality if not addressed with appropriate mitigation (see Table 3.2.7-2). The significance of any mortality events would be dependent on the location and level of fish use at the time of the occurrence. For example, during winter on Alaska's North Slope, and some drainages north of the Yukon River, large proportions of a stream's fish population may be concentrated in relatively few riverine pools or reaches, making any mortality event potentially significant to that population. As described in Table 3.2.7-2, the length of in-stream work would be reduced and construction windows would be timed to occur outside of sensitive time periods to the maximum extent practicable. Thus, any mortality of fish that might occur during construction of the Project would be expected to be minor, and not to result in any significant or long-term population effects.

Various activities associated with construction of the Project could impede the free and efficient passage of fish. Any condition that increases water velocity, decreases water depth, decreases flow or causes flow to go subsurface, or blocks a watercourse could impede fish passage. The potential effects on fish passage range from minor to major depending on the location, timing, and duration of the blockage. Blockages of fish passage in habitats used only for rearing of juveniles would have the lowest potential effect on fish and habitat. Many of the streams crossed by the Project have only "presence" or "rearing" identified as their use, suggesting temporary blockages to fish passage would be of minor impact and would only persist during the period of blockage, typically less than a few days. However, during spawning migrations, blockages could have a much greater effect, depending on the duration of blockage. Blockages of short periods to EFH species moving to spawning areas would likely have minor impacts to EFH species because spawning runs for most EFH species in the Project area are fairly prolonged. However, some spring-spawning resident fish are more dependent on short windows when conditions are optimal for spawning. Failure to reach preferred spawning habitats when water temperature conditions become optimal can lead to spawning in locations with poorer quality habitat and reduced fry production. Arctic grayling, a common species in the Project area, spawn in a fairly narrow temperature window each spring so that blockages of even a few days right after break-up can affect spawning success and result in low or failed age classes. This type of effect could indirectly affect the population for several years after the event. Similarly, blockages that occur during migrations to overwintering habitat that prevent fish from gaining access to viable wintering habitat could affect fish survival. Blockages to fish movements into wintering areas could have minor to moderate affects; however, most streams crossed by the Mainline are small and likely provide rearing habitat for small portions of the drainage's fish, including EFH species. As described in Table 3.2.7-2, construction windows would also be timed to occur outside of sensitive time periods to the maximum extent practicable. Effects would most likely be short-term and minor, with no measurable effects on any fish populations. Blockages of large drainages could have longer-term, more-intense effects on fish, including EFH species, however, such blockages are not anticipated.

Best management practices (BMPs), Project component plans, mitigation measures, and state and federal permit conditions would significantly reduce the potential for adverse effects to fish from blockages to passage. Resource-specific information for each drainage crossed would be incorporated into determining the best timing windows to conduct various work in streams and would identify needed mitigation measures for work to be conducted during unavoidable windows.

TABLE 3.2.7-2

Potential Construction Impacts and Proposed Mitigation Measures for Fish

Activity	**Potential Impact**	**Mitigation**[a]
CONSTRUCTION OF FACILITIES, ROADS, AND PIPELINES		
General Construction	Disruption of habitat that may lead to direct and indirect mortality and a decrease in mobility.	• Follow construction techniques as outlined in t No. 2 and Applicant's *Plan* and *Procedures*; • Keep construction activities within the proposed limits of disturbance (LODs); • Construction activities will comply with all ADEC water quality regulations; • Use temporary bridges for transportation of construction equipment and materials; • Follow measures identified in the Plans identified in Section 3.2.7; and • Identify stream crossing locations with the use of ROW signage.
Waterbody Crossings	Disruption of habitat, fish mobility, and downstream sediment transport	• Use site-specific crossing methods to reduce length of in-stream work (open-cut, dam and pump, or flumed crossing); • Construction windows as agreed with ADF&G would be timed to occur outside sensitive time periods, especially near identified important fish habitats (e.g., spawning and wintering) or sensitive waterbodies to the extent practicable; • Construct crossings as "tie-in" locations and use "tie-in" crews to take advantage of optimal crossing widows; • Design ice roads and bridges per ADF&G requirements and in accordance with NMFS guidelines; • Backfill streams with native material; • Follow Applicant's *Plan and Procedures*; • Construct pipeline crossing during low-flow or frozen times of the year; and • Keep temporary bridges clear of excessive mud and debris.
Grubbing/Grading	Vegetation removal can lead to thermal impacts to the underlying soil making it potentially more susceptible to erosion and ultimately increasing the likelihood of sediment runoff into waterbodies.	• Follow Applicant's *Plan* and *Procedures*; • Reduce the removal of riparian vegetation to the extent practicable; • Institute a "no-grubbing" zone within 50 feet of each stream crossing, until crews and materials are onsite and ready to be installed to manage erosion/sedimentation; and • Restore disturbed banks upon completion of each crossing or as soon as practical to avoid bank erosion and sediment transport into waterbodies.

TABLE 3.2.7-2

Potential Construction Impacts and Proposed Mitigation Measures for Fish

Activity	Potential Impact	Mitigation[a]
Floodplain Material Source Development	Stream channel changes, altered productivity, fish entrapment, barriers to fish passage	• Follow Applicant's *Procedures*; and • Follow guidelines for floodplain material site placement and design in McLean (1993) and Joyce et al. (1980a, b).
Blasting	Sedimentation, noise, vibrations, and alteration in stream morphology	• Follow *Blasting Plan* guidelines; • Avoid blasting during sensitive times of the year (spawning, wintering, etc.) to the extent practicable (e.g., exposed gravels within the active floodplain should be targeted first); and • Follow ADF&G recommended measures where blasting is allowed. A Fish Habitat Permit from ADF&G would be required for any blasting operations that occur either in or near the banks of a fish-bearing waterbody.
Access Roads (Temporary)	Habitat disruption, barrier to fish passage, change in stream morphology, increased dust deposition, and thermal impacts	• Use existing roads, two-tracts, cart-ways, and the construction ROW travel lanes to the extent possible; • Limit vegetation removal to tree trimming instead of removal; • Install proper-sized flumes and equipment bridges; and • Follow dust suppression measures outlined in Project's *Fugitive Dust Control Plan*.
Contamination	Degradation in water quality	• In some instances parking and refueling would be required within wetlands. In accordance with the Applicant's *Procedures*, appropriate steps would be taken by the Project representatives and contractors (including secondary containment structures) to prevent spills and provide for prompt cleanup in the event of a spill.; • Identify "no fueling" areas with ROW signage; • Reduce spills by following procedures outlined in the *SPCC Plan*; and • Follow Project *Unanticipated Contaminant Discovery Plan*.
Water Withdrawal, Discharge, and Dewatering Activities	Impingement and entrainment of small fish, larvae, and eggs; degradation in water quality and stream morphology.	• Follow Project *Water Use* plan; • Use appropriately sized fish screens for water withdrawals and adhere to state and federal guidelines for fish protection; and • Follow Applicant's *Procedures*.

[a] These measures would be used where practical

3.2.7.1 Liquefaction Facility

3.2.7.1.1 Foundation Construction

3.2.7.1.1.1 Inland Resident Fisheries

There are no major freshwater waterbodies or streams on the Liquefaction Facility site known to support sport or commercial fisheries; therefore, no impacts to inland resident fisheries are expected from foundation construction at the LNG Plant.

3.2.7.1.2 Anadromous Fisheries

There are no major freshwater waterbodies or streams on the Liquefaction Facility site. There are no expected impacts to anadromous fisheries from foundation construction of the LNG Plant.

3.2.7.1.3 Marine Fisheries and EFH

The LNG Plant would be located in an upland area (at an elevation between 100 and 140 feet above sea level) on the eastern shore of Cook Inlet. No impacts to marine fisheries and EFH would be expected from foundation construction.

Potential effects related to construction of the Marine Terminal are discussed in the following subsections.

3.2.7.1.4 Dredging/Dredge Disposal

3.2.7.1.5 Marine Fisheries and EFH

3.2.7.1.5.1 Dredging

Direct impacts from construction excavation in Cook Inlet areas would include loss of about 82 acres of seafloor substrate including dredging, construction of the material offloading facility (temporary MOF), the product loading facility (PLF), and shoreline protection. The dredging would take place within EFH for Pacific salmon. Dredging would result in a temporary loss of marine invertebrates within the dredged area; dredging would also result in a temporary increase in turbidity and sound levels and mobile species are anticipated to temporarily avoid the area. Increased turbidity in the water column could result in physical impairment of aquatic species, causing potential turbidity-induced clogged gills (i.e., suffocation, or abrasion of sensitive epithelial tissue) and alteration of foraging behavior for visual predators. The effects would be limited to the period during and immediately following dredging. Turbidity levels are anticipated to rapidly return to background following active dredging. In addition, turbidity and sedimentation rates are naturally high in the Upper Cook Inlet due to the abundance of glacial sediments and strong currents. Upper Cook Inlet experiences some of the most extreme tides in the world, demonstrated by a mean tidal range from 4 meters at the Gulf of Alaska end to 8.8 meters near Anchorage (USACE, 2013). Tidal current data obtained from the NOAA Center for Operational Oceanographic Products and Services (CO-OPS) database, which has 48 current station locations within Cook Inlet, shows that near the Marine Terminal depth-averaged maximum current ranges from 3 to 4.1 knots, with 10 percent probability of exceeding 3 knots and a 2 percent probability of exceeding 4.1 knots. Site-specific current measurement performed in 2015–2016 and subsequent Extreme Value Analysis (EVA) shows that Depth-Averaged Current speed can reach 6.85 feet per second (4.1 knot) for a one-year return period and 7.38 feet per second (4.4 knot) for a 100-year return period.

Suspended sediment concentrations in Upper Cook Inlet range from 100 to 2,000 parts per million. The incremental increase in turbidity from dredging would be reduced by the use of hydraulic (suction) dredging for the majority of the sediments. Hydraulic dredging methods mobilize sediment directly from the seafloor into suction tubes/pipelines, reducing the exposure of sediments to the entire water column. The additional, temporary mobilization of sediment because of dredging is not anticipated to have a significant impact to any fish or marine invertebrate and zooplankton populations in the area.

There is also the potential that dredge spoils could release contaminants into the water column. Although toxicity tests have not been performed on benthic organisms located within the vicinity of the dredge area but sediments were tested for contaminant levels. Results of the testing are discussed in Resource Report No. 2, Section 2.3.2.1.1.3 and Appendix Q of Resource Report No. 2 (Analytical Results of Sediment Sampling Near the Marine Terminal in Cook Inlet). Examination of sediment samples collected in other Cook Inlet sites in the general area indicates that dredged sediments are not anticipated to contain significant levels of contaminants. Suspended and bottom sediments from Cook Inlet offshore of the proposed Marine Terminal site have been sampled and analyzed. The sediments were generally found to contain metals concentrations at or near regional background concentrations. All samples were well below screening level guidelines established for the Seattle Dredged Material Management Program (USACE, 2014), which is used by the U.S. Environmental Protection Agency (EPA) and USACE to evaluate dredged material in Alaska in lieu of an Alaska-specific program. The Guidance Manual for the Seattle Dredged Material Management Program (USACE, 2014) is attached in Appendix R, and outlines sediment testing, dredging protocol; and disposal site management and monitoring requirements. Most samples were also below the Alaska Department of Environmental Conservation's (ADEC's) recommended sediment quality guidelines consisting of marine threshold levels developed by MacDonald et al. (2000) and NOAA Screening Quick Reference Table values. Several metals (nickel, copper, chromium, arsenic) exceeded threshold levels but were below permissible exposure limits and within the range of background concentrations. Threshold effects levels are concentrations at which toxic effects can be rarely expected, while permissible exposure limits are concentrations where toxic effects can be expected. Total petroleum hydrocarbons concentrations were low in the samples indicating no evidence of contamination with petroleum. Additional details are provided in Appendix Q of Resource Report No. 2. Site-specific sediment sampling and analysis results, and the potential impacts based on these results, will be submitted to FERC when available. Any proposed dredging activity would be in compliance with USACE requirements for sediment testing and disposal. Disposal sites would be properly managed (e.g., disposal site marking buoys, inspectors, the use of sediment capping and dredge sequencing) and monitored (e.g., chemical and toxicity testing, benthic recovery) to reduce potential impacts associated with dredged material disposal.

There is the possibility of direct impacts to fish, including EFH species, due to exposure to elevated sound levels as a result of the dredging activity. However, any impacts would be anticipated to be behavioral and short-term because most species are transiting through this region. Dredging (excavation) and dredged material disposal activities would generate sounds of a relatively low frequency range (20 to 1,000 hertz [Hz]) that diminishes with increased distance from the point source, resulting in the sound pressure level (SPL) in decibels root mean square (dB_{rms}) decreased from 15 to 30 dB re 1 microPascal (μPa) at 150-meter and 5,500-meter distances, respectively (Dickerson et al., 2001). An underwater sound characterization study conducted by the U.S. Army Engineering Research and Development Center (ERDC) and the Dredging Operations and Environmental Research (DOER) Program established baseline data for mechanical dredging activities in Cook Inlet (see discussion in Appendix D).

Cook Inlet is known for its extreme environmental conditions, especially the large tidal fluctuations, sound from relatively high current flow, and sedimentation displacement. These conditions create a relatively high ambient sound level. A recent study (May 2011) in Knik Arm showed that ambient sound levels ranged from 105 to 148 dB re 1 μPa, with a mean of 124 dB re 1 μPa. Thirty-eight percent of ambient sound measurements were above 125 dB re 1 μPa (Knik Arm Bridge and Toll Authority [KABATA], 2011). There is no indication that sound, both natural and from dredging at the Port of Anchorage is affecting salmon migration. Salmon regularly return to Ship Creek, which terminates adjacent to the Port of Anchorage, and to other area streams.

Ambient sound conditions in and around the temporary MOF are likely not as "loud" as those at Knik Arm and that they would be closer to the ambient levels reported in Dickerson et al. (2001). However, the apparent lack of significant effect of sound on salmon at the Port of Anchorage - which is consistent with the literature - indicates there would be a similar lack of effect from dredging activities from the temporary MOF area.

Finally, sounds higher than ambient sound levels generated by the proposed dredging activities would be focused in a small location—when compared to the entire ecosystem. The sound values presented by the KABATA and Dickerson et al. (2001) reports are within the range of hearing for salmonids (Popper and Hastings, 2009). However, migrating fish (juveniles and adults) within the majority of the construction areas are able to freely avoid the activities and would avoid harmful exposure.

Habitat displacement of marine vertebrates, mobile invertebrates, zooplankton, and ichthyoplankton due to the physical actions of dredging and the associated increased turbidity and noise would be minor, short-term, and localized. The proposed action would occur prior to juvenile salmon outmigration into Cook Inlet and in-migration of spawning adult eulachon and salmon, but possibly around the onset of capelin movements into the area for spawning. Most mobile organisms would be able to move to adjacent habitat during the short time during which material would be excavated. In addition, the proposed dredged area for the MOF is a small percentage of the total EFH in Cook Inlet. The EFH for Pacific Salmon in Cook Inlet encompasses all similarly situated shallow shoreline areas along both sides of the Inlet. The relatively small area impacted by dredging for the MOF is indistinguishable from the surrounding Cook Inlet offshore shallow shoreline areas. Other than the EFH, no designated sensitive or limiting designated habitat protection areas would be impacted. The direct impacts associated with the dredging activity are discussed in Section 3.2.7.1.2.1. All such impacts are estimated to be behavioral and short-term.

Houghton et al. (2005a) and other sources indicate that returning adult salmon tend to occupy shallow water. Welch et al. (2013) reported that returning Chinook adults were at a median depth of 16 feet, while returning sockeye adults had a median depth of 6 feet. Dredging would occur along the margins of this depth contour, however, adult salmon would not be concentrated in the Project area during the proposed timeframe for the excavation and disposal. Dredging activities along the shoreline could potentially displace capelin if any move into the area to spawn in shallow habitats in late April. The MOF location at Nikiski would force migrating fish into deeper water possibly increasing their risk for predation.

The impact of dredging, seafloor substrate removal, and removal of associated benthic invertebrates as a result of material excavation is often dependent on the location, size, and duration of the removal. Due to scouring, mixing, and sediment transport from the strong currents in Cook Inlet that combine to severely restrict survival, the marine invertebrate, zooplankton, and ichthyoplankton populations are reportedly low in abundance and diversity (Houghton et al., 2005a; USACE, 1996). Of the 50 stations sampled by Saupe et al. (2005) for marine invertebrates in Southcentral Alaska, the Upper Cook Inlet station had by far the lowest abundance and diversity. Finally, the fish community of Upper Cook Inlet is characterized largely by migratory fish—eulachon, capelin, and Pacific salmon—returning to spawning rivers, or outmigrating salmon smolts. Most of these fish are not focused on feeding, but instead on spawning; therefore, the temporary disruption of prey resources would not have lasting impacts on the fish species. The effects of removal and burial of any marine benthic invertebrates, within the Project area would be minor and short-term.

3.2.7.1.5.2 Dredge Material Disposal

Dredged material placement would result in increased turbidity, area avoidance by mobile fauna, and covering of benthic fauna. Turbidity would temporarily increase, but the suspended particles would be rapidly flushed out with the extensive tides. The physical presence of scow barges and other vessels in addition to the sound associated with in-water dredged material placement would likely temporarily displace species from the immediate area. Following placement, the placement area would reach stasis and organisms would begin to recolonize. The timing of this is unknown, but due to the small size of the area relative to the entire Inlet, there would be no anticipated lasting impacts to the fauna or habitat, overall. There would no opportunity for the transport of invasive aquatic organisms because the material would be excavated and disposed of within Cook Inlet. The proposed dredge material disposal sites, including deep-water locations, are identified on Figure 1.5.2-1 in Resource Report No. 1. Section 10.6.4.2.1.3 – In-Water and/or Nearshore Placement. Dredge material disposal, site management, sediment testing, and monitoring would follow USACE Seattle District Dredged Material Evaluation and Disposal Procedures – User Manual, Chapter 13 – Dredging and Disposal. The User Manual is provided as Appendix R of this Resource Report.

If offshore disposal is not selected as the method for dredge material placement, dredged material could be placed in a scow barge and transported to a shoreline dredged material placement area. Material would be removed from the scow barge using a backhoe excavator that would place the material on the beach location. It is expected that some water runoff would occur, but based on the dynamics of Cook Inlet tides, these conditions would change constantly. Depending on timing, dredged material placement and stabilization could interfere with capelin spawning and egg survival since they spawn within the gravel/sand of the surf zone area. However, any such effects would be minor given that the placement area would represent a tiny fraction of available capelin spawning habitat in Cook Inlet, and would be short-term. Effects of dredge material disposal are also discussed in Appendix D Draft Essential Fish Habitat (EFH) and Assessment Report. (Appendix D)

3.2.7.2 Pile Driving

3.2.7.2.1 Marine Fisheries and EFH

The primary sources of underwater sound from Project construction that would potentially affect fish, ichthyoplankton, zooplankton, and marine invertebrates, include:

- Impact sheet pile driving associated with the temporary MOF construction;
- Impact pile driving associated with the Marine Terminal and temporary MOF construction; and
- Pile driving associated with Marine Terminal construction.

Pile-driving techniques have been shown to cause serious injury to nearby fish (Popper and Hastings, 2009; Halvorsen et al., 2012) in the zone of ensonification (area varies depending on hammer type and weight, water depth, and substrate). Pile-driving effects on ichthyoplankton, zooplankton, and marine invertebrates would be minor due to the low abundance in Upper Cook Inlet (USACE, 1996).

The duration of pile-driving may be considerable and is a function of the desired depth and resistance to penetration, which are determined by substrate characteristics and the diameter of the pile (Rodkin and Pommerenck, 2014). Placement of a 24-inch-diameter temporary pile is estimated to require 15 minutes of vibratory hammer and one hour of impact hammer. Vibratory removal of 24-inch-diameter piles is estimated to require one hour (Rodkin and Pommerenck, 2014).

Direct impacts would include potential mortality/injury to migrating juvenile and adult fish within the zones of ensonification from sounds exceeding 187-206 dB re 1µPa^2 -s SEL for areas where the activity is conducted in ice-free waters. Sound levels approaching 150 dB re 1µPa^2 –s are expected to affect fish behavior. Fish, including EFH species, that could be exposed to unnatural sounds are mobile and some would likely avoid the ensonified area. Impacts from pile placement (impact and vibratory hammers) would be intermittent, minor, and short-term, and are not expected to cause serious or long-term impacts to the EFH or fish with the region. Direct and indirect impacts to migrating salmon and forage fish can be mitigated through BMPs, which include the use of sound attenuating measures such as soft starting the impact hammer (low energy initial strikes), sound attenuation measures, timing activities to avoid migration windows (May to October) when practical, using the smallest size hammer practicable, driving the pile as deep as possible with a vibratory hammer before using the impact hammer, and/or avoiding impact pile driving at low tide during these same migration windows.

3.2.7.2.2 Access Roads

3.2.7.2.2.1 Marine Fisheries and EFH

There would be potential indirect impacts to the local fish fauna in the region from increased turbidity due to runoff as a result of road construction. Runoff would be controlled by silt fences, vegetative buffers, and other control measures as specified by the Project's *SWPPP* (Appendix J of Resource Report No. 2) and the Applicant's *Plan* (Appendix A of Resource Report No. 7). Any effects to fish and fish habitat, including EFH and EFH species, would be intermittent and minor. Any such habitat effects would be short-term due to the dynamic nature of Cook Inlet.

3.2.7.2.3 Vessel Activity

3.2.7.2.3.1 Marine Fisheries and EFH

Sound generated by heavy lift vessels (HLVs) could have negative direct impacts on fish, including EFH species. There would also be indirect impacts to the local fish fauna in the region due to physical presence of construction vessels—scow barges, dredging barges, and support vessels. Because of the sound energy levels generated by vessels and because fish are mobile organisms, only behavioral effects would be expected to occur.

Fish have been shown to react when engine and propeller sounds exceed a certain level (Olsen et al. 1983, Ona 1988, Ona and Godo 1990). Avoidance reactions have been observed in fish such as cod and herring when vessel sound levels were 110–130 dB (Nakken, 1992; Olsen, 1979; Ona and Godo, 1990; Ona and Toresen, 1988); however, others have found that fish may be attracted to stationary vessels (silent, engines running, and in dynamic-positioning) and vessels underway (Rostad et al., 2006). Vessel sound source levels in the audible range for fish are typically 150–170 dB re 1 µPa/Hz (Richardson et al.) In calm weather, ambient sound levels in audible parts of the spectrum lie between 60–100 dB re 1 μPa. Any avoidance reactions would last only minutes longer than the vessel is at a location, and would be limited to a relatively small area (Mitson and Knudsen, 2003; Ona et al. 2007).

Any of these effects from vessel traffic would be minor and short-term. There would be no long-term effects from the sound of vessels on fish and fish habitat, including EFH and EFH species. Vessel sounds would be intermittent and localized. During periods where vessel sounds are emitted, fish may avoid the area during migration to and from anadromous rivers and streams and may suffer greater mortality due to potential predation. However, this is not expected to cause a dramatic impact on fish, including EFH species, since the area is mostly a transition zone to other river locations and similar to the sounds currently taking place in Cook Inlet.

3.2.7.2.3.2 Aquatic Nuisance Species and Nonindigenous Animals

Vessels calling at the temporary MOF during construction could act as vectors for transmission of marine aquatic invasive and nuisance organisms. This includes cutter suction and trail hopper dredges that are typically used for major port developments and operate on a global basis, spending two to six months at each site before moving slowly to their next worksite and have been noted to be a transport mechanism for the introduction of species (e.g., Clapin and Evans, 1995).

Ballast water and hull fouling are the two most-significant vectors for non-native tunicate introduction (USFWS, 2014c). The Pacific transparent sea squirt, golden star tunicate, violet tunicate, and glove leather tunicate have each been reported from southern Alaskan waters and could spread to Cook Inlet via vessel traffic originating from infected Alaskan waters or via vessels originating from non-Alaskan ports with established tunicate invasions. Some invasive tunicates can successfully reproduce at temperatures above approximately 45 °F (7.2 °C).

Invasive crabs, including the green crab and Chinese mitten crab, are also transported in ballast water and through hull fouling. The construction vessels visiting the Liquefaction Facility and other Alaska ports will, due to their commercial nature, generally have clean hulls. Biofouling and aquatic nuisance organisms can also accumulate in niche areas such as seachests, bow thrusters, rudders, and shafts (Coutts et al., 2003). While adult crabs may be tolerant of water temperatures as low as 32 °F (0 °C), larvae of both species require temperatures above 52 °F (11 °C) (Anger, 1991; Harney, 2007). Average water temperatures in Cook Inlet range from 27 °F to 41 °F (-2.7 °C to 5 °C) in the spring and 49 °F to 33 °F (9.4 °C to 0.5 °C) in the fall (NOAA, 2017). Ambient water temperatures in Cook Inlet are at the lower end of the threshold for invasive crabs.

According to the Aquatic Nuisance Species Management Plan foreign coastal planktonic organisms can be transported in ballast water from commercial ships from other countries. The spiny water flea (*Bythotrephes longimanus*), tiny cladoceran or aquatic crustacean is another invasive marine zooplankton originally from Europe and found in California and the Great Lakes that displaces existing zooplankton communities but is unpalatable to fish. The end result of its invasion is much lower production of fish for harvest. Another method of transport besides ballast water is through sport fishing gear that has not been disinfected.

Invasive aquatic organisms on or in semi-submersible vessels, barges, and tugs would be controlled by ballast water regulations that require a ship-specific Ballast Water Management Plan, a ballast water record book, ballast water exchange, an approved ballast water treatment system, and an International Ballast Water Management Certificate. All vessel operations would comply with U.S. Coast Guard (USCG) regulations.

The Project-specific *Noxious and Invasive Plant and Animal Control Plan* (Appendix K) would also be followed for the prevention of the spread of aquatic nuisance organisms. Before any construction activities, equipment brought in from outside of Alaska would be thoroughly decontaminated upon entering Alaska; any equipment stored in Alaska would also be decontaminated. With the implementation of these procedures, it is anticipated that the spread of noxious and invasive species should be adequately prevented and controlled.

3.2.7.2.4 Hydrostatic Testing

The source of the hydrostatic test-water for the LNG tanks would be salt water withdrawn from Cook Inlet. The intake within Cook Inlet would be screened and the intake rate reduced to the extent practicable to reduce the potential for entrainment and impingement of marine life. On completion of hydrotesting the tanks, the test water would be treated and discharged to Cook Inlet in compliance with applicable permits. No additives to hydrostatic test water are contemplated at this time. Marine invertebrates, zooplankton, and ichthyoplankton communities are reportedly low in abundance in the MOF near Nikiski (see discussion in Section 3.2.4.1.6). Any effects on fisheries and aquatic species from hydrotesting the LNG tanks would be minor and short-term..

Direct impacts of the seawater intake would include entrainment of fish, invertebrate eggs, and larvae passing through the intake screen. There would be no long-term effects from seawater intake on fish and fish habitat, including EFH and EFH species, due to this activity. While these impacts may be minor, given the timing of the testing, the actual impacts would be temporary and isolated both spatially and temporally. While there is the potential for entrainment of larval/juvenile fish during uptake, the volume overall is miniscule when compared to the entire region. The potential for entrainment would be mitigated through the use of screens to decrease the amount of organisms captured.

Discharge of the hydrostatic waters could create thermal refugia for larval, juvenile, and adult fish. These thermal refuges could concentrate prey resources and have more dramatic impacts on the fauna of the region. BMPs typically used in these situations include to ensure discharge water temperatures match the ambient temperatures of the outflow area. Impact to fish and fish habitat, including EFH and EFH species, would be localized, short-term, and minor.

3.2.7.2.5 Water Use

3.2.7.2.5.1 Marine Fisheries and EFH

Potential impacts associated with water use are related to hydrostatic testing, see Section 3.2.7.1.6.

3.2.7.2.6 Spills

Minor releases of hydrocarbons (e.g., diesel fuel, lubricants) could result in short-term, minor, direct adverse impacts on marine invertebrates, zooplankton, ichthyoplankton, and juvenile and adult fish, including death or chronic effects. The impacts of hydrocarbons are caused by either the physical nature of the oil (physical contamination and smothering) or by its chemical components (toxic effects and bioaccumulation). It is anticipated that the immediate response reaction of fish would be avoidance.

Incidental spills are spills that can be safely controlled at the time of release by shipboard personnel, do not have the potential to become an emergency within a short time, and are of limited quantity, exposure, and potential toxicity. Incidental spills also include normal vessel operational discharges such as release of ballast or bilge water that might contain oils or oily detergents from deck washdown operations. They also include accidental releases of small volumes of hydraulic fluids, motor fuels, and oils, and other fluids used in normal ship operation, usually as a result of overfilling tanks. Incidental spills can also occur during vessel and transportation tank fueling at docks.

Minor releases of hydrocarbons could result in short-term, indirect, adverse impacts on fish, marine invertebrates, zooplankton, ichthyoplankton, and fish habitat from releases and potential spills that might affect their eggs and food sources. The impacts would depend on the depth of the oil spill and the type of oil that is spilled. It is likely that oil spills at the surface would tend not to sink below depths of 35 feet (MMS, 2002a, b). When oil sinks to depths around 35 feet, it is at concentrations several orders of magnitude lower than those demonstrated to have an effect on marine organisms (MMS, 2002b).

A comprehensive *Spill Prevention, Control and Countermeasures (SPCC)* Plan (Appendix J of Resource Report No. 2) has been developed and will be implemented to reduce the impacts of potential spills. Proposed measures to reduce the risk of hazardous material spills and reduce impacts should a spill occur include, but are not limited to:

- Visual inspections of tanks, vehicles, equipment, and automatic leak shut-offs would be conducted daily;
- Secondary containment would be used for all single-walled containers, portable (e.g., skid-mounted) fuel tanks, aboveground tanks, and containers in excess of 55 gallons. Secondary containment capacity would generally be 110 percent of the volume of the container;
- Impermeable, plastic lining materials would be used for any temporary storage of contaminated materials;
- Personnel would be trained on the components of the *SPCC Plan*;
- Sorbent, boom, and cleanup materials would be available on all construction sites. All fueling vehicles would carry spill response materials;
- Cook Inlet-specific Project *SPCC Plan* practices specified for that location would be followed for all facilities at the Liquefaction Facility; and

- If a spill occurs in an upland area, all construction activity in the area would cease until the spill is stopped and contained. Small spills would be cleaned up with absorbent materials to reduce penetrations into soils, and large spills would be immediately pumped into tank trucks. Contaminated cleanup materials, excavated soil, and water would be disposed of at a licensed hazardous waste disposal facility, if required.

With implementation of measures in the *SPCC Plan* to reduce the potential for oil spills, the impacts would be anticipated to be minor and short-term.

3.2.7.2.7 Waste

All waste generated from construction would be handled in accordance with the *Waste Management Plan* (Appendix J of Resource Report No. 8). This plan addresses hazardous and nonhazardous waste materials and volumes, handling, and disposal in detail. Potential impacts to fish and fish habitat will be avoided or reduced through waste management and spill response planning. All waste, including contaminated absorbent materials, would be stored and disposed of by the Contractor in compliance with state and federal regulations. There are no licensed hazardous waste treatment or disposal facilities in Alaska. All hazardous waste and contaminated soils may be stored in a secure location at the Contractor yard until shipment to a licensed facility. To prevent and mitigate against inadvertent contamination from waste, all waste storage areas would be located in upland areas and would be properly contained until disposal. With the design features and *SPCC Plan*, construction of the Liquefaction Facility is not anticipated to spread existing contamination or cause contamination to waterbodies, affecting fish and fish habitat, including EFH and EFH species.

3.2.7.2.8 Contamination

The actions proposed with dredging, dredged material placement, foundation placement, backfill, and pile placement would all have the potential to disturb the benthic substrate and release any chemicals and metals that may be present in the sediments. As discussed in Section 3.2.7.1.2, based on sediment samples from other Cook Inlet sites, dredged sediments are not anticipated to contain significant levels of contaminants. Site-specific sediment sampling and analysis results, and the potential impacts based on these results, will be submitted to FERC when available. Proposed dredging would be in compliance with USACE requirements for sediment testing and disposal. Disposal sites would be properly managed as required to reduce potential impacts associated with dredged material disposal.

If unanticipated contamination is discovered during construction of the Liquefaction Facility, the Project's *Unanticipated Contamination Discovery Plan* (Appendix I of Resource Report No. 8) would be followed to protect waterbodies and associated fishery resources.

3.2.7.3 Interdependent Project Facilities

To reduce potential effects on fishery and other aquatic resources, construction activities would comply with all ADEC water quality regulations during construction. In addition, a Fish Habitat Permit from the ADF&G would be required for most Project activities. The ADF&G would evaluate specific activities on a case-by-case basis prior to the construction phase. It is expected that ADEC water quality regulations, ADF&G permit requirements, and the implementation of appropriate mitigation measures would reduce impacts to fish and fish habitat, including EFH and EFH species. In addition to the mitigation measures identified below, site-specific mitigation measures and BMPs would be further developed throughout design and permitting phases of the Project.

3.2.7.3.1 Pipelines

3.2.7.3.1.1 Mainline

Stream crossings were categorized into three FERC waterbody classes based on wetted width at the time of construction: minor, streams less than 10 feet wide; intermediate, streams 10 to 100 feet wide; and major, streams greater than 100 feet wide. Based on these criteria (including the PTTL), approximately 507 minor (many of which are ephemeral drainages or seasonal high water channels), 92 intermediate, and 12 major waterbody crossings would be constructed (Appendix H in Resource Report No. 2). One of the crossings confirmed to be a fish bearing stream would be frozen to the ground during construction. One hundred sixty-three waterbody crossings that have been actively sampled or inspected for presence of fish habitat were either found to be lacking viable habitat or fish sampling captured no fish. Two hundred forty-eight waterbodies that would be crossed by the Mainline have no fish data, however, 220 of these are at minor streams; Mainline construction would occur during winter at 105 of these crossings. One hundred twenty-five of those crossings would occur during winter when the streams would be frozen to the bed; 59 would be constructed during summer. The numbers of fish bearing stream crossings by method and season are indicated in Table 3.2.7-3. Of these fish bearing streams, 79 are expected to be frozen to the bed at the time of construction.

In-stream pipeline construction across waterbodies could have both direct and indirect effects on aquatic species and their habitats, including increased sedimentation and turbidity, alteration or removal of aquatic habitat cover, stream bank erosion, impingement or entrainment of fish and other biota associated with the use of water pumps, downstream scouring, and the potential for spills. Construction of pipeline stream crossings would use one of several modes dependent on the conditions at the site and fish use during construction. Open-cut and frozen open-cut crossings would be constructed at 96 fish bearing waters anticipated to be dry, lack surface flow, or not require dry-ditch construction during the season of construction. Of those, 36 would occur in anadromous waterbodies, including 30 in streams with EFH. Streams crossed by this method that also have flow would be limited to a 24-hour in-water work window for minor streams and a 48-hour in-water work window for intermediate streams; none are proposed for major stream crossings.

Mainline construction of waterbody crossings either when frozen or dry would be constructed similar to all upland pipeline installation in the respective spread and would include trench excavation, pipeline installation, and then trench stabilization. Construction impacts to fish and fish habitat are not anticipated from this mode of construction, as fish will not be present. Fish habitat could be impacted through sedimentation, stream bank erosion, and changes in water temperature from the lack of riparian vegetation. Movement of stream bottom sediment during spring break-up and flood events would be expected to ameliorate most stream bed habitat effects. This method of construction could be employed at all classes of waterbody provided the crossing is dry.

TABLE 3.2.7-3

Summary of Coldwater Resident, Anadromous, and EFH Species Waterbody Crossings for the Mainline by Construction Season and Method

Class[a]	Proposed Crossing Method[b]	Fish Presence[c]	Construction Season[d]		Totals
			Summer	Winter	
Minor	Aerial	Resident		17	17
		Anadromous		10	10
	Frozen Cut	Anadromous EFH		10	10
		Anadromous	1		1
		Resident		10	10
	Isolation Cut (Dry Ditch)	Anadromous		1	1
		Anadromous EFH	4	8	12
		Resident	9	10	19
	Open Cut	Anadromous	4	1	5
		Anadromous EFH	14	2	16
		Resident	31	11	42
Intermediate	Isolation Cut (Dry Ditch)	Anadromous			
		Anadromous EFH	5	7	12
		Resident	11	5	16
	Open Cut	Resident	1	7	8
		Anadromous EFH	3	1	4
Major	Aerial	Anadromous EFH		1	1
	Open Cut	Anadromous EFH	1	4	5
	Trench-less	Anadromous EFH	5		5
Grand Total			**89**	**105**	**194**

Notes:

[a] Based on the FERC's Wetland and Waterbody Construction and Mitigation Procedures (2013) definitions for waterbodies, includes any natural or artificial stream, river, or drainage with perceptible flow at the time of crossing, and other permanent waterbodies such as ponds and lakes. Minor Waterbody is less than or equal to 10 feet wide at the water's edge at the time of crossing; Intermediate Waterbody is greater than 10 feet wide but less than or equal to 100 feet wide; and Major Waterbody is greater than 100 feet wide at the water's edge at the time of crossing.

[b] Proposed crossing method is based on Revision B route for Mainline and PTTL. Aerial crossings are above ground with no impact to waterbodies.

[c] Fish presence is based on Project Summer Field Studies, ADF&G Anadromous Waters Catalog (AWC 2015) and Alaska Freshwater Fish Inventory (AFFI 2015). Anadromous EFH as defined by 50 C.F.R. Part 600 and Alaska Statue 41.14.870(a).

[d] Waterbodies with perceptible flow at the time of crossing. Waterbodies that are dry or frozen to the bed will be crossed using standard upland construction techniques in accordance with the Applicant's *Plan*.

Dry-ditch (isolation-cut) methods would be employed in both winter and summer and would be applied to flowing waterbodies, unless appropriate state and federal agencies determine that dry-ditch installation would not be needed based on the fish resources at the crossing location. Dry-ditch (isolation-cut) construction would occur at 60 known fish-bearing streams anticipated to have flow during their respective construction season; 25 would occur in anadromous streams, 24 of which have EFH species; and 35 would be constructed in streams bearing coldwater resident species. Fewer than half of the dry-ditch (isolation-cut) method crossings in anadromous streams would be constructed during winter, while the majority of crossings of coldwater resident streams would occur during summer (3.2.5-1 and 3.2.7-2).

Dry-ditch (isolation-cut) methods include dam and pump or flume crossing methods to move water around the construction site. Dam and pump methods would only be used in cases where sensitive fish species passage during the construction window has not been specified or indicated though resource agency guidance. In addition to the dry-ditch methods, in braided systems with multiple nearby channels, or in dynamic systems characterized by frequent and common channel shifts, diversions could be constructed to move flow to a historic channel, or newly created channel within the braidplain. In all cases there would be potential for short-term impacts to fish in the immediate vicinity of the construction area. Fish passage could be impeded or inhibited during this timeframe which, if during critical migration periods, could lead to delayed or eliminated access to spawning habitats. Crossing locations in or upstream from spawning areas could dewater spawning gravels and kill eggs or larval fish depending on the timing of installation. These crossing methods could also result in increased release of sediments and increased turbidity and sedimentation in the immediate Project area, potentially resulting in decreased stream productivity during construction within the influence of the release. However, various mitigation measures, referenced earlier in this document, would reduce the potential for significant adverse effects. The primary potential for impacts during installation of pipeline crossings using this method would be associated with spawning migrations and spawning habitat impacts. Timing of installations has already sought to avoid sensitive periods of the year to avoid these impacts as possible. However, identification of anadromous fish spawning habitat is not comprehensive in Alaska or along the alignment and additional spawning areas, not currently identified, are likely to be present at some streams.

Winter crossings of sensitive overwintering areas on the North Slope could have minor to moderate effects on fish wintering at the crossing location and, depending on the density of fish, could have long-term effects if mortality were to occur. The winter dry-ditch (isolation-cut) construction of the PTTL across the east channel of the Sagavanirktok River crosses a sensitive overwintering area and a likely spawning area for anadromous broad whitefish. In addition, pink salmon spawning is documented within the reach. It is anticipated that planning and permitting for this site would identify the needed mitigation measures to reduce the potential for significant adverse effects on EFH species and other species dependent on this location for spawning and overwintering. Similarly, dry-ditch (isolation-cut) methods proposed to install the Chatanika River crossing upstream from Minto Flats could impact overwintering northern pike that winter downstream from the crossing, however, this reach of the Chatanika River is a migratory corridor for EFH and other anadromous species and spawning has not been documented near the crossing. Generally, if significant proportions of a population are in a wintering area that is affected during construction, numerous age classes of fish could be affected and killed. No EFH is designated for any such crossings, with the exception of the East (Main) Channel of the Sagavanirktok River. Cataloging of fish overwintering areas along the alignment generally has not occurred. Most streams crossed would not have viable fish overwintering areas, but some would. Documentation of adequate under-ice water volume of high enough quality to overwinter fish would be needed to fully assess impacts and would provide information to ensure adequate mitigation methods are employed.

Some stream crossings would be constructed aerially, where the pipeline would be suspended over the waterbody. For purposes of this analysis, aerial modes include vertical support member (VSM)-supported pipeline crossings typical to the North Slope, as well as single-span, multi-span, and cable suspension bridges with and without in-stream supports. Ninety-seven crossings would be constructed in the aerial mode, almost all of which would be constructed on the North Slope, and most associated with the PTTL. Two aerial crossings would be constructed along the Mainline (Appendix H, Resource Report No. 2). Aerial crossing methods would have minimal potential for impact to fish or fish habitat. VSM or aerial bridge support installation within a waterbody could have short-term effects on fish species depending on the timing of installation. North Slope installations would occur during winter with limited to no fish presence and no EFH species present. Pile installation would tend to avoid most waterbodies. Pile driving associated with larger aerial crossings of water bodies could disturb fish and could produce SPLs high enough to lead to mortality in the absence of mitigation. No such installations are proposed in EFH or anadromous streams. Eleven aerial crossings of anadromous streams would occur along the PTTL, and all streams would be dry during winter construction with the exception of the crossing of the West Channel of the Sagavanirktok River, which will be constructed on existing/modified support structures (no in-water work is proposed).

Five river crossings (Middle Fork Koyukuk, Yukon, Tanana, Chulitna, and Deshka rivers) would be constructed using buried trenchless methods where the pipeline would be installed beneath the rivers. Most potential impacts to fish are avoided using this method because there is no open cut across the stream bed or banks. There would be some potential for loss of drilling muds into the rivers during installation, which would result in short-term increases in turbidity near the site of loss and possibly some increased sedimentation of proximate stream bed habitat. Depending on the magnitude of mud loss and whether or not drilling muds escape the river beds into the water column, there could be some potential for sedimentation of substrates for some distance downstream from the release site. While unlikely, some loss of productivity and spawning habitat could occur within the clear water systems crossed with this method. Measures would be implemented that are outlined in the Project-specific *HDD Inadvertent Release Contingency Plan* (Appendix M) to reduce the risk of trenchless crossing complications and the potential for inadvertent releases of drilling fluid. It is anticipated that any impacts to fish and fish habitat, including EFH and EFH species, from trenchless construction would be localized and minor. If buried, trenchless crossings prove infeasible, alternative methods of crossing construction, such as the aerial or trenched methods, would be employed.

Construction Schedule

The timing of stream crossing construction activities in freshwater habitats has been developed based on coordination with ADF&G regarding known periods of fish use for spawning and overwintering, the most sensitive periods for most fish species. Because most potential impacts to fish and fish habitats associated with the Project are short-term in duration and construction-related, scheduling construction timing for non-sensitive, low-use periods of the year has been accommodated as possible. Most stream crossing construction would occur during winter when fish use is less dispersed and when most seasonal use habitats are absent of fish. One hundred-forty-one of the 258 known fish bearing crossings would occur during winter when fish are least likely to be present. Conversely, sites with known overwintering could be more sensitive during this time frame and such locations would be mitigated on a site-specific basis. Determination of fish overwintering has been assumed for crossings that occur in documented anadromous fish spawning areas, however, identification of under-ice flow prior to construction would provide the needed information to make overwintering habitat suitability determinations at individual crossings. Most crossings, however, would not occur in fish overwintering habitats.

Material Source Development

Mainline and associated facilities construction would require an estimated 20 million cubic yards of material for access roads, camp pads, storage yards, facilities pads, and the ROW granular pad. As much material as possible would be sourced from existing material sites, hilltop and ROW cuts, with approximately 9.5 million cubic yards coming from the ROW. A total of almost 300 sites within 35 miles of the Mainline have been identified as potential sources for supplying needed material for the Project. Numerous floodplain material sites would either be developed or continue to be developed to provide the additional material needed. Potential sites proximate to anadromous fish bearing waters, including some with potential EFH, are identified and discussed in Appendix D. Current review of all potential material sources suggests that up to 6 sites may be within or near drainages that could affect anadromous fish; although, given final site selection and mining plans, it is anticipated that far fewer would be within anadromous or EFH species habitats. Species codes for proximate anadromous fish bearing waters are provided, however, this analysis is preliminary and likely is an overestimate of sites that could affect fish.

Construction of material sources within floodplains could have a variety of effects on fish. Material extraction sites studied in Arctic and Subarctic floodplains in Alaska have shown a variety of adverse and beneficial effects on fish and fish habitat (Joyce et al., 1980a; Ott et al., 2014). The effects of extraction from floodplains on fish and fish habitat is dependent on many factors, including the type and size of the river, the type of material extraction employed, and the amount of material extracted. Material site development can lead to destabilization of river channels, river channel capture, floodplain widening, increased erosion and sedimentation, increased water velocities, reduced water quality, and aquatic habitat shifts; in some instances, it has been documented to cause surface flows into the gravel, creating a barrier to fish passage (Joyce et al., 1980a). Fish habitat changes then lead to changes in fish distributions in terms of fish species and age class distributions within the altered habitats. Material sites that alter the hydrologic regime of a stream can have long-term deleterious effects on fish and their habitats (Joyce et al., 1980a). The study determined that active channel mining should be avoided as possible, particularly when important spawning or wintering habitats were nearby. Fish entrapment potential was also documented at some sites where extraction sites left depressions in floodplains that were later flooded at high water and then became isolated as water levels dropped.

However, the study identified configurations where specific mining methods of specific floodplain features (limitations of gravel removed specific to stream type and size) and location of removal sites could produce habitat enhancements and reduce the potential for stream altering processes to be initiated. Some benefits to local fish populations, including the creation of wintering habitats and productive feeding habitats, have been identified. Ott et al. (2014) summarizes fish use of several granular material sites, most constructed as pits that were subsequently connected to nearby drainages, on Alaska's North Slope. While some sites took many years to be used by appreciable numbers of fish, most were used for overwintering. Extraction sites in that study provided a habitat that is in limited quantities in the Arctic. Several of the sites studied had been rehabilitated primarily to provide for fish overwintering, but also had productive shallow water habitats incorporated in their design to foster both productivity and enhanced overwintering habitat. A companion document was prepared along with the aforementioned study that provides detailed guidelines for the removal of granular materials from Arctic and Subarctic river systems (Joyce et al., 1980b). In addition, McClean (1993) conducted a similar review of material source development and, building from Joyce et al. (1980b), produced decision matrices and guidelines for Alaska's North Slope. The guidelines are applicable throughout Alaska.

Project-related material site development could potentially have long-term adverse effects on fish, but these are unlikely given mitigation measures that would be in place. The use of upland material sites could also potentially affect fish and fish habitats primarily by mobilization of sediments at the material site into proximate used habitats. BMPs typically employed by projects include: using settling ponds and sediment curtains to control sediment transport and limit the spread of suspended sediments; monitoring of turbidity of in-water activities during critical fish life history stages to determine if turbidity is exceeding predetermined threshold levels; minimizing the aerial extent of ground disturbance; and monitoring of the site post-reclamation to implement corrective measures if necessary. To reduce the potential for adverse effects, the BMPs detailed in the Project's *Gravel Sourcing Plan and Reclamation Measures* (Appendix F of Resource Report No. 6) would be followed. Mining plans for removal of material from eskers within floodplains will include drainage mitigation measures to ensure hydrologic regime and water quality is not impaired. In addition, the construction *SWPPP* (Appendix J of Resource Report No. 2) would be used to manage surface water during pit operation, and the *SPCC Plan* (Appendix M of Resource Report No. 2) would address potential spills and leaks from equipment. All extraction of granular materials from below the ordinary high water level of any fish bearing rivers would be coordinated with the ADF&G and would comply with ADF&G permit conditions.

Once final selection of the primary material sites is made, testing for contaminants as well as quality and quantity of material in the site would be done as required. Site selection, site-specific mining plan design, and reclamation would reduce the potential for adverse impacts and could enhance fish habitats in some drainages. With the *SWPPP* and *SPCC Plan* mitigation measures in place, as well as adherence to permit requirements, any affects to fish and fish habitat, including EFH and EFH species, would be anticipated to be minor and short-term.

Clearing, Grading, Trenching, and Blasting

Clearing, grading, and trenching near streams could affect fish and fish habitat during construction primarily through the introduction of sediment and increased turbidity. Increased turbidity and sediment input to streams can reduce fish productivity directly by inhibiting fish feeding, displacing fish and aquatic organisms that are food resources for fish. High sediment input rates could also lead to changes in stream channels and substrate composition. Streams confined by ice rich banks and floodplains would be most likely to experience higher levels of sediment input and increased turbidity during construction but most fish-bearing streams in ice-rich soils would be crossed during winter, substantially limiting the potential for increased sediment during periods of fish use. Mitigation measures would be employed to reduce the potential for sediment introduction into watercourses, including implementation of the Applicant's *Plan*, *Procedures*, and *SWPPP*. The mitigation measures include limiting clearing and grading activities near riparian areas and providing buffers form watercourses. As practicable, riparian vegetation would be cut off at ground level to leave the existing root systems in place to provide streambank stability, and the pulling of tree stumps and rooting for grading activities would be limited to the area directly over the trench line.

Trench dewatering at stream crossing locations either in, or upstream of, spawning areas could dewater spawning gravels and kill eggs or larval fish depending on the timing of installation. Dewatering could also result in an increased release of sediments, increased turbidity, and increased sedimentation in the immediate Project area, potentially resulting in decreased stream productivity during construction within the influence of the release. Typically, the pumped water would be discharged into a dewatering structure or directed into stable, vegetated areas. Impacts during construction dewatering would be managed according to the *SWPPP* and *SPCC Plan*, and in compliance with Alaska Pollutant Discharge Elimination System (APDES) permit stipulations. All dewatering activities would be done under the supervision of the Project's Environmental Inspectors. It is anticipated that any impacts from dewatering during construction would be localized, short-term, and minor.

Specific sections of the Mainline have been identified that may require the use of explosives for ditch construction (Table 3.4.10-16). Material site development may also employ explosives. Blasting could occur proximate to fish-bearing waters along the Project Mainline and could occur in and near EFH. Use of explosives proximate to occupied fish habitat can produce in-water overpressures and in-gravel particle velocities that could injure or kill fish and kill fish eggs in spawning gravels. In 2013, Kolden and Aimone-Martin conducted a literature review of research conducted on the effects of various overpressures and particle velocities on fish and fish eggs. They found that the slowest LD10 particle velocity occurred with Chinook salmon eggs at 5.8 inches per second, with other salmon species showing considerably faster particle velocities required to achieve an LD10: coho, 9.1 inches per second; chum, 16.4 inches per second; pink, 24.5 inches per second; and sockeye, 33.0 inches per second. Their review also found that the lowest SPL identified using modern measuring equipment shown to injure fish was 10 pounds per square inch. The report ultimately recommended that blast-related overpressures and peak particle velocities in fish-bearing water should be set at some point below those thresholds known to injure fish and kill eggs. In 2013, ADF&G adopted revised blasting standards to be applied to projects where the impacts of blasting on fish and embryos in fish-bearing water bodies cannot be avoided or mitigated. The revised standards limit the in-water instantaneous pressure rise in the water column on rearing habitat and migration corridors to no more than 7.3 pounds per square inch where and when fish are present. Specified peak particle velocities in spawning gravels are limited to no more than 2 inches per second during the early stages of embryo incubation, before epiboly completion (Timothy, 2013).

Sound-related behavioral effects can also be caused by explosives use near fish-bearing waterbodies; however, explosives are not likely to be used at any one location for long enough to have persistent effects on fish behavior. A Fish Habitat Permit from the ADF&G would be required for any blasting that would occur either in or near the banks of a fish-bearing waterbody. To reduce or avoid impacts, the BMPs listed in the Project's *Blasting Plan* (Appendix B of Resource Report No. 6) would be followed, all in-stream blasting permit requirements would be followed, and blasting in sensitive streams during critical periods would be avoided. Any potential impacts to fish and fish habitat from blasting are anticipated to be localized, short-term, and minor.

Offshore Trenching and Pipelay

Upper Cook Inlet experiences some of the most extreme tides in the world. All tidal cycles create significant turbulence and vertical mixing of the water column in the Inlet (USACE, 2013), and are reversing, meaning that they are marked by a period of slack tide followed an acceleration in the opposite direction (Mulherin et al., 2001). The majority of the Mainline would be laid on the bottom of Cook Inlet and would not be trenched in. The incremental, temporary, and localized increase in turbidity from pipelay and shoreline trenching is not anticipated to have a significant impact to any fish or invertebrate population in the area; any such effects would be minor and short-term.

Of the 50 stations sampled by Saupe et al. (2005) for marine invertebrates in Southcentral Alaska, the Upper Cook Inlet station had, by far, the lowest abundance and diversity. The effects of removal and burial of any marine benthic invertebrates during offshore trenching would be anticipated to be minor and short-term, resulting in minimal effects to fish and fish habitat, including EFH and EFH species. The fish community of Upper Cook Inlet is characterized largely by migratory fish—eulachon, capelin, and Pacific salmon—returning to spawning rivers or outmigrating salmon smolts. Most of these fish are therefore not feeding or spawning but are simply migrating through the area.

Sound from bow thruster operation during Mainline pipelay across Cook Inlet could potentially affect fish. When activated, in-hull bow thrusters produce large bursts of cavitation sound. The level of sound is a function of the effect that both blade design and inflow have on hydrodynamic performance. Estimated SPLs with distance are 2.31 miles to the 120 dB isopleth, 16 feet to the 180 dB isopleth, and 6.6 feet to the 190 dB isopleth. Direct impacts would include potential mortality/injury to migrating juvenile and adult fish within the zones of ensonification from sounds exceeding 187–206 dB re 1μPa^2 -s sound exposure level (SEL). Sound levels approaching 150 dB re 1μPa^2 –s are expected to affect fish behavior. Fish exposed to unnatural sounds are expected to avoid the area of active pipelay. Impacts related to bow thrusters operation would be localized and short-term and are not expected to cause any significant long-term impacts to fish or fish habitat, including EFH and EFH species.

Hydrostatic Testing

Hydrostatic testing of the Mainline would account for about 287 million gallons of the Project's anticipated construction water demand over the seven-year construction time frame (see Section 3.2.7.2.1.5 for more details). Approximately 10 million gallons of Cook Inlet seawater is expected to be used to test the offshore portion of the pipeline (see Resource Report No. 1 Section 1.5.2.3.8.12. However, this amount would be spread out over the entire Project area. Withdrawal for any one pipeline segment would be localized and short-term. While total volumes required for hydrostatic testing are high, needed flow rates in comparison with overall availability in the Project area are low. The potential sources that have been identified that could supply the water requirements for construction of the Mainline, including Pipeline Aboveground Facilities, are listed in the Project's *Water Use Plan* (Appendix K in Resource Report No. 2).

Water withdrawal activities could affect fish in multiple ways. Fish could be entrained or entrapped within the pumping system itself or become impinged on the intake structure at the point of withdrawal. Excessive withdrawal from any given site could also have impacts to fish and fish and habitat, including EFH and EFH species. Water withdrawal during winter can lead to water levels that reduce habitat quality including inadequate volume to resist freezing and inadequate volume to retain high enough dissolved oxygen concentration for survival of fish. Winter withdrawal could lead to reduced flows in small streams and could affect spawning beds and fish eggs within the gravel, as well as impede fish passage to and between important overwintering habitats. Fish overwintering areas, particularly in spreads 1 and 2 can exist as isolated pools or stream reaches that would be highly sensitive to water removal. Summer season withdrawal can also have similar effects on fish and fish habitat if volume removal is too high. Reductions in water levels and flows can increase water temperatures to beyond the thermal tolerances of some fish species, but could also increase productivity for juveniles of others. Any withdrawal that leads to discontinuous surface flows within a creek or lake outlet would trap fish. During winter, effects of water withdrawal could be major, and would likely persist for the entire winter construction season. Summer withdrawals would have less potential for adverse effects on fish and fish habitat, but excessive withdrawal could still lead to minor to moderate short-term impacts depending on the timing of the withdrawal.

Discharges of hydrostatic test water could locally increase flows, alter water temperatures, and increase turbidity in receiving waters. However, discharges would have to meet applicable water quality standards that would mitigate the potential effects of discharge on fish.

The Project representatives would acquire the necessary permits and approvals from state and federal agencies and obtain or comply with water rights before appropriating surface waters, including obtaining a Fish Habitat Permit from ADF&G and a Temporary Water Use Authorization from the Alaska Department of Natural Resources (ADNR). The potential effects of water withdrawals from surface waters would be reduced by adherence to measures in the Applicant's *Procedures* (Appendix N of Resource Report No. 2) and permit limits. Adequate flow rates to protect aquatic life would be maintained during intake from freshwater sources, and water withdrawal rates would be monitored to avoid significant impacts on stream flow or downstream resources.

Hydrostatic test water discharges would be performed in accordance with all applicable state water regulations and federal and state discharge requirements. Hydrostatic test water would be discharged into erosion control devices in upland areas to reduce the potential for scour, erosion, and sedimentation into nearby waterbodies in accordance with the Applicant's *Procedures* (Appendix N of Resource Report No. 2) and would comply with the ADEC APDES permit requirements. Hydrostatic test water for marine crossing hydrotesting would be discharged in Cook Inlet in accordance with ADEC APDES permit requirements. Because the majority of testing is planned to occur during the summer or fall, no test-water additives would be necessary. All hydrostatic test water discharges would be done under the supervision of the Project's Environmental Inspectors.

Based on compliance with state and federal permit conditions and implementation of BMPs in the Applicant's *Procedures*, it is anticipated that impacts from hydrostatic testing to fish and fish habitat, including EFH and EFH species, would be localized, short-term, and minor.

Aquatic Nuisance and Nonindigenous Animals

The Project-specific *Noxious and Invasive Plant and Animal Control Plan* (Appendix K) would be followed for the prevention of the spread of aquatic nuisance organisms. The Project's proposed measures to reduce the risk of spreading invasive species would include, but are not limited to:

- Informing and training construction personnel regarding noxious weed and invasive species identification and the protocols to prevent or control the spread of invasive species. Environmental Inspectors would be employed during construction to monitor and provide oversight and implementation of the *Noxious and Invasive Plant and Animal Control Plan*;
- Identifying areas that are currently infested with noxious or invasive species. Prior to construction, areas of concern would be identified and flagged with signage in the field;

- Before any construction activities, equipment brought in from outside of Alaska would be thoroughly decontaminated upon entering Alaska;
- Any equipment stored in Alaska would also be decontaminated; and
- All equipment and gear used by personnel (including boots, waders, etc.) would be decontaminated between watersheds to ensure invasive species are not inadvertently spread between work sites.

With the implementation of the procedures identified, it is anticipated that the spread of noxious and invasive species should be adequately prevented and controlled.

Spills

All fuel and hazardous material handling needed for construction of the Mainline would be in accordance with ADEC requirements and the Project's *SPCC Plan* (Appendix M of Resource Report No. 2) and managed by the Project's Environmental Inspectors. This includes that secondary containment would be used for single-walled containers; and storage and construction equipment would be maintained and inspected daily for leaks. For some crossings, it may not be practicable to remove equipment to an upland parking location on a daily basis. In some instances, parking and refueling would be required within wetlands. In accordance with the Applicant's *Procedures*, appropriate steps would be taken s (including secondary containment structures) to prevent spills and provide for prompt cleanup in the event of a spill. In these instances, the Project's Environmental Inspectors would monitor activities and verify that all equipment that must be parked within 100 feet of any waterbody is in good repair with no leaks.

Spills could occur at various locations along the Project during construction, but most would be associated with fuel and hydraulic systems of construction equipment. Fuel spills that fail to be contained prior to reaching waterbodies with fish and fish habitat would affect fish. Effects would depend on the season, size, and aerial extent of the spill. Spills would be expected to have acute effects on fish proximate to the spill location and potentially would lead to avoidance of the area by fish. Large spills that move appreciably downstream from the spill location would have a higher potential to affect more fish and more habitat over a longer distance. Stream productivity could be affected by large spills for a number of years. The size of spills would ultimately determine the potential for impacts to fish.

During development of the construction infrastructure, temporary fuel storage tanks would be set up at pioneer camps, civil construction spreads, pipeline construction camps, and each spread's active contractor yard. Interim storage tanks would be located along Dalton Highway and provide fuel for transport trucks. Tanks would be double-walled and/or complete with secondary spill containment.

While a spill has the potential for significant adverse environmental impacts, adherence to the Project's protective measures previously outlined (see Section 3.2.7.1.8) would greatly reduce the likelihood of such impacts, as well as reduce the resulting impacts should a spill occur. In addition, much of the construction would take place during winter seasons, which would further mitigate the potential for spills to reach fish bearing waterbodies. As such, significant adverse impacts to fish and fish habitat, including EFH and EFH species, due to contamination from spills or releases are unlikely.

Waste

Construction wastes would be disposed of outside of active floodplains and in approved sanitary landfill locations. Ditch excavation will produce a substantial quantity of material along sections of the Mainline that cannot be used as backfill in the ditch. Handling of excess unusable ditch material could increase overall construction-related sediment inputs to local streams, depending on the mode of disposal. Disposal plans including discharge of waste material into excavated upland material sites would mitigate the potential for sediment mobilization into streams and potential effects to fish and fish habitat, including EFH and EFH species.

All waste generated from construction would be handled in accordance with the Project's *Waste Management Plan* (Appendix J of Resource Report No. 8). This plan addresses hazardous and nonhazardous waste materials and volumes, handling, and disposal in detail. Potential impacts to fish and fish habitat would be avoided through waste management and spill response planning. All waste, including contaminated soils and absorbent materials, would be stored and disposed of by the Contractor in compliance with state and federal regulations. There are no licensed hazardous waste treatment or disposal facilities in Alaska. All hazardous waste and contaminated soils may be stored in a secure location at the Contractor yard until shipment to a licensed facility. To prevent and mitigate against inadvertent contamination from waste, all waste storage areas would be located in upland areas and would be properly contained until disposal. With the design features and *SPCC Plan*, construction of the Mainline is not anticipated to spread existing contamination or cause contamination to waterbodies, affecting fish and fish habitat, including EFH and EHH species.

Contamination

If unanticipated contamination is discovered during construction of the Mainline, the Project's *Unanticipated Contamination Discovery Plan* (Appendix I of Resource Report No. 8) would be followed to protect waterbodies and associated fisheries.

3.2.7.3.1.2 PTTL

The PTTL would be 62.5-mile pipeline in length and 32-inch-diameter primarily supported by VSMs; construction would occur during winter. Fish habitat is considered absent during winter months because it is not being utilized by fish, even though it is still present. The pipeline would cross many waterbodies, most either with no fish or ninespine stickleback. The ninespine stickleback is considered a non-sensitive fish species by ADF&G based on its hardiness and tolerance to low dissolved oxygen levels. However, 11 streams crossed by the VSM-supported pipeline are used seasonally by anadromous Dolly Varden or whitefish. Three rivers, the Shaviovik, Kadleroshilik, and East Channel of the Sagavanirktok, are used by resident and anadromous fish species and would be crossed during winter using open-cut or isolation-cut construction methods. The Shaviovik and East Channel Sagavanirktok rivers both contain identified pink salmon spawning habitat in the vicinity of the pipeline crossing. However, the crossings of the Kadleroshilik and Shaviovik rivers occur near enough to the coast that fish use during winter would likely be low, and the crossing may be dry/frozen.

Some VSM installation could occur in active channels along the alignment, which could have local effects on the stream bed through erosion in the immediate vicinity of the piles. However, most stream channels would be avoided. Installation would not affect fish because channels would be frozen to the bed and no fish habitat present.

The PTTL would be installed under (open cut) the Main Channel of Sagavanirktok River. The crossing location is within an overwintering area for anadromous broad whitefish, and pink salmon spawning has been identified at the location. If grounded ice conditions are not present during construction, isolation-cut methods would have to be employed. Potential effects to overwintering fish and fish habitat at this location could include dewatering and degraded water quality of downstream overwintering habitats and spawning gravels.

Hydrostatic Testing

Potential effects to fish and fish habitat from PTTL hydrostatic testing are the same as those discussed for hydrostatic testing in Section 3.2.7.2.1.1 in areas north of the Brooks Range because the streams and fish species are similar, the same procedures would be used, and the same mitigation measures would be implemented. Based on compliance with state and federal permit conditions and implementation of BMPs in the Applicant's *Procedures* (Appendix N of Resource Report No. 2), it is anticipated that any impacts to fish and fish habitat, including EFH and EFH species, from hydrostatic testing would be temporary (short-term) and minor. Water volumes for hydrostatic testing can be found in the Project's *Water Use Plan* (Appendix K of Resource Report No. 2).

Aquatic Nuisance and Nonindigenous Animals

The Project-specific *Noxious and Invasive Plant and Animal Control Plan* (Appendix K) would be followed for the prevention of the spread of aquatic nuisance organisms. With the implementation of the procedures in the *Noxious and Invasive Plant and Animal Control Plan*, as described for the Mainline (see Section 3.2.7.2.1.1), it is anticipated that the spread of noxious and invasive species should be adequately prevented and controlled.

Spills

Minor releases of hydrocarbons (e.g., diesel fuel, lubricants) could result in short-term, minor, direct adverse impacts on juvenile and adult fish, including death or chronic effects. The potential effects to fish and fish habitat, including EFH and EFH species, from spills during PTTL construction would be the same as those previously discussed in Section 3.2.7.1.2.1. However, because construction would occur during winter, the potential for spills entering fish-bearing habitats prior to being contained is further reduced.

All fuel and hazardous material handling needed for construction of the PTTL would be in accordance with ADEC requirements and the Project's *SPCC Plan* (Appendix M of Resource Report No. 2) and managed by the Project's Environmental Inspectors. While a spill has the potential for significant adverse environmental impacts, adherence to the Project's protective measures previously outlined (see Section 3.2.7.1.8) would greatly reduce the likelihood of such impacts, as well as reduce the resulting impacts should a spill occur. As such, significant adverse impacts to fish and fish habitat, including EFH and EHH species, due to contamination from spills or releases are unlikely. The effects of any small spills that might occur would be minor and short-term.

Waste

Ditch spoils would be the most likely construction waste with potential to impact fish and fish habitat. However, because the majority of the PTTL would be constructed on VSMs, ditch spoil production would be minimal. Disposal plans including discharge of waste material into excavated upland material sites would mitigate the potential for sediment mobilization into streams and potential affects to fish and fish habitat, including EFH and EFH species.

All waste generated from construction would be handled in accordance with the Project's *Waste Management Plan* (Appendix J of Resource Report No. 8). This plan addresses hazardous and nonhazardous waste materials and volumes, handling, and disposal in detail. Potential impacts to fish and fish habitat will be avoided or reduced through waste management and spill response planning. All waste, including contaminated soils and absorbent materials, would be stored and disposed of by the Contractor in compliance with state and federal regulations. There are no licensed hazardous waste treatment or disposal facilities in Alaska. All hazardous waste and contaminated soils may be stored in a secure location at the Contractor yard until shipment to a licensed facility. To prevent and mitigate against inadvertent contamination from waste, all waste storage areas would be located in upland areas and would be properly contained until disposal. With the design features and *SPCC Plan*, construction of the PTTL is not anticipated to spread existing contamination or cause contamination to waterbodies, affecting fish and fish habitat, including EFH and EHH species.

Contamination

If unanticipated contamination is discovered during construction of the PTTL, the Project's *Unanticipated Contamination Discovery Plan* (Appendix I of Resource Report No. 8) would be followed to protect waterbodies and associated fisheries.

3.2.7.3.1.3 Prudhoe Bay Gas Transmission Line (PBTL)

The PBTL would be an approximately 1-mile, 60-inch-diameter aboveground pipeline to transport natural gas from the Central Gas Facility (CGF) to the GTP. The PBTL does not cross fish-bearing waters and would therefore have no impact on fish or fish habitat, including EFH and EFH species.

Hydrostatic Testing

Potential effects to fish and fish habitat from PBTL hydrostatic testing (see Section 3.2.7.2.1.1) north of the Brooks Range because the streams and fish species are similar, the same procedures would be used, and the same mitigation measures would be implemented.

Spills

Small releases of hydrocarbons (e.g., diesel fuel, lubricants) could result in short-term, minor, direct adverse impacts. The potential effects to fish and fish habitat from spills during PBTL construction would be the similar as those previously discussed in Section 3.2.7.2.1.1 because the type and volumes of any spills would be expected to be similar. However, because construction would occur during winter from an ice road and pads, the potential for spills entering fish-bearing habitats prior to being contained is further reduced.

Waste

Ditch spoils would be the most likely construction waste with potential to impact fish and fish habitat. However, because the PBTL would be constructed on VSMs, ditch spoil production would be limited to VSM pile borehole spoils and would be minimal.

Contamination

If unanticipated contamination is discovered during construction of the PBTL, the Project's *Unanticipated Contamination Discovery Plan* (Appendix I of Resource Report No. 8) would be followed to protect waterbodies and associated fisheries.

3.2.7.3.1.4 Pipeline Aboveground Facilities

No waterbodies would be crossed by the Pipeline Aboveground Facilities. Pipeline Aboveground Facilities are not anticipated to effect fish and fish habitat, including EFH and EFH species. Any water withdrawals are addressed in Section 3.2.7.2.1.5 Pipeline Associated Infrastructure below.

3.2.7.3.1.5 Pipeline Associated Infrastructure

The following sections discuss Pipeline Associated Infrastructure related to the Mainline, PTTL, and PBTL.

Material Source Development

See Section 3.2.7.1.2.1.

Water Use

Water demands would be higher during construction than during operations, and highest during hydrostatic testing and ice road construction. To reduce haulage, water sources would be identified along the Project corridor. Water withdrawal would occur from a mix of surface water sources, including: roadside impoundments, streams, lakes, and groundwater wells as described in the Project's *Water Use Plan* (Appendix K in Resource Report No. 2; Appendix A). Potential water sources include those with documented anadromous and EFH species habitats (Appendix D, Table A-4). Water source selection is preliminary at this time and far fewer sources would be used for the Project than are currently identified. A more detailed review of specific impacts to anadromous and EFH species would be conducted, if necessary, as sites are selected for permitting. However, the following assessment would still be applicable for each site.

Mainline and PTTL construction would require approximately 1.74 billion gallons of water to construct and support construction-related activities (including testing). Approximately 90 percent of that demand would be from surface water sources spread throughout the Project area. Demands would fluctuate by year of construction, but generally demand would be highest for any given spread during hydrostatic testing (except along Mainline Spread 1 and the PTTL where the demands would be highest during ice pad construction). Mainline Spread 1 from the GTP to near the Dietrich River would account for more than 50 percent of the total freshwater demand for Mainline construction.

As described in Section 3.2.7.2.1.1, Project representatives would acquire the necessary permits and approvals from state and federal agencies and obtain or comply with water rights before appropriating water for construction use, including obtaining applicable Fish Habitat Permits from ADF&G and Temporary Water Use Authorizations from ADNR. The potential effects of water withdrawals from surface waters would be reduced by adherence to measures in the Applicant's *Procedures* (Appendix N of Resource Report No. 2) and permit limits. Adequate flow rates to protect aquatic life would be maintained during intake from freshwater sources and water withdrawal rates would be monitored to avoid significant impacts on stream flow or downstream resources. With these measures in place, any effects on fisheries and aquatic resources would be minor and short-term.

Access Roads

Construction and operation of access road stream crossings, including ice roads, temporary granular access roads, and ROW temporary stream crossings, could affect fish and fish habitat. Access road stream crossings can impede the free and efficient passage of fish. Any condition that increases water velocity, decreases water depth, decreases flow or causes flow to go subsurface, or blocks a watercourse would impede fish passage. The effects of fish passage can range from minor to significant depending on the timing and duration of the blockage. Blockages to fish passage in habitats used only for rearing of juveniles would have the lowest potential effect on fish. Many of the streams crossed by the Project have only "presence" or "rearing" identified as their use of the stream, suggesting temporary blockages to fish passage would be of minor impact and would only persist during the period of blockage, typically less than a few days. However, during spawning migrations blockages could be more significant depending on the duration of blockage. Blockages of short periods to EFH species passage moving to spawning areas would likely have minor impacts to EFH species because spawning runs for most species of fish in the Project area are fairly prolonged. However, some spring spawning resident fish are more dependent on short windows during spring. Failure to reach preferred spawning habitats when water temperature conditions become optimal can lead to spawning in locations with suboptimal habitat and to reduced fry production. Arctic grayling are a common species in the Project area that spawn in a fairly narrow temperature window each spring. Blockages of a few days post break-up can affect spawning success and result in low or failed age classes. This could indirectly affect the population for several years after the event. Similarly, blockages that occur during migrations to overwintering habitat that prevent fish from gaining access to viable wintering habitat would affect fish survival. Blockages to fish moving into wintering areas could have minor to moderate affects; however, most drainages crossed by the Mainline are small systems that likely provide rearing habitat for only small overall components of a drainage's population of fish and rearing EFH species. Impacts would most likely be of short duration and not have significant effects on any population of fish. Blockages of large drainages could have longer-term, more intense effects on fish and EFH species; however, such blockages are not anticipated. Intake rates would be specified in ADF&G and ADNR permit stipulations.

BMPs, Project component plans, and state and federal permit conditions would significantly reduce the potential for adverse effects to fish, including EFH species, from blockages to passage. In addition, NMFS and ADF&G have provided guidance: NMFS Anadromous Salmonid Passage Facility Design guidance document (NMFS, 2011b); Design, Permitting, and Construction of Culverts for Fish Passage

(ADF&G/Alaska Department of Transportation and Public Facilities [ADOT&PF], 2001); Stream Crossing Design for Fish Streams, North Slope Coastal Plain (McDonald & Associates, 1994); and A Regime Stream Channel Reclamation Approach for Placer-Mined Watersheds (ADF&G, 1997). BMPs typically include that bridges and culverts are designed to avoid altering the direction and velocity of stream flow, to span the entire non-vegetated stream channel, and to cross riparian zones and water courses perpendicular to the main channel. All access road stream crossings would be constructed to pass the highest anticipated flow during the period of use, which would provide for adequate fish passage during most flows. Any permanent stream crossings of access roads would be constructed to pass fish and maintain fish habitats as required by any state and federal permits.

The primary potential effects of ice road construction would be associated with water withdrawal for road bed construction as addressed above in Water Use. Other potential effects of ice road construction and use on fish and fish habitat are primarily associated with two major factors: freeze-down of fish overwintering areas and impedance of break-up flows during spring. Ice road crossings over deep-water riverine pools, typically isolated from one another on the North Slope, can reduce habitat volume by additional freeze-down of the thawed water below the natural ice and can serve to alter the temperature regimes of the pools, potentially fostering a slushing condition of the entire overwintering pool. Similarly, ice road crossings of flowing waters that freeze down into the substrates can stop subsurface flow, forcing it above the ice. If subsurface flow is impeded, downstream wintering habitats and eggs, if spawning habitats are nearby, can be dewatered or degraded, leading to mortality. During break-up, when river water levels rise dramatically each spring in most of Alaska, ice roads within floodplains can dam break-up flows and lead to erosion of stream banks and stream beds. Stream bed and bank erosion can be most pronounced at ice road crossings of incised streams. Ice road crossings of streams with persistent winter flow have the potential to scour the stream bed below the ice road as the channel is constricted from freeze-down; however, the ice would likely erode faster than the stream bed, minimizing the effects to fish habitats. Ice roads can also divert sheet flow during break-up, potentially affecting natural recharge to lakes on the downgradient side of the road. Most ice road stream crossings for the Project would occur on the North Slope, and over streams with limited to no flow by late winter. Crossings of deeper rivers would maintain water below the ice as freeze-down to the bed would likely be prohibited for most.

State and federal permits would be required for authorization to construct the ice roads, and the conditions listed in the permits would be followed in order to reduce any potential impacts. Stream crossings would also be in compliance with the requirements of Alaska Statutes (AS§16.05.841, Fishway Required, and AS §16.05.871, Protection of Fish and Game) regarding Project-related winter ice-bridge crossings (and summer ford crossings) of all anadromous and resident fish streams. If necessary for winter ice-bridge crossings, natural ice thickness could be augmented (through snow removal and water application to increase ice thickness, or other techniques) if site-specific conditions, including water depth, are suitable for a crossing that will protect fish habitat and maintain fish passage. In addition, slotting of the ice roads could be conducted at designated stream crossings at the end of the season.

Aquatic Nuisance and Nonindigenous Animals

The Project-specific *Noxious and Invasive Plant and Animal Control Plan* (Appendix K) would be followed for the prevention of the spread of aquatic nuisance organisms. Preventive measures are discussed in Section 3.2.7.2.1.1. These include that before any construction activities, equipment brought in from outside of Alaska would be thoroughly decontaminated upon entering Alaska; any equipment stored in

Alaska would also be decontaminated. All equipment and gear used by personnel (including boots, waders, etc.) would be decontaminated between watersheds to ensure invasive species are not inadvertently spread between work sites.

With the implementation of the procedures identified in the *Noxious and Invasive Plant and Animal Control Plan*, it is anticipated that the spread of noxious and invasive species should be adequately prevented and controlled.

Spills

During development of the construction infrastructure, temporary fuel storage tanks would be set up at pioneer camps, civil construction spreads, pipeline construction camps, and each spread's active contractor yard. Interim storage tanks would be located along Dalton Highway and provide fuel for transport trucks. Tanks would be double-walled and/or complete with secondary spill containment. Minor releases of hydrocarbons (e.g., diesel fuel, lubricants) could result in short-term, minor, direct adverse impacts on juvenile and adult fish, including death or chronic effects. The potential impacts of spills are similar to those described in Section 3.2.7.2.1.1.

All fuel and hazardous material handling needed for construction of the Pipeline Associated Infrastructure or the Pipeline Aboveground Facilities would be in accordance with ADEC requirements and the Project's *SPCC Plan* (Appendix N) and managed by the Project's Environmental Inspectors. While a spill has the potential for significant adverse environmental impacts, adherence to the Project's protective measures previously outlined (see Section 3.2.7.1.8) would greatly reduce the likelihood of such impacts, as well as reduce the resulting impacts should a spill occur. As such, significant adverse impacts to fish and fish habitat due to contamination from spills or releases are unlikely. The effects of any small spills that were to occur would be minor and short-term.

Waste

All waste generated from construction would be handled in accordance with the Project's *Waste Management Plan* (Appendix J of Resource Report No. 8). This plan addresses hazardous and nonhazardous waste materials and volumes, handling, and disposal in detail. Potential impacts to fish and fish habitat would be avoided or reduced through waste management and spill response planning. All waste, including contaminated soils and absorbent materials, would be stored and disposed of by the Contractor in compliance with state and federal regulations. There are no licensed hazardous waste treatment or disposal facilities in Alaska. All hazardous waste and contaminated soils may be stored in a secure location at the Contractor yard until shipment to a licensed facility. To prevent and mitigate against inadvertent contamination from waste, all waste storage areas would be located in upland areas and would be properly contained until disposal. With the design features and the *SPCC Plan*, construction of the Pipeline Associated Infrastructure or the Pipeline Aboveground Facilities is not anticipated to spread existing contamination or cause contamination to waterbodies, affecting fish and fish habitat, including EFH and EHH species.

Contamination

If unanticipated contamination is discovered during construction of the Pipeline Associated Infrastructure or the Pipeline Aboveground Facilities, the Project's *Unanticipated Contamination Discovery Plan* (Appendix I of Resource Report No. 8) would be followed to protect waterbodies and associated fisheries.

3.2.7.3.2 GTP

3.2.7.3.2.1 GTP Facility

Pad Construction

No waterbodies would be crossed by the GTP facility. Construction of the GTP pad is not anticipated to have any adverse effects on fish or fish habitats, including EFH and EFH species. Details are provided in Appendix D Draft *Essential Fish Habitat (EFH) Assessment Report* for details on EFH and Project facilities.

Hydrostatic Testing

The potential effects of hydrostatic testing would be similar to those described see Section 3.2.7.2.1.1. The potential effects of GTP-specific water withdrawal during construction are addressed in the following section.

Water Use

Estimates of camp and other water needs during construction of the GTP are approximately 160,000 gallons of potable water per day at the peak of construction. In addition, about 95.7 million gallons of water would be needed for pipeline construction ice roads. Potential early water sources proposed for GTP construction are identified in the Project's *Water Use Plan* (Appendix K in Resource Report No. 2; Appendix A). The sources are predominantly absent of fish, however, one proposed lake has non-sensitive species and one flooded material site has both resident and anadromous fish species. No sites proposed have identified EFH. The Project representatives would acquire the necessary permits and approvals from state and federal agencies and obtain or comply with water rights before appropriating surface waters, including obtaining a Fish Habitat Permit from ADF&G and a Temporary Water Use Authorization from ADNR. The potential effects of water withdrawals from surface waters would be reduced by adherence to measures in the Applicant's *Procedures* (Appendix N of Resource Report No. 2) and permit limits. Adequate flow rates to protect aquatic life would be maintained during intake from freshwater sources and water withdrawal rates would be monitored to avoid significant impacts on stream flow or downstream resources.

Once constructed, the GTP water system would provide water to the GTP and associated camps from a water reservoir. The water used to supply the reservoir would originate from the Putuligayuk River. Due to the Arctic conditions of the area, this river is generally not available for water uptake for the majority of the year. Therefore, to ensure year-round water supply to the facility, water from the river would be used to fill a reservoir in a limited period of time during an approximately 20-day fill window in the summer months, while there is sustained water runoff, to ensure year-round water supply to the facility. Initial filling of the GTP reservoir would require in excess of 250 million gallons of water. Withdrawal would be conducted primarily during break-up, when large volumes of water are moving through the system.

The preliminary design includes a reservoir of approximately 35 acres with a depth of approximately 35 to 60 feet. The reservoir is designed to form an ice pack of 8 feet; the design assumes this ice pack is not available for use. Subtracting out the 8-foot-deep ice pack leaves a reservoir depth of approximately 27 to 52 feet. In actuality, during the summer months, some portion (if not all) of this ice pack does become available for use from melting. While it may be used, if needed, in the summer, this volume would need to be restored in the following spring season from the Putuligayuk River.

The Putuligayuk River pipeline (approximately 1 mile of 14-inch pipe) would draw water up out of the Putuligayuk River to accommodate single- and dual-pump operation. Since the operation is constrained to the summer season, the water uptake pipe would not be heat-traced and insulated. Filters at the uptake pipe would remove silt and sand. The river intake structures would comply with ADF&G and federal regulations to protect fish. With these mitigation measures implemented, any effects of fisheries and aquatic resources would be minor and short-term.

Aquatic Nuisance and Nonindigenous Animals

The Project-specific *Noxious and Invasive Plant and Animal Control Plan* (Appendix K) would be followed for the prevention of the spread of aquatic nuisance organisms. Preventive measures are discussed in Section 3.2.7.2.1.1. These include that before any construction activities, equipment brought in from outside of Alaska would be thoroughly decontaminated upon entering Alaska; any equipment stored in Alaska would also be decontaminated. All equipment and gear used by personnel (including boots, waders, etc.) would be decontaminated between watersheds to ensure invasive species are not inadvertently spread between work sites.

With the implementation of the procedures identified in the *Noxious and Invasive Plant and Animal Control Plan*, it is anticipated that the spread of noxious and invasive species should be adequately prevented and controlled.

Spills

As discussed in Section 3.2.7.2.1.1, minor releases of hydrocarbons (e.g., diesel fuel, lubricants) could result in short-term, minor, direct adverse impacts on juvenile and adult fish, including death or chronic effects. All fuel and hazardous material handling needed for construction of the GTP would be in accordance with ADEC requirements and the Project's *SPCC Plan* (Appendix M of Resource Report No. 2) and managed by the Project's Environmental Inspectors. While a spill has the potential for significant adverse environmental impacts, adherence to the Project's protective measures (as practicable) previously outlined (see Section 3.2.7.1.8) would greatly reduce the likelihood of such impacts, as well reduce the resulting impacts should a spill occur. As such, significant adverse impacts to fish and fish habitat, including EFH and EFH species, due to contamination from spills or releases are unlikely.

Waste

Waste material would be disposed as required by federal, state, and local environmental regulations and in accordance with Project's *Waste Management Plan* (Appendix J of Resource Report No. 8). Wastewater would be disposed of in Underground Injection Control (UIC) wells, as described in Resource Report No. 1.

Nonhazardous solid wastes would be transported to an approved disposal facility, such as the NSB Oxbow Landfill for disposal. Recyclables would be segregated from other waste streams and sent to a recycling facility. Hazardous wastes would be collected and temporarily stored until transport to a hazardous waste disposal facility in the Lower 48. No impacts on fish or fish habitat, including EFH and EFH species, are expected.

Contamination

If unanticipated contamination is discovered during construction of the GTP, the Project's *Unanticipated Contamination Discovery Plan* (Appendix I of Resource Report No. 8) would be followed to protect waterbodies and associated fisheries.

3.2.7.3.2.2 GTP Associated Infrastructure

Pad and Dock Construction

Direct impacts from construction at the West Dock area would include filling an area of about 31 acres with granular fill to construct DH 4, which would occur primarily in the summer. There would be a permanent loss of EFH and anadromous fish habitat within this area. There would be a temporary increase in turbidity during the construction of DH 4. Mobile species would avoid the area due to both turbidity and sound associated with the construction, including installation of sheet piles (discussed in the subsequent section). Recent data on marine invertebrates, zooplankton, and ichthyoplankton populations in the Prudhoe Bay area is limited for assessment of potential impacts, however populations reportedly increase in Prudhoe Bay area during the spring and summer (see Section 3.2. 4.2.10), which would result in permanent impacts due to loss of habitat from granular fill and short-term, minor impacts from increased turbidity from construction. Potential impacts to marine invertebrates and zooplankton populations would be reduced during the winter construction phases due to decline of plankton populations with the return of sea ice in the winter (Horner and Murphy, 1985).

Dock Head 4 (DH 4)

A new Dock Head (DH 4) would be built at the seawater treatment plant (STP) and five berths would be constructed. The dock face would be approximately 1,000 feet wide and elevated approximately 8 feet. The new dock would provide a working area of approximately 31 acres with five or more new berths dedicated to Project operations.

Sediment samples were collected (Alaska LNG 2014b) in 2014 from five locations in Prudhoe Bay near West Dock, and analyzed for physical and chemical parameters. The analytical results are presented in Appendix R of Resource Report 2. Metal concentrations were found to be below both the Seattle Dredged

Material Management Program (DMMP, USACE 2014) screening levels and ADEC's recommended permissible exposure limits, and within the range of background sediments for the Beaufort Sea coastal area. Arsenic, copper, and nickel concentrations in some samples exceeded their marine threshold effects levels; however Beaufort Sea sediments are naturally high in these three metals, and the observed concentrations were well within the established range for background. No evidence of petroleum contamination was observed in the samples; concentrations of both diesel range organics and residual range organics in all samples were found to be below ADEC-recommended soil cleanup levels for the Arctic. Polycyclic aromatic hydrocarbons (PAHs) were found to be low in all samples analyzed with all concentrations (well below the DMMP screening levels and threshold effects levels and permissible exposure limits). Overall, concentrations of petroleum hydrocarbons in the sediment samples were found to be low and well within the range of natural background levels. Petroleum hydrocarbon concentrations were well below DMMP guidance and sediment quality guideline levels, and showed no evidence of anthropogenic inputs or contamination. Very low levels of pesticides were observed in some samples; however, generally, there was no indication of any contamination from chlorinated pesticides or polychlorinated biphenyls of the test trench sediments. These data support other recent findings that the West Dock area of Prudhoe Bay is generally free of contamination with metals or hydrocarbons (Oasis 2006, 2008).

Pile Driving

A temporary barge bridge consisting of two barges ballasted to the sea floor to bridge the gap is the Applicant's proposed alternative. The barges would be placed at the beginning of the open-water season prior to each sealift. The barge bridge offers three areas for fish passage: the area between the barges and two areas between each barge and the dock bulkheads. The barges would be removed at the end of each sealift. Pre-work would be performed a year before the first sealift to level the sea floor and install breasting-dolphins for the barge bridge support. Four dolphins would be placed in the West Dock causeway where needed to secure the temporary bridge during construction. Work would be performed each sealift year to level the sea bed for ballasting the barge bridge into position. Direct impacts of pile driving could occur in areas where the activity is conducted in ice-free waters. The potential effects to fish and fish habitat, including EFH and EFH species, as well as mitigation measures, would be minor and short-term and similar to those described in Section 3.2.7.1.3.1.

Access Roads

Although road construction would not directly impact any waterbodies, there could be potential indirect impacts. Ground compaction caused by expansion of existing roads and new access roads could generate increased turbidity due to runoff and could disrupt surface flows. This could result in localized avoidance of the area by fish during periods of elevated turbidity. Erosion and sediment control measures would be implemented as outlined in the Applicant's *Plan* and *Procedures*, and Project *SWPPP* to reduce any sedimentation and flow, thereby minimizing any potential effects to fish and fish habitat, including EFH and EFH species. Any effects would be minor and short-term.

Other general access ice roads would be needed during the initial phases of construction. The number, routing, length, and duration of use of general access ice roads have not yet been determined. Various state and federal permits would be required for authorization to construct the ice roads, and the conditions listed in the permits would be followed in order to reduce any potential impacts to fisheries or EFH. In addition, slotting of the ice roads could be conducted at the end of the season.

Vessel Activity

There would be indirect impacts to the local fish fauna in the region due to physical presence of construction vessels and associated sound. Potential effects would be similar to those described in Section 3.2.7.1.5.1. However, any effects would be intermittent and localized and therefore minor and short-term. Fish would avoid the region during migration to and from anadromous rivers and streams and may suffer greater mortality due to potential predation. However, this is not expected to cause a dramatic impact on fish, including EFH species, because the area is mostly a transition zone to other river locations.

Aquatic Nuisance and Nonindigenous Animals

HLVs transporting modules for the GTP could act as vectors for transmission of aquatic invasive organisms. HLVs could originate from Asia or the United States. Ballast water and hull fouling are the two most significant vectors for non-native introductions (USFWS, 2014c). The Beaufort Sea is covered in ice most of the year and water temperatures beneath the ice range remain at or below freezing 30 °F (-1 °C) (Weingartner et al., 2009). Water temperature is likely a significant limiting factor for establishment of aquatic invasive organisms. Although invasive tunicates have become established in southern Alaskan waters, these same species are unlikely to become established in Prudhoe Bay. With projected increasing water temperatures and increased energy and shipping-related vessel traffic, the Beaufort Sea may be more vulnerable to invasive aquatic organisms in the future (Cobb et al., 2008). Future invasions could include phytoplankton, macroalgae, crustaceans, shrimp, mollusks, and tunicates. Discussion of potential transportation of invasive plankton species in ballast water is provided in Section 3.2.7.2.3.2 Aquatic Nuisance Species and Nonindigenous Animals.

HLVs would be compliant with current regulations in regards to ballast loads. Use of freshwater ballast would allow for removal of ballast within transporting marine aquatic invasive organisms. Invasive aquatic organisms on or in semi-submersible vessels, barges, and tugs would be controlled by ballast water regulations that require a ship-specific Ballast Water Management Plan, a ballast water record book, ballast water exchange, an approved ballast water treatment system, and an International Ballast Water Management Certificate. HLVs would wash down before entering Alaskan coastal waters and exchange ballast at sea to ensure a clean water discharge to reduce introduction of aquatic invasive organisms. All HLV operations would comply with USCG regulations.

The Project-specific *Noxious and Invasive Plant and Animal Control Plan* (Appendix K) would also be followed for the prevention of the spread of aquatic nuisance organisms. Preventive measures are discussed in Section 3.2.7.2.1.1. These include that before any construction activities, equipment brought in from outside of Alaska would be thoroughly decontaminated upon entering Alaska; any equipment stored in Alaska would also be decontaminated. All equipment and gear used by personnel (including boots, waders, etc.) would be decontaminated between watersheds to ensure invasive species are not inadvertently spread between work sites.

With the implementation of the procedures identified, it is anticipated that the spread of noxious and invasive species should be adequately prevented and controlled.

Spills

As discussed in Section 3.2.7.1.8, minor releases of hydrocarbons (e.g., diesel fuel, lubricants) could result in short-term, minor, direct adverse impacts on juvenile and adult fish, including death or chronic effects. All fuel and hazardous material handling needed for construction of the GTP Associated Facilities would be in accordance with ADEC requirements and the Project's *SPCC Plan* (Appendix N) and managed by the Project's Environmental Inspectors. While a spill has the potential for significant adverse environmental impacts, adherence to the Project's protective measures previously outlined (see Section 3.2.7.1.8) would greatly reduce the likelihood of such impacts, as well reduce the resulting impacts should a spill occur. As such, significant adverse impacts to fish, marine invertebrates, zooplankton, ichthyoplankton, and marine habitat due to contamination from spills or releases are unlikely.

Waste

The GTP would develop two Class I wells under the UIC program. There would be no impact on surface water from wastewater disposal in underground injection wells due to their depth and lack of contact with surface water. No impacts on fish or fish habitat, including EFH and EFH species, are expected.

Contamination

If unanticipated contamination is discovered during construction of the GTP Associated Infrastructure, the Project's *Unanticipated Contamination Discovery Plan* (Appendix I of Resource Report No. 8) would be followed to protect waterbodies and associated fisheries.

3.2.8 Potential Operational Impacts and Mitigation Measures

Operational activities that could potentially impact fish and fish habitat, including EFH and EFH species, include the following:

- Discharges of wastewater;
- Fueling and use of hazardous materials;
- Maintenance and repair activities, including continued material extraction;
- Surface water withdrawals;
- Spills;
- Stormwater management and runoff;
- Vessel ballast water/cooling water update and/or discharge; and
- Waste disposal.

Table 3.2.8-1 outlines potential operations impacts to fish and associated mitigation measures.

TABLE 3.2.8-1

Potential Operations Impacts and Mitigation to Fish Associated with the Project

Activity	Potential Impact	Mitigation
ROUTINE OPERATIONAL ACTIVITIES		
Pipeline Maintenance and Inspections	Thermal impacts, erosion, and sedimentation	• Follow Applicant's *Procedures* and *Plan*.
Access Roads (Permanent)	Increase in impervious areas and stormwater run-off; increased public access to otherwise secluded waterbodies	• Structural BMPs would be installed as part of the overall facility design and *SWPPP*; and • ROW patrolling, no-trespassing signs and the installation of gates, chains, or large boulders at pubic road and trail crossings.
Vessel Traffic	Sound, vessel movement, potential spills, and introduction of non-native nuisance species	• Ballast water management would comply with regulations, which require a ship-specific Ballast Water Management Plan, a ballast water record book, ballast water exchange, an approved ballast water treatment system, and an International Ballast Water Management Certificate; and • Develop and implement an operations *Spill Response Plan* and train onsite spill response personnel.
Stormwater Discharge from the GTP and Liquefaction Facility	Water quality and thermal impacts due to operational discharge	• Adhere to permit conditions outlined in required stormwater discharge permits; and • Use of catchment basins (except at the GTP) for collecting and storing surface runoff from upland facilities and other impervious surfaces to remove contaminants prior to delivery to any receiving waters.

Practices designed to reduce or mitigate potential impacts on fish and fish habitat, including EFH and EFH species, are proposed to be implemented during operation and maintenance as informed by the following Project-specific plans and guidance:

- Alaska LNG Project *Plan* (Appendix A of Resource Report No. 7);
- Alaska LNG Project *Procedures* (Appendix N of Resource Report No. 2);
- Facility-specific SPCC plans to be developed prior to operations, as required;
- Facility-specific SWPPPs to be developed prior to operations, as required;
- *Noxious/Invasive Plant and Animal Control Plan* (Appendix K of Resource Report No. 3);
- *Project Waste Management Plan* (Appendix J of Resource Report No. 8);
- *Project Restoration Plan*); and
- *Unanticipated Contamination Discovery Plan* (Appendix I of Resource Report No. 8).

3.2.8.1 Liquefaction Facility

3.2.8.1.1.1 Inland Resident Fisheries

There are no major freshwater waterbodies or streams on the Liquefaction Facility site, therefore impacts to inland resident fisheries would not be expected from operation of the Liquefaction Facility.

3.2.8.1.1.2 Anadromous Fisheries

There are no major freshwater waterbodies or streams on the Liquefaction Facility site. There are no expected impacts to anadromous fisheries from operation of the Liquefaction Facility.

3.2.8.1.1.3 Marine Fisheries and EFH

All paved and non-paved surfaces outside of the operational areas would drain into stormwater ponds. A *SWPPP* for operations would be developed before the facilities are placed in service. Water from these ponds would be discharged in accordance with APDES requirements via outfalls into Cook Inlet. Turbidity and sediment in discharge waters to Cook Inlet would be in compliance with the APDES permit and any potential impacts to fish and fish habitat, including EFH and EFH species, are expected to be long-term but minor due to the settling basins and the already high turbidity levels in Cook Inlet.

Surface drainage and oily water from process areas would be collected for wastewater treatment. The discharge location of all wastewater effluent streams would be an outfall to Cook Inlet that complies with the APDES individual permit requirements. One of the three onsite ponds would serve as the receiving area prior to discharge. Because wastewater would be treated prior to discharge to Cook Inlet in compliance with the APDES discharge permit, any potential impacts to fish and fish habitat, including EFH and EFH species, are expected to be long-term but minor.

Anticipated impacts to marine and EFH species and habitats would be primarily limited to operation of the Marine Terminal and are discussed in the following sections: Vessel Activity, Spills, Waste, and Maintenance Activities.

3.2.8.1.2 Vessel Activity

3.2.8.1.2.1 Marine Fisheries and EFH

Sound generated by LNGCs' engine/boiler operations could have negative direct impacts on fish, including EFH species. As discussed in Section 3.2.7.1.5.1, potential impacts of sound exposure on fish could include death or injury, including physical damage; physiological stress responses; and behavioral responses such as startle response, alarm response, or avoidance. Sound from routine Marine Terminal operations would be associated with ship transits, the regasification process on the LNGCs when moored to the PLF, and LNGC-maneuvering activities. Because fish are mobile organisms, only behavioral effects would be expected to occur during operations.

There would be no long-term effects from the sound of vessels on fish and fish habitat, including EFH and EFH species. Vessel sounds would be intermittent and localized. During periods where vessel sounds are emitted, fish may avoid the area during migration to and from anadromous rivers and streams and may suffer greater mortality due to potential predation. However, this is not expected to cause a dramatic impact on fish, including EFH species, because the area is mostly a transition zone to other river locations and similar to the sounds currently taking place in Cook Inlet.

LNGCs calling at the Marine Terminal would be carrying ballast water (seawater) upon arrival to Cook Inlet. The ballast water would have been exchanged in international waters according to international convention. As LNG is loaded onto the LNGCs at the Marine Terminal, the LNGCs would release the ballast water, thereby replacing the sea water with LNG product as ballast to maintain stability of the LNGC in the water. Approximately 2.9–3.2 billion gallons of ballast water would be discharged per year from LNGCs during LNG loading operations at the Marine Terminal, with the range in annual discharge volume due to varying LNGC sizes and number of voyages that may call at the Marine Terminal. The water discharged would be approximately 0–25 °F warmer than ambient water temperature in Cook Inlet. Ballast water discharged in Cook Inlet would be treated according to U.S. regulations. Seawater intake often occurs through one of two upper or lower sea chests each measuring 4.9 feet by 6.56 feet. Average water velocity through the lattice screens at the hull side shell would not exceed 0.5 feet per second (USCG and MARAD, 2009).

Direct impacts of the seawater intake could include entrainment of fish, marine invertebrates, ichthyoplankton, phytoplankton, and zooplankton passing through the intake screen. Both screens on the seawater intake structure and a seawater intake velocity of 0.5 feet per second would prohibit most juvenile and adult fish from being entrained in the seawater intake. It is assumed that mortality of juvenile salmon, ichthyoplankton, marine invertebrates, and zooplankton that become withdrawn by the LNGCs' seawater intakes would be 100 percent. Indirect impacts would also occur because marine invertebrates, zooplankton, ichthyoplankton, fish, and shellfish serve as a source of food for some juvenile and adult fish species. Impacts to fisheries resources are expected to be minor given the small scale of the LNGCs' intakes when compared to the entire area of Cook Inlet. Long-term, direct and indirect, adverse impacts on fish and shellfish would result from the seawater intake associated with LNGC operations; however, effects are anticipated to be minor and would not significantly impact any species populations, including EFH species.

Approximately 1.6–2.4 billion gallons of seawater per year may be taken in and discharged by LNGCs as cooling water while at the Marine Terminal. The water would undergo minimal filtration upon intake and supports a heat exchange process to provide cool water needed for the LNGC integrated cooling systems for equipment onboard such as main engines and diesel generators. The range in intake/discharge volumes account for the varying LNGC sizes and estimates of the number of LNGC calls at the Marine Terminal. The water discharged could be approximately 5 °F warmer than ambient water temperature in Cook Inlet and would be expected to cool to within 1.8 °F above ambient temperature within 328 feet of the discharge. The cooling water discharge is not expected to reach the seafloor. Therefore, demersal fish and benthic shellfish would not be affected. Cooling water discharge could create thermal refugia for larval, juvenile, and adult fish. These thermal refuges could concentrate prey resources, resulting in localized effects on the fauna of the region. An increase in temperature could result in adverse behavioral and physiological impacts on fish. Pelagic fish would be expected to exhibit some avoidance of the cooling water discharge. Because the two cooling water plumes compose a relatively small area and the temperature differentials are small and would be rapidly ameliorated within the high-energy environment of Cook Inlet, the impacts are expected to be minor. The discharges would occur over the life of the operations but would be intermittent and the effects short-term and localized.

3.2.8.1.2.2 Aquatic Nuisance and Nonindigenous Animals

LNGCs calling at the Liquefaction Facility during operations could act as vectors for transmission of aquatic invasive organisms. Ballast water and hull fouling are the two most significant vectors for non-native tunicate introduction (USFWS, 2014c). The Pacific transparent sea squirt, golden star tunicate, violet tunicate, and glove leather tunicate have each been reported in southern Alaskan waters and could spread to Cook Inlet via vessel traffic originating from infected Alaskan waters or via vessels originating from non-Alaskan ports with established tunicate invasions. Invasive crabs, including the green crab and Chinese mitten crab, are also transported in ballast water and through hull fouling. While adult crabs may be tolerant of water temperatures as low as 32 °F (0 °C), larvae of both species require temperatures above 52 °F (11 °C) to survive (Anger, 1991; Harney, 2007). Water temperatures in Cook Inlet range from 40.2 °F to 48.2 °F in the spring and 47.7 °F to 52.1 °F in the fall (Okkonen and Howell, 2003). The lowest mean temperatures (approximately 5 °C to 5.5 °C (41 °F to 41.9 °F) and the largest amplitude seasonal temperature signal (approximately 8.5 °C (47.3 °F)) occurs between the Forelands. The temperature maximum in the upper 100 meters (328 feet) of the water column occurs in late August to early September (Okkonen, Pegau, and Saupe, 2009). Therefore, water temperatures in Cook Inlet are at the lower end of the threshold for invasive crabs.

All vessels brought into State of Alaska or federal waters are subject to USCG 33 C.F.R. 151 regulations, which are intended to reduce the transfer of aquatic invasive organisms. Adherence to the USCG 33 C.F.R. 151 regulations would reduce the likelihood of Project-related vessel traffic introducing aquatic invasive species. In addition, the measures described in the *Noxious and Invasive Plant and Animal Control Plan* (Appendix K) would be followed in order to prevent the introduction or spread of aquatic nuisance organisms.

3.2.8.1.3 Spills

As discussed in Section 3.2.7.1.8, minor releases of hydrocarbons (e.g., diesel fuel, lubricants) could result in short-term, minor, direct adverse impacts on juvenile and adult fish, including death or chronic effects. Spills of hazardous liquids, including fuels and lubricants, could occur in any area where these compounds are used or stored and have the potential to damage surface water resources. Fuels and lube oils would not be handled at the Marine Terminal. Any storage of these materials at the Liquefaction Facility would comply with current regulatory requirements and personnel would be trained for proper handling, storage, disposal, and spill response of potential contaminants, and an *SPCC Plan* for operations would be developed. All petroleum, oil, and lubricant handling required during Project operations would be dictated by the *SPCC Plan*. Storage tanks and containers for fuels and hazardous liquids would be constructed with appropriately sized secondary containment, and oil-filled operational equipment would be managed consistent with the requirements of 40 C.F.R. 112. As such, significant adverse impacts to fish and fish habitat due to contamination from spills or releases are unlikely.

3.2.8.1.3.1 Marine Fisheries and EFH

A vessel-related spill would be a large spill involving the rupture of a vessel fuel tank, usually as a result of a collision, sinking, fire, or running aground. None of the operation vessels would be hauling fuel as payload, so the maximum spill size would be limited to the content of the fuel tank at the time of the accident. All LNGCs would be double-hulled.

Minor releases of hydrocarbons (e.g., diesel fuel, lubricants) could result in short-term, minor, direct adverse impacts on juvenile and adult fish, including death or chronic effects. The impacts of hydrocarbons are caused by either the physical nature of the oil (physical contamination and smothering) or by its chemical components (toxic effects and bioaccumulation). It is anticipated that the immediate response reaction of fish would be avoidance.

As discussed in Resource Report No. 11, there has never been a major incident involving a large LNG spill or fire on water. Although unlikely, a spill of LNG could still be hazardous to aquatic organisms. A spill of LNG could occur from a tank rupture or valve failure, during LNGC loading, during LNGC grounding, or due to another adjacent accident.

LNG is not water soluble and would vaporize rapidly upon contact. Because LNG would not mix with water, no water contamination would occur. The greatest threat to aquatic organisms near a LNG spill would be from changes in water temperature. The extremely cold LNG would rapidly cool the upper water layers nearest the spill as it begins to vaporize. Organisms in proximity would be exposed to freezing temperatures, which could cause injury or mortality. Alternatively, vaporized LNG could ignite if in contact with a heat source, resulting in a fire and localized heating of the surface water. Neither heating nor cooling would likely cause the overall water column to change temperature and effects would be limited to the surface layer. Fish and other large organisms would respond to spills by moving away from undesirable temperatures, but plankton and shellfish would be unable to avoid negative impacts.

This would result in potential short-term, direct, and minor adverse impacts on fish near the surface, through either behavioral avoidance of colder waters or physiological effects. In addition, there could be short-term indirect adverse impacts on fish from releases and potential spills that might affect their eggs and food sources at the surface. The release of LNG is very unlikely and impacts would be short-term and over a limited area; therefore, no significant effects to fish and fish habitat, including EFH and EFH species, would be expected from a discharge of LNG to marine waters.

3.2.8.1.4 Waste

Operation of the Liquefaction Facility would generate onsite waste. All waste would be handled in accordance with the Project's *Waste Management Plan* (Appendix J of Resource Report No. 8). This *Plan* addresses hazardous and nonhazardous waste materials and volumes, handling, and disposal in detail. The *Plan* would ensure compliance with all regulations for transportation, treatment, storage, and disposal. With adherence to the Project's *Waste Management Plan* procedures and mitigation measures, no impacts to fish or fish habitat, including EFH and EFH species, would be anticipated from waste handling.

3.2.8.1.5 Maintenance Activities

Maintenance and repair activities at the Liquefaction Facility would require minimal site preparation (e.g., excavation) and hydrostatic testing. It is anticipated that any potential impacts to fish and fish habitat, including EFH and EFH habitat, would be similar but of a lower magnitude (approximately one-tenth) than those described for construction. Impacts would be long-term but intermittent and minor.

Approximately 140,000 cubic yards of maintenance dredging is expected to be necessary at the MOF berths and approach, but this would be done during the later construction seasons. The MOF is temporary and would be removed or repurposed soon after operations commence. Potential contamination of the area due to release of harmful toxins is not likely to create any long-term effects; tidal flushing would remove or dilute any potential toxins.

3.2.8.2 Interdependent Project Facilities

3.2.8.2.1 Pipelines

Operation of the Project pipelines between Point Thomson, Prudhoe Bay, and Nikiski, Alaska, could affect fish and fish habitat in both the short and long-term. The primary operations risks to coldwater resident, anadromous, and EFH species and habitat would be associated with stream crossings and material sources, and would include potential for erosion, sediment input, impeded fish passage, and alterations to stream channels.

3.2.8.2.1.1 Mainline

Thermal Effects

Potential impacts to fish habitats from operation of the buried pipeline would be mostly associated with frost bulb formation induced by chilled gas. The formation of frost bulbs at some waterbody crossings could affect water flow within the streambed, particularly in late winter at low flow streams. Additionally, downstream water temperatures may be slightly lower for very-low-flow streams as a result of the chilled gas flow and frost bulb. Operation of a chilled Mainline in the substrates of smaller streams could affect local water temperatures within streams and could result in lowered stream productivity during summer. However, it is unlikely that altered water temperatures would persist much downstream from the pipeline freeze bulb. Water temperature effects would be minor and localized, with negligible potential for minor effects to fish and fish habitats during summer.

Winter water temperature reductions would pose a higher potential risk, particularly at stream crossings with low, but persistent, winter flows. On the North Slope, crossings of sensitive overwintering areas that remain just above freezing all winter could freeze during exceptionally cold winters with the added thermal drop associated with the below-freezing pipeline. Small drainages with persistent low flows of cool water during winter, most common in spreads between the Brooks Range and the Alaska Range, would be most susceptible to winter reductions in water temperatures. If crossings are able to freeze solid, water would be forced to the surface as aufeis and downstream overwintering and spawning habitats could be dewatered. Most streams meeting this risk potential are not heavily used for spawning or overwintering so effects to fish would be minor and infrequent. Most drainages used for summer, fall, and winter spawning by EFH and other fish would be large enough to be unaffected. Appendix D, Table A-1 identifies Mainline stream crossings with identified overwintering habitats in anadromous Pacific salmon spawning areas. Specific identification of potential overwintering areas at proposed stream crossings would require assessment of winter flows during site-specific inspections. However, most streams crossed north of the Alaska Range would have minimal to no flow during winter. In the continuous permafrost region, the pipeline temperature will be a relatively constant 30 °F year-round to prevent thaw settlement of the pipeline. In discontinuous permafrost regions, in order to minimize differential settlement of the pipe relative to that of the ROW, pipeline sections would operate above freezing in the summer months and below freezing throughout the winter months. The average annual discharge temperature would be maintained at or below freezing for the majority of the line. This would ensure overall preservation of permafrost in the vicinity of the pipe. Effects would be minor but long-term.

Erosion

Erosion could continue to occur at Mainline stream crossings, and erosion of the ditch line could affect fish and fish habitat, including EFH and EFH species. Erosion potential through operations of the Mainline would be associated with the same activities described for construction and would include pipeline stream crossings, material sites, and ditch stabilization. In addition, operation of the pipeline could affect the potential for erosion through either frost bulbs or thermal degradation of permafrost that could locally alter water movement at some sites during winter or summer. This could also lead to erosion by constricting the area available below the stream bed, resulting in increased water velocity and erosion. Potential effects to fish and habitat would be much more limited during operations because most sites would be stabilized prior to or early in operations. Construction-related effects could continue into operations at some sites that are persistently difficult to stabilize. Effects would be similar to those described for construction, but the potential limited in overall scope because it would likely only involve a small number of locations. However, the duration would be longer-term, which could lead to indirect habitat altering effects, such as stream channel alterations, habitat shifts, and lowered productivity. These sites would be more likely to have stream level effects on fish use, and if located proximate to important spawning and overwintering areas, could affect local productivity.

To reduce the potential for erosion after the design grade is obtained, cut slopes would be stabilized immediately, and stream banks would be restored per the Applicant's *Plan* and *Restoration Plan*. To protect stream banks and beds from scour erosion, site-specific BMPs would be implemented based on scour and erosion potential at each site. In addition, Project representatives would collaborate with ADF&G to apply appropriate in-stream bank erosion structures to provide post-construction bank stability and reduce erosion. Maintenance of the pipeline ROW at stream crossings would be conducted according to the measures outlined in the Applicant's *Plan* and *Procedures*. Routine inspections would be used to identify areas of erosion, exposed pipeline, and nearby construction activities, to allow for early identification of bank stability problems and minimization of the potential for continuing environmental effects during pipeline operation. With these mitigation measures and BMPs, effects would be short-term and minor.

Barriers to Fish Passage

Barriers to fish passage during operation of the Mainline are not an anticipated effect of the Project, post-construction. Alterations to stream break-up could affect upstream movement of Arctic grayling to spawning habitats during spring if ice dams associated with new aufeis production or enhanced ice thickness at Mainline crossings were to occur. Delays in excess of a few days could affect overall spawning success at some locations. However, Arctic grayling often move over surface and shelf ice to spawning areas during periods of break-up, so they would likely be able to negotiate any Mainline crossings. However, conditions described in various prior sections that could lead to persistent erosion, sedimentation, and to channel changes within fish bearing streams could alter fish passage, depending on the extent of channel changes. Conditions that could lead to impeded fish passage would be identified quickly and rehabilitation of the causal mechanisms would occur. If barriers to fish passage were to occur during operations, the effects would likely be short-term and minor. Barriers to passage that may occur during spawning and overwintering migrations could have minor to moderate effects on local populations, but would likely persist for only one season.

Hydrological Changes

Hydrological changes during operations would be minor. Surface water withdrawal from fish-bearing waters during operations would be limited. Fill placed for additional temporary workspace, workpads, and access roads that remain during operations could have longer-term effects on stream hydrology if they intercept surface flow within drainages and are able to redirect flow outside the drainage. Such situations likely would be remedied quickly through installation of additional cross-drainage pipes to ensure road integrity. Any effects would be short-term and minor and few, if any, would occur in EFH.

Stream Channel Alteration

Stream channel alterations during operations would be minimal and limited to those discussed as potentially occurring during construction of the Mainline, material sources, and continued erosion, as described previously in Section 3.2.7.2.1.1. Stream channel alterations associated with prolonged erosion, sediment inputs, and any condition that alters the ability of a stream to move bedload under its design flow regime (stream type) would change the stream type and alter geomorphic processes. Habitat quality could be degraded and fish use altered. Alterations of critical habitats such as spawning and overwintering habitats, should they occur, would have longer-lasting, moderate effects on fish and potentially EFH species. Maintenance of the pipeline ROW at stream crossings would be conducted according to the measures outlined in the Applicant's *Plan* and *Procedures* to reduce the potential for stream channel alteration. Additional mitigation measures related to the prevention of erosion and sediment input are described previously in the Erosion subsection.

Maintenance Activities

Over the life of the Project, maintenance activities at waterbody crossings could lead to similar short-term, minor impacts as those described for construction but on a significantly smaller scale. However, routine maintenance activities within the ROW would be conducted to ensure ROW integrity and reduce potential impacts to fish and fish habitat over the long-term. In addition, only waterbody crossings that present stabilization issues would likely require actual in-water maintenance. Maintenance of the pipeline ROW would be conducted according to the measures outlined in the Applicant's *Plan* and *Procedures*. Potential impacts to fish and fish habitat from maintenance and repair activities are anticipated to be long-term but intermittent and minor.

If unanticipated contamination is discovered during maintenance activities at the Liquefaction Facility, the Project's *Unanticipated Contamination Discovery Plan* (Appendix I of Resource Report No. 8) would be followed to protect waterbodies and associated fisheries.

3.2.8.2.1.2 PTTL

Routine maintenance activities associated with the PTTL would not be anticipated to have adverse effects on fish. Routine inspections and maintenance would occur during winter when surface waters are largely frozen. Maintenance of belowground river crossings, if needed, could have similar effects to those described for Mainline operations.

3.2.8.2.1.3 PBTL

The PBTL is not anticipated to cross fish-bearing water. Routine maintenance of the PBTL would not impact fish or fish habitat.

3.2.8.2.1.4 Pipeline Aboveground Facilities

No waterbodies would be crossed by the Pipeline Aboveground Facilities. Periodic testing of pipelines and associated discharges would have similar effects on fish and fish habitat as those described previously for water withdrawal and associated discharges (see Section 3.2.8.2.1.1). Overall water needs for periodic testing would be minor in comparison to those required during construction and it is anticipated that potential impacts would be minimal.

Spills

As discussed in Section 3.2.7.2.1.1, minor releases of hydrocarbons (e.g., diesel fuel, lubricants) could result in short-term, minor, direct adverse impacts on juvenile and adult fish, including death or chronic effects. Spills of hazardous liquids, including fuels and lubricants, could occur in any area where these compounds are used or stored and have the potential to damage surface water resources. However, storage of these materials would comply with current regulatory requirements and personnel would be trained for proper handling, storage, disposal, and spill response of potential contaminants, and develop *SPCC Plans* would be developed for facility operations. All petroleum, oil, and lubricant handling required during Project operations would be dictated by the *SPCC Plan*. Storage tanks and containers for fuels and hazardous liquids would be constructed with appropriately sized secondary containment, and oil-filled operational equipment would be managed consistent with the requirements of 40 C.F.R. 112. As such, significant adverse impacts to fish and fish habitat due to contamination from spills or releases are unlikely.

Waste

All waste would be handled in accordance with the Project's *Waste Management Plan* (Appendix J of Resource Report No. 8). This plan addresses hazardous and nonhazardous waste materials and volumes, handling, and disposal in detail. The plan would ensure compliance with all regulations for transportation, treatment, storage, and disposal. Waste management activities would be performed in accordance with the waste management hierarchy. In order of preference, the aim would be avoidance, minimization, reuse, recycle, recover, and lastly disposal. Operation of the Pipeline Aboveground Facilities would generate onsite waste. With adherence to the Project's *Waste Management Plan* procedures and mitigation measures, there would be no expected impacts to fish and fish habitat, including EFH and EFH species, during operations of aboveground facilities.

Maintenance Activities

Planned maintenance activities at compressor stations and meter stations would include routine checks, calibration of equipment and instrumentation, inspection of critical components, and servicing and overhauls of equipment. Unplanned maintenance activities would include investigating problems identified by the natural gas control center and station monitoring systems and the implementation of corrective actions.

Maintenance and repair activities at the Pipeline Aboveground Facilities are anticipated to require minimal site preparation (e.g., excavation) and hydrostatic testing. In addition, maintenance activities would be conducted according to the measures outlined in the Applicant's *Plan* and *Procedures.* Potential impacts to fish and fish habitat from maintenance and repair activities are anticipated to be long-term but intermittent and minor.

If unanticipated contamination is discovered during maintenance activities at the Liquefaction Facility, the Project's *Unanticipated Contamination Discovery Plan* (Appendix I of Resource Report No. 8) would be followed to protect waterbodies and associated fisheries.

3.2.8.2.2 GTP

3.2.8.2.2.1 GTP Facility

Annual water withdrawal from the Putuligayuk River would be required to maintain water levels in the GTP reservoir. Approximately 98 million gallons of water would be required annually to maintain an adequate reserve for operations. Potential effects to resident and anadromous fish using the Putuligayuk River would be minimal. Intake screening would be employed to reduce the potential for fish entrapment, entrainment, and impingement associated with the withdrawal. In addition, water withdrawal would be focused on the annual period of high flow that occurs each spring. Significant long-term effects to fish populations and fish habitat would not be anticipated.

Spills

As discussed in Section 3.2.7.2.1.1, minor releases of hydrocarbons (e.g., diesel fuel, lubricants) could result in short-term, minor, direct adverse impacts on juvenile and adult fish, including death or chronic effects. Spills of hazardous liquids, including fuels and lubricants, could occur in any area where these compounds are used or stored and have the potential to damage surface water resources. However, storage of these materials would comply with current regulatory requirements and personnel would be trained for proper handling, storage, disposal, and spill response of potential contaminants, and an *SPCC Plan* would be developed for operations. All petroleum, oil, and lubricant handling required during Project operations would be dictated by the *SPCC Plan*. Storage tanks and containers for fuels and hazardous liquids would be constructed with appropriately sized secondary containment, and oil-filled operational equipment would be managed consistent with the requirements of 40 C.F.R. 112. As such, significant adverse impacts to fish and fish habitat due to contamination from spills or releases are unlikely.

Waste

Operation of the GTP would generate onsite waste. All waste would be handled in accordance with the Project's *Waste Management Plan* (Appendix J of Resource Report No. 8). This *Plan* addresses hazardous and nonhazardous waste materials and volumes, handling, and disposal in detail. The *Plan* would ensure compliance with all regulations for transportation, treatment, storage, and disposal. Waste management activities would be performed in accordance with the waste management hierarchy. In order of preference, the aim would be avoidance, minimization, reuse, recycle, recover, and lastly disposal.

The GTP would develop two UIC Class I wells that would be used to dispose of Resource Conservation and Recovery Act-exempt liquid waste streams, wastewater, and nonhazardous wastes. The wells would be approximately 6,000 to 7,000 feet deep and thus would extend below the depth of permafrost. It is not anticipated that waterbodies would be impacted from use of the wells and that fish or fish habitat would be impacted.

Maintenance Activities

Maintenance and repair activities at the GTP would require minimal site preparation (e.g., pad maintenance) and hydrostatic testing. No waterbodies would be crossed by the GTP facility. Maintenance and repair activities on the GTP pad are not anticipated to have any adverse effects on fish or fish habitats, including EFH and EFH species.

If unanticipated contamination is discovered during maintenance activities at the GTP, the Project's *Unanticipated Contamination Discovery Plan* (Appendix I of Resource Report No. 8) would be followed to protect waterbodies and associated fisheries.

3.2.8.2.2.2 GTP Associated Infrastructure

Vessel Activity

Routine vessel activity is not anticipated for operation of the GTP. Most materials, supplies, and personnel would use ground or air transportation.

Maintenance Activities

Maintenance and repair activities of the GTP Associated Infrastructure (e.g., reservoir, waterline) are anticipated to require minimal site preparation (e.g., excavation) and hydrostatic testing. Maintenance activities would be conducted according to the measures outlined in the Applicant's *Plan* and *Procedures.* As practicable, maintenance activities could also be planned for the winter when sea ice returns reducing populations of ichthyoplankton, zooplankton, and marine invertebrates, which would further reduce the potential for effects. It is anticipated that any potential impacts to fish and fish habitat would be similar but of a lower magnitude (approximately one-tenth) than those described for construction. Potential impacts to fish, ichthyoplankton, zooplankton, and marine invertebrates, habitat from maintenance and repair activities conducted in marine waters are anticipated to be long-term but intermittent and minor.

3.3 VEGETATION

This section describes the various ecoregions and terrestrial vegetation communities associated with the Project components, including the Liquefaction Facility, approximately 807 miles of underground pipeline, and the GTP. Many vegetation communities are widely distributed throughout the Project areas and within the Project corridor. Because changes in biotic conditions across the Project are reflected and previously described based on ecoregions, this discussion is organized by ecoregions. Where possible, specific vegetation resources associated with the Liquefaction Facility and Interdependent Project Facilities are described.

3.3.1 Project Vegetation Resources and Ecoregions

The Project crosses a diverse array of vegetation communities extending from the Beaufort Coastal Plain Ecoregion across Interior Alaska to the Cook Inlet Basin in Southcentral Alaska (see Appendix B). As discussed in Section 3.2 Fisheries and Aquatic Resource, the description of vegetation communities within the Project area follows the 32 unified Alaska ecoregions based on a unified interagency effort to delineate ecoregion boundaries in Alaska (ADF&G, 2006) (see Figure 3.3.1-1).

3.3.1.1 Liquefaction Facility

The Liquefaction Facility would be located in the Cook Inlet Basin Ecoregion. A description of the terrain and vegetation communities within this ecoregion is provided in the following section.

3.3.1.1.1 Cook Inlet Basin Ecoregion

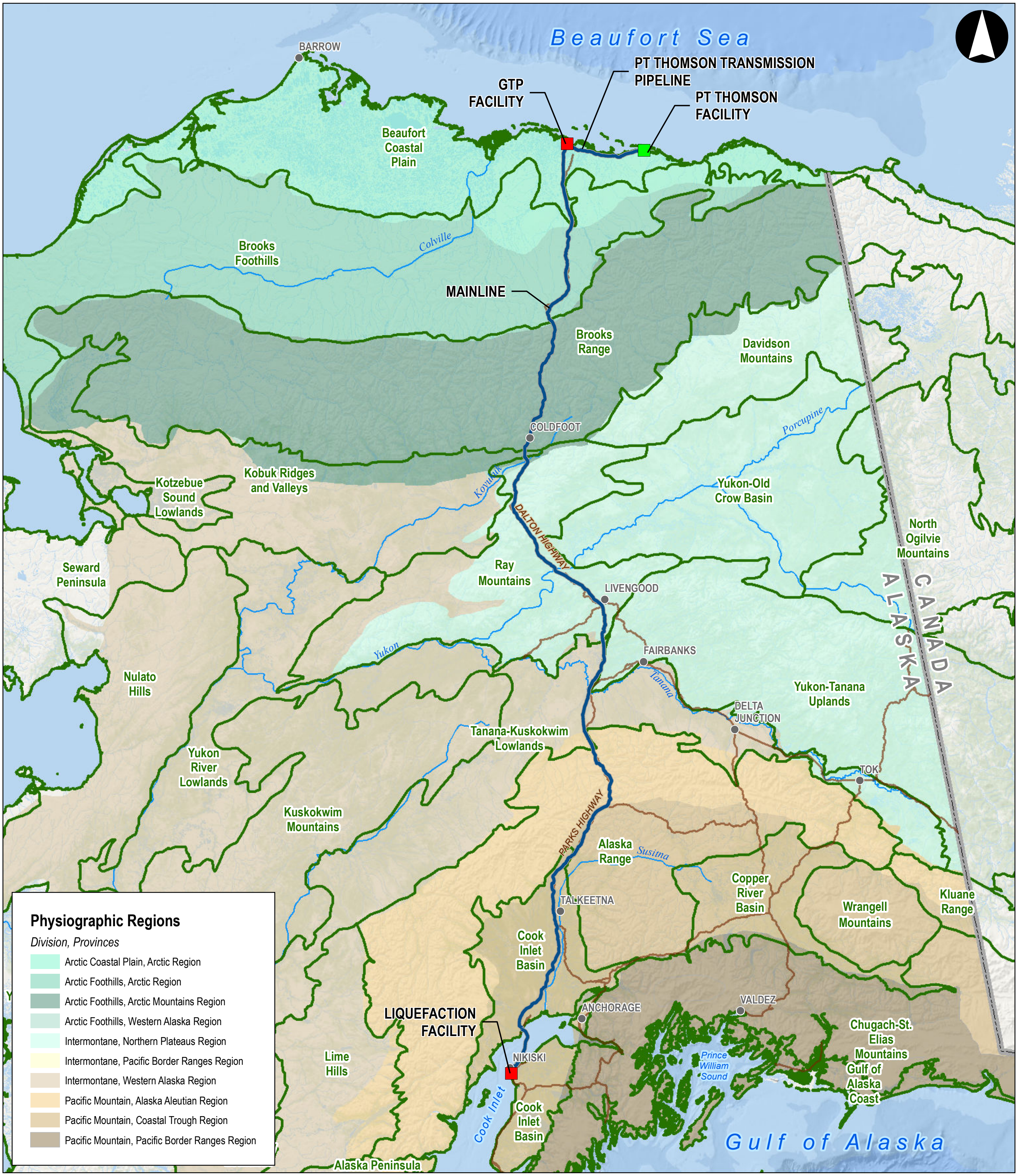
Located in the Southcentral part of Alaska adjacent to Cook Inlet, the Cook Inlet Basin Ecoregion has one of the mildest climates in the state. The climate, the level to rolling topography, and the proximity to the coast have attracted most of the settlement and development in Alaska. The region has a variety of vegetation communities, but is dominated by stands of spruce and hardwood trees. The area is generally free from permafrost. Unlike many of the other nonmontane ecoregions, the Cook Inlet Basin Ecoregion was intensely glaciated.

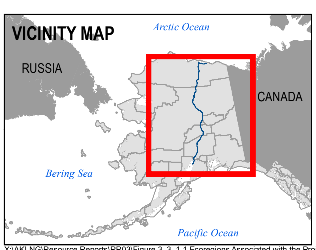
A variety of vegetation communities occur within the Cook Inlet Basin Ecoregion, including needleleaf, broadleaf, and mixed forests, which are the most widespread. Tall scrub communities form thickets on floodplains, along streambanks, and in drainageways. The wettest areas are colonized by tall scrub swamp, low scrub bog, and wet herbaceous vegetation (Gallant et al., 1995).

Cook Inlet marine habitat types include the following: rocky intertidal areas, mudflats and beaches, eelgrass beds, and nearshore, and benthic environments (ADF&G 2006). Rocky intertidal areas are exposed to moderate to strong wave actions, and provide a rocky substrate for communities of invertebrates algae, rockweed, mussels, and barnacles. Cracks, crevices, overhangs, and rock bottoms provide microhabitats. Macroalgal species are prolific, especially during the spring and summer (ADF&G 2006). Mudflats and beaches are characterized by five habitat types: fine-grained sand, coarse-grained sand, mixed sand and gravel, exposed tidal flats, and sheltered tidal flats. Eelgrass beds are found in low intertidal and shallow subtidal sandy mudflats the blades dying off in the fall. The roots and rhizomes, which are dormant during the winter, stabilize the soft substrate, and provide a buffer from tides and storms (ADF&G 2006).

The nearshore marine habitats in the vicinity of the Project area (MOF and Mainline Cook Inlet Crossing) include primarily seagrass and algae. These habitats are further addressed in Section 3.3.6.

The needleleaf forests within the Cook Inlet Basin Ecoregion are dominated by white spruce (*Picea glauca*), black spruce (*Picea mariana*), and Sitka spruce (*Picea sitchensis*). Broadleaf forests are dominated by quaking aspen (*Populus tremuloides*), balsam poplar (*Populus balsamifera*), black cottonwood (*Populus trichocarpa*), and Kenai birch (*Betula kenaica)*. The mixed forest areas are co-dominated by both needleleaf and broadleaf species.





LEGEND

- Project Facility
- Existing Facility
- Alaska Place Names
- Alaska LNG Rev C2 Route
- Major Highways
- Major Rivers
- Ecoregions

0 25 50 100 150 Miles

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ECOREGIONS ASSOCIATED WITH THE PROJECT

FIGURE 3.3.1-1

ALASKA LNG

X:\AKLNG\Resource Reports\RR03\Figure 3_3_1-1 Ecoregions Associated with the Project.mxd

Floodplains and active alluvial areas support relatively pure or mixed stands of Sitka spruce, black cottonwood, balsam poplar, and paper birch. Lower shrubs typically include prickly rose (*Rosa acicularis*), highbush-cranberry (*Viburnum edule*), and devilsclub (*Oplopanax horridus*). Tall scrub swamps are dominated by alder (*Alnu*s spp.) or a combination of alder and willow (*Salix* spp.) with understory consisting of highbush-cranberry, currant (*Ribes* spp.), prickly rose, and Pacific red elder (*Sambucus callicarpa*). Sedges (*Carex* spp.), bluejoint (*Calamagrostis canadensis*), dwarf dogwood (*Cornus canadensis*), and horsetail (*Equisetum* spp.) are typical herbaceous plants. Low scrub bog communities are dominated by low mixed shrubs, tussock-forming sedges, and a mixture of birch, willow, and other low shrubs.

3.3.1.2 Interdependent Project Facilities

3.3.1.2.1 Beaufort Coastal Plain Ecoregion

The Beaufort Coastal Plain Ecoregion occurs west of the U.S.–Canada border along the coast of the Beaufort Sea. This wind-swept plain gradually ascends from the Beaufort Sea coast southward to the foothills of the Brooks Range. The terrain is flat to undulating and is underlain by unconsolidated deposits of marine, fluvial, glaciofluvial, and eolian origin and lacks bedrock (Nowacki et al., 2001). A dry, polar climate dominates throughout the year, with short, cool summers and long, cold winters. Proximity to the Beaufort Sea and abundant sea ice contribute to the cool and frequently foggy summers (EPA, 2010).

Due to low temperatures, permafrost is continuous across the region, except in localized areas below naturally occurring thaw bulbs under large rivers and thaw lakes (Nowacki et al., 2001). Permafrost and other frost processes result in a large variety of surface features such as pingos, ice-wedge polygons, and oriented thaw lakes. The presence of permafrost prevents the drainage of water; therefore, the soils are typically saturated and have thick organic horizons. Thaw lakes make up approximately 50 percent of the surface area and with the prevalence of saturated organic soil; most all of the region is considered wetland. Vegetation is dominated by wet sedge tundra typically with water sedge (*Carex aquatilis*) and cottongrass (*Eriophorum angustifolium*) in drained lake basins, swales, and floodplains; and by sedge-tussock tundra with tussock sedge (*Eriophorum vaginatum*) and diamondleaf willow (*Salix planifolia*); and sedge-*Dryas* tundra with water sedge (*Carex aquatilis*) and mountain-avens (*Dryas integrifolia*) on elevated ridges. Low shrub willow thickets with diamondleaf willow (*Salix planifolia*) grow on well-drained riverbanks (Nowacki et al., 2001; Viereck et al., 1992).

3.3.1.2.2 Brooks Foothills Ecoregion

The Brooks Foothills Ecoregion consists of rolling hills and plateaus that rise from the Beaufort Coastal Plain on the north to the Brooks Range on the south, extending from the Yukon Territory, Canada on the east to the Chukchi Sea on the west. Narrow alluvial valleys, glacial moraines, and outwash are interspersed with linear ridges, buttes, and mesas that are covered with colluvial and eolian deposits (Nowacki et al., 2001). The dry, polar climate dominates. The surface is underlain by thick, continuous permafrost, which impedes drainage such that soils in the active layer are usually saturated and have fairly thick organic horizons. Soils in lower foothills tend to be calcareous, while soils in the upper foothills are frequently acidic (Nowacki et al., 2001). Lakes are infrequent, some streams freeze solid in winter, and braided streams and rivers in the region are highly variable in seasonal discharge (Nowacki et al., 2001)

Vegetation is primarily mixed shrub-sedge tussock tundra with willow thickets along rivers and streams and Dryas tundra on ridges (Nowacki et al., 2001). Typical graminoid plants include tussock cottongrass (*Eriophorum vaginatum*) and Bigelow sedge (*Carex bigelowii*); typical low shrubs include dwarf birch (*Betula nana*), crowberry (*Empetrum nigrum*), Labrador tea (*Ledum decumbens*), and mountain cranberry (*Vaccinium vitis-idaea*; Gallant et al., 1995). Calcarious areas support sedge-Dryas tundra with mountain-avens (*Dryas* spp.; Nowacki et al., 2001).

3.3.1.2.3 Brooks Range Ecoregion

The Brooks Range Ecoregion extends from the Richardson Mountains in the northern Yukon and traverses east/west through much of northern Alaska. Accreted terrains originating from the Arctic Ocean underlie most of the Books Range with the high central portion having steep angular summits of sedimentary and metamorphic rock draped with rubble and scree (Nowacki et al., 2001). The dry, polar climate along this range has short, cool summers and long, cold winters. Air temperatures decrease rapidly with rising elevation, but climate is variable due to aspect, winds, and other factors. Major mountain passes can be subject to strong outflow winds, causing severe wind chill conditions (Wiken et al., 2011).

Valleys and lower mountain slopes on the northern side of the range are covered by mesic shrub and herbaceous communities of shrub-sedge tussock tundra with willow thickets along rivers and streams (Nowacki et al., 2001). Alpine tundra and barrens dominate at higher elevations along the entire crest of the range (Wiken et al., 2011). Alpine tundra vegetation consists of lichens, mountain-avens (*Dryas* spp.), and intermediate to dwarf ericaceous shrubs, sedge (*Carex* spp.), mosses, and cottongrass (*Eriophorium angustifolia*) in wetter sites. Subalpine vegetation on the southern portion of the ecoregion consists of discontinuous open stands of dwarf white spruce (*Picea glauca*) in a matrix of willow (*Salix* spp.), dwarf birch (*Betula nana*), and Labrador tea (*Ledum decumbens*) (Nowacki et al., 2001).

3.3.1.2.4 Kobuk Ridges and Valleys Ecoregion

The Kobuk Ridges and Valleys Ecoregion is a series of paralleling ridges and valleys. This diagnostic feature is created in part by high-angle reverse faults and interceding troughs. This area was overridden by past ice sheets descending from the north. Today, immense U-shaped valleys harbor large rivers that originate in the Brooks Range. The broad valleys are lined with alluvial and glacial sediments, whereas the intervening ridges are covered with rubble. Thin to moderately thick permafrost underlies most of the area. A dry continental climate prevails with long cold winters and short cool summers. Frigid conditions are reinforced during the winter as the valleys serve as cold-air drainages for the Brooks Range (Wiken et al., 2011).

Forests and woodlands dominate much of the valley bottoms and mountainsides with black spruce (*Picea mariana*) in wetland bogs, white spruce (*Picea glauca*) and balsam poplar (*Populus balsamifera*) along rivers, and white spruce, Alaska paper birch (*Betula neoalaskana*), and quaking aspen (*Populus tremuloides*) on well-drained uplands. Tall and short shrublands of willow (*Salix* spp.), birch (*Betula* spp.), and alder (*Alnus* spp.) communities occur on ridges. Trees become increasingly sparse, less robust, and restricted to lower elevations in the west. (Nowacki et al., 2001).

3.3.1.2.5 Ray Mountains Ecoregion

The Ray Mountains Ecoregion is an overlapping series of compact, east-west trending ranges underlain by the Ruby terrain that includes the low hills both north and south of the Yukon River. The Ray Mountains consist of metamorphic bedrock usually covered with rubble, and soils are subsequently shallow and rocky. Permafrost is generally discontinuous and ranges from thin to moderate thickness (Nowacki et al., 2001). The climate is strongly continental with dry, cold winters and somewhat moist, warm summers. Precipitation increases with elevations (Wiken et al., 2011).

The vegetation throughout this ecoregion is dominated by black spruce woodlands and dwarf tree communities, while closed and open mixed needleleaf and deciduous forests of white spruce, Alaska paper birch (*Betula neoalaskana*), and aspen (*Populus tremuloides*) usually are restricted to warm, south-facing slopes (Nowacki et al., 2001). Floodplains are dominated by white spruce, balsam poplar (*Populus balsamifera*), alders (*Alnus* spp.), and willows (*Salix* spp.). Forest understory varies greatly with stand density and the amount of moisture on the forest floor. Common tall shrubs found in various mixtures in white spruce forests include green alder (*Alnus crispa*) and Bebb willow (*Salix bebbiana*) and common low shrubs include Labrador tea, blueberry (*Vaccinium uliginosum*), and especially mountain cranberry (*Vaccinium vitus-idaea*). In mixed forest stands on floodplains, horsetails (*Equisetum* spp.) are a major ground cover, with feathermosses and foliose lichens prominent in the moist habitats (Nowacki et al., 2001). Shrub birch and *Dryas*-lichen tundra prevail at higher elevations. Forest fires only occasionally occur in the summer in the Ray Mountains subregions and are an important part of the ecosystem (Nowacki et al., 2001).

3.3.1.2.6 Yukon-Tanana Uplands Ecoregions

The Yukon-Tanana Uplands Ecoregion consists of broad, rounded hills rising 500 to 1,500 feet above adjacent valleys (up to 3,000 feet total elevation) with gentle side slopes. Surficial deposits are bedrock and rubble on ridges and upper slopes, colluvium on lower slopes, and alluvium in narrow valleys. Discontinuous permafrost occurs throughout the ecoregion, particularly on north-facing slopes. The climate is continental with cold winters and warm summers.

Vegetation consists of white spruce, resin birch, and quaking aspen dominating south-facing slopes. Black spruce woodlands occur on north facing slopes, and black spruce woodlands and tussock bogs cover valley floors. Low birch ericaceous shrub and *Dryas*-lichen tundra are common at upper elevations.

3.3.1.2.7 Tanana-Kuskokwim Lowlands Ecoregion

The Tanana-Kuskokwim Lowlands Ecoregion within the Project area occupies a large alluvial plain along the Tanana River and tributaries and extends through the lower-lying areas from the Little Chena River, north of Fairbanks, to the Tetlin National Wildlife Refuge (NWR). The undifferentiated sediments of fluvial and glaciofluvial origin are capped by varying thicknesses of eolian silts and organic soils (Nowacki et al., 2001). Surface moisture is rather abundant due to the gentle topography, patches of impermeable permafrost, and poor soil drainage. Permafrost is thin and discontinuous, and temperatures are near the melting point. Collapse-scar bogs and fens caused by retreating permafrost are frequent (Nowacki et al., 2001). The Tanana-Kuskokwim Lowlands Ecoregion has a dry Subarctic, continental-influenced climate, marked by cool to mild summers and long cold winters. Summer temperatures can be relatively warm (Wiken et al., 2011).

Boreal forest communities of needleleaf, deciduous, and mixed forest occur resulting from the interplay of permafrost, surface water, fire, local elevation relief, and hill slope aspect. Lightning fires are very frequent. Black spruce woodland and dwarf tree communities occur in bogs, with tamarack in low wet areas. White spruce and balsam poplar are common along rivers. Active floodplains and river bars support tall stands of alders and willows. South-facing slopes support stands of white spruce, paper birch, and quaking aspen (*Populus tremuloides*) (Nowacki et al., 2001). The coldest, wettest areas on permafrost flats support birch-ericaceous shrubs and sedge tussocks. Wet sedge meadows and aquatic vegetation occur in sloughs and oxbow ponds. Tall willow, resin birch (*Betula glandulosa*), and green alder communities are scattered throughout (Nowacki et al., 2001).

3.3.1.2.8 Alaska Range Ecoregion

The mountains of the Alaska Range are very high and steep. The ecoregion is covered by rocky slopes, icefields, and glaciers. Much of the area is barren of vegetation. Dwarf shrub communities are common at higher elevations and on windswept sites where vegetation does exist. The Alaska Range has a continental climate regime, but due to the extreme height of the ridges and peaks, the annual precipitation at higher elevations is similar to ecoregions having a maritime climate.

Open needleleaf forests and woodlands occur on well-drained sites in some of the valleys and on lower hillslopes (Gallant, et al. 1995). Dwarf scrub communities are typically dominated by mountain-avens such as *Dryas octopetala*, *D. intergrifolia*, and *D. drummondii; Vaccinium* spp.; and *Cassiope tetragona*, *Arctostaphylos alpine*, and *Arctostaphylos rubra*. Other plants may include sedges (*Carex* spp.) and alpine sweetgrass (*Anthoxanthum monticola*). Lichens, forbs, and mosses typically form the ground layer of these communities.

Low shrub communities are dominated by birch (*Betula* spp.) and willows (*Salix* spp.). Other shrubs commonly found in these communities include red-fruit bearberry (*Arctostaphylos rubra*), bog blueberry, (*Vaccinium uliginosum*), mountain-avens (*Dryas* spp.), netleaf willow (*Salix reticulate*) and Arctic willow (*Salix arctica*). Common herbs are fescue grass (*Festuca altaica*), alpine sweetgrass (*Anthoxanthum monticola*), Bigelow sedge (*Carex bigelowii*), Arctic sweet coltsfoot (*Petasites frigidus*), and Arctic worm-wood (*Artemisia arctica*).

Tall scrub communities occur at altitudinal treeline and along streambanks, drainages, and on floodplains. These communities are dominated by willow (*Salix* spp.), alder (*Alnus* spp.), and birch (*Betula* spp.). There are low shrubs, such as Alaska bog willow (*Salix fuscescens*), Beauverd spirea (*Spirea beauverdiana*), narrow leaf Labrador tea (*Ledum decumbens*), and bog blueberry (*Vaccinium uliginosum*). Understory herbs include polar grass (*Arctagrostis latifolia*), fescue grass (*Festuca altaica*), Bigelow sedge (*Carex bigelowii*), and large flowered wintergreen (*Pyrola grandiflora*).

Needleleaf forest and woodlands are dominated by white spruce (*Picea glauca*) or white spruce mixed with black spruce (*Picea mariana*). The understory typically consists of low woody vegetation, such as eightpetal mountain avens (*Dryas octopetala*), red-fruit bearberry (*Arctostaphylos rubra*), Arctic willow

(*Salix arctica*), crowberry (*Empetrum nigrum*), and mountain cranberry (*Vaccinium vitis-idaea*) (Gallant et al., 1995).

3.3.1.2.9 Cook Inlet Basin Ecoregion

The Cook Inlet Basin Ecoregion is described in Section 3.3.1.1.

3.3.2 Terrestrial Plant Communities

Many plant communities are widely distributed throughout Alaska and within the Project area. Because changes in biotic conditions across Alaska are reflected and previously described based on ecoregions, this discussion is organized by ecoregions.

One tree that is widely distributed throughout Alaska was previously considered and is referenced throughout most cited ecoregion descriptions as a single species, the paper birch (*Betula papyrifera*). More recently, three species of birch trees have been recognized in Alaska: Alaska paper birch (*Betula neoalaskana* Sarg.), Kenai birch, and western paper birch (*Betula papyrifera* Marshall; Viereck and Little, 2007). Two of these birch tree species occur in the Project area—the Alaska paper birch and the Kenai birch. Alaska paper birch trees are found to the tree line in the Project area south of the Brooks Range throughout Interior and Southcentral Alaska to the central Kenai Peninsula (Viereck and Little, 2007). The Kenai birch occurs south of and along the Yukon River in similar habitats as the Alaska paper birch. Kenai birch trees are less abundant, with a patchy distribution north of the Cook Inlet Basin Ecoregion. These birch trees are distinguished by leaf length, shape, and bark coloration (Viereck and Little, 2007). The Kenai birch and Alaska paper birch also are known to hybridize (Viereck and Little, 2007). The western paper birch occurs in southeast Alaska, outside of the Project area (Viereck and Little, 2007).

Where possible, specific plant resources associated with the Liquefaction Facility and Interdependent Project Facilities are described. Descriptions are generally consistent with Level III of Viereck's Alaska Vegetation Classification System (Viereck et al., 1992). This classification is based on (Level I) dominant growth forms (tree, shrub, herb), (Level II) canopy height, and (Level III) closure, general soil moisture and salinity, and dominant plants. Vegetation communities crossed by the Project footprint based on Project-specific vegetation mapping is provided in Table 3.3.2-1. For ease in presentation and to avoid duplication, Table 3.3.2-1 is organized with north to south columns running left to right: the Liquefaction Facility would be constructed in the Cook Inlet Basin Ecoregion, which is in the last column of the table.

TABLE 3.3.2-1

Vegetation Communities Crossed by the Project by Ecoregion (acres)

General Designation (Level II)[b]	Subclass (Level III)[b]	Common Plant Communities	Arctic Tundra[a]			Beringia Boreal[a]				Alaska Range[a]	
			BCP	BF	BR	KRV	RM	YTU	TKL	AR	CI
FORESTED											
IA Evergreen Forest	1 Closed Evergreen Forest 2 Open Evergreen Forest 3 Woodland Evergreen Forest	• White Spruce • Black Spruce • Black Spruce-White Spruce • Black Spruce-Tamarack			701	3	1,213	223	695	1,238	317
IB Deciduous Forest	1 Closed Deciduous Forest 2 Open Deciduous Forest 3 Woodland Deciduous Forest	• Alaska/Kenai Birch • Quaking Aspen) • Birch-Aspen • Balsam Poplar • Black Cottonwood			1		270	113	310	17	838
IC Mixed Forest	1 Closed Mixed Forest 2 Open Mixed Forest 3 Woodland Mixed Forest	• Spruce-Birch • White Spruce-Birch- Quaking Aspen-Balsam Poplar • White or Black Spruce- Birch-Balsam Poplar • Balsam Poplar-White spruce			104	3	1,062	523	458	456	3,599
SHRUB											
IIA Dwarf Tree Scrub	1 Closed Dwarf Tree Scrub 2 Open Dwarf Tree Scrub 3 Woodland Dwarf Tree Scrub	• Black Spruce			315	28	468	1	89	112	83
IIB Tall Scrub	1 Closed Tall Scrub 2 Open Tall Scrub	• Alder • Willow • Alder-Willow • Resin Birch (*Betula gladulosa*)		37	135	8	462	104	122	445	65
IIC Low Scrub	1 Closed Low Scrub 2 Open Low Scrub	• Low Willow • Low Dwarf Birch (*Betula nana*)- Ericaceous Shrub Dwarf Birch-Willow • Low Resin Birch-Ericaceous Shrub	15	586	1,163	46	1,231	38	281	733	275

TABLE 3.3.2-1

Vegetation Communities Crossed by the Project by Ecoregion (acres)

General Designation (Level II)[b]	Subclass (Level III)[b]	Common Plant Communities	Arctic Tundra[a]			Beringia Boreal[a]				Alaska Range[a]	
			BCP	**BF**	**BR**	**KRV**	**RM**	**YTU**	**TKL**	**AR**	**CI**
		• Mixed Shrub-Sedge Tussock Tundra									
IIC Dwarf Scrub	1 Dryas Dwarf Scrub 2 Ericaceous Dwarf Scrub 3 Willow Dwarf Scrub	• Dryas-Sedge Tundra • Vaccinium Tundra • Cassiope Tundra	116	416	222		135		1		2
IIIA Graminoid Herbaceous	1 Dry Graminoid Herbaceous 2 Mesic Graminoid 3 Herbaceous Wet Graminoid Herbaceous	• Dry Fescue • Midgrass-Shrub/Herb • Bluejoint Meadow • Bluejoint-Herb • Tussock Tundra • Sedge Meadow	4,005	915	264	8	299	10	38	70	217
IIIB Forb Herbaceous	1 Dry Forb Herbaceous 2 Mesic Forb Herbaceous 3 Wet Fob Herbaceous	• Alpine Herbs • Mixed Herbs • Fireweed • Large Umbels					76				74
IIIC Bryoid Herbaceous	1 Lichens 2 Mosses	• Crustose/Foliose Lichens • Wet/Dry Mosses									
IIID Aquatic Herbaceous	1 Freshwater aquatic herbaceous 2 Brackish water aquatic herbaceous 3 Marine aquatic herbaceous	• Pondlily • Common marestail • Aquatic buttercup • Burreed	3								3

Source: Project Vegetation Mapping

[a] Ecoregion Abbreviations: BCP – Beaufort Coastal Plain; BF – Brooks Range Foothills; BR – Brooks Range; KRV – Kubuk Ridges and Valleys; RM – Ray Mountains; YTU – Yukon-Tanana Uplands; TKL – Tanana-Kuskokwim Lowlands; AR – Alaska Range; CI = Cook Inlet Basin

[b] Field data points by vegetation type: IA1 5, IA2 1, IA3 16, IB1 9, IB2 26, IB3 11, IC1 3, IC2 53, IC3 16, IIA1 2, IIA2 31,IIA3 13, IIB1 17, IIB2 38, IIC1 11, IIC2 51, IID1 2, IID2 5, IID3 0, IIIA1 2, IIIA2 33, IIIA3 22, IIIB1 1, IIIB2 1, IIB3 0, IIIC1 0, IIIC2 0, IIID1 0, IIID2 0, IIID3 0

3.3.3 Non-native and Invasive Plants

A non-native plant is one introduced with human help (intentionally or accidentally) to a new place or new type of habitat where it was not previously found. Invasive plants are non-native to the ecosystem under consideration, and whose introduction causes or is likely to cause economic or environmental harm or harm to human health (AKNHP 2017). Non-native landscape plants can play the same role as other non-native and invasive plants. The revegetation seed mixture and restoration plan would be developed to meet approval and guidance by the Department of Agriculture and other relevant agencies.

Non-native plants found in Alaska can be associated with natural processes (fluvial, animal, and fire), but are primarily correlated with anthropogenically disturbed areas (roads, trails, recreation sites, and material sites). The Alaska Natural Heritage Program (AKNHP) documented that 70 percent of recorded infestations (68,485 of 97,828 total records) of non-native plants were due to fill importation projects such as roads and railroad grades; 2.4 percent and 1.7 percent for mowing and material extraction, respectively (Nawrocki et al., 2011). Most infestations found in Alaska are associated with anthropogenic activities and are relatively small in area (less than 0.01 acre), which would allow for them to be more easily eradicated (Nawrocki et al., 2011).

Non-native and invasive plants potentially occurring in the Project area are listed in Table 3.3.3-1. Project construction could propagate non-native and invasive plants through several pathways. Streams can transport and spread these plants if the disturbance occurs along waterways. However, propagation would likely be limited to the area of disturbance, which would be mitigated. These potential pathways include:

- Transport and use of construction equipment and personnel within Alaska and from the continental United States where invasive and non-native plants are common;

- Spread of invasive and non-native plants already associated with existing ROWs (Alaska Railroad Corporation [ARRC], TAPS, and highways) and material sites by construction equipment and personnel;

- Transport of invasive plant material from within Alaska and from the continental United States via: straw, erosion control materials, construction mats, machinery, footwear and clothing, hand tools, and vehicle tires; and

- Seed mixtures sourced from within Alaska and from the continental United States used to revegetate exposed soils could contain invasive and non-native seeds. However, mixtures have a maximum allowable weed seed limit.

The non-native plant ranking system applied by Nawrocki et al. (2011) consisted of a climate screening and an evaluation of the ecological impacts, biological characteristics and dispersal ability, ecological amplitude and distribution, and feasibility of control. Climate screening evaluated potential for non-native plants to become established in the Pacific Maritime, Interior-Boreal, and Arctic-Alpine ecogeographic regions based on known occurrences in similar climates. Evaluations were weighted according to their relative importance with: ecological impacts assigned 40 possible points, biological characteristics and ecological attributes each assigned 25 possible points, and feasibility of control assigned 10 possible points. Ecological impacts were emphasized because of the extensive natural areas in the state and interest of land managers in protecting those areas. The overall invasiveness ranks are scaled from 0 to 100, with 0 representing a plant that poses no threat to native ecosystems and 100 representing a plant that poses a major threat to native ecosystems. Ecological impacts and biological characteristics were found to be the best predictors of overall invasiveness score; however, the ability of non-native plants to establish and spread in Alaska was not necessarily correlated with the degree of ecological impact (Nawrocki et al., 2011).

Invasive, non-native plants thrive and establish quickly on recently disturbed soils. Invasive plants are aggressive in growth and reproduction, are generalists, and are tolerant to many environmental conditions. Thus, they outcompete and displace native plants once exposure has allowed establishment. Non-native plants with the highest ranking for invasiveness reported from the Project area include bird vetch (*Vicia cracca*), waterweed (*Elodea* sp.), white sweetclover (*Melilotus alba*), and reed canarygrass (*Phalaris arundinacea)* (Table 3.3.3-1; AKEPIC, 2014). White sweetclover has the most extensive distribution due to its adaptable properties and introduction into Alaska in the early 1900s (ADNR, 2011). The AKNHP has reported white sweetclover in the Arctic, Interior, and coastal areas of Alaska where it thrives along roadsides and disturbed areas. White sweetclover is currently found in the area of the Mainline corridor from the Alaska to Brooks Ranges (AKEPIC, 2014). White sweetclover degrades natural grasslands and riparian areas and is fire tolerant. Its presence alters soil characteristics; this plant is very prolific with each plant capable of producing up to 350,000 seeds that may remain viable for up to 81 years (AKNHP, 2011). Three alien species of seaweeds have been identified in Alaska: the seagrass (*Ceramium kondoi*), a purple coldwater seaweed (*Porphyra purpurea*), and the Japanese wireweed (*Sargassum muticum*). These species have not been classified as invasive and are not known to occur within the Project area. In addition to these species, Dead Man's Fingers (*Codium fragile*), native to Japan, has been identified in Prince William Sound, but is not known to occur in the Project area (NMFS, 2011c).

TABLE 3.3.3-1

Invasive Plant Occurrence by Facility and Ecoregion

Common Name	Scientific Name	Invasive Rank[c]	Liquefaction Facility	Mainline [a, b]								
				Arctic Tundra			Beringia Boreal				Cook Inlet Basin	
			CI	BCP	BF	BR	KRV	RM	YTU	TKL	AR	CI
Alsike clover	*Trifolium hybridum L.*	57	0	0	0	0	0	4	0	0	0	0
Annual bluegrass	*Poa annua L.*	46	0	0	0	0	0	0	0	0	1	0
Bird vetch	*Vicia cracca L. ssp. cracca*	73	0	0	0	0	0	1	0	0	1	0
Common dandelion	*Taraxacum officinale F.H. Wigg.*	58	2	0	0	2	0	11	0	0	1	0
Common pepperweed	*Lepidium densiflorum Schrad.*	25	0	0	0	0	0	7	0	0	0	0
Common plantain	*Plantago major L.*	44	0	0	0	4	0	9	0	0	0	0
Foxtail barley	*Hordeum jubatum L.*	63	0	0	0	10	0	18	0	0	3	0
Herb sophia	*Descurainia sophia (L.) Webb ex Prantl*	41	0	0	0	0	0	1	0	0	0	0
Lambsquarters	*Chenopodium album L.*	37	0	0	0	0	0	4	0	0	0	0
Narrowleaf hawksbeard	*Crepis tectorum L.*	56	0	0	0	1	0	15	0	0	3	0
Narrowleaf hawkweed	*Hieracium umbellatum L.*	51	0	0	0	0	0	2	0	0	0	0
Oxeye daisy	*Leucanthemum vulgare Lam.*	61	0	0	0	1	0	0	0	0	0	0
Pineappleweed	*Matricaria discoidea DC*	32	0	0	0	1	0	9	0	0	1	0
Prostrate knotweed	*Polygonum aviculare L.*	45	0	0	0	1	0	6	0	0	1	0
Reed canarygrass	*Phalaris arundinacea L.*	83	1	0	0	0	0	0	0	0	0	0
Smooth brome	*Bromus inermis Leyss.*	62	0	0	0	0	0	2	0	0	0	0
Spreading bluegrass or Kentucky bluegrass	*Poa pratensis L. ssp. irrigata (Lindm.) H. Lindb. or Poa pratensis L. ssp. pratensis*	52	0	0	0	0	0	1	0	0	0	0
White clover	*Trifolium repens L.*	59	0	0	0	0	0	0	0	0	0	1
White sweetclover	*Melilotus alba Medikus*	81	0	0	0	1	0	27	0	0	3	0
Yellow sweetclover	*Melilotus officinalis (L.) Lam.*	69	0	0	0	0	0	0	0	0	2	0
Yellow toadflax	*Linaria vulgaris P. Mill.*	69	1	0	0	0	0	0	0	0	0	0

TABLE 3.3.3-1

Invasive Plant Occurrence by Facility and Ecoregion

Common Name	**Scientific Name**	**Invasive Rank[c]**	**Liquefaction Facility**	**Mainline [a, b]**									
				Arctic Tundra			**Beringia Boreal**				**Cook Inlet Basin**		
			CI	**BCP**	**BF**	**BR**	**KRV**	**RM**	**YTU**	**TKL**	**AR**	**CI**
Total Number of Invasive Plant Occurrences			4	0	0	21	0	117	3	0	16	1
Number of Invasive Plant Species in All Occurrences			3	0	0	8	0	15	3	0	9	1

Source: AKEPIC, 2014 – Alaska Exotic Plants Information Clearinghouse (a clearing house of data from numerous sources from 1901-2016).

[a] Within construction footprint representing the Mainline. No invasive plant records occur in the vicinity of the GTP or PTTL on the Beaufort Coastal Plain Ecoregion, and the Kubuk Ridges and Valleys and Tanana-Kuskokwim Lowlands.

[b] Ecoregion Abbreviations: BCP – Beaufort Coastal Plain; BF – Brooks Range Foothills; BR – Brooks Range; KRV – Kubuk Ridges and Valleys; RM – Ray Mountains; YTU – Yukon-Tanana Uplands; TKL – Tanana-Kuskokwim Lowlands; AR – Alaska Range; CI = Cook Inlet Basin

[c] Invasiveness rank is calculated based on a species' ecological impacts, biological attributes, distribution, and response to control measures. The ranks are scaled from 0 to 100, with 0 representing a plant that poses no threat to native ecosystems and 100 representing a plant that poses a major threat to native ecosystems (Nawrocki et al., 2011).

[d] *Elodea* spp noted as *Elodea Canadensis* and *Elodea nuttallii* are known to hybridize.

3.3.4 Forest Pests and Disease

Forest pests and diseases can be spread through vegetation clearing, ground disturbance, and revegetation, or can be exacerbated by stress on trees from changes in microclimate or soil moisture caused by construction of facilities. Existing forest damage detected using aerial surveys caused by defoliating insects, diseases, and abiotic factors affected 3.9 percent of the 32.2 million acres of forest surveyed in Alaska in 2014 (Heutte and Dubois, 2015). This aerial survey employed aerial-sketch mapping to observe and document forest change events from aircraft. Forest damage increased by 45 percent from 2013, with much of the change due to increases in birch with thin crowns, as well as increases in willow, spruce, cottonwood, and mixed hardwood defoliation (Table 3.3.4-1).

TABLE 3.3.4-1

Forest Insect and Disease Activity During 2013 and 2014 in Alaska and Potential Occurrence within the Project Area

Damage	Hosts	Liquefaction Facility	Interdependent Project Facilities	Total Affected (thousand acres) 2013	Total Affected (thousand acres) 2014
Alder defoliation	Leaf roller (*Epinotia solandriana)* Striped alder sawfly (*Hemichroa crocea*)	X	X	133.1	176.9
Aspen defoliation	Aspen leaf blight (*Marssonia populi*) Aspen leaf miner (*Phyllocnistis populiella*) Large aspen tortrix (*Choristoneura conflictana*)		X	102.4	138.6
Birch defoliation	Birch aphid (*Euceraphis betulae*) Birch leaf miners (*Profenusa thomsoni*, *Heterarthrus nemoratus*, *Fenusa pumila*) Leaf roller (*Epinotia solandriana*) Spear-marked black moth (*Rheumaptera hastata*)	X	X	354.9	586.7
Cottonwood defoliation	Leaf beetles (*Chrysomela* spp., *Phratora* spp., *Macrohaltica* spp.) Leaf blotch miner (*Phyllonorycter nipigon*) Leaf roller (*Epinotia solandriana*)	X	X	19.5	53.4
Spruce mortality	Spruce beetle (*Dendroctonus rufipennis*) Northern spruce engraver (*Ips perturbatus*)	X	X	35.1	22.1
Willow defoliation	Leaf blotch miner (*Micrurapteryx salicifoliella*) Willow rust (*Melampsora epitea*)		X	28.2	149.5

Source: Holsten et al., 2008; Heutte and Dubois, 2014 & 2015, Map 1, Tables 1 and 2

There are no currently recognized serious exotic tree pathogens of native trees that have been introduced or have become established in Alaska (Graham and Heutte, 2014). The vastness of the state and limited transportation corridors may delay detection of invasive pathogens, however, and pathogens are often difficult to detect and identify. Potential invasive tree pathogens with potential native hosts and invasiveness rankings that could affect trees within the Project area are listed in Table 3.3.4-2. Importation and movement of live plant materials is the primary pathway for introduction of plant pathogens (Graham and Heutte, 2014).

TABLE 3.3.4-2

Potential Invasive Tree Pathogens and Diseases for Trees that Occur in the Project Area

Pathogen	Disease	Potential Alaskan Host Trees/Plants	Currently in Alaska	Invasive Rank
Chrysomyxa abietis (Wallr.) Unger	Spruce needle rust	Spruce	No	High
Chrysomyxa ledi var. *rhododendri* (de Bary.) Savile	Rhododendron-spruce needle rust	Spruce and Rhododendron	No	Moderate
Melampsora larici-tremulae Kleb.	Poplar rust	Aspen and Larch	No	Moderate
Phytopthora ramorum Werres deCock Man in't Veld	Sudden oak death	Rhododendron, Viburnum, Salmonberry	No	Low
Phytophthora alni ssp. *unifomis* Brasier and SA Kirk	Alder phytophthora	Alder	Yes	Low[a]
Taphrina betulae (Fckl.) Johans.	Birch leaf curl	Birch	No	Low
Taphrina betulina Rostr.	Birch witches broom	Birch	No	Low
Valsa hariotii	Valsa canker	Aspen, Cottonwood, Willow	No	Low

Source: Graham and Heutte, 2014

[a] *Phytophthora alni* was detected in Alaska in 2007. High genetic diversity and lack of damage to native alder suggest that this pathogen has long been established and is not invasive.

3.3.5 Unique, Sensitive, and Protected Vegetation Communities

3.3.5.1 Timber and Non-Timber Forest Resources

Alaska timber products include: lumber, finished house logs, log homes, energy wood products such as wood pellets and firewood, log furniture, roundwood, sawlogs, tonewood for musical instruments, and novelty items like bowls, spoons, mugs, and knife handles (Berg et al., 2011). Trees used for timber products from Interior to Southcentral Alaska within the Project area include Alaska paper birch, Kenai birch, Sitka spruce (*Picea sitchensis*), white spruce (*Picea glauca*), black spruce (*Picea mariana*), western hemlock (*Tsuga heterophylla*), balsam poplar (*Populus balsamifera*), black cottonwood (*Populus trichocarpa*), quaking aspen (*Populus tremuloides*), and mountain ash (*Sorbus* spp.). The volume of trees on timberlands crossed by the construction ROW was estimated using the U.S. Department of Interior's Disposable Timber Volume Inventory database. These data indicated that clearing of the construction ROW would result in the clearing of approximately 2.0 million cubic feet of deciduous timber resources and 5.2 million cubic feet of coniferous timber resources (Alaska LNG 2016).

Alaska's diverse non-timber forest products (NTFP) or special forest products include: bark, berries, buds and tips, burls and galls, cones, conks, cuttings, diamond willow stems and trunks, evergreen boughs, floral greenery, leaves and flowers of woody plants, lichens, mosses and liverworts, mushrooms, tender edible shoots, stems, leaves and/or flowers of non-wood perennials, roots, seed heads, seeds, and transplants (Pilz, 2006). NTFPs can be used to produce products for sale or personal use such as bark for weaving, basketry, dyes, and medicine; syrup, berries, shoots, stems, leaves, flowers, roots, mushroom, and tips for edible goods; mature stems, leaves, flowers, evergreen boughs, cones, buds and tips, seed heads, and conks for crafts and artwork (ADNR, 2008). The Project area crosses a variety of vegetation communities that contain NTFP. Table 3.3.5-1 lists plants with documented historical or contemporary use with their general locations.

TABLE 3.3.5-1

Non-Timber Forest Products Potentially Occurring in the Project Area

Common Name	Scientific Name	Use	Regional Occurrence
COMMERCIAL OR MEDICINAL PLANTS, DYES			
Alders	*Alnus* spp.	Bark for dyes and medicine, branches and stems	Widely used
Anemone	*Anemone* spp.	Burned to drive away mosquitoes; food; medicinal (with caution)	Interior
Birch	*Betula* spp.	Bark, transplants, burls and galls, branches, and stems	Widely used
Birch fungus	*Phellinus tremulae*	Ashes mixed with snuff or tobacco	Widely used
Chokecherry	*Prunus virginiana*	Dyes and medicine	Southcentral
Common juniper	*Juniperus communis*	Tea for colds; edible berry (with caution)	Interior, widely used
Currant	*Ribes* spp.	Bark for dyes and medicine	Widely used
Devil's club	*Oplopanax horridus*	Medicinal	Southcentral
Dwarf fireweed, river beauty	*Chamerion latifolium* (previously *Epilobium latifolium*)	Seed fluff in padding or clothes	Widely used
Elderberry	*Sambucus* spp.	Bark used for dyes and medicine	Southcentral
Ferns	*Dryopteris* spp.	Medicinals; bedding and padding	Widely used
Fireweed	*Chamerion angustifolium* (formerly *Epilobium angustifolium*)	Cord (fishing nets); seed fluff in padding or clothes	Widely used
Horsetail, mouse food	*Equisetum* spp.	Abrasives for polishing; basketry; possible medicinal	Subarctic
Kinnickinnick, bearberry	*Arctostaphylos uva-ursi*	Medicinal tea; wash; smoke mixture	Widely used
Nettles	*Urtica* spp.	Fiber; tonic	Widely used
Pineapple weed	*Matricaria discoidea*	Sachets	Widely used
Rose	*Rosa* spp.	Medicinal use of bark and leaves	Widely used
Roseroot	*Rhodiola rosea* (formerly *Sedum roseum*)	Medicinal use	Widely used
Salal, laughing berry	*Gaultheria shallon*	Medicinal leaves	Widely used
Sea-watch, wild celery	*Angelica lucida*	Medicinal; poultice	Widely used
Sitka spruce	*Picea sitchensis*	Fuel; medicinal	Southcentral

TABLE 3.3.5-1

Non-Timber Forest Products Potentially Occurring in the Project Area

Common Name	Scientific Name	Use	Regional Occurrence
Sphagnum moss	*Sphagnum* spp.	Bedding; diapers; packing; cabin chinking	Widely used
Strawberry	*Fragaria* spp.	Leaves as medicinal and tea	Southcentral
Willow	*Salix* spp.	Medicinal use; dye	Widely used
Wooly lousewort	*Pedicularis lanata (kanei)*	Medicinal	Widely used
Yarrow	*Achillea millefolium*	Medicinal	Southcentral
EDIBLE PLANTS			
Alpine bearberry	*Arctostaphylos alpina*	Edible berry	Widely used
American sweetvetch, Eskimo potato	*Hedysarum alpinum*	Edible roots	Widely used
Birch	*Betula* spp.	Sap	Widely used
Blackberry, crowberry	*Empetrum nigrum*	Edible berry	Widely used
Blueberry	*Vaccinium uliginosum, V. caespitosum, V. alaskensis*	Edible berries, shoots	Widely used
Bog cranberry	*Vaccinium oxycoccos = Oxycoccus oxycoccos*	Edible berries	Widely used
Brackenfern	*Pteridium aquilinum*	Edible rhizomes, fiddleheads (carcinogenic)	Widely used
Brook saxifrage	*Saxifraga punctata*	Edible leaves or shoots	Widely used
Bunchberry	*Cornus canadensis and C. suecica*	Edible berry	Widely used
Chives	*Allium schoenoprasum*	Edible Leaves	Widely used
Cinquefoil, silverweed, wild sweet potato	*Potentilla* spp.	Food (root)	Southcentral
Clasping twistedstalk, watermelon berry	*Streptopus amplexifolius*	Edible leaves, berries; medicinal use	Southcentral
Cloudberry	*Rubus chamaemorus*	Edible berry, shoots; medicinal use of roots	Widely used
Coltsfoot	*Petasites frigidus*	Food, edible leaves or shoots	Widely used
Common cowparsnip	*Heracleum lanatum*	Edible leaves or stalk; medicinal uses (with caution)	Subarctic
Common mare's-tail, goose grass	*Hippuris vulgaris*	Edible leaves or stalk	Widely used
Currant	*Ribes* spp.	Edible berry	Widely used
Dwarf fireweed, river beauty	*Chamerion latifolium* (previously *Epilobium latifolium*)	Edible leaves or shoots	Widely used
Elderberry	*Sambucus* spp.	Edible berry (use caution with red berry species)	Southcentral
Ferns	*Dryopteris* spp.	Edible fiddleheads and roots (with caution)	Widely used

TABLE 3.3.5-1

Non-Timber Forest Products Potentially Occurring in the Project Area

Common Name	Scientific Name	Use	Regional Occurrence
Fireweed	*Chamerion angustifolium* (formerly *Epilobium angustifolium*)	Edible leaves or shoots	Widely used
Giant knotweed	*Polygonum sachalinense*	Edible shoots (with caution)	Widely used
Highbush cranberry	*Viburnum edule*	Edible berry	Widely used
Horsetail, mouse food	*Equisetum* spp.	Edible root (with caution)	Subarctic
Kinnickinnick, bearberry	*Arctostaphylos uva-ursi*	Edible berry	Widely used
Labrador tea	*Ledum groenlandicum*	Tea, infusion (in moderation)	Widely used
Lambsquarters	*Chenopodium album*	Edible leaves or shoots	Widely used
Lowbush cranberry, lingonberry	*Vaccinium vitis-idaea*	Edible berry	Widely used
Mountain sorrel, sourgrass	*Oxyria digyna*	Edible leaves or shoots (with caution)	Widely used
Nagoonberry	*Rubus arcticus*	Edible berry	Widely used
Nettles	*Urtica* spp.	Edible shoots, leaves	Widely used
Northern rice root, black lily, Indian rice	*Fritillaria camschatcensis*	Edible bulbs	Southcentral
Pallus' buttercup	*Ranunculus pallasii*	Edible leaves	Subarctic
Pea	*Lathyrus* spp.	Edible leaves or seeds	Southcentral
Pineapple weed	*Matricaria discoidea*	Tea	Widely used
Red fruit bearberry	*Arctostaphylos rubra*	Edible berry	Widely used
Red raspberry	*Rubus idaeus*	Edible berry	Widely used
Rockcress	*Arabis hirsuta, A. lyrata, A. holboellii*	Edible leaves or shoots	Southcentral
Rose	*Rosa* spp.	Edible shoots and hips	Widely used
Roseroot	*Rhodiola rosea* (formerly *Sedum roseum*)	Edible leaves, roots, shoots	Widely used
Salal, laughing berry	*Gaultheria shallon*	Edible berries	Widely used
Salmonberry	*Rubus spectabilis*	Edible berry	Southcentral
Sea plantain, goose tongue	*Plantago maritima*	Edible leaves	Southcentral
Sea-watch, wild celery	*Angelica lucida*	Edible leaves or shoots	Widely used
Sitka spruce	*Picea sitchensis*	Food	Southcentral
Soopolallie, soapberry	*Shepherdia canadensis*	Edible berry	Widely used
Sourdock	*Rumex arcticus*	Edible leaves	Widely used
Strawberry	*Fragaria* spp.	Edible berry	Southcentral
Strawberry-blight, blite goosefoot	*Chenopodium capitatum*	Edible leaves or shoots	Interior
Tall cottongrass, mouse food	*Eriophorum angustifolium*	Edible root	Subarctic, widely used

TABLE 3.3.5-1

Non-Timber Forest Products Potentially Occurring in the Project Area

Common Name	Scientific Name	Use	Regional Occurrence
Water sedge	*Carex aquatilis*	Possible food	Southcentral
Willow	Salix spp.	Edible leaves	Widely used
Wooly lousewort	*Pedicularis lanata (kanei)*	Edible leaves or shoots	Widely used
Yellow cowslip, yellow marsh marigold	*Caltha palustris*	Edible leaves (with caution)	Subarctic
Yellow oxytrope	*Oxytropis maydelliana*	Edible root	Widely used
ARTS AND HANDICRAFTS			
Birch	*Betula* spp.	Bark, burls and galls, branches, and stems	Widely used
Sitka spruce	*Picea sitchensis*	Wood articles; roots in basketry and crafts	Southcentral
Willow	*Salix* spp.	Basketry; nets; rope	Widely used

Sources: Pilz et al., 2006

3.3.5.2 Biophysical Setting and Plant Associations of Conservation Concern

The AKNHP recognizes two biophysical settings (BpSs) of conservation concern that could potentially occur within the Project area:

- Geothermal Springs Ecosystem; and
- Tidal Marsh and Mud Flats: Northern Alaska BpS (Boggs et al. 2014).

3.3.5.2.1 Geothermal Springs Ecosystem

Geothermal springs are sensitive habitats that support rare and disjunctive populations of plants and thermophilic microbes. There is limited information available on plant associations for Alaska's geothermal springs; potential rare plants could include the annual forb water pygmyweed (*Crassula aquatica*) and perennial forb northern bugleweed (*Lycopus uniflorus*; Boggs et al., 2014). Both plants are considered obligate wetland plants. A thermal spring has been identified approximately 4.8 miles northwest of Mainline milepost 756 on the west side of Cook Inlet.

3.3.5.2.2 Tidal Marsh and Mud Flats: Northern Alaska Biophysical Setting (BpS)

Tidal marshes and mud flats along the Arctic Ocean coastline form a narrow fringe along tidal river channels, inlets, lagoons, and on salt-killed tundra (Boggs et al., 2014). Development of tidal marshes is limited by coastal erosion that truncates seaward expansion of salt marsh vegetation. Vegetation zonation patterns are recognizable with creeping alkali grass (*Puccinellia phryganodes*) typical in the lower tidal zone, where it may form a dense turf or scattered runners (Boggs et al., 2014). Hoppner's sedge (*Carex subspathacea*) and lesser saltmarsh sedge (*Carex glareosa*) typically occur in the mid-tidal zone. Fisher's tundra grass (*Dupontia fisheri*) may also occur in the mid-tidal zone with saltmarsh starwort (*Stellaria humifusa*) or bear sedge (*Carex ursina*) may be co-dominant. Hoppner's sedge-Arctic seashore willow (*Carex subspathacea-Salix ovalifolia*) occurs in the upper tidal zone (Boggs et al., 2014). Salt-killed tundra occurs where tundra has been inundated by tides or storm surges and salt tolerant plants such as Fisher's tundragrass (*Dupontia fisheri*), creeping alkali grass (*Puccinellia phryganodes*), Arctic seashore willow (*Salix ovalifolia*), smooth northern-rockcress (*Braya glabella* ssp. *purpurascens*), hairy braya (*Braya pilosa*), Bering chickweed (*Cerastium beerinagianum*), Danish scurvygrass (*Cochlearia groenlandica*) and saltmarsh starwort (*Stellaria humifusa*; Boggs et al., 2014). Two rare plants may occur in Arctic tidal marshes: fringed gentian (*Gentianopsis richardsonii*) and Arctic alkaligrass (*Puccinellia arctica*; Boggs et al., 2014).

A limited amount of Arctic tidal marsh is present in the Project area at West Dock. A field survey of the marsh area has not been conducted but the eight plant associations of conservation concern that could occur in Arctic tidal marshes are indicated in Table 3.3.5-2.

TABLE 3.3.5-2

Plant Associations of Conservation Concern in Arctic Tidal Marshes[a]

Plant Association	Global Rank	State Rank
Carex subspathacea	G3	S3
Carex subspathaces-Dupontia fischeri-Salix ovalifolia	G3	S3
Carex ursina	GNR	SNR
Cochlearia officinalis	G3	S3
Puccinellia andersonii	G3	S3
Puccinellia phryganodes-Carex ursina-C. subspathacea-Salix ovalifolia	G3	S3
Salix ovalifolia, Carex subspathacea, C. ursina, Puccinellia phryganodes, Stellaria humifuxa, Cochlearia groenlandica, Rhodiola rosea	GNR	SNR
Stellaria humifusa	GNR	SNR

Source: Boggs et al., 2014
G3 = Global vulnerable
GNR = Global not ranked
S3 = State vulnerable
SNR =State not ranked
Notes:
[a] Field surveys have not been conducted of the Arctic tidal marsh within the Project area at West Dock.

3.3.5.3 Rare and Sensitive Plants

Listings of rare and sensitive plants potentially occurring in the vicinity of the Project area were prepared from data received from AKNHP, plant surveys conducted in the Project area (e.g., Carroll et al., 2003; Lipkin and Parker, 1995; Cortes-Burns et al., 2009), and Project biologists' knowledge of the Project area. BLM also maintains a list of sensitive plants known to occur on BLM-managed lands in Alaska. Rare plants, including BLM Sensitive and Watch List plants that are tracked by the AKNHP and potentially occur within 1.9 miles of the Project footprint, are listed in Table 3.3.5-3. BLM Sensitive species are native species that occur on BLM lands, that either have a known or predicted downward decline or depend on threatened habitat, and for which the BLM has significant management capability to affect their conservation status. BLM Watch List species are not considered BLM sensitive species and associated sensitive species policy guidance does not apply. Watch List species include species that may be added to the sensitive species list depending on new information concerning threats, species biology, or statewide trends. The Watch List includes species with insufficient data on population or habitat trends or the threats are poorly understood. However, there are indications that these species may warrant special status species designation and appropriate inventory or research efforts should be a management priority. The general objective is to provide proactive protection to species by minimizing or eliminating threats on federally managed lands, thus reducing the chances of federal listings under the ESA. BLM designates sensitive species and implements measures to conserve certain species and their habitats on BLM land in compliance with the Federal Land Policy Management Act (FLPMA). The BLM is required to comply with Section 7 of the ESA for the Project because lands administered under its jurisdictions are crossed by the Interdependent Project Facilities. BLM Sensitive and Watch List plants that potentially occur in the Project area are presented in Table 3.5.2.3 of Section 3.5.2.

TABLE 3.3.5-3

Rare and Sensitive Plants Potentially Occurring Near the Project Area

Facility	Location	Plants		Ecoregions[a]			Status			Distance to Nearest Facility (miles)[c]	Distance to Pipeline (miles)[c]
	Milepost	Common Name	Scientific Name	Arctic Tundra	Beringia Boreal	Cook Inlet Basin	Global Rank	State Rank	Federal Listings		
PBTL	MP 0	Vahl's Alkaligrass	*Puccinellia vahliana*	X			G4	S3	BLM Watch	0.53	0.53
PTTL	MP 60	Bluegrass	*Poa sublanata*	X			GNR			0.70	0.74
	MP 62	Vahl's Alkaligrass	*Puccinellia vahliana*	X			G4	S3	BLM Watch	0.13	0.89
MAINLINE											
Mainline	MP 2	Bluegrass	*Poa sublanata*	X			GNR			0.47	0.48
	MP 5	Yellow Mountain Saxifrage	*Saxifraga aizoides*	X			G5	S1		0.81	0.83
	MP 63	Muir's fleabane	*Erigeron muirii*	X			G2	S2S3	BLM Sensitive	0.47	0.49
	MP 65	Muir's fleabane	*Erigeron muirii*	X			G2	S2S3	BLM Sensitive	0.34	0.36
	MP 130	Muir's fleabane	*Erigeron muirii*	BLM			G2	S2S3	BLM Sensitive	0.02	1.22
	MP 140	Northern Fescue	*Festuca viviparoidea ssp viviparoidea*	BLM			G4G5	SU		0.18	0.19
	MP 141	Northern Fescue	*Festuca viviparoidea ssp viviparoidea*	BLM			G4G5	SU		0.44	0.46
	MP 170	Macoun's Draba	*Draba macounii*	BLM			G3G4	S3		0.61	0.63
	MP 175	Macoun's Draba	*Draba macounii*	BLM			G3G4	S3		0.95	0.97
	MP 208	Fragile Rockbrake	*Cryptogramma stelleri*	BLM			G5	S3S4		1.06	1.07
	MP 208	Northern Fescue	*Festuca viviparoidea ssp viviparoidea*	BLM			G4G5	SU		1.11	1.16
	MP 208	Northern Fescue	*Festuca viviparoidea*	BLM			G4G5	SU		1.10	1.15
	MP 212	Longstem Sandwort	*Arenaria longipedunculata*	BLM			G3G4Q	S3S4	BLM Watch	0.59	0.60
	MP 213	Longstem Sandwort	*Arenaria longipedunculata*	BLM			G3G4Q	S3S4	BLM Watch	0.38	0.39
	MP 227	Bristleleaf Sedge	*Carex eburnea*	BLM			G5	S3		0.36	0.39

TABLE 3.3.5-3

Rare and Sensitive Plants Potentially Occurring Near the Project Area

Facility	Location	Plants		Ecoregions[a]			Status			Distance to Nearest Facility (miles)[c]	Distance to Pipeline (miles)[c]
	Milepost	Common Name	Scientific Name	Arctic Tundra	Beringia Boreal	Cook Inlet Basin	Global Rank	State Rank	Federal Listings		
	MP 227	Bristleleaf Sedge	*Carex eburnea*	BLM			G5	S3		0.16	0.17
	MP 228	Bristleleaf Sedge	*Carex eburnea*	BLM			G5	S3		0.23	0.26
	MP 229	Yukon Aster	*Symphyotrichum yukonense*	BLM			G3	S3	BLM Watch	1.08	1.10
	MP 230	Longstem Sandwort	*Arenaria longipedunculata*	BLM			G3G4Q	S3S4	BLM Watch	0.93	0.96
	MP 230	Longstem Sandwort	*Arenaria longipedunculata*	BLM			G3G4Q	S3S4	BLM Watch	0.19	0.20
	MP 230	Longstem Sandwort	*Arenaria longipedunculata*	BLM			G3G4Q	S3S4	BLM Watch	0.51	0.52
	MP 230	Field Locoweed	*Oxytropis tananensis*	BLM			G3	S3	BLM Watch	0.21	0.23
	MP 230	Yukon Aster	*Symphyotrichum yukonense*	BLM			GNR	S3S4Q	BLM Watch	0.88	0.90
	MP 231	Rock Stitchwort	*Minuartia dawsonensis*	BLM			G5	S3S4		0.16	0.18
	MP 231	Rock Stitchwort	*Minuartia dawsonensis*	X			G5	S3S4		0.90	0.92
	MP 243	Fragile Rockbrake	*Cryptogramma stelleri*	X			G5	S3S4		0.27	0.52
	MP 267	Lapland Sedge	*Carex lapponica*		BLM		G4G5Q	S3S4		0.30	0.32
	MP 473	Spreading dogbane	*Apocynum androsaemifolium*		X		G5	S3		0.62	0.63
	MP 473	Windmill Fringed Gentian	*Gentianopsis barbata*		X		GNR	S3Q	BLM Sensitive	0.02	0.53
	MP 474	Windmill Fringed Gentian	*Gentianopsis barbata*		X		GNR	S3Q	BLM Sensitive	0.50	0.94
	MP 496	Williams' Milkvetch	*Astragalus williamsii Rydberg*		X		G4	S3		0.78	0.80
	MP 499	Williams' Milkvetch	*Astragalus williamsii Rydberg*		X		G4	S3		0.36	1.11
	MP 532	Selkirk's Violet	*Viola selkirkii*			X	G5?	S3S4		0.74	0.76
	MP 536	Northern Bluebell	*Mertensia paniculata*			X	G5TNR	S3S4Q		1.09	1.20

TABLE 3.3.5-3

Rare and Sensitive Plants Potentially Occurring Near the Project Area

Facility	**Location**	**Plants**		**Ecoregions[a]**			**Status**			**Distance to Nearest Facility (miles)[c]**	**Distance to Pipeline (miles)[c]**
	Milepost	**Common Name**	**Scientific Name**	**Arctic Tundra**	**Beringia Boreal**	**Cook Inlet Basin**	**Global Rank**	**State Rank**	**Federal Listings**		
	MP 537	Rock Stitchwort	*Minuartia dawsonensis*			X	G5	S3S4		0.68	0.69
	MP 539	Field Locoweed	*Oxytropis tananensis*			X	GNR	S3S4Q	BLM Watch	1.17	1.20
	MP 551	Yenisei River Pondweed	*Potamogeton subsibiricus*			X	G3G4	S3S4	BLM Watch	0.83	0.85
	MP 568	Coontail	*Ceratophyllum demersum*			X	G5	S3S4		0.45	0.76
	MP 569	Coontail	*Ceratophyllum demersum*			X	G5	S3S4		0.03	1.09
	MP 575	Robbins' pondweed	*Potamogeton robbinsii*			BLM	G5	S2	BLM Watch	0.92	1.14
	MP 577	Robbins' pondweed	*Potamogeton robbinsii*			X	G5	S2	BLM Watch	0.14	0.15
	MP 582	Lapland Sedge	*Carex lapponica*			X	G4G5Q	S3S4		0.64	0.66
	MP 585	Selkirk's Violet	*Viola selkirkii*			X	G5?	S3S4		1.15	1.16
	MP 586	Hudson Bay Sedge	*Carex heleonastes*			X	G4	S3	BLM Watch	1.06	1.08
	MP 791	Coontail	*Ceratophyllum demersum*			X	G5	S3S4		1.36	1.90
LIQUEFACTION FACILITY											
Liquefaction Facility	Nikiski MP 804	Coon's Tail	*Ceratophyllum demersum*			X	G5	S3S4		11.712	4.50

Sources: FERC_FOOTPRINT_REVC2_A; PLC_PREFEED_REVC2_ROUTE_3D_L
Notes:
Note: Documented occurrences are 000 meters (1.9 miles) of the Project footprint; Shaded rows indicate that rare plant observation was less than 0.25 miles from pipeline ROW or nearest facility
[a] Presence = X, Presence on BLM land = BLM
[b] Distance to Liquefaction Facility
[C] Facilities include infrastructure (e.g., access roads); distances are from documented occurrence to nearest Project footprint.

TABLE 3.3.5-3

Rare and Sensitive Plants Potentially Occurring Near the Project Area

Facility	Location	Plants		Ecoregions[a]			Status			Distance to Nearest Facility (miles)[c]	Distance to Pipeline (miles)[c]
	Milepost	**Common Name**	**Scientific Name**	**Arctic Tundra**	**Beringia Boreal**	**Cook Inlet Basin**	**Global Rank**	**State Rank**	**Federal Listings**		

Near the Pipeline ROW means within 10,000 feet of the Rev B centerline
Status Codes:
G = Global
S = State
1 = Critically imperiled (typically five or fewer occurrences)
2 = Imperiled (6–20 occurrences)
3 = Vulnerable to extirpation or extinction (21–100 occurrences)
4 = Apparently secure (Usually more than 100 occurrences)
5 = Demonstrably secure
? = Inexact numeric rank

3.3.6 Marine Vegetation Resources

About 550 algal species occur in Alaska, and their life histories and reproductive strategies are complex and varied. The persistence of algae varies by species and environment; some algal are perennial while others are annual or ephemeral (Lindeberg and Lindstrom, 2010). Algal may reproduce sexually, asexually, or vegetatively, with abundance and diversity increasing during the spring and summer as daylight increases (ADF&G, 2015c). Marine algae occurring in the general vicinity of the Project area are listed in Table 3.3.6-1. Algae can provide substrate for fish and invertebrates, however it is susceptible to ice gouging as it is predominantly found in the intertidal zone.

Eelgrass (*Zostera marina*) is the dominant seagrass in Alaska ranging from southeast Alaska, west along the Gulf of Alaska and north into the Bering Sea to its upper limit at the Chukchi coast (67°N latitude) (NMFS, 2014c; Hogrefe et al., 2014). Eelgrass usually grows in mud, sand or gravel within moderately to fully sheltered areas. This species grows from the mid-intertidal into subtidal range and provides important nursery habitat for many important fish species, including spawning habitat for Pacific herring (NMFS, 2014c; Hogrefe et al., 2014). Two additional species of seagrass in Alaska include Scouler's surfgrass (*Phyllospadix scouleri*) and serrulated surfgrass (*P. serrulatus*). Both seagrass species occur in the intertidal and on more solid substrate than eelgrass which is found on soft or mixed substrates. Of the two surfgrasses, serrulated surfgrass is found higher in the intertidal zone from the mid- to lower intertidal on rock ramps and boulder fields. Scouler's surfgrass is found in the low intertidal to upper subtidal bedrock on partially to fully exposed shores. Scouler's surfgrass ranges from Sitka Sound Alaska south, with serrulated seagrass extending further north along the Alaskan coast. Surfgrass beds increase water clarity by filtering water and trapping sediments and can stabilize the sediment, preventing erosion and protecting invertebrates (NMFS, 2014c).

Zimmerman and Prescott (2014) mapped upper Cook Inlet for vegetative resources such as kelp beds, and reported no kelp or seagrass along the pipeline route. NOAA conducted Shorezone Mapping of all intertidal areas in the Upper Cook Inlet. No kelp or seagrass beds are known to occur in the Project area.

3.3.6.1 Liquefaction Facility

The shoreline near the Liquefaction Facility is semi-exposed with mobile sediments composed primarily of sand beaches (NMFS, 2014c). No marine algal beds or seagrass has been noted to occur in the intertidal or subtidal zone within the footprint of the Liquefaction Facility site, including the dredge area (NMFS, 2014c).

In the Project vicinity, small patches of the perennial rockweed (*Fuscus gardneri*), a sheet-like green algae (*Ulva* spp. or *Monostroma* spp.), a filamentous brown algae—sea felt (*Pylaiella littoralis*), a filamentous green algae—green string lettuce (*Ulva linza* [as *Enteromorpha* c.f. *linza*]), and patches of a diatomaceous film were documented along the eastern Cook Inlet shoreline at Kalifornsky Beach and/or Moose Point, south and north of the Liquefaction Facility, respectively (Lees et al., 2013). At both of these locations the only perennial macroalgae, rockweed, was represented by young-of-year plants and conditions were considered too harsh to allow for overwinter survival (Lees et al., 2013). Alaska ShoreZone shore station data for Upper Cook Inlet at Fire Island lists the brown algae, rockweed (*Fucus distichus*), and blue-green algae (Cyanobacteria) as present during data collection (Table 3.3.6-1; NMFS, 2014c). The closest documented submerged aquatic vegetation to the Liquefaction Facility and Marine Terminal, as mapped by the NOAA in their ShoreZone Mapping, are beds of rockweed found along the southern shoreline of the

West Foreland, at a distance of more than 10 miles from the proposed Project faciltities. Shorezone Mapping also indicates the existence of beds of green and red algae and rockweed in the interidal zone of Kalgin Island approximately 20 miles south/southwest of the proposed facilities.

Marine algae vegetatively reproduce by fragmentation, adventitious thalli, and akinetes; asexually reproduce by formation of spores; and sexually reproduce through the fusion of gametes. Meiosis usually takes place at a later time resulting in an alternation of generations life cycle (Lindeberg and Lindstrom, 2010). Sexual reproduction generally takes place after accumulation of nutrients and after the peak of vegetative growth, sunny conditions, suitable pH, and optimal temperatures. Brown algae can reproduce vegetatively, asexually, or sexually. Brown algae release sperm cells in the water that swim using two flagella; egg cells are sessile and produce pheromones to attract sperm cells. Brown algae, except those in the order Fucales that includes some of the more common seaweeds, have an alternation of generations life cycle (haploid and diploid forms). In brackish water, brown algae are almost all asexual (Hogan, 2011). Fucales reproduce sexually. Green algae can reproduce vegetatively, asexually, or sexually. Vegetative reproduction usually takes place by fragmentation, and asexual reproduction is through of spores. Green algae asexual reproduction is by flagellated zoospores that produce zoosporangia, and sexual reproduction is an alternation of generations. Red algae may reproduce vegetatively by fragmentation, asexual with nonmotile spores, or sexually. The nonmotile spores and gametes of red algae are passively transported by water. Red algae have a triphasic life cycle: a haploid gametophyte phase, and two diploid sporophyte phases. All three phases are part of the sexual reproduction cycle with separate male and female plants (Searles, 1980).

TABLE 3.3.6-1

Marine Algae Occurring in the Project Vicinity

Common Name	Scientific Name	Persistence	Reproduction	Location	Distance from Shore/Depth	Substrate
Brown Algae (Seaweeds)						
Rockweed	*Fucus distichus*	Perennial	Asexual, alternation of generations (sexual and asexual)	Cook Inlet: Tolerant of freshwater and freezing temperatures	Hight to low intertidal	Estuarine to semi-exposed rock
Sea Felt	*Pylaiella littoralis*	Ephemeral	Asexual, alternation of generations	Cook Inlet: Protected and estuarine habitats	Mid intertidal	On rock, algae, or free floating
Split Kelp	*Saccharina groenlandicum*	Perennial	Asexual, alternation of generations	Cook Inlet: Semi-protected to semi-exposed	Low intertidal to shallow subtidal zones	Rock
Arctic Suction-cup Kelp	*Laminaria solidungula*	Perennial	Asexual, alternation of generations	Prudhoe Bay/Beaufort Sea	Shallow subtidal	Rock, boulder patches
Green Algae (Seaweeds)						
Green String Lettuce	*Ulva linza*	Annual (spring ephemeral)	Vegetative, asexual, alternation of generations	Cook Inlet: Protected to semi-protected	Mid to low intertidal	Cobble, boulders, and bedrock
Sea Lettuce or Sea Cellophane	*Ulva lactuca or Monostroma greville*	Annual (spring ephemeral)	Vegetative, asexual, alternation of generations	Cook Inlet: Protected to semi-protected	Mid-low intertidal	Cobble, boulders, and bedrock
Red Algae (Seaweeds)						
Red Blade	*Dilsea socialis* (formerly *Neodilsea integris*	Perennial	Triphasic life history	West Dock/Beaufort Sea: Semi-protected habitats	Low intertidal and upper subtidal	Pebbles
Common Sea Oak	*Phycodrys fimbriata* (formerly *Phycodris rubens*)	Perennial	Triphasic life history	West Dock/Beaufort Sea: Semi-protected to semi-exposed	Low intertidal	Rock
Sea Brush	*Odonthalia dentata*	Perennial	Triphasic life history	West Dock/Beaufort Sea: Semi-exposed and semi-protected	Lower intertidal pools and subtidal	Rocks

Source: NMFS, 2014c; Lees et al., 2013; Houghton, 2012; Lindeberg and Lindstrom, 2010; Houghton et al., 2005a

3.3.6.2 Interdependent Project Facilities

3.3.6.2.1 Beaufort Coastal Plain Ecoregion

Offshore in Stefansson Sound, east of West Dock, mud and silt substrates are interrupted with sporadic boulders and cobble that support Arctic kelp beds (Barnes and Reimnitz, 1974), referred to as the Boulder Patch (Dunton and Schonberg, 2000). Trawls conducted in potential dredge disposal study areas north of

West Dock, were investigated by Houghton (2012) for the former Alaska Pipeline Project (APP). Samples generally contained macroalgae including: brown algae—Arctic suction-cup kelp (*Laminaria solidungula*), red algae—red blade (*Dilsea socialis* [as *Neodilsea integris*]), common sea oak (*Phycodrys fimbriata* [as *Phycodris rubens*]), and sea brush (*Odonthalia dentata*). Most of the macroalgae were not attached to bottom materials, suggesting they had drifted from other locations, although a few of the Arctic suction-cup kelp were attached to small gravels or coarse sand. The presence of considerable amounts of macroalgae, including some attached to pebbles, in the trawl samples north of West Dock indicates that there may be patches of cobble or boulders within the area (Houghton, 2012). Green macroalgae is noted to be present around West Dock on shoreline maps (NMFS, 2014c).

3.3.6.2.2 Cook Inlet Basin Ecoregion

The Interdependent Facility located in Cook Inlet is the Mainline and Mainline MOF. The Mainline would cross Upper Cook Inlet to the Kenai Peninsula. The shoreline where the Mainline corridor would enter Upper Cook Inlet, south of the Beluga River mouth, consists of semi-protected, mobile sediments composed primarily of sand and gravel, or is a mud flat (NMFS, 2014c). This is also the same area that the Mainline MOF is located. No macroalgae or seagrass was noted during previous sampling near this area (Lees et al., 2013) or are listed on shoreline maps (NMFS, 2014c). However, it is likely that a biofilm covers the tidal flats.

The shoreline in the area where the Mainline will exit upper Cook Inlet, near Boulder Point, consists of semi-protected mobile sediments (mixture of sand and gravel) and scattered boulders (NMFS, 2014c). No macroalgae or seagrass were noted during previous sampling near this area (Lees et al., 2013). Rockweed and scattered annual green algae (*Ulva* spp. [as *Enteromorpha* spp.]) were found at Point Woronzof and north of Point MacKenzie (Houghton et al., 2005a: Station KA 13 and KA 16). The rockweed at Station KA 16 was on the northeast face of large granite boulders that may offer some protection against ice scour. The closest documented occurrences (Shorezone Mapping) of submerged aquatic vegetation to the offshore pipeline route are beds of rockweed found along the southern shoreline of the West Foreland, more than 17 miles from the pipeline route. The nearest kelp beds mapped by Zimmerman and Prescott (2014) are along the Cook Inlet shoreline near the mouth of Kachemak Bay, 60 miles to the south.

3.3.7 Potential Construction Impacts and Mitigation Measures

Construction of the Project would affect about 25,200 acres of vegetated habitats and a diversity of vegetation communities (Table 3.3.2-1). Vegetation and habitat impacts were assessed based on Project-specific vegetation mapping and footprints for proposed Project components (see Appendix B and Appendix Q). This differs from assessments in Resource Report No. 8, which are based on more general land cover mapping. The total acres of vegetation cover potentially affected by the construction footprint include about 11,900 acres of forested habitats, about 7,600 acres of scrub (shrub) habitats, and about 5,700 acres of herbaceous habitats. An additional area of about 2,300 acres of barren habitat including previous granular fill and non-vegetated habitats would also potentially be affected by construction.

These areas of cleared/developed land associated with the construction ROW would provide fire protection controls in remote and high-risk areas along the Mainline, at pipeline aboveground facilities, and at GTP and LNG facilities. Most areas of land cleared during construction would be restored after construction is complete, unless the cleared land is in a fire suppression management area that requires a buffer area free of vegetation. These areas would remain free of vegetation for the life of the Project The Applicant would develop wildfire management plans prior to construction and would follow, as appropriate, the guidance for implementation of federal wildland fire management policies outlined in the 2016 Alaska Interagency Wildland Fire Management Plan that (BLM 2016).The Applicant would respond to any fires that directly threaten human life and pipeline facilities. Emergency notification and reporting procedures listed in the Fire Suppression Plan would be followed. The Applicant would not be libel for any associated cost including fire suppression and resource damage costs for fires caused by arson or by human activity not associated with the Project construction or operations.

The primary construction-related activities that could affect vegetation are clearing and grading, as well as placement or excavation of granular fill for construction. Vegetation cover may be temporarily impacted by Project construction through: clearing, grading, trenching, ice road/pads, dredging (marine vegetation), spread of invasive plants, spread of plant pathogens and damaging insects, fugitive dust, timber harvest, and fragmentation. Impacts would last until the point in time when the native vegetation cover has regenerated. In areas such as the Beaufort Coastal Plain Ecoregion, recovery of vegetation would be expected to be slower than in other areas farther south, due to the short growing season. Permanent alteration of potential vegetation cover may occur from placement of granular fill or excavation. In most cases these impacts would be long-term.

The Project has been designed to avoid or minimize impacts where practical. Clearing of vegetation in the Project corridor would take place during the winter, when the ground is frozen and precipitation is low, this minimizes soil compaction and prevents damage to root mats of dormant plants. Measures that would be implemented to avoid and reduce potential direct and indirect impacts to vegetation are summarized in Table 3.2.7-1.

Table 3.3.7-1 outlines potential construction impacts to vegetation and associated mitigation measures.

TABLE 3.3.7-1

Potential Construction Impacts and Mitigation to Vegetation Associated with the Project

Activity	Potential Impact	Mitigation[a]
Construction of Facilities, Roads, and Pipelines		
General Construction	Increased sedimentation and erosion, loss of habitat, introduction of invasive species, soil compaction, dust deposition, and contamination	• Follow Applicant's *Plan* and *Procedures* and implement organic materials segregation; • Keep construction activities within the proposed LODs; • Follow Project's *SWPPP* and *Draft Project Restoration Plan* to mitigate impacts associated with sedimentation and erosion, loss of habitat, and soil compaction, etc., • Implement Applicant's *Plan* and *Procedures* and *Invasive Species Mitigation Plan,* which includes measures for re-establishing herbaceous or woody vegetation, controlling the establishment or spread of invasive species, weed control, and monitoring; • Implement *Fugitive Dust Control Plan* to control dust deposition during construction (see Resource Report No. 9 for further details); • Mitigate the potential for accidental releases of hazardous materials and contamination by following procedures outlined in the *SPCC Plan* developed for this Project; and • Mitigate spills.

TABLE 3.3.7-1

Potential Construction Impacts and Mitigation to Vegetation Associated with the Project

Activity	Potential Impact	Mitigation[a]
Clearing, Grubbing, and Grading	Loss of rootstock, increased erosion and sedimentation, fragmentation, increased soil temperature, and introduction of invasive species	• Follow Applicant's *Plan* and *Procedures*; • Reduce vegetation removal as practicable; and • Use certified native "weed-free" seed mixtures during temporary and permanent stabilization.
Trenching and Backfilling	Topsoil/subsoil mixing and excessive mounding and subsidence, changes in localized hydrology and therefore vegetation	• Follow Applicant's *Plan* and *Procedures* and implement topsoil segregation, keeping at least a 1-foot distance between spoil piles when side-casting to prevent topsoil/subsoil mixing when grading across wetlands in summer; • Segregate up to 1 foot of organic material when grading (i.e., Mode 5A) across wetlands in the summer; • Proper compaction and scarification to allow vegetation to establish; and • Follow Project *Draft Project Restoration Plan.*
Access Roads (Temporary)	Habitat disruption, introduction/spread of invasive and/or noxious weeds, increased dust deposition, and soil compaction	• Use existing roads, two-tracts, cart-ways, and the construction ROW travel lanes to the greatest extent possible; • Limit vegetation removal to tree trimming instead of removal, where practical; • Follow *Dust Suppression Plan*; • Where required by the landowner, restore roads to previous conditions following construction; • Scarify and reseed any portions of the roads that were widened; and • Follow protocols in the *Invasive Species Mitigation Plan.*

[a] These measures would be used where practical

3.3.7.1 Liquefaction Facility

During construction, the Liquefaction Facility, including the temporary construction camp, would encompass approximately 980 acres onshore. Vegetation that would be affected during the construction of the Liquefaction Facility would cover about 739 acres (Table 3.3.7-2). Construction activities that would impact vegetation cover include vegetation clearing, grading, placement of fill, and excavation for the construction of access roads, facility pads, workspaces, camps, drainage structures, and ponds for onshore facilities.

Direct vegetation impacts from construction of the Liquefaction Facility would primarily affect forested habitats (86 percent), followed by scrub (11 percent), and herbaceous habitats (2 percent). Forest communities affected by construction of the Liquefaction Facility would be predominately mixed forest (88 percent) and deciduous forest (9 percent). Scrub communities affected by construction of the Liquefaction Facility would be open low scrub, and herbaceous communities would be mostly graminoid (Table 3.3.7-2). Potential impacts to waters and wetlands are provided in Resource Report No. 2.

TABLE 3.3.7-2

Vegetation Area (Acres) Affected by Construction and Operation of the Liquefaction Facility

Vegetation Type	Marine Terminal		Liquefaction Operations Area		Construction Camp		Total	
	Const	Ops	Const	Ops	Const	Ops	Const	Ops
Deciduous Forest	0.00	0.00	74.38	74.38	5.64	0.00	80.02	74.38
Mixed Forest	0.00	0.00	498.03	498.03	56.89	0.00	554.91	498.03
Forest Subtotal	*0.00*	*0.00*	*572.41*	*572.41*	*62.53*	*0.00*	*634.94*	*572.41*
Dwarf Tree Scrub	0.00	0.00	0.20	0.20	0.00	0.00	0.20	0.20
Low Scrub	0.71	0.00	75.51	75.51	11.01	0.00	87.24	75.51
Scrub Subtotal	*0.71*	*0.00*	*75.71*	*75.71*	*11.01*	*0.00*	*87.44*	*75.71*
Graminoid Herbaceous	0.00	0.00	10.67	10.67	0.00	0.00	10.67	10.67
Forb Herbaceous	0.00	0.00	3.36	3.36	0.00	0.00	3.36	3.36
Aquatic Herbaceous	0.00	0.00	2.22	2.22	0.00	0.00	2.22	2.22
Herbaceous Subtotal	*0.00*	*0.00*	*16.25*	*16.25*	*0.00*	*0.00*	*16.25*	*16.25*
Vegetated Area Subtotal	***0.71***	***0.00***	***664.37***	***664.37***	***73.54***	***0.00***	***738.62***	***664.37***
Unvegetated Total	*81.51*	*18.67*	*237.24*	*237.24*	*7.77*	*0.00*	*326.52*	*255.90*
Liquefaction Facility Total	**82.52**	**18.67**	**901.61**	**901.61**	**81.31**	**0.00**	**1,065.14**	**920.28**

Source: Project Vegetation Mapping; FERC_FOOTPRINT_REVC2_A; WE_WETLANDS_A_20160921
Const = Construction, Ops = Operations; Construction acreage includes operational areas. See Resource Report No. 1, Table 1.4-1 for definitions of construction and operations affected areas.

3.3.7.1.1 Dredging/Dredge Disposal

Construction of the MOF would require dredging to establish a safe navigation channel for HLVs. Potential impacts to marine and estuarine habitats would include dredging an area of approximately 51 acres and dredge disposal over about 1,200 acres—at a site located offshore from the MOF (refer to Resource Report No. 1, Table 1.4-1 for detailed acreage of affected lands). No marine algal beds occur in the intertidal zone at the MOF (NMFS, 2014c); thus no impacts to marine algal beds are anticipated.

3.3.7.1.2 Clearing and Grading

Construction of the Liquefaction Facility including the temporary LNG construction camp would require clearing all vegetation (739 acres, Table 3.3.7-2) and grading the site prior to construction. Some excavation to establish foundations for the LNG Plant modules and provide fill would likely be required. Potential impacts to surrounding vegetation during clearing and grading activities could include loss of seed banks for forested and shrub habitats, cover by fugitive dust, and a loss or alteration of natural effective buffers and filtration systems for surface runoff resulting in erosion and sediment deposition. These effects would be minor and short-term. Most of the site would be maintained clear of natural vegetation (e.g., lawn, granular fill, pavement, buildings) for safety and fire prevention, so effects on vegetation in these areas would be minor with respect to the extent of vegetation present in the area around the site but long-term because little would be maintained on site (east and southern edges of the property). Ponds and drainage to capture precipitation are incorporated into the facility design.

3.3.7.1.3 Access Roads

The site for the Liquefaction Facility would require construction of temporary and permanent access roads, which would include heavy haul roads, access roads to the facility, a beach access road, and improvements to existing roadway systems. These access and haul roads are within the footprint of the LNG Facility and included in Table 3.3.7-2 (under Liquefactions Operations Area). The beach access road would be installed at the base of the existing bluff and would be protected from erosion by using granular material filled geo-tubes. Material used in the construction of access roads would be sourced onsite, from existing material borrow sources, or from quarries within Alaska. Potential impacts from the construction of temporary and permanent access roads include removal of vegetation cover, burial of soils with granular material, potential spread or introduction of noxious and invasive plants, creation of fugitive dust, interruption of surface sheet flow, erosion, and sedimentation. These effects on vegetation would be minor and permanent.

3.3.7.1.4 Vessel Traffic

The shoreline location for the proposed Marine Terminal and temporary MOF is undeveloped. The beach at this location is unvegetated, and some of the shoreline would be modified to facilitate construction of the Liquefaction Facility. The primary mode of transportation for modules and construction material to the site would be HLVs, module carriers and barges. High currents and a large tidal range preclude use of the beach for offloading of modules and construction material. Construction of a temporary MOF would provide for module offloading and material-receiving capabilities for the construction of the Liquefaction Facility. Vessel movements are not expected to contribute to shoreline erosion, due to the necessarily low speeds mandated for operational safety in and near the Marine Terminal. Tidal fluctuation, wind, waves, and ice are the primary shoreline erosive forces. No effects on vegetation are expected from vessel traffic.

3.3.7.1.5 Hydrostatic Testing

Hydrostatic testing of LNG tanks would occur during summer using saltwater withdrawn from Cook Inlet. Only approved additives, such as oxygen scavengers, biocides or preservatives, would be used, as necessary. Test water would be filtered and tested prior to discharge to Cook Inlet. No impacts to vegetation are anticipated as the hydrostatic testwater would be discharged to Cook Inlet in compliance with discharge permits.

Groundwater from the onsite construction wells would possibly be used for the hydrostatic testing of piping and other equipment. Water would be tested before use to ensure the water meets all applicable code requirements. The used test water would be filtered and discharged into onsite sediment basins in compliance with applicable permits before discharge to the Cook Inlet. If additives are required, only approved additives such as oxygen scavengers, biocides, or preservatives would be used. No impacts to vegetation are anticipated because the hydrostatic testwater would be discharged to upland sediment basins.

3.3.7.1.6 Spills

Diesel fuel and gasoline stored on site could potentially damage or kill vegetation if spills reach vegetated habitats or soils. Much of the Liquefaction Facility site will not be suitable for reestablishment of native vegetation where impervious surfaces and granular pads are constructed to support buildings and the LNG Plant. Spills can occur from fuel trucks, during fueling, from improperly maintained equipment, and the improper use and storage of fuels, lubricants, and other hazardous materials.

All fuel handling necessary for construction of the Liquefaction Facility would be in accordance with ADEC requirements and the Project's *SPCC Plan*. The *SPCC Plan* would be managed by the Project's Environmental Inspectors during construction. This includes that secondary containment would be used for single-walled containers, and storage and construction equipment would be maintained and inspected daily for leaks. In some instances, parking and refueling would be required within wetlands. In accordance with the Applicant's *Procedures*, appropriate steps would be taken (including secondary containment structures) to prevent spills and provide for prompt cleanup in the event of a spill.

While a spill has the potential for significant adverse environmental impacts, adherence to the Project's proposed protective measures outlined in the *SPCC Plan* would greatly reduce the likelihood of such impacts, as well reduce the resulting impacts should a spill occur. As such, significant adverse impacts to vegetation due to a release are unlikely.

3.3.7.1.7 Waste

All waste would be handled in accordance with the Project's Waste Management Plan (Appendix J of Resource Report No. 8). This *Plan* addresses hazardous and nonhazardous waste materials and volumes, handling, and disposal in detail. The plan would ensure compliance with all regulations for transportation, treatment, storage, and disposal of waste. Waste management activities would be performed in accordance with the waste management hierarchy. In order of preference, the aim would be avoidance, minimization, reuse, recycle, recover, and lastly disposal.

The generation and storage of hazardous wastes during construction would be minimal. Volumes and types of waste would be determined when construction contractors are selected and construction plans finalized. At that time, each contractor would be required to develop a waste management plan that follows the guidance in the Project's *Waste Management Plan* and outlines the types, volumes, and disposition of wastes anticipated during construction. With adherence to the Project's *Waste Management Plan* procedures and mitigation measures, adverse impacts to vegetation due to waste management during construction of the Liquefaction Facility would not be anticipated.

3.3.7.1.8 Non-native and Invasive Plants

Invasive plants and animals can damage native vegetation by out-competing native plants and can compromise wildlife habitats by reducing quality of forage or cover. Invasive plants likely to occur at or near the Liquefaction Facility are listed in Table 3.3.3-1, and include: oxeye daisy, butter and eggs, reed canarygrass, common dandelion, and white sweet clover. Of these invasive plants of concern established at or near the Liquefaction Facility include reed canarygrass. Reed canarygrass impacts vegetation community composition, structure, and interactions, forming dense persistent monotypic stands in wetlands. This perennial wetland invasive plant can reproduce by seeds and rhizomes; invasion is promoted by disturbances such as ditching in wetlands, stream channelization, and intentional planting. Ground disturbance provides an opportunity for invasive plants to become established as the soil is exposed and there is no competition from existing vegetation. Once established, control is difficult.

Vectors for transmission of invasive plants include equipment, personnel, construction materials, erosion control materials, and revegetation seed mixes. Invasive plants and animals can be transported on equipment mobilized from the contiguous United States or from contaminated sites within Alaska or Canada; spread from contaminated sites within the Project area during construction; spread from contaminated materials such as straw, small machinery, hand tools, footwear, clothing, or tires from other areas within or outside of the state; and through use of seed mixtures that contain invasive and non-native seeds.

Measures described in the *Noxious and Invasive Plant and Animal Control Plan* (Appendix K) and *Draft Restoration Plan* (Appendix P) would be implemented to prevent the introduction or spread of aquatic nuisance organisms. Preventative measures include identifying locations and the extent of existing infestations, mapping and flagging infested areas, treatment of infested areas prior to work, establishing cleaning stations, and inspecting field equipment and vehicles before entering Project sites. The appropriate treatment methods would be based on the specific invasive plant or animal, the extent of infestation, and area-specific conditions. Treatment methods would include manual or mechanical removal, or application of herbicide.

Invasive plants and animals that damage native ecosystems can be transported on cargo or in ballast water by vessel traffic. Vectors for introducing aquatic invasive organisms from ship traffic include ballast-water discharge, fouled ship hulls, and equipment placed overboard (e.g., anchors). Aside from HLVs and barges, most of the vessels used in construction of the Liquefaction Facility would be local. All vessels brought into the State of Alaska or federal waters are subject to USCG 33 C.F.R. 151 regulations, which are intended to reduce the transfer of aquatic invasive organisms. Management of ballast water discharge is regulated by federal regulations (33 C.F.R. 151.2025) that prohibit discharge of untreated ballast water into the waters of the United States unless the ballast water has been subject to a mid-ocean ballast water exchange (at least 200 nautical miles offshore). Vessel operators are also required to remove "fouling organisms from hull, piping, and tanks on a regular basis and dispose of any removed substances in accordance with local, state, and federal regulations" (33 C.F.R. 151.2035(a)(6). Adherence to the USCG 33 C.F.R. 151 regulations would reduce the likelihood of Project-related vessel traffic introducing aquatic invasive species.

3.3.7.1.9 Forest Pests and Disease

Forest insects and diseases active at or near the Liquefaction Facility include insects that cause defoliation of alder, birch, and cottonwood, such as leaf rollers, and spruce mortality, including spruce beetles and northern spruce engravers (Table 3.3.4-1). These pests can be spread through vegetation clearing, ground disturbance, and revegetation, or can be exacerbated by stress on trees from changes in microclimate or soil moisture caused by construction of facilities. There are currently no recognized serious exotic tree pathogens that have been introduced or have become established in Alaska, although detection may be difficult (Table 3.3.4-2). Importation or movement of infected live plant materials for revegetation are the primary pathways for introduction of plant pathogens.

3.3.7.1.10 Sensitive Vegetation Types or Communities

Surveys expressly for plant communities of conservation concern have not been undertaken, however vegetative and wetland mapping crews mapped any sensitive or rare vegetation types or communities if found during surveys. No plant associations of concern or rare and sensitive plant species were documented at the Liquefaction Facility. No impacts are anticipated to plant associations of concern or rare and sensitive plants from construction of the Liquefaction Facility.

3.3.7.1.11 Marine Vegetation

No marine algal beds or seagrass has been noted to occur in the intertidal or subtidal zone within the footprint of the Liquefaction Facility site, including the dredge area. No direct effects to marine vegetation are anticipated from construction of the Liquefaction Facility.

Turbidity and sedimentation resulting from dredging may cover individuals and temporarily reduce habitat suitability for any marine vegetation in the vicinity. Because of the high natural turbidity in upper Cook Inlet, it is unlikely that dredging and dredge disposal would exceed background water turbidity more than 200 feet from these activities. As noted in Section 1.5.2.2.1.16 of Resource Report No. 1, dredging at the MOF may be conducted with either a hydraulic (cutterhead) dredger or a mechanical dredger. According to NOAA Fisheries guidance, turbidity levels associated with cutterhead dredge sediment plumes typically range from 11.5 mg/L to 282.0 mg/L, with the highest levels detected adjacent to the cutterhead dredge and concentrations decreasing with greater distance from the dredge. For mechanical dredging, total suspended solid levels can be higher near the bottom, ranging from 105 mg/L in the mid-water column to 445 mg/L at the bottom near the dredge bucket, depth averaged to be 210 mg/L (NOAA, 2017). Shore-based field measurements in the Project area in September indicate suspended sediment estimates ranging from 220 mg/L to 1,113 mg/L, depending on the day measured and tidal cycle (CH2M, 2016a). Thus, the anticipated highest turbidity from either dredging method falls within expected background concentrations, and those numbers represent the highest concentrations expected adjacent to the dredger. Any additional sediment loading from dredging is anticipated to match the ambient suspended solids concentration and would be expected to decrease rapidly as one moves away from the point of discharge. Habitat effects from turbidity would be temporary and of short duration.

3.3.7.2 Interdependent Project Facilities

3.3.7.2.1 Pipeline

3.3.7.2.1.1 Mainline

The Mainline would be approximately 807 miles long, spanning from the GTP at MP 0 to the Liquefaction Facility at MP 806. From the GTP in Prudhoe Bay to Livengood, the Mainline generally follows TAPS. From Livengood, the Mainline heads southwest toward Cook Inlet. Vegetated areas that would be affected by the construction of the Mainline are enumerated by vegetation type in Table 3.3.7-3. Construction activities that would impact vegetation cover include vegetation clearing, grading, placement of fill, and excavation for construction of access roads, facility pads, workspaces, and camps. Vegetation clearing is planned during the winter prior to pipeline construction, outside the migratory bird nesting windows as established through consultation with the USFWS.

Construction impacts (acres) to vegetation are provided in Table 3.3.7-3 by vegetation types. Direct vegetation impacts from construction of the Mainline ROW would primarily affect forested habitats (45 percent) and scrub habitats (36 percent) followed by herbaceous habitats (19 percent). Forest communities affected by construction of the Mainline ROW would be predominately mixed (48 percent) followed by evergreen forests (40 percent) and deciduous forests (12 percent; Table 3.3.7-3). Scrub communities affected by construction of the Mainline ROW would be predominately low scrub (58 percent) followed by tall scrub (15 percent), dwarf tree scrub (15 percent) and dwarf scrub (12 percent; Table 3.3.7-3). Herbaceous communities affected by construction would be predominately graminoid (97 percent; Table 3.3.7-3). Potential impacts to waters and wetlands are provided in Resource Report No. 2. Construction and vehicle movement could result in soil compaction and loss of soil structure with consequential impact on vegetation. Potential soil compaction is discussed in Resource Report No. 7, Section 7.5.2.4 Compaction-Prone Soils.

TABLE 3.3.7-3

Vegetation Area (Acres) Affected by Construction and Operation of the Mainline

Vegetation Type	Mainline ROW[a]		Compressor Stations		Associated Infrastructure[b]		Mainline Total	
	Const	Ops	Const	Ops	Const	Ops	Const	Ops
Mainline								
Evergreen Forest	2,338.35	935.57	46.14	46.14	2,278.50	154.62	4,663.00	1,136.33
Deciduous Forest	620.62	238.48	29.32	29.32	854.81	42.71	1,504.75	310.51
Mixed Forest	2,576.46	1,039.07	31.97	31.97	2,732.98	192.92	5,341.41	1,263.97
Forest Subtotal	*5,535.43*	*2,213.12*	*107.44*	*107.44*	*5,866.29*	*390.25*	*11,509.16*	*2,710.81*
Dwarf Tree Scrub	664.43	273.49	23.56	23.56	468.66	19.22	1,156.65	316.27
Tall Scrub	717.71	279.13	4.05	4.05	756.84	68.52	1,478.77	351.87
Low Scrub	2,524.83	1,043.93	69.72	69.72	1,632.41	52.00	3,645.43	1,165.48
Dwarf Scrub	557.63	231.03	30.92	30.92	275.39	1.52	863.93	263.47
Scrub Subtotal	*4,464.59*	*1,827.58*	*128.25*	*128.25*	*3,133.31*	*141.26*	*7,726.14*	*2,097.09*
Graminoid Herbaceous	2,229.81	873.14	21.79	21.79	863.32	18.13	3,114.92	913.06
Forb Herbaceous	36.43	16.01	0.00	0.00	86.61	9.07	123.05	25.08
Bryoid Herbaceous	0.31	0.13	0.00	0.00	0.09	0.00	0.39	0.13
Aquatic (Nonemergent) Herbaceous	0.33	0.14	0.00	0.00	0.84	0.00	1.17	0.14
Herbaceous Subtotal	*2,266.89*	*889.42*	*21.79*	*21.79*	*950.86*	*27.21*	*3,239.54*	*938.41*
Vegetated Subtotal	*12,266.91*	*4,930.12*	*257.47*	*257.47*	*9,950.45*	*558.72*	*22,474.84*	*5,343.18*
Unvegetated Total	38,352.61	413.06	0.00	0.10	1,747.13	90.79	40,099.84	503.95
Mainline Total	**50,619.52**	**5,343.18**	**257.47**	**257.58**	**11,729.85**	**649.51**	**62,606.95**	**6,250.27**

Source: Project Vegetation Mapping; Boggs et al., 2012

Const = Construction, Ops = Operations; Construction acreage includes operational areas. See Resource Report No. 1, Table 1.4-1 for definitions of construction and operations affected areas.

[a] Mainline Construction and Operations rights-of-way included about 50 acres of overlapping MLBV and compressor station footprints.

[b] Associated Infrastructure excludes ice infrastructure, and includes selected access roads that would be retained during operations. See Resource Report No. 1, Table 1.4-1 for definitions of construction and operations affected areas.

Note: Approximately 15 percent of the Mainline construction impact area for material sites was not covered by Project vegetation mapping, the AKNHP mapping was used to fill in missing vegetation mapping.

Mainline construction-related impacts would alter or remove vegetation and soils and could potentially lead to melting of permafrost, spills and contamination, introduction or spread of invasive plants and pests, fragmentation of vegetation communities, and damage to sensitive vegetation communities or rare plants. These concerns would be addressed through the Project's mitigation plans and are briefly discussed in the following sections.

A discussion of construction ROW width requirements for the Project is provided in Resource Report No. 1, Section 1.4.2.1.1, and Resource Report No. 1, Appendix G.

Clearing and Grading

Mainline construction would take place over two winters and two summers. Sections selected for winter construction were based on the presence of permafrost, and/or swampy and relatively flat terrain where water sources are available for frost packing and construction of ice pads and ice roads. Sites selected for summer work were chosen based on construction safety and include thaw-stable and unfrozen soils or difficult terrain (hills with steep slopes). Summer construction in ice-rich permafrost areas would require ditching. Open-ditch time would be reduced for both summer and winter construction. Winter construction (ROW preparation) can begin when the ground surface is frozen deep enough to support construction equipment. Winter construction would protect wetlands in thaw-unstable permafrost terrain. For North Slope winter construction in Spread 1, it is assumed that typical tundra travel requirements would apply. These include soil temperature and snow cover guidelines. In coastal areas, the target is 6 inches of snow and soil temperature of 23 °F at 1 foot below ground surface. In the foothills region, the target is 9 inches of snow cover and 23 °F at 1 foot below ground surface. Low ground-pressure tundra equipment would be used for any summer work with frost packing starting as early as November 1, and ice pad construction starting around December 8. Typical winter construction would begin with a ROW survey, followed by frost packing and ice pad construction, then pipe laying and welding. Where practicable, stringing, bending, and welding activities would precede trenching in both winter and summer construction to limit the amount of time the trench remains open. The ROW would be reclaimed, equipped with erosion control structures, and seeded on the ditch line and side cut locations. Rehabilitation and revegetation would begin following spring break-up.

Clearing of vegetation would occur during winter, following procedures described in the Applicant's *Plan* and *Procedures*. Forest health prevention measures would follow practices, depending on location of clearing and land ownership, as required by BLM Forestry Alaska Division and State of Alaska Department of Natural Resources Division of (Section 41.17.08) and include the following:

- Tree tops shall be lopped and brush shall be scattered flat and away from standing trees to avoid creation of fuel ladders;
- No trees shall be left lodged into other trees;
- To the extent practicable and with concerns for safety, the permittee shall remove the entire bole of any trees cut, from a 6-inch stump to a 4-inch top;
- Harvested timber must be removed from public lands. Storage or disposal of harvested timber on public land must be permitted separately;

- Any green tree bole 6” diameter at breast height (DBH) or larger that cannot be removed from public lands within 12 months of felling must be limbed and scored at least 1 inch deep for the entire length of the bole to facilitate drying.

Vegetation cut in wetland areas would be left to just above ground-level height, leaving root systems in place to stabilize soils. In upland areas, the top 1 foot of organic material may be segregated during construction. Grading and topsoil stripping could destroy the plant rootstock, which would delay vegetation recovery substantially. Subsoil exposed to physical environmental properties before construction could cause erosion, and sedimentation impacts and the extent of impacts would depend on the length of time the soil is exposed. Temporary sediment barriers would be installed during the initial disturbance of wetlands during summer and prior to spring break-up. Erosion and sediment control measures are outlined in the Applicant’s *Plan*.

At the northern end of the Mainline, ice work surfaces would be used where possible to reduce damage to tundra vegetation. Potential vegetation impacts from trenching to install the pipeline will vary with the type of ROW construction method (ice workpad, granular workpad, no workpad), construction season, and the amount of preparation necessary for the construction ROW (no vegetation clearing, minimal vegetation clearing, vegetation clearing and grading, cut/fill slopes). Vegetation clearing, where necessary, would be completed during winter. The greater the requirement for removal of vegetation and soils to establish a safe construction ROW, the greater the potential effects on vegetation cover. Impacts to tundra vegetation from ice roads and workpads typically require no restoration and the tundra recovers naturally within about 10 years (NSSI, 2013). Removal of trees and shrubs would have a greater effect on vegetation structure than clearing and grading herbaceous communities. In permafrost regions, removal of vegetation cover may induce degradation and thawing of permafrost; in thaw-unstable soils, this would lead to subsidence and instability of the trench and pipeline and possibly alter the hydrology. Permafrost conditions and measures to minimize disturbance to thermal stability are discussed in Resource Report No. 7. Construction seasons and methods by Mainline spread are described in Resource Report No. 1. Areas that are constructed in the winter on ice pads would have considerably less impact because grading would occur only over the centerline. Natural establishment of native vegetation should occur over time from slow encroachment and seed dispersal of surrounding vegetation. However, sensitive plants or species that are intolerant to this type of disturbance may not fully recover.

The ROW would be reclaimed following the Applicant’s *Plan* and *Procedures* and *Project Restoration Plan* (Appendix P). A reestablishment plan for herbaceous and/or woody plants would be implemented along with revegetation monitoring and weed control, where applicable. Herbaceous and scrub-shrub vegetative communities would be expected to recover within 5 to 20 years (ADF&G, 2001) so these impacts would be minor and long-term. Forested vegetation would take much longer to recover due to the length of time it takes for trees to reach maturity. Where forested vegetation is allowed to grow back (in areas outside of the permanent ROW), it would take several decades to several hundred years to reach pre-disturbance conditions (ADF&G, 2001). Recovery times in tundra regions vary with the severity of impact and definition of recovery, but may also take decades for full recovery (although a productive vegetation cover can usually be established much sooner; see discussions in Appendix P). The potential for disturbance to forested vegetation types is reduced by associating the proposed Project alongside existing infrastructure where the amount of forested vegetation is generally less.

Hydrostatic Testing

Hydrostatic testing would occur during the summer and shoulder seasons. Test water from freshwater sources would be discharged within the same drainage basin. Vegetation impacts could occur from construction of sediment basins, water discharged to upland vegetated areas causing erosion, and spread of invasive aquatic plants and animals. Where practicable, test water would come from sources that do not harbor invasive aquatic organisms. If test water is used from infested sources, water would be discharged back into the same waterbody and would not be discharged into other watersheds. Installing stormwater protection measures prior to hydrostatic testing would be used to mitigate potential erosion. With these measures in place, effects on vegetation would be minor due to the small areas affected, and long-term due to the plant regeneration time.

Spills

Diesel, gasoline, and other fuels stored on site could potentially damage or kill vegetation if spills reach vegetated habitats or soils.

All fuel handling necessary for construction of the Mainline would be in accordance with ADEC requirements and the Project's *SPCC Plan* (Appendix M of Resource Report No. 2). The *Plan* would be managed by the Project's Environmental Inspectors during construction. The storage of fuels and lubricants would be in secured containers manufactured for their purposes and stored in a secure area with proper labels. Secondary containment would be used for single-walled containers. In addition to proper storage, construction equipment should be maintained and inspected daily for leaks, and any waste should be contained, collected, and disposed of in an appropriate manner.

While a spill has the potential for significant adverse environmental impacts, adherence to the Project's protective measures outlined in the *SPCC Plan* would greatly reduce the likelihood of such impacts, as well reduce the resulting impacts should a spill occur. As such, significant adverse impacts to vegetation due to a release are unlikely.

Waste

All waste would be handled in accordance with the Project's *Waste Management Plan* (Appendix J of Resource Report No. 8). This *Plan* addresses hazardous and nonhazardous waste materials and volumes, handling, and disposal in detail. The *Plan* would ensure compliance with all regulations for transportation, treatment, storage, and disposal of waste. Waste management activities would be performed in accordance with the waste management hierarchy. In order of preference, the aim would be avoidance, minimization, reuse, recycle, recover, and lastly disposal.

The generation and storage of hazardous wastes during construction would be minimal. Volumes and types of waste would be determined when construction contractors are selected and construction plans finalized. At that time, each contractor would be required to develop a waste management plan that follows the guidance in the Project's *Waste Management Plan* and outlines the types, volumes, and disposition of wastes anticipated during construction. To prevent and mitigate against inadvertent contamination from waste, all waste storage areas would be located in upland areas and would be properly contained until disposal. Solid waste would be disposed of at an approved facility such as the NSB Oxbow Landfill. With adherence to the Project's *Waste Management Plan* procedures and mitigation measures, adverse impacts to vegetation due to waste management during construction of the Mainline are not anticipated.

Non-native and Invasive Plants

Invasive plants and animals can damage native vegetation by out-competing native plants and can compromise wildlife habitats by reducing quality of forage or cover. Invasive plants that occur along the Mainline are listed in Table 3.3.3-1. Of these, the invasive plants with the highest invasive ranks that are established within the Mainline corridor include reed canarygrass in the Cook Inlet Basin Ecoregion; white sweetclover throughout the Mainline corridor; waterweed (*Elodea* sp.) in the Cook Inlet Basin Ecoregion, and bird vetch in the Brooks Range and Ray Mountain ecoregions (Table 3.3.3-1).

Reed canarygrass impacts vegetation community composition, structure, and interactions, forming dense persistent monotypic stands in wetlands. This perennial wetland invasive plant can reproduce by seeds and rhizomes; invasion is promoted by disturbances such as ditching in wetlands, stream channelization, and intentional planting. Once established, control is difficult. White and yellow sweetclover are large annual or biennial legumes that rapidly colonize open areas and spread along riparian areas and riverbanks. They degrade natural grassland communities by shading out native plants, are toxic to animals, alter soil conditions by fixing nitrogen, and can alter sedimentation rates of river systems. Mechanical control can manage infestations, however, several treatments may be necessary and seeds remain viable for many years, requiring monitoring for control actions. Waterweed (*Elodea* spp.) is a perennial freshwater aquatic plant that can form dense mats that displace native aquatic plants, decrease planktonic productivity, increase water pH and turbidity, decrease dissolved oxygen concentrations, and reduce local biodiversity. Waterweed is established and spread primarily through vegetative reproduction. Stem fragments can be dispersed by waterfowl, boat propellers or trailers, vehicles that cross fords, and floatplane rudders. Once established, control usually requires use of herbicides. Bird vetch is a climbing or trailing perennial legume that overgrows herbaceous vegetation and can climb over shrubs. Because bird vetch is a legume and fixes nitrogen, it alters soil conditions. Bird vetch can be introduced with topsoil and seed can be carried in tangled vegetation that clings to construction equipment. Once established it is very difficult to eradicate.

Vectors for transmission of these and other invasive plants include equipment, personnel, construction materials, erosion control materials, and revegetation seed mixes. Invasive plants and animals can be transported on equipment mobilized from the continental United States or from contaminated sites within Alaska or Canada; spread from contaminated sites within the Project area during construction; spread from contaminated materials such as straw, small machinery, hand tools, footwear, clothing, or tires from other areas within or outside of the state; and through use of seed mixtures that contain invasive and non-native seeds. In addition, pipeline and construction materials arriving from outside the United States could transport seeds or propagules of invasive plants. Pipe storage yards within Alaska could be or become infested with invasive plants that could be transported throughout the Mainline corridor during construction.

Preventative measures include identifying locations and the extent of existing infestations, mapping and flagging infested areas, treatment of infested areas prior to work, establishing cleaning stations, and inspecting field equipment and vehicles before entering Project sites. Appropriate treatment methods would be based on the specific invasive plant or animal, the extent of infestation, and area-specific conditions. Treatment methods could include manual or mechanical removal, or application of herbicide.

Forest Pests and Disease

Forest insects and diseases active throughout the Mainline corridor include insects that cause defoliation of alder, aspen, birch, cottonwood, and willow, such as leaf rollers and spruce mortality, including spruce beetles and northern spruce engravers (Table 3.3.4-1). These pests can be spread through vegetation clearing, ground disturbance, and revegetation, or can be exacerbated by stress on trees from changes in microclimate or soil moisture caused by construction of facilities. There are currently no recognized serious exotic tree pathogens that have been introduced or established in Alaska, although detection may be difficult (Table 3.3.4-2). Importation or movement of infected live plant materials for revegetation are the primary pathways for introduction of plant pathogens. The use of local plant materials that have been inspected and cleared for pests and disease for revegetation efforts and using machine washing stations could assist in controlling the spread of damaging insects and potential pathogens.

Sensitive Vegetation Types or Communities

No known plant associations of concern are located in proximity to the Mainline. No impacts are anticipated to plant associations of concern from construction of the Mainline.

No known rare or sensitive plant species would be crossed by the construction ROW for the Mainline. Forty-six rare plant populations are documented near the Mainline and off-ROW facilities based on reference data from the AKNHP (UAA 2014). These occurrences are listed in Table 3.3.5-3. All but 6 of the 46 occurrences are located more than 0.25 mile from the Mainline ROW: in the Arctic Tundra Ecoregion these include northern fescue near milepost 140, bristleleaf sedge near mileposts 227 and 228, longstem sandwort near milepost 230, and rock stitchwort and field locoweed near milepost 231; and in the Alaska Range Ecoregion these include Robbins' pondweed near milepost 577 (Table 3.3.5-3). A comprehensive survey of rare and sensitive plant species has not been conducted along the proposed Project route. Should an individual be located within the construction footprint at the time of ROW preparation, the plants would be subject to the same impacts as other terrestrial and wetland vegetation. One of the species that has been observed within 0.25 mile is an aquatic species, Robbins' pondweed, and the proposed waterbody crossing near its location would be a dry-ditch crossing method (dam and pump, dam and flume) in the summer (See Appendix H of Resource Report No. 2), minimizing any downstream impacts (turbidity and sedimentation). Any individual in the immediate vicinity could also potentially be indirectly impacted due to dust or off-site runoff. These indirect impacts would be avoided or minimized by adherence to the Project's *Fugutive Dust Control Plan* and the Applicant's *Plan* and *Procedures*. Effects on these species, if any, would be minor but long-term. These species are not protected by the ESA or state laws. Several of these populations are located on BLM property and are included in BLM's management plans.

Timber Harvesting

Prior to construction, timber would be cleared along the Mainline construction ROW, storage yards, camps, extra workspaces, and access roads during winter. About 11,200 acres of forest would be cleared (Table 3.3.7-3). Forested habitats would not be restored along the Mainline operation ROW.

Per 43 C.F.R. 2885.13, the United States retains "ownership of the resources of the land covered by the grant [of right of way] or temporary use permit, including timber and vegetation or mineral materials and any other living or non-living resource. Timber cleared from BLM-managed lands for this project would be purchased and harvested; The BLM would be consulted with prior to vegetation clearing to coordinate timber cruises and purchases. After purchase timber harvesting would follow procedures detailed in previous Section 3.3.7.2.1.1 clearing and grading.

Marine Vegetation

No macroalgae or seagrass were noted to be present at the shoreline crossing locations of the Mainline in Cook Inlet. Impacts to the intertidal area would be avoided with the use of a trenchless crossing method. No direct effects to marine vegetation are anticipated from construction of the Mainline in Cook Inlet.

There could be minor impacts to nearby habitat from placement of equipment or movement of pipeline on the ocean floor causing short-term increases in turbidity. Any habitat effects from turbidity would be temporary and of short duration.

3.3.7.2.1.2 PBTL and PTTL

The PBTL would connect the PBU CGF with the GTP. The PBTL would be approximately 1 mile long and would be above ground on VSMs. The PTTL would extend from the PTU at milepost 0 to the GTP at milepost 62. Both pipelines would be above ground on VSMs, constructed in winter from ice workpads, and would cross primarily herbaceous and scrub tundra vegetation (Table 3.3.7-4). Potential impacts to tundra vegetation could include delayed phenology from late snowmelt, alteration of vegetation communities (e.g. invasive plant and animal species), alteration of soil moisture regime, thermokarst, contamination from spills, damage to tussocks and dwarf shrubs, and compaction of microtopography. There is potential for introduction of non-native or invasive plants, but the potential is reduced because most of the work is proposed for winter and does not involve importation of fill from other areas. Appendix K *Noxious and Invasive Plant and Animal Control Plan* in this report discusses invasive plant and animal species and mitigation measures.

TABLE 3.3.7-4

Vegetation Area (Acres) Affected by Construction and Operation of the PBTL and PTTL

Vegetation Type	PBTL ROW		PTTL ROW		PTTL Associated Facilities		PTTL Total	
	Const	Ops	Const	Ops	Const	Ops	Const	Ops
Dwarf Scrub	0.00	0.00	4.54	1.71	0.41	0.00	4.95	1.71
Low Scrub	0.00	0.00	17.86	5.63	39.96	0.30	57.82	5.92
Scrub Subtotal	*0.00*	*0.00*	*22.40*	*7.34*	*40.36*	*0.30*	*62.77*	*7.63*
Graminoid Herbaceous	5.49	5.49	1,491.83	542.68	248.31	1.11	1,740.14	543.79
Aquatic (nonemergent) Herbaceous	0.00	0.00	3.04	0.48	0.00	0.00	3.04	0.48
Herbaceous Subtotal	*5.49*	*5.49*	*1,494.87*	*543.16*	*248.31*	*1.11*	*1,743.18*	*544.27*
Vegetated Area Subtotal	***5.49***	***5.49***	***1,517.28***	***550.50***	***288.67***	***1.41***	***1,811.44***	***557.40***
Unvegetated Total	1.82	1.82	209.34	63.12	61.15	.05	270.49	63.17
Totals	**7.31**	**7.31**	**1,726.62**	**613.62**	**349.82**	**1.46**	**2,076.44**	**615.07**

Source: Project Vegetation Mapping; Boggs et al., 2012.

Const = Construction, Ops = Operations; Construction acreage includes operational areas. See Resource Report No. 1, Table 1.4-1 for definitions of construction and operations affected areas.

Note: PTTL ROW Operations includes both the ROW and Aboveground Infrastructure within the ROW; Associated Infrastructure = Camps, Helipad, Pipe Storage Yard (gravel); remaining associated infrastructure assumed to be constructed from ice.

Note: Approximately 45 percent of the PBTL was not covered by Project vegetation mapping, the AKNHP mapping was used to fill in missing vegetation mapping.

Unvegetated-ponds, lakes, streams, offshore waters, and disturbed areas are included within this category.

Ice Roads

Ice roads may have minor or negligible effects on vegetation. Construction of ice roads may damage tundra vegetation by affecting the plants' thermal environment at the base of the ice road or through scraping or compression. The most notable effects generally occur in low snow areas in tussock tundra when tussocks are broken or scraped. Wet tundra typically shows little to no effect from ice roads. Impacts to tundra vegetation from ice roads typically require no restoration and the tundra recovers naturally within about 10 years (NSSI, 2013). Any effects to vegetation form ice road construction and use would be minor and short-term.

Hydrostatic Testing

Hydrostatic testing would occur during summer using freshwater. Test water would come from permitted water sources and would be discharged within the same drainage basin. The PTTL would be tested in sections. The middle test sections would be dependent upon access to water in the spring, summer, or fall. Potential impacts to vegetation could occur from the discharge of the test water to vegetated areas, potentially causing erosion. However, any such discharges to the ground would be first directed through an energy-dissipating device to reduce the potential for erosion and encourage infiltration back into the soil, so any effects would be minor and short-term.

Spills

Spills along the PBTL and PTTL ROWs could include oil, fuel, or other hazardous materials, improperly maintained equipment, and the improper use and storage of fuels, lubricants, or other hazardous materials. The PBTL and PTTL would be constructed during the winter from ice workpads. Spills could occur on ice roads or workpads along the ROW. Most spills would be small, contained, and removed. Spills on ice would be immediately chipped, and bagged for disposal. All temporary fuel storage tanks would have secondary containment. The Project's Environmental Inspectors would oversee and inspect the Contractor's compliance with the provisions of the *SPCC Plan*. In all areas, the *SPCC Plan* would be followed during construction and made specific to the ecoregion and conditions for the working environment.

While a spill has the potential for significant adverse environmental impacts, adherence to the Project's protective measures included in the *SPCC Plan* would greatly reduce the likelihood of such impacts, as well as reduce the resulting impacts should a spill occur. As such, significant adverse impacts to vegetation due to a release would be unlikely. If small spills were to occur, the effects would be minor and short-term.

Waste

All waste would be handled in accordance with the Project's *Waste Management Plan* (Appendix J of Resource Report No. 8). This *Plan* addresses hazardous and nonhazardous waste materials and volumes, handling, and disposal in detail. The *Plan* would ensure compliance with all regulations for transportation, treatment, storage, and disposal of waste. Waste management activities would be performed in accordance with the waste management hierarchy. In order of preference, the aim would be avoidance, minimization, reuse, recycle, recover, and lastly disposal.

The generation and storage of hazardous wastes during construction would be minimal. Volumes and types of waste would be determined when construction contractors are selected and construction plans finalized. At that time, each contractor would be required to develop a waste management plan that follows the guidance in the Project's *Waste Management Plan* and outlines the types, volumes, and disposition of wastes anticipated during construction. To prevent and mitigate against inadvertent contamination from waste, all waste storage areas would be located in upland areas and would be properly contained until disposal. Solid waste would be disposed of at an approved disposal facility such as the NSB Oxbow Landfill. With adherence to the Project's *Waste Management Plan* procedures and mitigation measures, adverse impacts to vegetation due to waste management during construction of the PBTL and PTTL are not anticipated.

Sensitive Vegetation Types or Communities

No known plant associations of concern are located in proximity to the PBTL or PTTL. No impacts are anticipated to plant associations of concern from construction of the PBTL or PTTL.

No known observations of rare and sensitive plant species are located within 0.25 mile of the PBTL or PTTL. No impacts are anticipated to rare or sensitive plants from construction of the PBTL or PTTL

3.3.7.2.1.3 Pipeline Aboveground Facilities

Aboveground facilities for the Mainline include compressor stations, meter stations, MLBVs, and heater stations. Aboveground facilities would be built on granular pads. Use of granular material and pad thickness would depend on site conditions, including consideration for protection of permafrost. Impacts to vegetation would include loss of vegetation from placement of granular fill, potential increased erosion and sedimentation, thermokarst with thaw settlement, contamination from runoff, cover with dust or gravel spray from access roads and granular pads, increased moisture and delayed melt from snow piles, and habitat fragmentation. Buffers around compressor and heater stations would be maintained free of trees and shrubs to prevent fires. The impacts to vegetation would be minor because of the relatively small area involved but long-term because the natural vegetation would not be allowed to recover under the granular fill or within the buffer areas.

Aboveground facilities for the Mainline would cover about 257 vegetated acres (Table 3.3.7-3). Aboveground facilities for the PTTL would cover about 0.5 acre (Table 3.3.7-4). No aboveground facilities would be necessary for the PBTL. Mainline facilities would be located primarily within scrub habitats (50 percent), followed by forested (42 percent) and herbaceous (8 percent) habitats. Forested areas would be primarily evergreen forests (43 percent), while scrub habitats would be primarily low (54 percent) and dwarf scrub (24 percent) (Table 3.3.7-3).

Hydrostatic Testing

Hydrostatic testing for aboveground facilities would occur in summer using freshwater. Water would not contain additives and would comply with conditions and restrictions of water permits. Test water would come from nearby ponds or streams and would be discharged into the same drainage basin. Potential impacts to vegetation could occur from water discharged to vegetated areas causing erosion, spread of invasive aquatic plants or animals, or fuel spills. Where practicable, test water would come from sources that do not harbor invasive aquatic organisms. If test water from infested sources is used, water would be discharged into the same waterbody and would not be discharged into other watersheds. Erosion would be prevented by using erosion control structures for discharge or hydrostatic test water. With these measures in place, any effects on vegetation from hydrostatic testing would be minor and short-term.

Spills

Vegetation would be cleared from the site prior to granular pad and facility construction. Spills from construction of aboveground facilities could include oil, fuel, or other hazardous materials due to improperly maintained equipment or the improper use and storage of fuels, lubricants, and other hazardous materials. Spills could contact vegetation from infiltration through pad edges, runoff, or spills from construction equipment. To avoid potential contamination of vegetation and soils around aboveground facilities, all fuel handling necessary for construction of the Pipeline Aboveground Facilities would be in accordance with ADEC requirements and the Project's *SPCC Plan* (Appendix M of Resource Report No. 2). The *SPCC Plan* would be managed by the Project's Environmental Inspectors during construction. Management under the *SPCC Plan* would include: secondary containment for single-walled containers; proper maintenance of storage and construction equipment and daily inspections for leaks. In some instances, parking and refueling would be required within wetlands. In accordance with the Applicant's *Procedures*, appropriate steps would be taken (including secondary containment structures) to prevent spills and provide for prompt cleanup in the event of a spill.

While a spill has the potential for significant adverse environmental impacts, adherence to the Project's protective measures outlined in the *SPCC Plan* would greatly reduce the likelihood of such impacts, as well reduce the resulting impacts should a spill occur. As such, significant adverse impacts to vegetation at aboveground facilities due to a release are unlikely. If a small spill were to occur the effects on vegetation would be minor and short-term.

Waste

The generation and storage of hazardous wastes during construction would be minimal. Volumes and types of waste would be determined when construction contractors are selected and construction plans finalized. At that time, each contractor would be required to develop a waste management plan that follows the guidance in the Project's *Waste Management Plan* and outlines the types, volumes, and disposition of wastes anticipated during construction. To prevent and mitigate against inadvertent contamination from waste, all waste storage areas would be located in upland areas and would be properly contained until disposal. Waste management activities would be performed in accordance with the waste management hierarchy. In order of preference, the aim would be avoidance, minimization, reuse, recycle, recover, and lastly disposal. Solid waste would be disposed of at the NSB Oxbow Landfill or other approved facility. With adherence to the Project's *Waste Management Plan* procedures and mitigation measures, adverse impacts to vegetation due to waste management during construction of the Pipeline Aboveground Facilities are not anticipated.

Non-native and Invasive Plants

Vectors for transmission of invasive plants include equipment, personnel, construction materials, erosion control materials, and revegetation seed mixes. Invasive plants and animals can be transported on equipment mobilized from the continental United States or from contaminated sites within Alaska or Canada; spread from contaminated sites within the Project area during construction; spread from contaminated materials such as straw, small machinery, hand tools, footwear, clothing, or tires from other areas within or outside of the state; and through use of seed mixtures that contain invasive and non-native seeds. Preventative measures include identifying locations and the extent of existing infestations, mapping and flagging infested areas, treatment of infested areas prior to work, establishing cleaning stations, and inspecting field equipment and vehicles before entering Project sites. The appropriate treatment methods would be based on the specific invasive plant or animal, the extent of infestation, and area-specific conditions. Treatment methods could include manual or mechanical removal, or application of herbicide.

Noxious and invasive weeds that have been identified within 0.25 mile of Compressor and Heater Stations are listed in Table 3.3.7-5. Most of these sites have not been surveyed for weeds. The Ray River Compressor Station and the Coldfoot Compressor Station area have both had control measures for white sweetclover applied by the BLM (AKEPIC, 2014). The disturbance identified for these white sweetclover infestations was fill importation (AKEPIC, 2014).

TABLE 3.3.7-5

Noxious and Invasive Plant Occurrences within 0.25 Mile of Compressor and Heater Stations

MP	Compressor or Heater Station	Area (acres)	None	Common Dandelion	Prostrate Knotweed	White Sweetclover	Total
76.0	Sagwon Compressor Station	30.3	1	-	-	-	1
148.5	Galbraith Lake Compressor Station	30.3	-	1	-	-	1
240.1	Coldfoot Compressor Station	30.3	1	-	-	-	1
332.6	Ray River Compressor Station	30.3	-	1	1	2	4
421.6	Minto Compressor Station	30.3	1	-	-	-	1
517.6	Healy Compressor Station	30.3	1	-	-	-	1
597.4	Honolulu Creek Compressor Station	22.7	1	-	-	-	1
675.2	Rabideux Creek Compressor Station	30.3	1	-	-	-	1
749.1	Theodore River Heater Station	22.7	1	-	-	-	1
Total		**257.5**	**7**	**2**	**1**	**2**	**12**

Source: AKEPIC, 2016.

Weed surveys have not been completed at most MLBV locations; reported locations of noxious and invasive plants within 0.25 miles of MLBV sites are indicated in Table 3.3.7-6. Narrowleaf hawksbeard is the most common, occurring at five locations. (Table 3.3.7-6). Helipads would be located at MLBVs, compressor stations, heater stations, and camps. Infested helipads could be a source of invasive plant seeds, especially white sweetclover, which is able to colonize the types of habitats typical of granular pads.

TABLE 3.3.7-6

Noxious and Invasive Plant Occurrences within 0.25 mile of Mainline Block Valves

MP	Mainline Block Valve	None	Bird vetch	Narrowleaf hawksbeard	Reed canary grass	White sweetclover	Yellow sweetclover	Total
36.7	MLBV 2	1	-	-	-	-	-	1
112.0	MLBV 4	1	-	-	-	-	-	1
194.1	MLBV 6	1	-	-	-	-	-	1
286.1	MLBV 8	1	-	-	-	-	-	1
377.9	MLBV 10	1	-	1	-	1	-	3
444.9	MLBV 12	1	-	-	-	-	-	1
467.1	MLBV 13	1	-	-	-	-	-	1
493.0	MLBV 14	1	-	-	-	-	-	1
534.8	MLBV 16	-	1	2	-	-	2	5
538.8	MLBV 17	1	-	-	-	-	-	1
546.5	MLBV 18	1	-	-	-	-	-	1
572.2	MLBV 19	1	-	-	-	-	-	1
625.8	MLBV 21	1	-	-	-	-	-	1
648.2	MLBV 22	1	-	-	-	-	-	1
703.7	MLBV 24	1	-	-	-	-	-	1

TABLE 3.3.7-6

Noxious and Invasive Plant Occurrences within 0.25 mile of Mainline Block Valves

MP	Mainline Block Valve	None	Bird vetch	Narrowleaf hawksbeard	Reed canary grass	White sweetclover	Yellow sweetclover	Total
725.9	MLBV 25	1	-	-	-	-	-	1
766.0	MLBV 27	1	-	-	-	-	-	1
793.3	MLBV 28	1	-	-	-	-	-	1
799.9	MLBV 29	-	-	-	2	-	-	2
Grand Total		**17**	**1**	**3**	**2**	**1**	**2**	**26**

Source: AKEPIC, 2016; FAC_MS_MAINLINE_BLOCKVALVES_A
Note: - = no documented occurrence in the database

Sensitive Vegetation Types or Communities

No known plant associations of concern occur near compressor station, heater station, or MLBV locations. No impacts are anticipated to plant associations of concern from construction of the aboveground facilities.

No known rare or sensitive plants are located within 0.25 mile of compressor station, heater station, or MLBV locations. No impacts are anticipated to rare or sensitive plants from construction of the aboveground facilities.

3.3.7.2.1.4 Pipeline Associated Infrastructure

Pipeline Associated Infrastructure for the Mainline includes additional temporary workspaces, access roads, construction camps, pipe storage yards, material sites, railroad spur and workpad, and the Mainline MOF. Pipeline Associated Infrastructure may be ice or granular work surfaces. The use of granular fill and pad thickness would depend on site conditions, including consideration for protection of permafrost. Impacts to vegetation would include loss of vegetation from placement of granular fill, excavation, potential increased erosion and sedimentation, thermokarst with thaw settlement, contamination from runoff, cover with dust or gravel spray from access roads and gravel pads, increased moisture and delayed melt from snow piles, and habitat fragmentation.

Pipeline Associated Infrastructure for the Mainline would cover about 11,173 acres of which 9,408 acres would be vegetated (Table 3.3.7-3). Pipeline Associated Infrastructure for the PTTL would cover about 350 acres (Table 3.3.7-4). Mainline infrastructure would be located primarily within forested habitats (59 percent), followed by scrub (31 percent) and herbaceous (10 percent) habitats. Forested areas would be primarily mixed forests (50 percent) and evergreen forests (36 percent), while scrub habitats would be low (55 percent), dwarf tree (14 percent), tall scrub (22 percent), and dwarf scrub (8 percent) (Table 3.3.7-3).

Access Roads

Construction of the Mainline pipeline would require the construction of access roads. About 513 access (ice and granular) roads may be used to construct the Mainline and associated facilities. Ice access roads would be used in the Beaufort Coastal Plain Ecoregion to access water sources and other ice workspaces.

Potential impacts from the construction of ice access roads would include delayed melt the following spring, potential interruption of spring snowmelt runoff causing ponding and erosion, breakage of tussocks, compaction of standing dead vegetation, and potential soil compaction. Granular access roads would be constructed along the Mainline to material and water sources, which would remain through operations. Potential impacts from construction of granular access roads include burial of vegetation and soils, excavation of vegetation and soils for road-building materials, interruption of surface drainage leading to upslope ponding and downslope drying, potential introduction of noxious and invasive plants, vegetation coating with fugitive dust, erosion, and sedimentation.

Potential access road impacts to vegetation, summarized under Associated Infrastructure in Table 3.3.7-7, would cover about 1,837 acres of primarily forested habitat, with lesser amounts of scrub and herbaceous habitats. Most access roads (88 percent) would have a granular surface.

Mitigation measures described in the Applicant's *Plan* and *Procedures* would be implemented to provide for uninterrupted surface water flow, control fugitive dust, avoid erosion and sedimentation, and avoid potential contamination from spills. As described, dust control methods could include the application of nontoxic chemical dust suppressants alone or combined with mulch, and should be explored where suitable water is not available; prompt removal of material tracked onto paved streets; covering of open body trucks where applicable when there is risk of airborne dust; and reduction in the speed of construction vehicles along the ROW and unpaved roads. As construction is completed and access roads are phased out, the areas disturbed for access road construction would be revegetated. The use of granular material from weed-free certified pits combined with seed mixes and plants native to the area during revegetation would reduce the potential introduction and spread of noxious and invasive plants.

TABLE 3.3.7-7

Vegetation Area (Acres) Affected During Construction by Mainline Associated Facilities - Access Roads

Vegetation Type	Gravel	Ice	Total
Evergreen Forest	**317.00**	.88	242.46
Deciduous Forest	112.75	0.87	103.70
Mixed Forest	399.74	0.69	364.60
Forest Subtotal	*829.49*	*1.75*	*710.76*
Dwarf Tree Scrub	44.24	0.00	34.31
Tall Scrub	123.54	0.09	92.98
Low Scrub	249.14	0.70	201.53
Dwarf Scrub	34.38	13.23	25.75
Scrub Subtotal	*451.30*	*14.02*	*354.57*
Graminoid Herbaceous	208.56	246.99	406.04
Forb Herbaceous	3.65	0.00	3.42
Aquatic (nonemergent) Herbaceous	0.66	0.00	0.61
Herbaceous Subtotal	*212.87*	*246.99*	*410.07*
Vegetated Area Subtotal	*1493.66*	*262.77*	*1,475.40*
Unvegetated Total	*466.95*	*129.16*	*361.15*
Access Road Total	1960.61	391.94	1,836.55

Source: Project Vegetation Mapping.

Construction acreage includes operational areas. See Resource Report No. 1, Table 1.4-1 for definitions of construction and operations affected areas and for total acreages that include existing access roads. Table 1.4-1 does not include ice access roads.

Spills

Diesel, gasoline, and other fuels stored on site could potentially damage or kill vegetation if spills were to reach vegetated habitats or soils.

All fuel handling necessary for construction of the Mainline would be in accordance with ADEC requirements and the Project's *SPCC Plan* (Appendix M of Resource Report No. 2). The Plan would be managed by the Project's Environmental Inspectors during construction. The storage of fuels and lubricants would be in secured containers manufactured for their purposes and stored in a secure area with proper labels. Secondary containment would be used for single-walled containers. In addition to proper storage, construction equipment should be maintained and inspected daily for leaks, and any waste should be contained, collected, and disposed of in an appropriate manner.

While a spill has the potential for significant adverse environmental impacts, adherence to the Project's protective measures outlined in the *SPCC Plan* would greatly reduce the likelihood of such impacts, as well reduce the resulting impacts should a spill occur. As such, significant adverse impacts to vegetation at Pipeline Associated Infrastructure areas due to a release are unlikely.

Waste

Potential impacts to vegetation would be avoided or reduced through waste management and spill response planning. Waste management activities would be performed in accordance with the waste management hierarchy. In order of preference, the aim would be avoidance, minimization, reuse, recycle, recover, and lastly disposal. All waste, including contaminated soils and absorbent materials, would be stored and disposed of by the Contractor in compliance with state and federal regulations. There are no licensed hazardous waste treatment or disposal facilities in Alaska. All hazardous waste and contaminated soils may be stored in a secure location at the Contractor yard until shipment to a licensed facility. To prevent and mitigate against inadvertent contamination from waste, all waste storage areas would be located in upland areas and would be properly contained until disposal. Solid waste would be disposed of at the NSB Oxbow Landfill or other approved facility. With the design features and *SPCC Plan*, construction of the Pipeline Associated Infrastructure facilities is not anticipated to spread existing contamination or cause additional soil contamination.

Non-native and Invasive Plants

Invasive plants and animals can damage to native vegetation by out-competing native plants and can compromise wildlife habitats by reducing quality of forage or cover. Invasive plants that occur along the Mainline are listed in Table 3.3.3-1. Of these, the invasive plants with the highest invasive ranks that are established within the Mainline corridor include reed canarygrass in the Cook Inlet Basin Ecoregion, white sweetclover throughout the Mainline corridor, waterweed (*Elodea* sp.) in the Cook Inlet Basin Ecoregion, and bird vetch in the Brooks Range and Ray Mountain ecoregions (Table 3.3.3-1).

Vectors for transmission of these and other invasive plants include equipment, personnel, construction materials, erosion control materials, and revegetation seed mixes. Invasive plants and animals can be transported on equipment mobilized from the continental United States or from contaminated sites within Alaska or Canada; spread from contaminated sites within the Project area during construction; spread from contaminated materials such as straw, small machinery, hand tools, footwear, clothing, or tires from other areas within or outside of the state; and through use of seed mixtures that contain invasive and non-native seeds. In addition, pipeline and construction materials arriving from outside the United States could transport seeds or propagules of invasive plants. Pipe storage yards within Alaska could be or become infested with invasive plants that could be transported throughout the Mainline corridor during construction.

Preventative measures include identifying locations and the extent of existing infestations, mapping and flagging infested areas, treatment of infested areas prior to work, establishing cleaning stations and inspecting field equipment and vehicles before entering Project sites. The appropriate treatment methods would be based on the specific invasive plant or animal, extent of infestation, and area-specific conditions. Treatment methods could include manual or mechanical removal, or application of herbicide.

Sensitive Vegetation Types or Communities

No known plant associations of concern are located in proximity to the Pipeline Associated Infrastructure. No impacts are anticipated to plant associations of concern from construction of the Pipeline Associated Infrastructure.

No known rare or sensitive plant species will be crossed by the Pipeline Associated Infrastructure. Four reported rare plant occurrences are located within 0.25 mile of the Pipeline Associated Infrastructure based on reference data from the AKNHP (UAA 2014). These occurrences are listed in Table 3.3.5-3 and include:

- Vahl's alkaligrass located approximately 0.13 mile from access road AR-MS-MLBV-PSY-E-129.55 near MP 0.00;
- Muir's fleabane approximately 0.02 mile from access road AR-MS-MLBV-PSY-E-129.56 near MP 130;
- Windmill fringed gentian approximately 0.03 mile from the Nenana pipe storage yard near MP 473; and
- Coon's tail, a native perennial aquatic plant found in ponds, lakes, and slow moving streams, and coincides has been reported approximately 0.03 mile from access road PSY-SP-N-568.78 and 0.09 mile from the Cantwell pipe storage yard near MP 569.

A comprehensive survey of rare and sensitive plant species has not been conducted along the entire proposed Project route. Should an individual be located within the construction footprint at the time of infrastructure construction, the plants would be subject to the same impacts as other vegetation. Any individual in the immediate vicinity could also potentially be indirectly impacted due to dust or off-site runoff. These indirect impacts would be avoided or minimized by adherence to the Project's *Fugutive Dust Control Plan* and the Alaska LNG Project's *Plan* and *Procedures*. Effects on the individual species, if any, would be anticipated to be minor but long-term. These rare or sensitive plant species are not protected by the ESA or state laws. Two of the populations within 0.25 mile are BLM sensitive species and the population of Muir's fleabane near MP 130 is located on BLM property and is included in BLM's management plan.

Timber Harvesting

Prior to construction, timber would be cleared. Per 43 C.F.R. 2885.13, the United States retains "ownership of the resources of the land covered by the grant [of ROW] or temporary use permit, including timber and vegetation or mineral materials and any other living or non-living resource. Timber cleared from BLM-managed lands for this project would be purchased and harvested; the BLM would be consulted with prior to vegetation clearing to coordinate timber cruises and purchases. After purchase, timber harvesting would follow procedures detailed in previous Section 3.3.7.2.1.1 clearing and grading.

Marine Vegetation

No macroalgae or seagrass were noted to be present at the shoreline location of the Mainline MOF in Cook Inlet. No direct effects to marine vegetation are anticipated from use of the Mainline MOF during construction.

Turbidity and sedimentation resulting from filling to construct the Mainline MOF and vessel use (e.g., prop wash) during construction may cover individuals and temporarily reduce habitat suitability for any marine vegetation in the vicinity. Because of the high natural turbidity in upper Cook Inlet, it is unlikely that construction and use of the Mainline MOF would exceed background water turbidity more than 200 feet from these activities. Habitat effects from turbidity would be temporary and of short duration

3.3.7.2.2 GTP

Construction of the GTP would be initiated during winter with some work on granular work pads continuing throughout the summer. The GTP would be constructed near the CGF in the PBU. The GTP Pad and the Operations Center Pad would be connected by a granular road, and would cover about 284 acres. The Mainline, PBTL, and PTTL would tie in to the GTP. Facilities at the GTP would include processing trains, a control building, flares, metering, residential buildings, maintenance shop, utility, telecommunications, parking, and waste management facility.

3.3.7.2.2.1 GTP Facility

The GTP Pad and the Operations Center Pad during construction would cover about 263 acres of tundra vegetation, of which about 99 percent consists of graminoid herbaceous habitat (Table 3.3.7-8).

The primary impacts to vegetation from construction of the GTP Pad and the Operations Center Pad would be associated with granular fill and excavation, including construction of the granular pads. Potential indirect impacts would include interruption of surface water flow, thermal degradation of permafrost, and cover with fugitive dust, gravel spray, and snow piles. Mitigation measures to avoid and reduce potential impacts to tundra vegetation are described in the Applicant's *Plan* and *Procedures.*

Spills

Spills at the GTP could include oil, fuel, or other hazardous materials, improperly maintained equipment, and the improper use and storage of fuels, lubricants, or other hazardous materials. Most spills would be small, contained, and removed. All fuel handling necessary for construction of the GTP would be in accordance with ADEC requirements and the Project's *SPCC Plan* (Appendix N). The *SPCC Plan* would be managed by the Project's Environmental Inspectors during construction. This includes that secondary containment would be used for single-walled containers; storage and construction equipment would be maintained and inspected daily for leaks. In some instances, parking and refueling would be required within wetlands. In accordance with the Applicant's *Procedures*, appropriate steps would be taken (including secondary containment structures) to prevent spills and provide for prompt cleanup in the event of a spill.

While a spill has the potential for significant adverse environmental impacts, adherence to the Project's protective measures previously outlined (see Section 3.2.7.1.8) as practicable would greatly reduce the likelihood of such impacts, as well as reduce the resulting impacts should a spill occur. As such, significant adverse impacts to vegetation due to contamination from a release at the GTP would be unlikely.

TABLE 3.3.7-8

Vegetation Area (Acres) Affected During Construction and Operations of GTP Facility

Vegetation Type	Gas Treatment Plant Construction	Gas Treatment Plant Operation	Associated Infrastructure Construction	Associated Infrastructure Operation	Total Construction	Total Operation
Gas Treatment Plant						
Graminoid Herbaceous	262.60	262.60	467.58	386.54	730.19	649.16
Aquatic (nonemergent) Herbaceous	0.07	0.07	0.00	0.00	0.07	0.07
Herbaceous Subtotal	*262.67*	*262.67*	*467.58*	*386.54*	*730.26*	*649.23*
Unvegetated Total	*21.19*	*21.19*	*174.49*	*118.87*	*195.68*	*140.06*
Gas Treatment Plant Total	**283.86**	**283.86**	**642.07**	**505.41**	**925.93**	**789.27**

Source: Project Vegetation Mapping; Boggs et al., 2012.

Construction acreage includes operational areas. See Resource Report No. 1, Table 1.4-1 for definitions of construction and operations affected areas. Gas Treatment Plant includes GTP Pad and GTP Operations Center Pad.

Note: Approximately 3.3 percent of the GTP was not covered by Project vegetation mapping, the AKNHP mapping was used to fill in missing vegetation mapping.

GTP Totals do not include 30 acres for the Pioneer Camp.

Waste

The Project *Waste Management Plan* addresses hazardous and nonhazardous waste materials and volumes, handling, and disposal in detail. Potential impacts to vegetation would be avoided or reduced through waste management and spill response planning. Waste management activities would be performed in accordance with the waste management hierarchy. In order of preference, the aim would be avoidance, minimization, reuse, recycle, recover, and lastly disposal. All waste, including contaminated soils and absorbent materials, would be stored and disposed of by the Contractor in compliance with state and federal regulations. There are no licensed hazardous waste treatment or disposal facilities in Alaska. All hazardous waste and contaminated soils may be stored in a secure location at the Contractor yard until shipment to a licensed facility. To prevent and mitigate against inadvertent contamination from waste, all waste would be properly contained until disposal. Solid waste would be disposed of at the NSB Oxbow Landfill or other approved facility. With the design features and *SPCC Plan*, construction of the GTP is not anticipated to spread existing contamination or cause additional soil contamination.

Non-native and Invasive Plants

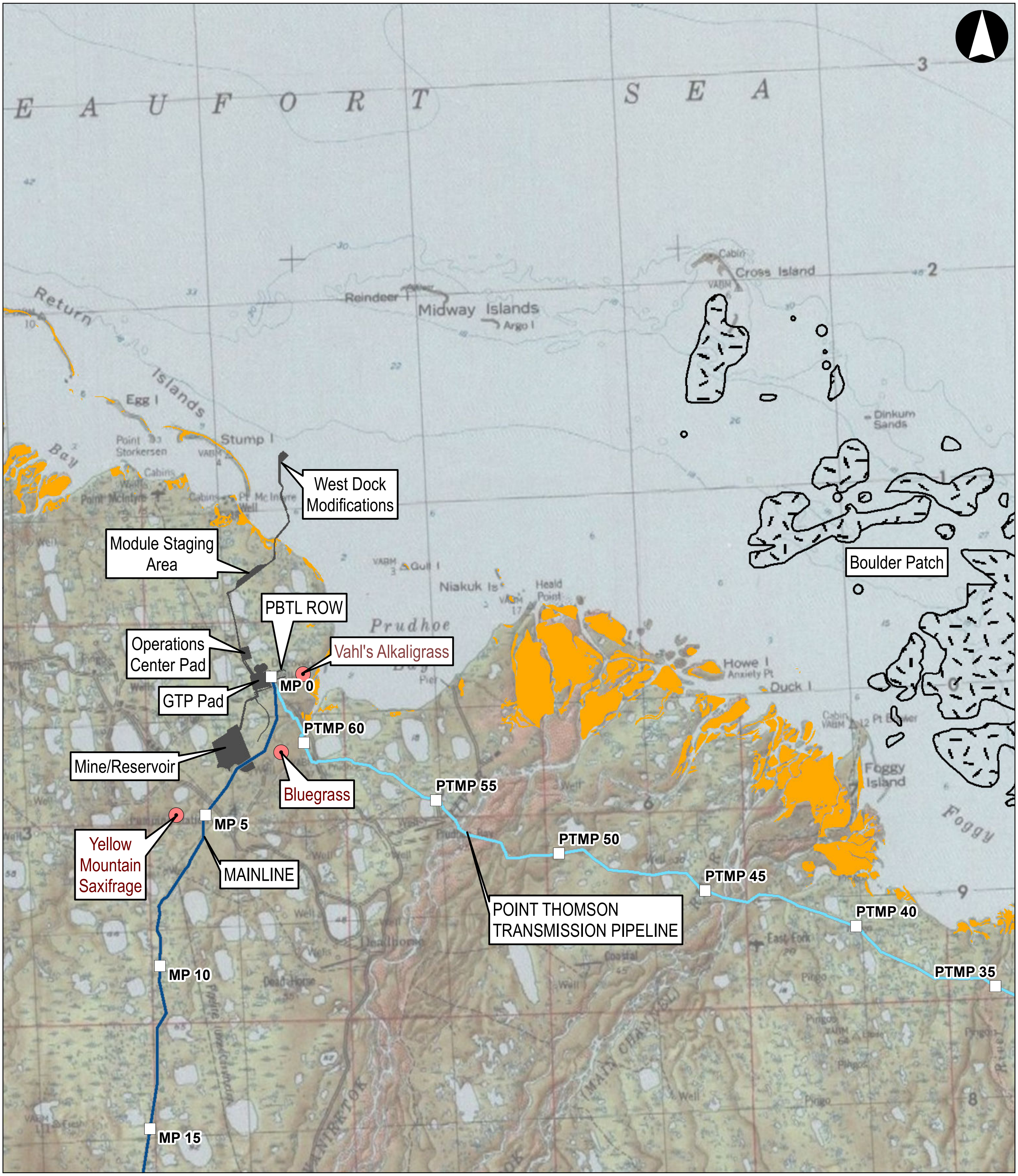
Invasive plants and animals can damage native vegetation by out-competing native plants and can compromise wildlife habitats by reducing quality of forage or cover. No invasive plants have been documented near the GTP. The closest survey, a little over 10 miles south of the GTP at a material site near Deadhorse, found no invasive plants. The Beaufort Coastal Plain Ecoregion has been largely spared from ecological issues from invasive plants because of the Arctic environment.

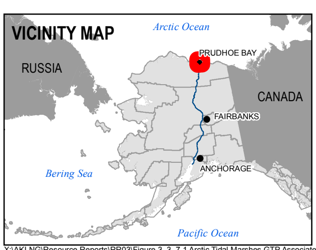
Vectors for transmission of invasive plants include equipment, personnel, construction materials, erosion control materials, and revegetation seed mixes. Invasive plants and animals can be transported on equipment mobilized from the continental United States or from contaminated sites within Alaska or Canada; spread from contaminated sites within the Project area during construction; spread from contaminated materials such as straw, small machinery, hand tools, footwear, clothing, or tires from other areas within or outside of the state; and through use of seed mixtures that contain invasive and non-native seeds. In addition, pipeline and construction materials arriving from outside the United States could transport seeds or propagules of invasive plants.

Preventative measures include identifying locations and the extent of existing infestations, mapping and flagging infested areas, treatment of infested areas prior to work, establishing cleaning stations, and inspecting field equipment and vehicles before entering Project sites. The appropriate treatment methods would be based on the specific invasive plant or animal, extent of infestation, and area-specific conditions. Treatment methods could include manual or mechanical removal, or application of herbicide.

Sensitive Vegetation Types or Communities

No known plant associations of concern or rare and sensitive plant species occur at the GTP. No impacts are anticipated to plant associations of concern or rare and sensitive plants from construction of the GTP.





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LEGEND

- Rare Plants
- Mile Post
- Alaska LNG Rev C2 Route
- PTTL Pipeline
- Tidal Marsh
- GTP Facility
- Boulder Patch

0 1.75 3.5 7 Miles

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DATE:	2017-03-07	SHEET:	1 of 1

ARCTIC TIDAL MARSHES GTP ASSOCIATED INFRASTRUCTURE

FIGURE 3.3.7-1

ALASKA LNG

3.3.7.2.2.2 GTP Associated Infrastructure

The GTP Associated Infrastructure during construction would cover about 468 acres of tundra vegetation and would be located primarily within graminoid herbaceous habitats (Table 3.3.7-8).

The primary impacts to vegetation from construction of GTP Associated Infrastructure would include granular fill and excavation, including construction of granular pads, access roads, camps, a material site, a water reservoir, and construction of DH 4 at West Dock. Potential indirect impacts include interruption of surface water flow, thermal degradation of permafrost, and cover with fugitive dust, gravel spray, and snow piles. Mitigation measures to avoid and reduce potential impacts to tundra vegetation are described in the Applicant's *Plan and Procedures*.

Access Roads

Access roads for the GTP are combined under Associated Infrastructure in Table 3.3.7-8. Vehicles traveling on granular roads would generate dust that can alter tundra vegetation communities and productivity. Use of ice access roads for construction would reduce impacts to tundra vegetation. Measures described in the Applicant's *Plan* and *Procedures* would be implemented to reduce potential effects of access roads on tundra vegetation.

Vessel Traffic

HLV traffic is not expected to impact shoreline vegetation. The primary mechanisms for shoreline erosion along Beaufort Sea coastlines are wind-blown waves and storm surges.

Spills

Spills from refueling at West Dock have the potential to reach tidal marshes. During barge fuel transfers, a containment boom would be deployed and spill response vessel and crew available to provide immediate assistance. The Project's Environmental Inspectors would oversee and inspect the Contractor's compliance with the provisions of the *SPCC Plan*. For marine vessels and marine construction traffic, the contractor would include Prudhoe Bay-specific spill prevention and response procedures. For barge and other vessel traffic fuel transfers, a containment boom would be deployed around marine vessels. With implementation of the measures in the *SPCC Plan*, spills are unlikely to reach vegetation.

Sensitive Vegetation Types or Communities

Modifications to the West Dock causeway to facilitate movement of modules to the GTP would impact approximately 0.55 acre of vegetated Arctic tidal marsh plant associations of concern (Figure 3.3.7-1; Table 3.3.5-2; Appendix E of Resource Report No. 2). The actual presence of any of the species listed in Table 3.3.5-2 within the Project footprint has not yet been confirmed. Of the species listed in Table 3.3.5-2, *Dupontia fisheri*, *Carex subspathacea*, *C. ursina* and *Puccinellia phryganodes* have been noted to be in the general vicinity (Lazy Mountain Research, LGL Alaska Research Associates, and BP Exploration Environmental Studies Program, 2004; OASIS Environmental and BP Exploration Environmental Studies Program, 2010). All of these species are considered both Global and State vulnerable. Any impacts to the plant associations would be long-term.

No known occurrences of rare or sensitive plants have been reported within 0.25 mile of the GTP Associated Facilities. No impacts are anticipated to rare and sensitive plants from construction of the GTP Associated Facilities.

Marine Vegetation

Algae may be present within the footprint of the improvements for the West Dock Causeway, resulting in mortality to any individuals present. Any impacts to the algal community would be long-term but are not anticipated to significantly affect algal species populations. In addition, permanent improvements to the causeway would result in new intertidal habitat.

3.3.8 Potential Operational Impacts and Mitigation Measures

Operation of the Project would affect about 11,900 acres of vegetated habitats and would affect a diversity of vegetation communities. Some of the vegetation impacts initiated with construction would continue through operations, due to excavation and fill, ROW maintenance, and the time required for vegetation recovery. However, much of the area affected by construction within pipeline ROWs would be negligible for aboveground pipelines and where herbaceous and shrub cover would be re-established over buried pipelines. Vegetation encompassed by aboveground and associated facilities would continue to be affected by changes to soil conditions by granular fill or excavation. Some revegetation would occur for associated facilities that are not required for operations, but granular fill would be left in place.

The total acres of vegetation cover potentially affected by the operation footprint includes about 5,229 acres of forested habitats, about 3,730 acres of scrub (shrub) habitats, and about 2,940 acres of herbaceous habitats. An additional area of about 336 acres of barren habitat, including previous granular fill and non-vegetated habitats would also potentially be affected during operation. Vegetation cover surrounding Project facilities may continue to be affected by spread of invasive plants, fugitive dust, and fragmentation.

Most areas of land cleared during construction would be restored after construction is complete, unless the cleared land is in a fire suppression management area that requires a buffer area free of vegetation. These areas would remain free of vegetation for the life of the Project. The Applicant would follow, as required and appropriate, fire management and prevention controls detailed in the 2016 Alaska Interagency Wildland Fire Management Plan. The fire management and prevention controls from this Plan will be incorporated into the Fire Suppression Plan in Appendix G of Resource Report No. 8 (see BLM, 2016). The Applicant would respond to any fires that directly threaten human life and pipeline facilities. Emergency notification and reporting procedures listed in the Fire Suppression Plan would be followed. The Applicant would not be libel for any and associated cost including fire suppression and resource damage costs for fires caused by arson or by human activity not associated with the Project construction or operations. The Project has been designed to avoid or reduce impacts where practical. Plans that address measures to avoid and reduce potential direct and indirect impacts to vegetation during operations include the following:

- Draft *Restoration Plan* (Appendix P in Resource Report No. 3);
- Applicant's *Erosion Control, Revegetation, and Maintenance Plan* (Appendix D in Resource Report No. 7);
- *Noxious and Invasive Plant and Animal Control Plan* (Appendix K);

- *Stormwater Pollution Prevention Plan (SWPPP)* (Appendix J in Resource Report No. 2);
- *Spill Prevention, Control, and Countermeasure (SPCC) Plan* (Appendix M in Resource Report No. 2);
- *Project Waste Management Plan* (Appendix J in Resource Report No. 8);
- *Fire Prevention and Suppression Plan* (Appendix G in Resource Report No. 8); and
- *Fugitive Dust Control Plan* (Appendix J in Resource Report No. 9).

Table 3.3.8-1 outlines potential operations impacts to vegetation and associated mitigation measures.

TABLE 3.3.8-1

Potential Operations Impacts and Mitigation to Vegetation Associated with the Project

Activity	Potential Impact	Mitigation
Routine Operational Activities		
Pipeline Maintenance and Inspections	Habitat alteration, loss, and fragmentation; increase public access to otherwise unattainable areas via vehicles and all-terrain vehicles	• Follow Applicant's *Plan* and *Procedures*; and • ROW patrolling, no trespassing sings, and the installation of gates, chains, or large boulders at pubic road and trail crossings.
Access Roads (Permanent)	Increase in impervious areas and stormwater run-off	• Structural BMPs to be installed as part of the overall facility design and *SWPPP*.
Vessel Traffic	Potential spills, and introduction of non-native nuisance species	• Implement *Spill Response Plan* and train onsite spill response personnel; and • Implement *Noxious and Invasive Plant and Animal Control* Plan

3.3.8.1 Liquefaction Facility

The operational footprint of the Liquefaction Facility would cover about 902 acres, of which 664 acres would be vegetated. These acres would be impacted during construction and remain so during operations. Direct vegetation impacts from operation of the Liquefaction Facility would primarily affect forested habitats (91 percent), with lesser amounts of herbaceous and scrub habitats (Table 3.3.7-2). Routine vegetation maintenance at the LNG Plant would be conducted about every four years. Areas near the liquefaction trains would need to be maintained free of vegetation for fire safety. All natural areas not developed during construction of the Facility would be retained during operations with minimal maintenance. Continued impacts to vegetation during operation of the Liquefaction Facility could include loss and alteration of vegetation, fugitive dust from unpaved roads, loss or alteration of surface water infiltration from impervious surfaces, spills, invasive and noxious plants, erosion, and sedimentation.

3.3.8.1.1 Vessel Traffic

LNGC traffic could potentially spread invasive plants as well as invasive aquatic organisms that can damage shoreline vegetation. Wakes from LNGCs are not likely to impact shoreline vegetation due to limited amounts of vegetation present, and vessel speed within the terminal will be reduced as to not cause wakes. Beyond the Marine Terminal, vessel distance from the shoreline would diminish wakes and therefore diminish any impacts caused by wakes.

3.3.8.1.2 Spills

Spills of hazardous liquids, including fuels and lubricants, could occur in any area where these compounds are used or stored and have the potential to damage vegetation resources.

Potential impacts to vegetation from releases of fuel or other substances during operation of the Liquefaction Facility and mitigation measures would be similar to those during construction. While a spill has the potential for significant adverse environmental impacts, adherence to the Project's protective measures previously outlined for the Liquefaction Facility (Section 3.2.7.1.8) would greatly reduce the likelihood of such impacts, as well as reduce the resulting impacts should a spill occur. As such, significant adverse impacts to vegetation resources due to contamination from spills or releases are unlikely.

As discussed in Resource Report No. 11, because of the design of the Liquefaction Facility, it is highly unlikely that there would be a spill or release of LNG. If LNG spilled or leaked, it would turn to vapor when exposed to the warmer atmosphere, and these vapors would rise as lighter than air. LNG is not soluble, would not mix with water, and would not contaminate surface water. Therefore, no impacts to vegetation resources are anticipated in the unlikely event of a spill or release of LNG.

3.3.8.1.3 Waste

Operation of the Liquefaction Facility would generate onsite waste. The *Waste Management Plan* addresses hazardous and nonhazardous waste materials and volumes, handling, and disposal in detail. Waste management activities would be performed in accordance with the waste management hierarchy. In order of preference, the aim would be avoidance, minimization, reuse, recycle, recover, and lastly disposal. With adherence to the *Plan's* procedures and mitigation measures, there would be no expected impacts to vegetation from operation of the Liquefaction Facility.

3.3.8.1.4 Non-native and Invasive Plants

Invasive plants and animals can damage native vegetation by out-competing native plants and can compromise wildlife habitats by reducing quality of forage or cover. Invasive plants likely to occur at or near the Liquefaction Facility are listed in Table 3.3.3-1 and include: oxeye daisy, butter and eggs, reed canarygrass, common dandelion, and white clover. Invasive plants imported or from surrounding areas may colonize disturbed areas at the Liquefaction Facility, which, in turn, could become sources for potential spread.

3.3.8.1.5 Sensitive Vegetation Types or Communities

No known plant associations of concern or rare and sensitive plant species occur at the Liquefaction Facility. No impacts are anticipated to plant associations of concern or rare and sensitive plants from operation of the Liquefaction Facility.

3.3.8.1.6 Marine Vegetation

No marine algal beds or seagrass has been noted to occur in the intertidal or subtidal zone within the footprint of the Liquefaction Facility site. No impacts to marine vegetation are anticipated from operation of the Liquefaction Facility.

3.3.8.2 Interdependent Project Facilities

3.3.8.2.1 Pipeline

3.3.8.2.1.1 Mainline

The analysis of vegetation area impacts for the Mainline operational ROW is detailed in Table 3.3.7-3. The Mainline operational ROW footprint would cover about 9,705 acres of land of which a majority is vegetated (9,212 acres). Vegetation within the proposed operational ROW includes forested habitats (45 percent), scrub habitats (37 percent), and herbaceous habitats (18 percent). Forest communities affected by operation of the Mainline would be predominately mixed forest (49 percent) and evergreen forests (40 percent), followed by a minor amount of deciduous forests impacted (11 percent). Scrub communities affected by operation of the Mainline ROW would be predominately low scrub (58 percent) and dwarf tree scrub (15 percent), followed by tall scrub (14 percent) and dwarf scrub (12 percent). Herbaceous communities affected by operation of the Mainline ROW would be predominately graminoid (97 percent). Potential impacts to waters and wetlands are provided in Resource Report No. 2.

The Mainline ROW would maintain a 53.5-foot permanent easement during operations. The ROW would be reclaimed following the Applicant's *Plan* and *Procedures* and *Project Restoration Plan* (Appendix P). A reestablishment plan for herbaceous and/or woody plants would be implemented along with revegetation monitoring and weed control, where applicable. Herbaceous and scrub-shrub vegetative communities would be expected to recover within 5 to 20 years (ADF&G, 2001) so these impacts would be minor and long-term. Where forested vegetation is allowed to grow back (in areas outside of the permanent ROW), it would take several decades to several hundred years to reach pre-disturbance conditions (ADF&G, 2001). The potential for disturbance to forested vegetation types is reduced by associating the proposed Project alongside existing infrastructure where the amount of forested vegetation is generally less. Forested habitats within the operations ROW (Table 3.3.7-3) would be permanently lost/converted to herbaceous or scrub shrub habitats for the life of the Project.

After construction, the ROW would be inspected to determine the success of revegetation, and problems with drainage or revegetation would be corrected. The ROW would need to be maintained free of obstructions. Routine vegetation mowing and clearing would not occur more frequently than every three years. Where it is necessary to provide for helicopter landings, larger areas along the ROW may be cleared of vegetation taller than 8 inches. Mechanical vegetation maintenance in thaw-sensitive areas, if necessary, would be completed in winter. Forest habitats would remain converted to herbaceous or low scrub habitats within the permanent, maintained ROW.

Non-native and Invasive Plants

Invasive plants that occur along the Mainline are listed in Table 3.3.3-1. Of these, the invasive plants with the highest invasive ranks that are established within the Mainline corridor include reed canarygrass in the Cook Inlet Basin Ecoregion, white sweetclover throughout the Mainline corridor, waterweed (*Elodea* sp.) in the Cook Inlet Basin Ecoregion, and bird vetch in the Brooks Range and Ray Mountain ecoregions (Table 3.3.3-1). Vegetation maintenance and ROW inspections are potential mechanisms for dispersal and spread of invasive plants.

Sensitive Vegetation Types or Communities

No known plant associations of concern are located in proximity to the Mainline. No impacts are anticipated to plant associations of concern from operation of the Mainline.

No known rare or sensitive plant species will be crossed by the operational ROW for the Mainline. Operation of the Mainline could indirectly affect rare or sensitive plants in the vicinity of the ROW. These rare or sensitive plant species are not protected by the ESA or state laws. However, several of the populations within 0.25 mile are located on BLM property and are included in BLM's management plans.

Marine Vegetation

No macroalgae or seagrass were noted to be present at the shoreline crossing locations of the Mainline in Cook Inlet. No impacts to marine vegetation are anticipated from operation of the Mainline.

3.3.8.2.1.2 PBTL and PTTL

Much of the PTTL operational ROWs would be collocated with existing pipelines.[3] The PTTL operations ROW is within approximately 5 feet of the operations ROW for the Badami Pipeline and/or the Point Thomson Export Pipeline for approximately 43 miles over which the centerlines for PTTL and Badami/Point Thomson Export Pipelines are approximately 50 feet apart (see Resource Report No. 1, Appendix N). During operations, tundra vegetation maintenance for these aboveground pipelines would not be necessary. Both pipelines would cross primarily herbaceous and scrub tundra vegetation and would likely have minor effects from construction (Table 3.3.7-4). Potential impacts to tundra vegetation from pipeline operations would include a snow fence effect that causes snow to accumulate around the pipeline corridor with accompanying minor delays in phenology and increased moisture. Pipeline maintenance or repair during summer could include use of low-pressure vehicles to access the pipeline. Pipeline maintenance or repair during winter would likely include overland travel with no impact; major repairs could include ice road and workpad construction.

Non-native and Invasive Plants

Invasive plants could be spread across the pipeline corridors during maintenance or repair. Because the tundra mat would not be removed for pipeline construction, there would be few areas for establishment of invasive plants. Additionally, arctic conditions generally prevent the establishment of invasive plants.

Sensitive Vegetation Types or Communities

No known plant associations of concern are located in proximity to the PBTL or PTTL. No impacts are anticipated to plant associations of concern from operation of the PBTL or PTTL.

No known rare or sensitive plant species are located within 0.25 mile of the PBTL and PTTL. No impacts are anticipated to rare or sensitive plants from operation of the PBTL or PTTL.

3.3.8.2.1.3 Pipeline Aboveground Facilities

Aboveground facilities for the Mainline include compressor stations, meter stations, MLBVs, and heater stations. Aboveground facilities would be built on granular pads. The use of granular material and pad thickness would depend on site conditions, including consideration for protection of permafrost. Aboveground facilities for the Mainline would cover about 258 acres (Table 3.3.7-3). Aboveground facilities for the PTTL would cover about 0.5 acre (Table 3.3.7-4). No aboveground facilities would be necessary for the PBTL. Mainline facilities would be located primarily within scrub habitats (50 percent), followed by forested (42 percent) and herbaceous (8 percent) habitats. Forested areas would be primarily

[3] Located parallel to and in proximity to, but not on the same VSMs.

evergreen forests (50 percent), while scrub habitats would be primarily low (54 percent) and dwarf scrub (24 percent) (Table 3.3.7-3).

Impacts to vegetation initiated during construction would continue during operation and include loss of vegetation from placement of granular fill, potential increased erosion and sedimentation, thermokarst with thaw settlement, contamination from runoff, cover with dust or gravel spray from granular pads, increased moisture and delayed melt from snow piles, and habitat fragmentation. Buffers would be maintained around compressor and heater stations that include the removal trees and tall shrubs to mitigate the spread of fires.

Spills

Spills of hazardous liquids, including fuels and lubricants, could occur in any area where these compounds are used or stored and have the potential to damage vegetation resources.

Potential impacts to vegetation from releases of fuel or other substances during operations and mitigation measures would be similar to those during construction. While a spill has the potential for significant adverse environmental impacts, adherence to the Project's protective measures previously outlined for the Liquefaction Facility (Section 3.2.7.1.8) would greatly reduce the likelihood of such impacts, as well reduce the resulting impacts should a spill occur. As such, significant adverse impacts to vegetation resources due to contamination from spills or releases are unlikely.

Spills of hazardous materials, including fuels and lubricants, could occur where these compounds are used or stored. Spills could contact vegetation from infiltration through pad edges, runoff, or spills from equipment. *SPCC Plans* would be developed for each facility prior to operation. The storage of fuels and lubricants would be in secured containers manufactured for their purposes and stored in a secure area with proper labels. Secondary containment would be used for single-walled containers. In addition to proper storage, construction equipment should be maintained and inspected daily for leaks, and any waste should be contained, collected, and disposed of in an appropriate manner.

Waste

All generated waste would be handled in accordance with the Project's *Waste Management Plan* (Appendix J of Resource Report No. 8). Waste management activities would be performed in accordance with the waste management hierarchy. In order of preference, the intent would be avoidance, minimization, reuse, recycle, recover, and lastly disposal. This plan addresses hazardous and nonhazardous waste materials and volumes, handling, and disposal. Hazardous wastes, nonhazardous wastes, or recyclable materials generated during the operation of the aboveground pipeline facilities, including contaminated soils and absorbent materials, would be stored and disposed of by the Contractor, following state and federal regulations. There are no licensed hazardous waste treatment or disposal facilities in Alaska.

Potential impacts to vegetation from waste generated during operation of the Pipeline Aboveground Facilities could include contamination of soil, killing of vegetation around facilities, and spills to vegetated areas. All hazardous waste and contaminated soils would be stored in a secure location at the Contractor yard until shipment to a licensed facility. To avoid potential contamination of vegetation and soils around aboveground facilities, the *SPCC Plan* would require equipment to be checked for leaks and properly maintained. Therefore, operation of the Pipeline Aboveground Facilities is not anticipated to spread existing contamination or cause additional soil contamination and/or the killing of vegetation around facilities.

Non-native and Invasive Plants

Vectors for transmission of invasive plants include equipment, personnel, construction materials, erosion control materials, and revegetation seed mixes. The most potential for contamination during operations would include personnel maintaining vegetation or inspecting aboveground facilities that travel between facilities and inadvertently transport seeds or propagules from infested sites on equipment or clothing. Preventative measures include identifying locations and the extent of existing infestations, mapping and flagging infested areas, and treatment of infested areas prior to work. The appropriate treatment methods would be based on the specific invasive plant or animal, the extent of infestation, and area-specific conditions. Treatment methods could include manual or mechanical removal, or application of herbicide.

Noxious and invasive weeds that have been identified within 0.25 mile of compressor stations and heater stations are listed in Table 3.3.7-5. Most of these sites have not been surveyed for weeds. The Ray River Compressor Station and the Coldfoot Compressor Station area have both had control measures for white sweetclover applied (AKEPIC, 2014). The disturbance identified for these white sweetclover infestations was fill importation (AKEPIC, 2014). Vegetation maintenance at compressor and heater stations would include removal of trees and tall shrubs within a buffer surrounding the stations. Creation of these disturbed areas would facilitate establishment of invasive plants and maintenance equipment could transport invasive plants between work areas. Weed surveys have not been completed at most MLBV locations (Table 3.3.7-6). White sweetclover is the most abundant invasive plant, occurring at five locations; of note, reed canarygrass has been documented at MLBV 51 (Table 3.3.7-6). Helipads would be located at MLBVs, compressor stations, heater stations, and camps. Infested helipads could be a source of invasive plant seeds, especially white sweetclover, which is able to colonize the types of habitats typical of granular pads.

Sensitive Vegetation Types or Communities

No known plant associations of concern occur near compressor station, heater station, or MLBV locations. No impacts are anticipated to rare or sensitive plants from operation of the aboveground facilities.

No known rare or sensitive plants are located within 0.25 mile of compressor station, heater station, or MLBV locations. No impacts are anticipated to rare or sensitive plants from operation of the aboveground facilities.

3.3.8.2.1.4 Pipeline Associated Infrastructure

Pipeline Associated Infrastructure during operations includes compressor station access roads and a PTTL helipad. Impacts to vegetation would include the continued loss of vegetation from placement of granular fill, potential increased erosion and sedimentation, thermokarst with thaw settlement, contamination from runoff, cover with dust or gravel spray from access roads and granular pads, increased moisture and delayed melt from snow piles, and habitat fragmentation. Granular fill placed during construction would not be removed, but would be revegetated for associated infrastructure that is not retained during operations. Ice-associated infrastructure built for construction would have no affect during operations.

Pipeline Associated Infrastructure for Mainline operations would cover about 390 acres (Table 3.3.7-3), and for the PTTL would cover less than 20 acres (Table 3.3.7-4). Mainline Associated Infrastructure would be located primarily within forested habitats (about 70 percent) with lesser amounts of scrub (26 percent) and herbaceous (4 percent) habitats. (Table 3.3.7-3).

Access Roads

Potential access road impacts to vegetation, summarized under Associated Infrastructure in Table 3.3.8-2, would cover about 445 acres of primarily forested (68 percent) habitat, followed by scrub (28 percent) and herbaceous (4 percent) habitats.

Mitigation measures described in the Applicant's *Plan* and *Procedures* would be implemented to provide for uninterrupted surface water flow, control fugitive dust, avoid erosion and sedimentation, and avoid potential contamination from spills. As described, dust control methods could include the application of nontoxic chemical dust suppressants, alone or combined with mulch, and should be explored where suitable water is not available. Other dust control methods include: prompt removal of material tracked onto paved streets, covering open-body trucks where applicable when there is risk of airborne dust, and reducing the speed of construction vehicles along the ROW and unpaved roads. As construction is completed and access roads are phased out, the areas disturbed for access road construction would be revegetated. The use of granular material that is from weed-free certified pits combined with seed mixes and plants native to the area during revegetation would reduce the potential introduction and spread of noxious and invasive plants.

TABLE 3.3.8-2

Vegetation Area (Acres) Affected During Operation of Mainline Associated Facilities - Access Roads

Vegetation Type	Gravel	Total
Evergreen Forest	152.41`	152.41`
Deciduous Forest	40.14	40.14
Mixed Forest	187.50	187.50
Forest Subtotal	**380.05**	**380.05**
Dwarf Tree Scrub	19.22	19.22
Tall Scrub	66.66	66.66
Low Scrub	51.22	51.22
Dwarf Scrub	1.52	1.52
Scrub Subtotal	**138.62**	**138.62**
Graminoid Herbaceous	13.38	13.38
Bryoid Herbaceous	9.07	9.07
Herbaceous Subtotal	**22.45**	**22.45**
Vegetated Area Subtotal	**541.13**	**541.13**
Barren	2.98	2.98
Water	0.13	0.13
Access Road Total	538.02	538.02

Source: Project Vegetation Mapping.
Operation acreage includes access roads to compressor stations and some MLBVs. See Resource Report No. 1, Table 1.4-1 for definitions of construction and operations affected areas.

Sensitive Vegetation Types or Communities

No known plant associations of concern or rare and sensitive species are located within the footprint of the Pipeline Associated Infrastructure. All of the infrastructure used for construction that was within 0.25 mile of a known are or sensitive species location was for temporary use, only during construction. No impacts are anticipated to plant associations of concern or rare and sensitive plant species during pipeline operation from the Pipeline Associated Infrastructure.

3.3.8.2.2 GTP

3.3.8.2.2.1 GTP Facility

The GTP would cover about 262 acres of tundra vegetation (Table 3.3.7-8). The GTP would be located almost entirely within graminoid (100 percent) herbaceous habitats (Table 3.3.7-8).

The primary impacts to vegetation from operation of the GTP would include continued loss of vegetation from granular fill, fugitive dust and gravel spray, and snow clearing. Potential indirect impacts include interruption of surface water flow and thermal degradation of permafrost. Mitigation measures to avoid and reduce potential impacts to tundra vegetation are described in the Applicant's *Plan* and *Procedures*.

Spills

Spills of hazardous materials, including fuels and lubricants, could occur where these compounds are used or stored and have the potential to impact vegetation resources. Personnel would be trained for proper handling, storage, disposal, and spill response of hazardous fluids, and an *SPCC Plan* would be developed for operations. While a spill has the potential for significant adverse environmental impacts, adherence to the Project's proposed protective measures outlined in the *SPCC Plan* would greatly reduce the likelihood of such impacts, as well reduce the resulting impacts should a spill occur. As such, significant adverse impacts to vegetation due to a release are unlikely.

Waste

All waste would be handled in accordance with the Project's *Waste Management Plan* (Appendix J of Resource Report No. 8). This *Plan* addresses hazardous and nonhazardous waste materials and volumes, handling, and disposal in detail. The plan would ensure compliance with all regulations for transportation, treatment, storage, and disposal of waste. Waste management activities would be performed in accordance with the waste management hierarchy. In order of preference, the aim would be avoidance, minimization, reuse, recycle, recover, and lastly disposal. The generation and storage of hazardous wastes during operations would be minimal. With adherence to the Project's *Waste Management Plan* procedures and mitigation measures, adverse impacts to vegetation due to waste management during operation of the GTP would not be anticipated.

Non-native and Invasive Plants

No invasive plants have been documented near the proposed GTP. The closest survey, a little over 10 miles south of the GTP at a material site near Deadhorse, found no invasive plants. The Beaufort Coastal Plain

Ecoregion has been largely spared from ecological issues from invasive plants because of the Arctic environment.

Sensitive Vegetation Types or Communities

No known plant associations of concern or rare and sensitive plant species occur at the GTP. No impacts are anticipated to plant associations of concern or rare and sensitive plants from operation of the GTP.

3.3.8.2.2.2 GTP Associated Infrastructure

The GTP Associated Infrastructure would cover about 387 acres of tundra vegetation during operation. GTP Associated Infrastructure would be located almost entirely within graminoid herbaceous (100 percent) habitats (Table 3.3.7-8).

Vessel Traffic

No vessel traffic would be required for operation of the GTP. Materials and supplies would be transported to Prudhoe Bay by ground or air.

Spills

Spills at GTP Associated Infrastructure could include oil, fuel, or other hazardous materials due to improperly maintained equipment and/or the improper use and storage of fuels, lubricants, or other hazardous materials. Personnel would be trained for proper handling, storage, disposal, and spill response of hazardous fluids, and an *SPCC Plan* would be developed for operations. While a spill has the potential for significant adverse environmental impacts, adherence to the Project's proposed protective measures outlined in the *SPCC Plan* would greatly reduce the likelihood of such impacts, as well reduce the resulting impacts should a spill occur. As such, significant adverse impacts to vegetation due to a release are unlikely.

Waste

The Project's *Waste Management Plan* would ensure compliance with all regulations for transportation, treatment, storage, and disposal of waste. Waste management activities would be performed in accordance with the waste management hierarchy. In order of preference, the aim would be avoidance, minimization, reuse, recycle, recover, and lastly disposal. The generation and storage of hazardous wastes during construction would be minimal. Volumes and types of waste would be determined when construction contractors are selected and construction plans finalized. At that time, each contractor would be required to develop a waste management plan that follows the guidance in the *Plan* and outlines the types, volumes, and disposition of wastes anticipated during construction. With adherence to the Project's *Waste Management Plan* procedures and mitigation measures, adverse impacts to vegetation due to waste management during operation of the GTP Associated Infrastructure would not be anticipated.

Sensitive Vegetation Types or Communities

Impacts to Arctic tidal marsh and plant associations of concern due to widening of the West Dock causeway are described in Section 3.3.7.2.2.2. This area would not be used during GTP operations. Impacts from operation of the GTP Associated Facilities are not anticipated to plant associations of concern

No known occurrences of rare or sensitive plants have been reported within 0.25 mile of the GTP Associated Facilities. No impacts are anticipated to rare and sensitive plants from operation of the GTP Associated Facilities.

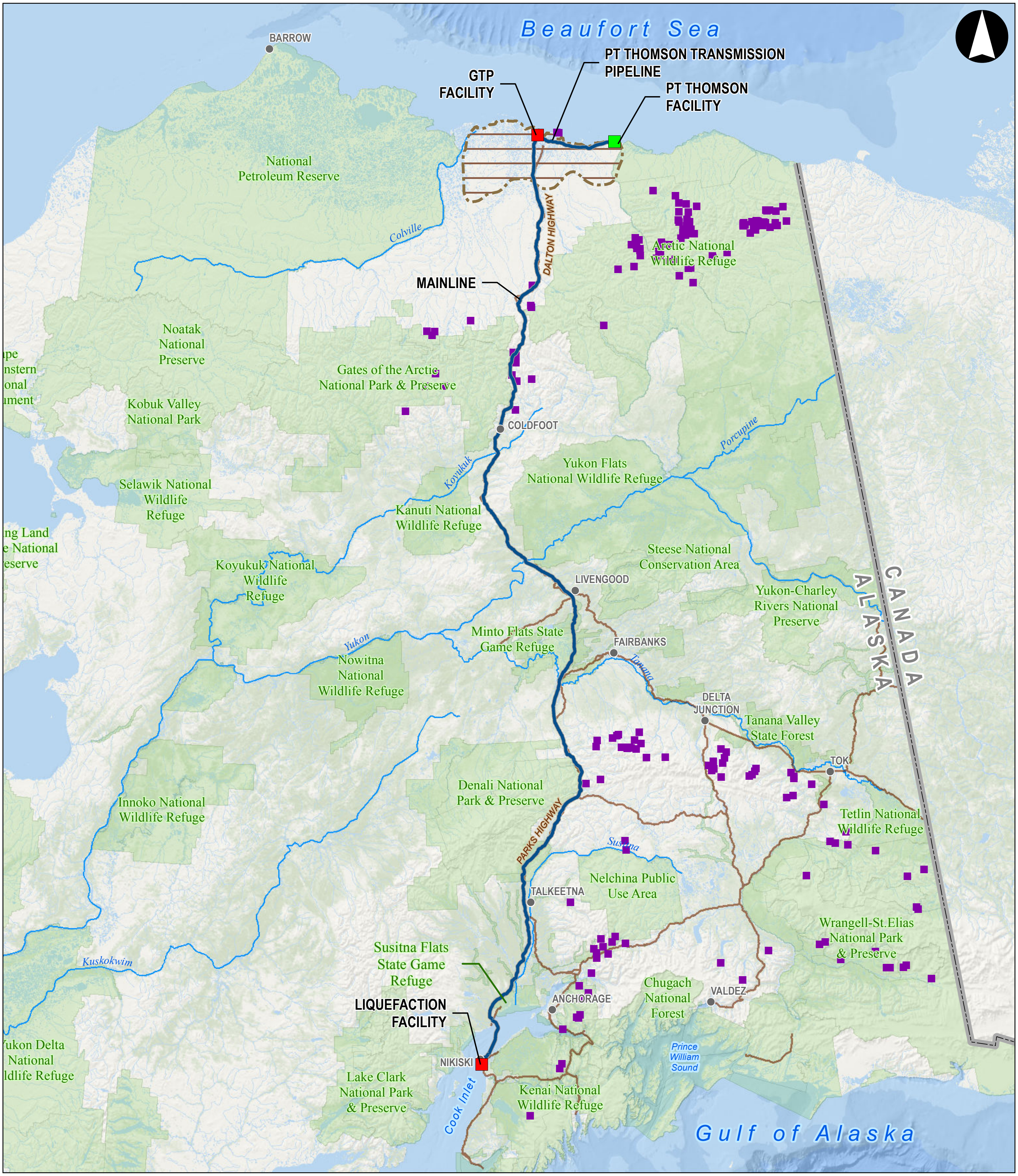
Marine Vegetation

Impacts to marine vegetation due to widening of the West Dock causeway are described in Section 3.3.7.2.2.2. This area would not be used during GTP operations. Impacts from operation of the GTP Associated Facilities are not anticipated to plant associations of concern.

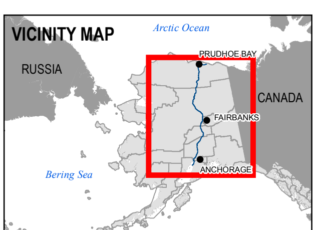
3.4 WILDLIFE AND TERRESTRIAL RESOURCES

A diversity of wildlife habitats and species occurs across the Project, encompassing most all of the resources evaluated in the ADF&G's Comprehensive Wildlife Conservation Plan (ADF&G, 2006). For most wildlife, habitats are largely intact. The exceptions are urbanized or industrial areas, such as portions of the Beaufort Coastal Plain Ecoregion, the Fairbanks area, the Matanuska-Susitna Valley, the Anchorage Bowl, and portions of the Kenai Peninsula. For many species, little is known and an accurate assessment of the health of populations or their key habitats is unavailable. Much of the Project would be located along existing transportation corridors and within industrialized areas on the North Slope and Kenai Peninsula. The exceptions would be the PTTL and portions of Mainline near Minto Flats (Livengood to Nenana) and from Talkeetna south to Cook Inlet (Figure 3.4-1). The Project skirts the Arctic National Wildlife Refuge (NWR), Gates of the Arctic National Park, Yukon Flats NWR, Denali National Park and Preserve (DNPP), and the Kenai NWR, and passes through Denali State Park. Areas of critical environmental concern (ACECs) designated by the BLM that would be skirted or crossed, north to south, include Toolik Lake Research Natural Area (RNA), Galbraith Lake, Snowden Mountain, Sukakpak Mountain, Nugget Creek, Poss Mountain, and Jim River. The Mainline traverses portions of the Minto Flats State Game Refuge and the Susitna Game Flats State Game Refuge. These sensitive wildlife habitat areas are described in Section 3.4.9. Wildlife habitats identified in ADF&G habitat atlases (ADF&G, 1985, 1986a, b) or designated by state or federal management agencies that are crossed by the Project area are listed in tabular form in the following sections.

Many plants and animals are widely distributed throughout Alaska and within the Project area. Because changes in biotic conditions across Alaska are reflected within these ecoregions, as previously described in Sections 3.2. Fisheries and Aquatic Resources and 3.3.1 Vegetation Resources and Ecoregions, this discussion is also organized by the 32 Unified Ecoregions of Alaska. . Transitional areas along ecoregion boundaries are areas sharing characteristics of two or more adjacent ecoregions, and the boundary between regions typically supports species common to each area. Where possible, specific wildlife resources associated with the proposed Liquefaction Facility and Interdependent Project Facilities are described.



VICINITY MAP



LEGEND

- Project Facility
- Existing Facility
- Alaska Place Names
- Known Mineral Licks
- Alaska LNG Rev C2 Route
- Major Highways
- Major Rivers
- Caribou Calving Areas
- State and Federal Conservation Lands

0 35 70 140 Miles

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WILDLIFE REFUGES, CALVING AREAS, AND MINERAL LICKS NEAR THE PROJECT

FIGURE 3.4-1

ALASKA LNG

X:\AKLNG\Resource Reports\RR03\Figure 3_4-1 Wildlife Refuges, Calving Areas, and Mineral Licks Near the Project.mxd

3.4.1 Alaska Wildlife Terrestrial Habitats and Ecoregions

3.4.1.1 Liquefaction Facility

The Liquefaction Facility would be located in the Cook Inlet Basin Ecoregion. A description of the common wildlife resources that could potentially occur within the Project area is provided in the following section.

3.4.1.1.1 Cook Inlet Basin Ecoregion

The Cook Inlet Basin ecoregion is composed of the low-lying basin surrounding Cook Inlet from the south side of the Alaska Range to Kachemak and Tuxedni Bays. It is bound on the east by the Kenai, Chugach, and Talkeetna Mountains and on the west by the Alaska and northern Aleutian mountain ranges. The ecoregion includes the western half of the Kenai Peninsula, the Anchorage bowl, the western Cook Inlet lowlands, and the Susitna lowlands (Nature Conservancy 2003).

The diversity of habitats within the Cook Inlet region results in a diversity of wildlife. Connected to the mainland only by a narrow isthmus and further fragmented by a road, the Kenai Peninsula acts as an island. This “island effect” limits the exchange of genetic material; consequently, populations found on the peninsula may be disjunct from those in the rest of the ecoregion (e.g., Kenai brown bear) (Nature Conservancy 2003). The numerous land, ponds, and wetlands attract large numbers of shorebirds and waterfowl, including tundra and trumpeter swans. Large numbers of western sandpipers, dunlins, rock sandpipers, long- and short-billed dowitchers, and Hudsonian godwits use Cook Inlet for breeding, resting, or wintering. Black-legged kittiwakes and common murres nest in colonies along its shores. Nearly the entire population of Wrangell Island Snow geese migrates across the mouth of the Kenai River and Trading Bay in the spring. Sensitive landbirds in the ecoregion include olive-sided flycatchers and blackpoll warblers.

The mix of lakes, large river basins, and drainages supports top-level predators such as the brown and black bear, gray wolf, wolverine, lynx, and coyote as well as prey such as moose, caribou, beavers, muskrats, pygmy shrew, and northern water shrew. Several endemic species include Kenai red squirrel, Kenai flying squirrel, and Kenai wolverine.

3.4.1.2 Interdependent Project Facilities

The Interdependent Project Facilities for the Project are located throughout the various ecoregions of Alaska. A description of the common wildlife resources that could potentially occur with the Project area is provided in the following section.

3.4.1.2.1 Beaufort Coastal Plain Ecoregion

Areas along the Beaufort Coastal Plain Ecoregion can be highly productive and annually produce 500 to 1,000 pounds of vegetation per acre, an important source of food for wildlife, particularly caribou, waterfowl, and shorebirds arctic fox, red fox, shrews, and voles. Because of the limited growing season, the vast majority of migratory wildlife species are present on the Beaufort Coastal Plain Ecoregion only during the summer, typically arriving in late May or early June and leaving by late August or September.

In addition to large herds of caribou, mammals of this region include the polar bear, brown bear, muskoxen, wolf, wolverine, mink, ermine, least weasel, and lemming. Polar bears predominately live on the ice pack, however, polar bears can range up to 60 miles inland. Many of the terrestrial mammals either hibernate or undergo seasonal migration as an adaptation to winter. Other mammals become nomadic (e.g., Arctic foxes) or remain active beneath the snowpack (e.g., collared and brown lemmings).

Arctic foxes are common on the ice pack and coastal areas during the winter. Muskoxen and gray wolves are found in limited numbers across the Beaufort Coastal Plain Ecoregion during this time of year, and wolverines are infrequently present.

Common small mammals inhabiting the Beaufort Coastal Plain Ecoregion include shrews, voles, and brown and collared lemmings. These resident species are critical to the ecosystem as prey items. Lemmings may be the most important mammals in the Beaufort Coastal Plain Ecoregion because several predators, including mammals and birds, depend on them as prey species. In years with cyclical declines in the number of lemmings, the Arctic and red fox are forced to switch from lemmings to young birds and eggs as dietary mainstays.

The wet tundra and aquatic habitat, including shallow water wetlands, lakes, and ponds, provide productive habitat for millions of migrating waterfowl and shorebirds during the summer months. Canada geese, greater white-fronted geese, snow geese, and brant nest in the Beaufort Coastal Plain Ecoregion and along the Project’s northern section in Alaska from mid-May to early September. Canada and greater white-fronted geese nest in isolated pairs, while brant and snow geese nest in colonies of a few to several hundred pairs. Tundra swans are also common breeders, nesting from May to early June and brood-rearing from July to mid-September.

Eighteen species of ducks have been recorded in the Beaufort Coastal Plain Ecoregion, including spectacled, Steller’s, and king eiders; long-tailed ducks; and northern pintails.

The Beaufort Coastal Plain Ecoregion is an important breeding area for several species of shorebirds, approximately 24 of which occur on the central North Slope. Only four species of birds are regular winter residents in the Beaufort Coastal Plain Ecoregion: the common raven, snowy owl, willow ptarmigan, and gyrfalcon. Ravens are relatively common and are often associated with areas of human habitation. Snowy owls can also be common on the Beaufort Coastal Plain Ecoregion in winter when their primary food, lemmings, is available.

Over 30 species of passerines have been recorded in the Beaufort Coastal Plain Ecoregion, but only one, the Lapland longspur, is commonly observed nesting on the tundra. Many of the passerines migrate from wintering areas in temperate and tropical regions in North and South America, though a few species migrate from Asia.

3.4.1.2.2 Brooks Foothills Ecoregion

Wildlife species inhabiting the Brooks Foothills Ecoregion are similar to those of the Beaufort Coastal Plain Ecoregion; however, the presence of drier vegetation communities and stream/river riparian areas provide for greater species diversity. Ermine and wolves are typically encountered in the Foothills and, more infrequently, in the Beaufort Coastal Plain Ecoregion (U.S. Department of the Interior [DOI], 1979). In addition, lemming populations differ between these areas, with more collared lemmings than brown lemmings in the foothills. More species of shrews and voles are found in the foothills than are found in the wet tundra areas of the Beaufort Coastal Plain Ecoregion.

Caribou are common across the foothills, and moose are found occasionally in wet meadows and shrub communities along rivers. Carnivorous mammals, including ermine, least weasel, wolverine, red fox, and wolf, inhabit the foothills, and their population densities usually reflects those of their respective preferred prey items. Common resident prey species include voles, lemmings, Arctic ground squirrels, and hares. Caribou are also an important prey species for the larger predators such as wolverines, brown bears, and the wolf.

The increased wildlife diversity in the foothills versus that of the Beaufort Coastal Plain Ecoregion is a direct reflection of the increase in diversity of habitats. These different habitats are indicators of the various soil moisture regimes and soil types found in the foothills. These habitats provide food and cover that are not present on the plain, resulting in the success of herbivorous species, especially small mammals that do not inhabit the Beaufort Coastal Plain Ecoregion. The resulting increase in resident small prey mammals is directly reflected by an increase in the populations of resident carnivorous mammals and predatory birds.

3.4.1.2.3 Brooks Range Ecoregion

The lack of ground cover over much of the Brooks Range Ecoregion limits the numbers of large and small herbivorous mammals. This, in turn, limits the presence of larger, predatory mammals. At lower elevations, shrews, voles, and lemmings may be present. At higher elevations, small to medium size mammals may be limited to the Alaska vole, hoary marmot, and collared pika, all of which may inhabit rocky substrates.

The Brooks Range is an important sport hunting area in Alaska that supports large mammals, such as moose, caribou, brown and black bear, wolf, and Dall sheep. The Brooks Range is the primary habitat for Dall sheep in the Project area. Caribou migrate through passes of the Brooks Range, but do not spend extensive periods foraging or resting in this ecoregion. Larger mammalian carnivores such as wolves may be found in the mountains, but usually only in the vicinity of Dall sheep or migrating caribou. Smaller mammals include wolverine, hoary marmot, red and Arctic fox, Arctic ground squirrel, snowshoe hare, lemming, and pika.

Brown bears are common residents in the Brooks Range, but their density is low. Brown bears are efficient and flexible omnivores. Although the bulk of their diet is vegetation, bears will eat caribou and calves, moose and calves, Dall sheep lambs, carrion, adult birds, young birds, and eggs when encountered. Ground squirrels are also an important food source for brown bears.

During the summer months, the Brooks Range is an important nesting area for several songbirds. Raptors are prominent in much of this area and include golden eagles, peregrine falcons, gyrfalcons, rough-legged hawks, northern harriers, and snowy and short-eared owls. The snowy and short-eared owls are ground nesters; other raptors nest at traditional sites on cliffs or rock outcroppings.

3.4.1.2.4 Beringia Boreal Ecoregion

This segment includes the Kobuk Ridge and Valleys, Ray Mountains, Yukon-Tanana Uplands, and Tanana-Kuskokwim Lowlands. The species presented here are all-inclusive, since many of the species commonly found in this Level 2 ecoregion are similar throughout the Level 3 ecoregions noted previously.

Mammals inhabiting the forested areas of the Beringia Boreal Ecoregion include brown and black bears, moose, caribou, wolves, ermines, least weasels, marten, snowshoe hares, pika, hoary marmot, red squirrel, voles, and shrews. Some of these species, including pika and hoary marmot, are suited to the rocky nature of the higher elevations, while others, including wolves, ermine, and bears, prefer the lower elevation and open forests. Most of these species reside year-round, but hibernate or undergo seasonal movements locally to optimum foraging grounds. The small mammals are critical to the ecoregion as prey items. Beaver, river otter, mink, and muskrat are common near the lakes and large streams of this ecoregion.

The open, mixed deciduous-conifer forests support a large variety of birds; 200,000 to 300,000 sandhill cranes migrate through the Project area along the Tanana River during their spring and fall migrations.

Much of the wildlife found in the Project area in Alaska is particularly important because the species have recreational, aesthetic, subsistence, or commercial value. Several areas in the Project corridor have been identified as sensitive wildlife habitats or have been designated as wildlife and game management areas. These habitats and areas are discussed in more detail in Section 3.4.3.

3.4.1.2.5 Alaska Range Ecoregion

The Alaska Range provides habitat to many of the larger species, including moose, brown bear, and caribou. White-tailed ptarmigan and golden eagles can be found in the Alpine tundra portions of the ecoregion. Northern bog lemmings are common in the more poorly drained areas of the region.

3.4.1.2.6 Cook Inlet Basin Ecoregion

The Cook Inlet Basin Ecoregion is described in Section 3.4.1.1.

3.4.2 Marine Mammals

The Marine Mammal Protection Act (MMPA) prohibits take of marine mammals without authorization from NMFS or USFWS. "Take" under the MMPA means “to hunt harass, capture, or kill” any marine mammal or attempt to do so (16 U.S.C. s 1362 [13]). NMFS and USFWS are given authority to implement the MMPA. In the Project area, USFWS is responsible for the conservation and management of Pacific walrus, northern sea otters, and polar bears; NMFS is responsible for management of seals, sea lions, whales, dolphins, and porpoises. Marine mammals potentially occurring in the Project area are listed in Table 3.4.2-1. Many of the marine mammals that potentially occur within the Project area, including marine transportation routes, are also protected as threatened or endangered under the ESA. These ESA-listed marine mammals are discussed in Section 3.5.1.

Among the 1994 amendments to the MMPA was addition of a mechanism to authorize the take of a small number of marine mammals incidental to activities other than commercial fishing and a definition of the term “harassment” found in the definition of the term “take.” Harassment means any act of pursuit, torment, or annoyance that (A) has the potential to injure a marine mammal or marine mammal stock in the wild; or (B) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering (16 U.S.C. § 1362 [18][a]). The NMFS has identified underwater sound-exposure criteria corresponding to these two levels of harassment. Level A harassment includes auditory injury. The NMFS criteria for Level A harassment, which are intended to represent cautionary estimates for the onset of auditory system injury, are unweighted SPLs of 190 dB_{rms} re 1 µPa SPL for pinnipeds (seals, sea lions) and 180 dB_{rms} re 1 µPa SPL for cetaceans (whales, dolphins, porpoises). Level B harassment includes behavioral disturbance. The NMFS criteria for Level B harassment (behavioral disturbance) are 160 dB_{rms} re 1 µPa SPL for impulsive sounds and 120 dB_{rms} re 1 µPa SPL for continuous sounds. NMFS is reviewing current research and assessing the need to update these criteria (NOAA, 2013).

TABLE 3.4.2-1

Non-ESA Listed Marine Mammals Potentially Occurring in the Project Area

Common Name	Scientific Name	Project Component	Seasonal Presence in Project Area	Range in Alaska and Habitat
SEALS				
Harbor Seal	*Phocis vitulina richardii*	Marine Terminal, Mainline	Year-round	Gulf of Alaska, Bering Sea, Cook Inlet; near coast, estuaries, may travel miles up rivers
Northern Fur Seal	*Callorhinus ursinus*	GTP Sealift	Summer	Gulf of Alaska, Bering Sea; pelagic – rookeries on remote islands
Ribbon Seal	*Histriophoca fasciata*	GTP Sealift	Summer	Bering and Chukchi seas; associated ice
Spotted Seal	*Phoca largha*	GTP	Summer	Bering, Chukchi, Beaufort seas, shelf waters and coastal
Ringed Seal [a]	*Phoca hispida*	GTP	Year-round	Bering, Chukchi, Beaufort seas, shelf waters and coastal
WHALES				
Beluga Whale	*Delphinapterus leucas*	GTP, GTP Sealift	Summer	Bering, Chukchi, Beaufort seas; Cook Inlet[a]; coastal or near ice
Killer Whale	*Orcinus orca*	Marine Terminal, Mainline	Summer	Gulf of Alaska, Cook Inlet, Bering, Chukchi, Beaufort seas; coastal waters
Minke Whale	*Balaenoptera acutorostrata*	LNGCs, GTP Sealift	Summer	Gulf of Alaska, Bering, Chukchi seas; pelagic and bays, shallow coastal waters near ice
Narwhal	*Monodon monoceros*	GTP Sealift	Summer	Rarely seen in Chukchi, Beaufort seas; coastal waters
Baird's Beaked Whale	*Berardius bairdii*	LNGCs, GTP Sealift	Winter	Gulf of Alaska, Bering Sea; pelagic
Cuvier's Beaked Whale	*Ziphius cavirostris*	LNGCs	Summer	Gulf of Alaska; pelagic
Stejneger's Beaked Whale	*Mesoplodon stejnegeri*	LNGCs, GTP Sealift	Summer	Gulf of Alaska, Bering Sea; unknown
Humpback Whale	*Megaptera novaeangliae*	LNGCs	Summer	Chukchi, Bering Seas, Cook Inlet, Gulf of Alaska; coastal and pelagic waters
Gray Whales (Eastern Stock)	*Eschrichtius robustus*	LNGCs, GTP Sealift	Summer	Bering, Chukchi, Beaufort seas; coastal and shelf waters
PORPOISES AND DOLPHINS				
Dall's Porpoise	*Phocoenoides dalli*	LNGCs, GTP Sealift	Year-round, summer	Gulf of Alaska, Cook Inlet, Bering Sea; pelagic and coastal

TABLE 3.4.2-1

Non-ESA Listed Marine Mammals Potentially Occurring in the Project Area

Common Name	Scientific Name	Project Component	Seasonal Presence in Project Area	Range in Alaska and Habitat
Harbor Porpoise	*Phocoena*	Marine Terminal, Mainline	Year-round, summer	Gulf of Alaska, Cook Inlet, Bering, Chukchi, and Beaufort seas; coastal waters
Pacific White-sided Dolphin	*Lagenorhynchus obliquidens*	LNGCs	Summer	Gulf of Alaska; mostly pelagic but also shelf waters

Source: Allen and Angliss 2014

[a] On March 11, 2016, the U.S. District Court for the District of Alaska issued a memorandum decision in a lawsuit challenging the listing of ringed seals under the ESA (Alaska Oil and Gas Association v. National Marine Fisheries Service et al., Case No. 4:14-cv-00029-RRB; North Slope Borough v. Pritzker et al., Case No. 4:15-cv-0000w-RRB; and State of Alaska v. National Marine Fisheries Service et al., Case No. 4:15-cv-00005-RRB). The consolidated decision vacated NMFS's listing of the Arctic ringed seal as a threatened species.

[b] On July 25, 2014, the U.S. District Court for the District of Alaska issued a memorandum decision in a lawsuit challenging the listing of bearded seals under the ESA (Alaska Oil and Gas Association v. Pritzker, Case No. 4:13-cv-00018-RRB). The decision vacated NMFS's listing of the Beringia DPS of bearded seals as a threatened species. NMFS filed an appeal for that decision in May 2015.

3.4.2.1 Liquefaction Facility

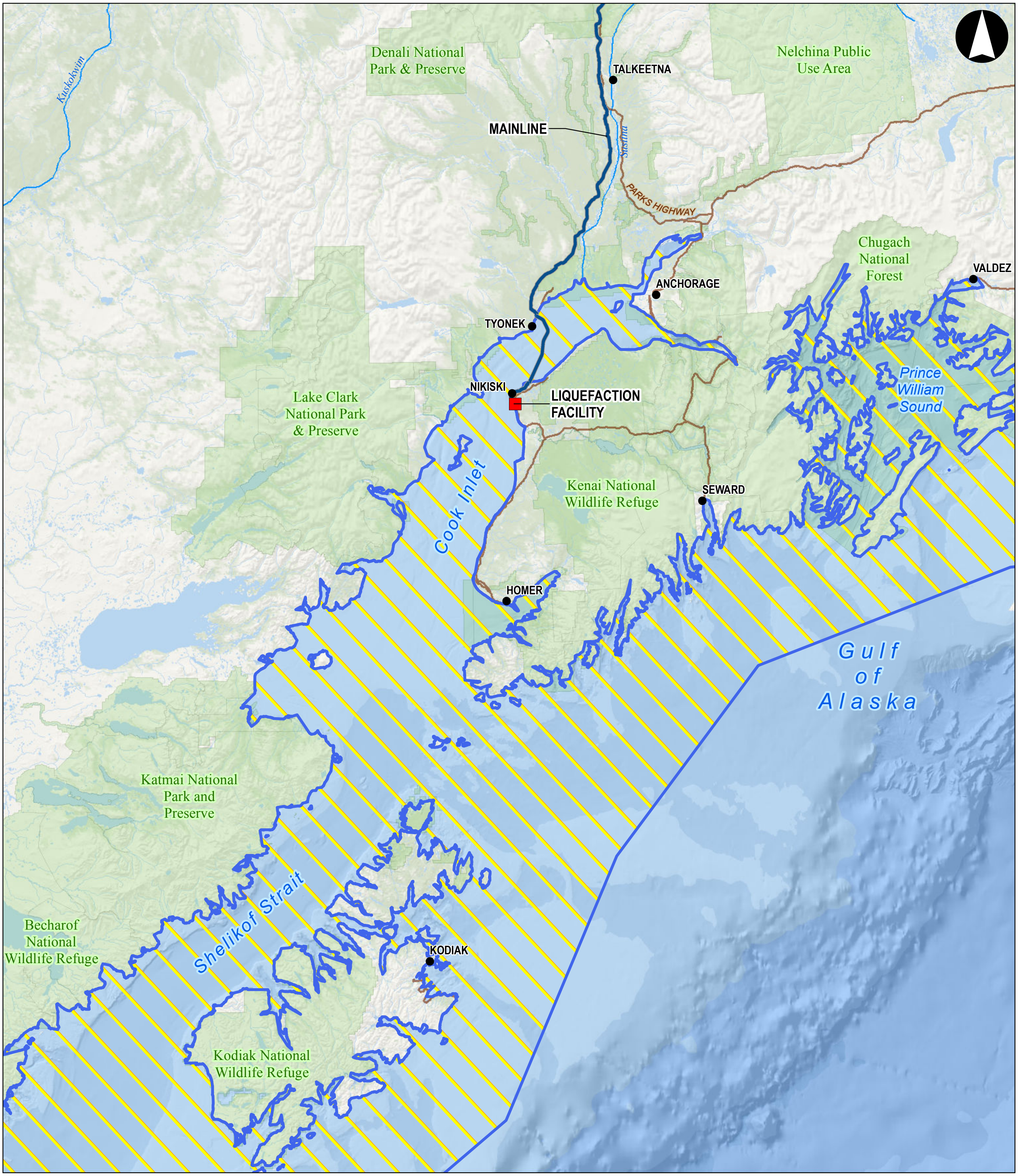
Non-ESA-listed marine mammals that occur in Cook Inlet near the Liquefaction Facility include: harbor seals, killer whale, and harbor porpoise (Table 3.4.2-1). In addition, marine vessel traffic associated with the Liquefaction Facility would occur within areas of the Gulf of Alaska used by northern fur seals, killer whales, minke whales, Baird's beaked whales, Cuvier's beaked whales, Stejneger's beaked whales, Dall's porpoises, harbor porpoises, and Pacific white-sided dolphins. These marine mammals are described in subsequent sections, with additional information on occurrence in association with proposed Project facilities provided at the end of each description.

3.4.2.1.1 Harbor Seals

Harbor seals (*Phoca vitulina richardii*) lack external ear flaps, which distinguishes them from other pinnipeds (ADF&G, 2015a). They are generally light gray with dark spots or dark with light rings (ADF&G, 2015a). Their pelvic bones are fused, so they move awkwardly on land; however, they are adapted for extended diving (ADF&G, 2015a). The average adult weighs 180 pounds and is 5 to 6 feet long; males are generally larger than females (ADF&G, 2015a). Harbor seals are sexually mature between 3 and 7 years (ADF&G, 2015a). Males live approximately 26 years, while females live 35 years (ADF&G, 2015a). Females give birth to a single pup annually, which is born between May and mid-July (ADF&G, 2015a). Alaska Natives hunt harbor seals for subsistence (ADF&G, 2015a).

Harbor seals inhabit coastal and estuarine waters along the West Coast, including southeast Alaska west through the Gulf of Alaska and Aleutian Islands, in the Bering Sea and Pribilof Islands (Allen and Angliss, 2014). Harbor seals haulout on rocks, reefs, beaches, and drifting glacial ice, and forage on a wide variety of schooling fish, flatfish, crustaceans, and squid in marine, estuarine, and, occasionally, freshwaters (Allen and Angliss, 2014). Harbor seals are considered non-migratory, but make local movements associated with tides, weather, season, food availability, and reproduction (Allen and Angliss, 2014).

Harbor seals in Alaskan waters are assigned to 12 separate stocks. Of these stocks, harbor seals in Cook Inlet Shelikof stock are likely to occur within the Project area in Upper Cook Inlet (Figure 3.4.2-1). Cook Inlet Shelikof stock was estimated at 22,900 seals in 2006 and is considered stable (Allen and Angliss, 2014).



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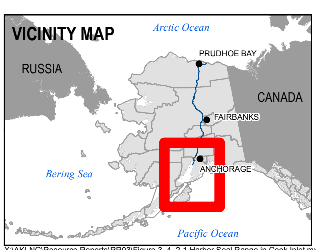

X:\AKLNG\Resource Reports\RR03\Figure 3_4_2-1 Harbor Seal Range in Cook Inlet.mxd

LEGEND

- Project Facility
- Alaska Place Names
- Alaska LNG Rev C2 Route
- Major Highways
- Major Rivers
- Harbor Seal Range
- State and Federal Conservation Lands

0 15 30 60 Miles

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HARBOR SEAL RANGE IN COOK INLET

FIGURE 3.4.2-1

ALASKA LNG

3.4.2.1.2 Northern Fur Seals

Northern fur seals (*Callorhinus ursinus*) vary in color (ADF&G, 2015a). Females and young males appear black when wet and gray or brown when dry (ADF&G, 2015a). Mature males are brownish-black, but their mane lightens around 6 years of age (ADF&G, 2015a). Northern fur seals have a visible ear flap and use their hind flippers to "walk" on land (ADF&G, 2015a). Males are 7 feet long and weigh 450 to 600 pounds, while females are 4.7 feet long and weigh 80 to 110 pounds (ADF&G, 2015a). Females are sexually mature at 3 to 5 years of age, giving birth to a single pup weighing 10 to 14 pounds in early to mid-June and mating again within one week (ADF&G, 2015a). Males are mature at 5 to 6 years, but do not enter the reproductive population until they are 9 to 10 years old (ADF&G, 2015a). Their life expectancy is 26 years (ADF&G, 2015a).

Northern fur seals occur from southern California north to the Bering Sea (Appendix G). During summer, most of the worldwide population is found on rookeries on the Pribilof Islands and a few other islands in the southern Bering Sea. They are an important subsistence resource for Alaska Natives on the Pribilof Islands. During the breeding season, males remain onshore from May to August and females remain onshore from June to November (Allen and Angliss, 2014). Fur seals feed on a variety of schooling fish and squid, including herring, capelin, and pollock. When not on rookeries, fur seals are pelagic.

Northern fur seals in Alaskan waters are assigned to a single stock, the eastern Pacific stock. The most recent population estimate, based on pup counts from 2008 to 2011, is 639,545 (Allen and Angliss, 2014). The population is declining and the stock is designated as depleted (Allen and Angliss, 2014).

Northern fur seals are unlikely to occur along the sealift route through the Bering, Chukchi, and Beaufort seas because these seals would be expected to remain near the rookeries during the summer shipping season. A few fur seals could occur near LNGC routes and could react to vessels, but are unlikely to collide with vessels.

3.4.2.1.3 Killer Whale

Killer whales (*Orcinus orca*) are predominantly black with white patches under the jaw, above and behind each eye, and on the ventral surface (ADF&G, 2015a). Their dorsal fin, which may reach 3 to 6 feet, and gray saddle patch are used to identify individual whales (ADF&G, 2015a). Killer whales are 23 to 27 feet long; males are larger than females and may weigh as much as 13,300 pounds (ADF&G, 2015a). Females are sexually mature at an average age of 15 years, giving birth to a single calf every four to six years, usually between fall and spring (ADF&G, 2015a). Males typically live 36 years and females live 63 years (ADF&G, 2015a).

Killer whales from both resident and transient stocks are found in the Gulf of Alaska (Appendix G). Killer whales are widely distributed, although they occur in higher densities in colder and more productive waters (Allen and Angliss, 2014). Killer whales are toothed whales that feed on fish, birds, squid, turtles, and marine mammals. In general, resident stocks feed primarily on fish, while transient stocks eat primarily marine mammals. Killer whales have been implicated as causing significant mortality for both northern sea otters and Cook Inlet beluga whales in lower Cook Inlet.

Killer whales are found throughout all Alaskan marine waters, but occur most commonly over the continental shelf from Southeast Alaska through the Aleutian Islands and northward to the Chukchi and

Beaufort seas. Whales from several transient Pacific stocks could occur in the Project area in the Gulf of Alaska, Bering, Chukchi, and Beaufort seas. The estimated populations and trends for these killer whale stocks are eastern North Pacific Northern resident stock: 261, increasing; combined Gulf of Alaska, Aleutian Islands, Bering Sea transient stock: 587, unknown; AT1 transient stock: 7, decline (Allen and Angliss, 2014). Only one of these stocks, the AT1 transient stock, is considered depleted under the MMPA.

Killer whales from these stocks could occur along the sealift route through the Bering, Chukchi, and Beaufort seas, and along LNGC routes through the Gulf of Alaska. Killer whales interact with trawl vessels and are occasionally struck by the propellers. However, there is no record of any killer whale ship strikes that have been reported from these stocks in Alaskan waters (Allen and Angliss, 2014; Neilson et al., 2012). Based on marine mammal survey reports, killer whales are unlikely to occur near the site of the proposed Marine Terminal (or elsewhere in the Upper Cook Inlet) during construction or operation. Killer whales were observed on only three flights during aerial surveys of Cook Inlet conducted annually from 1993 through 2004, and all of these observations occurred in the Kachemak and English Bay area (Rugh et al., 2005) more than 75 miles south of the proposed Marine Terminal site. There have been anecdotal reports of killer whales feeding on belugas in upper Cook Inlet, which began increasing in the 1990s (Shelden et al., 2003), but potential for occurrences of killer whales in the area remains low.

3.4.2.1.4 Minke Whales

Minke whales (*Balaenoptera acutorostrata*) are the smallest of the baleen whales in Alaska waters at an adult size of 28 to 35 feet; females may be slightly larger than males (Wynn, 1997; NMFS, 2015a). They are dark gray/black with a white ventral surface and white band on their pectoral flippers (NMFS, 2015a). They have a tall, falcate (e.g., hooked) dorsal fin and weigh up to 20,000 pounds (NMFS, 2015a). Minke whales are sexually mature at 3 to 8 years of age (e.g., when they reach 23 feet in length); they mate and calve in the winter (NMFS, 2015a). Females give birth to a single calf weighing 700 to 1,000 pounds and measuring 8 to 11.5 feet long (NMFS, 2015a). They are usually found in groups of two to three whales, and their estimated life expectancy is 50 years (NMFS, 2015a). Minke whales occur throughout the Gulf of Alaska, Bering Sea, and Chukchi Sea in summer feeding on schooling fish and zooplankton (Appendix G).

Minke whales in Alaskan waters are believed to be migratory and are considered a separate stock from the minke whales that are resident off the coast of California/Washington/Oregon (Allen and Angliss, 2014). No reliable population estimate is available; however, surveys in the southeastern Bering Sea during 1999 and 2000 indicated about 900 whales (Allen and Angliss, 2014).

Minke whales are likely to occur in Gulf of Alaska waters crossed by LNGCs and vessel traffic associated with construction. They are also likely to occur in the Bering and Chukchi sea waters crossed by the sealift barge traffic to Prudhoe Bay. Increased vessel traffic to Prudhoe Bay may increase the likelihood of vessel strikes of minke whales; of the six dead minke whales reported, one was determined to be the result of a vessel strike (Allen and Angliss, 2014).

3.4.2.1.5 Beaked Whales

Little is known about the three beaked whales that occur in Alaskan waters: the Baird's, Cuvier's, and Stejneger's beaked whales. These whales are deep, long diving toothed whales that vary in size: 40 feet for the Baird's, 21 feet for the Cuvier's, and 16 feet for the Stejneger's beaked whale.

Baird's beaked whale (*Berardius bairdii*) adults are mottled grayish and/or brownish, with a lighter ventral surface, weigh approximately 26,400 pounds, and are called “giant bottlenose whales” (NMFS, 2015a). They are generally found in groups of 2 to 20 individuals (NMFS, 2015a). Females are sexually mature at 10 to 15 years, and males at 6 to 11 years (NMFS, 2015a). Females will calve every three or so years, usually in March or April, producing a single calf that is 15 feet long (NMFS, 2015a). Females and males live 54 to 84 years, respectively (NMFS, 2015a).

Cuvier's beaked whale (*Ziphius cavirostris*) adults are dark gray to reddish-brown, with a lighter ventral surface, weigh 4,000 to 6,800 pounds, and are called “goose-beaked whales” (NMFS, 2015a). They are typically found alone or in groups of 2 to 12 individuals (NMFS, 2015a). They reach sexual maturity between 7 to 11 years of age, and have a lifespan of up to 60 years (NMFS, 2015a). Females give birth to a single calf that is 6.5 to 9 feet long and weighs 550 to 660 pounds, every two to three years (NMFS, 2015a).

Stejneger's Beaked Whale (*Mesoplodon stejnegeri*) adults are dark gray to brownish and black, with a dark cap across the top of the head, weigh up to 3,520 pounds, and are called saber-toothed whales (NMFS, 2015a). They are typically found alone or in groups of 3 to 15 individuals (NMFS, 2015a). They are sexually mature at approximately 14.8 feet in length (NMFS, 2015a). Females give birth usually between spring and fall to a single calf 7.5 to 8 feet long and weighing 175 pounds (NMFS, 2015a). Their estimated lifespan is 36 years (NMFS, 2015a).

These whales feed primarily on squid, deep-water fish, and benthic invertebrates (Wynne, 1997). Distributions for these whales are primarily known from strandings (Allen and Angliss, 2014) and include the Gulf of Alaska into the Bering Sea (Appendix G). Habitat concerns for these whales include sound disturbance where shipping or military activities are high. Shipping sound may disrupt their behavior and military sonars have been found to alter dive behavior, movements, and vocal activity (McCarthy et al., 2011; Tyack et al., 2011).

These whales are likely to occur in Gulf of Alaska waters crossed by LNGCs and vessel traffic associated with construction. Baird’s beaked whales range into the Bering Sea and occur in Gulf of Alaska waters in winter. Cuvier’s and Stejneger’s beaked whales occur in Alaska waters in summer. These two beaked whales also appear susceptible to ship-strike mortality. Two Cuvier’s beaked whales, one a probable and one a possible strike, washed ashore on Kodiak Island; and one Stejneger’s beaked whale, a possible strike, washed ashore along the northern Gulf of Alaska shoreline between 1978 and 2011 (Neilson et al., 2012).

3.4.2.1.6 Dall’s Porpoise

Dall’s porpoises (*Phocoenoides dalli*) are the fastest of the small cetaceans and have black and white markings similar to a killer whale (ADF&G, 2015a). Their head and flippers are small, and they lack a distinct beak (ADF&G, 2015a). The average adult is 6.4 feet long and weighs 300 pounds (ADF&G, 2015a). Females reach sexual maturity at 3 to 6 years, and males at 5 to 8 years (ADF&G, 2015a). Females give birth every three years, usually mid-summer, to a single calf 3 feet in length (ADF&G, 2015a). Dall’s porpoises live 16 to 17 years (ADF&G, 2015a).

Dall’s porpoises are widely distributed across the North Pacific Ocean from the shoreline out and over deep oceanic waters (Appendix G). They are not known to frequent shallow waters in Upper Cook Inlet (Allen and Angliss, 2014). Dall’s porpoises range throughout the Gulf of Alaska year-round and venture into the

Bering Sea in summer. They may travel alone or in groups, and they feed on squid and a variety of fish. Dall's porpoise in Alaskan waters are considered a single stock—the Alaska stock. No reliable population estimate or trend is available; sightings from surveys during 1999 to 2004 indicated on the order of 29,000 Dall's porpoises (Allen and Angliss, 2014).

Dall's porpoises are unlikely to occur near the proposed Marine Terminal in Upper Cook Inlet (Allen and Angliss, 2014). They are likely to occur in the Lower Cook Inlet and throughout the Gulf of Alaska year-round and in the Bering Sea in summer. They would likely occur along potential vessel routes through the Kennedy Entrance and Shelikof Strait.

3.4.2.1.7 Harbor Porpoise

Harbor porpoises (*Phocoena phocoena*) are shy, small cetaceans with blunt snouts and teeth (ADF&G, 2015a). They are dark grey or brown, fading to lighter grey on the sides, with a white ventral surface (ADF&G, 2015a). The average harbor porpoise is 5 feet long and weighs 130 pounds; females are slightly larger than males (ADF&G, 2015a). They reach sexual maturity at 3 to 4 years, and generally live 8 to 10 years (ADF&G, 2015a). Females give birth approximately every two years to a single calf weighing 14 to 22 pounds (ADF&G, 2015a).

Harbor porpoises are widely distributed in coastal areas from southeast Alaska to the Beaufort Sea (Allen and Angliss, 2014). They occur year-round in coastal areas on the south side of the Alaska Peninsula and Aleutian Islands (Appendix G). They occur most frequently in waters less than 300 feet deep; primarily frequenting coastal waters where they feed on schooling fish and invertebrates, including herring, mackerel, smelt, and squid. They generally travel alone or in small groups and are often concentrated in nearshore areas, bays, tidal areas, and river mouths. Three stocks of harbor porpoises have been defined for Alaskan waters, although with more data, additional stocks are likely to be distinguished (Allen and Angliss, 2014). The Gulf of Alaska stock occurs within the Project area. No reliable population estimate or trend is available; the previous estimate from 1998 was 25,987 for the Gulf of Alaska stock (Allen and Angliss, 2014). ADF&G considers the harbor porpoise to be ecologically important (ADF&G, 2015bc).

Harbor porpoises are likely to occur near the proposed Marine Terminal in Upper Cook Inlet (Allen and Angliss, 2014). They are also likely to occur in Lower Cook Inlet and the northern Gulf of Alaska year-round and in the Bering Sea in summer. Shipping and sound from oil and gas activities may be a habitat concern in the Chukchi Sea (Allen and Angliss, 2014). Harbor porpoises would likely occur along potential vessel routes through the Kennedy Entrance and through Shelikof Strait. They may also occur along portions of the sealift routes through the Bering and Chukchi seas.

3.4.2.1.8 Pacific White-sided Dolphin

The Pacific white-sided dolphin (*Lagenorhynchus obliquidens*) has a dark grey back and sides, which are separated from a white ventral surface by a black border (ADF&G, 2015a). The short, thick snout is black at the tip and the dorsal fin is bicolored (ADF&G, 2015a). Adults are 7 feet long and weigh 440 pounds; males are slightly larger than females (ADF&G, 2015a). Females are sexually mature at 5 to 6 years, and males at 8 to 10 years (ADF&G, 2015a). Females give birth to a single calf 3 feet long and weighing 14 pounds (ADF&G, 2015a). Their lifespan is 45 years (ADF&G, 2015a).

Pacific white-sided dolphins occur throughout the temperate North Pacific Ocean (Appendix G). In the eastern North Pacific this dolphin is found from the southern Gulf of California north to the Gulf of Alaska and west to Amchitka in the Aleutian Islands (Allen and Angliss, 2014). These dolphins are primarily pelagic, but are also found along the continental shelf margin. They often travel in herds of tens to several thousand animals. They feed on a variety of small schooling fish and squid.

Pacific white-sided dolphins in Alaskan waters are assigned to a single stock, the North Pacific stock. A minimum population estimate of 26,880 was developed in 1993, but a current population estimate is not available and neither is any reliable information on population trends (Allen and Angliss, 2014).

Pacific white-sided dolphins are unlikely to occur in Cook Inlet, but would be expected to occur along shipping routes into and out of Cook Inlet into the Gulf of Alaska. Dolphins may be attracted to vessels, but collisions are unlikely.

3.4.2.1.9 Northern Sea Otter

The northern sea otter (*Enhydra lutris*) is the largest member of the weasel family and has a brown, black, or silver coat and webbed feet for swimming (ADF&G, 2015a). Adult sea otters are 5 feet long and weigh 50 to 100 pounds; females are smaller than males (ADF&G, 2015a). Females are sexually mature at 2 to 5 years of age, and males at 4 to 6 years (ADF&G, 2015a). Females give birth each year, usually in the late spring in Alaska, to a single pup weighing 3 to 5 pounds (ADF&G, 2015a). Sea otters feed on fish and invertebrates, including clams, octopus, crabs, and sea urchins, which they find in shallow coastal waters (ADF&G 2015a). Their lifespan is 15 to 20 years (ADF&G, 2015a).

The Alaska subspecies of the northern sea otter (*E. lutris kenyoni*) ranges from southeast Alaska through the Aleutian Islands. Within this range, three stocks have been identified based on morphological and some genetic differences between the Southwestern and Southcentral Alaska stocks, and physical barriers to movement across the upper and the lower portions of Cook Inlet (Appendix G; 70 FR 46366). The southwest Distinct Population Segment (DPS), which includes sea otters along the Alaska Peninsula and Bristol Bay coasts, and the Aleutian, Barren, Kodiak, and Pribilof islands, was listed as a threatened in August 2005 (70 FR 46366) due to substantial observed population declines. The cause of the overall decline is not known with certainty, but the weight of evidence points to increased predation, most likely by killer whales (USFWS, 2013). Other threats include infectious disease, biotoxins, contaminants, oil spills, food limitations, bycatch in commercial fisheries, subsistence harvest, loss of habitat, and illegal take, although most of these are considered of low to moderate importance for recovery (USFWS, 2013). Appendix C further details the Northern sea otter southwest DPS presence in Cook Inlet with Project associated impacts and mitigations.

3.4.2.2 Interdependent Project Facilities

Additional non-ESA-listed marine mammals that occur in the Bering, Chukchi, and Beaufort seas that could occur near the West Dock modifications or along the marine transportation routes through the Gulf of Alaska, Bering, Chukchi, and Beaufort seas to Prudhoe Bay include: ribbon seals, spotted seals, beluga whales, and narwhals. All of the marine mammals described for the Liquefaction Facility could also occur along the marine transportation routes to Prudhoe Bay (Table 3.4.2-1).

3.4.2.2.1 Ribbon Seals

Ribbon seals (*Histriophoca fasciata*) have a dark body and light bands (e.g., ribbons) around their neck, front flippers, and hips (NMFS, 2015a). They are approximately 5 feet long and weigh about 175 pounds (NMFS, 2015a). Ribbon seals become sexually mature at 3 to 5 years of age; they breed during May (NMFS, 2015a). Females produce one offspring per year; pups are 3 feet long, weigh 25 pounds and are white at birth (NMFS, 2015a). Ribbon seals live 20 to 30 years (NMFS, 2015a).

Ribbon seals are ice-associated seals and they are found primarily in the Bering Sea along the continental shelf break from late March to early May (Appendix G). Ribbon seals are occasionally harvested by Alaska Natives in the Bering and Chukchi seas (Allen and Angliss, 2014). Ribbon seals are found most abundantly in the central and western Bering Sea, where they form small groups on the pack ice in the spring to give birth, nurse pups, and molt. From May to mid-July, ribbon seals move northward with the receding sea ice, moving into the Chukchi and western Beaufort seas (Allen and Angliss, 2014). Ribbon seals forage on a variety of pelagic fish and invertebrates, shrimp, crabs, squid, cod, sculpin, Pollock, capelin, and eelpouts. They are rarely found hauled out on land.

Ribbon seals in Alaskan waters are assigned to a single stock, the Alaska stock. A recent estimate based on aerial surveys in the Bering Sea indicated the population was 61,100 with a 95-percent confidence interval of 35,200 to 189,300 (Ver Hoef et al., 2014). No reliable estimates or trends are available for the larger population beyond the Bering Sea (Allen and Angliss, 2014).

Ribbon seals are unlikely to occur along the sealift route through the Bering, Chukchi, and Beaufort seas because these seals would be expected to remain near the ice edge during the summer shipping season. A few seals could occur near shipping routes and they could react to vessels, but they would avoid collisions with vessels. Ribbon seals are unlikely to occur near West Dock in summer.

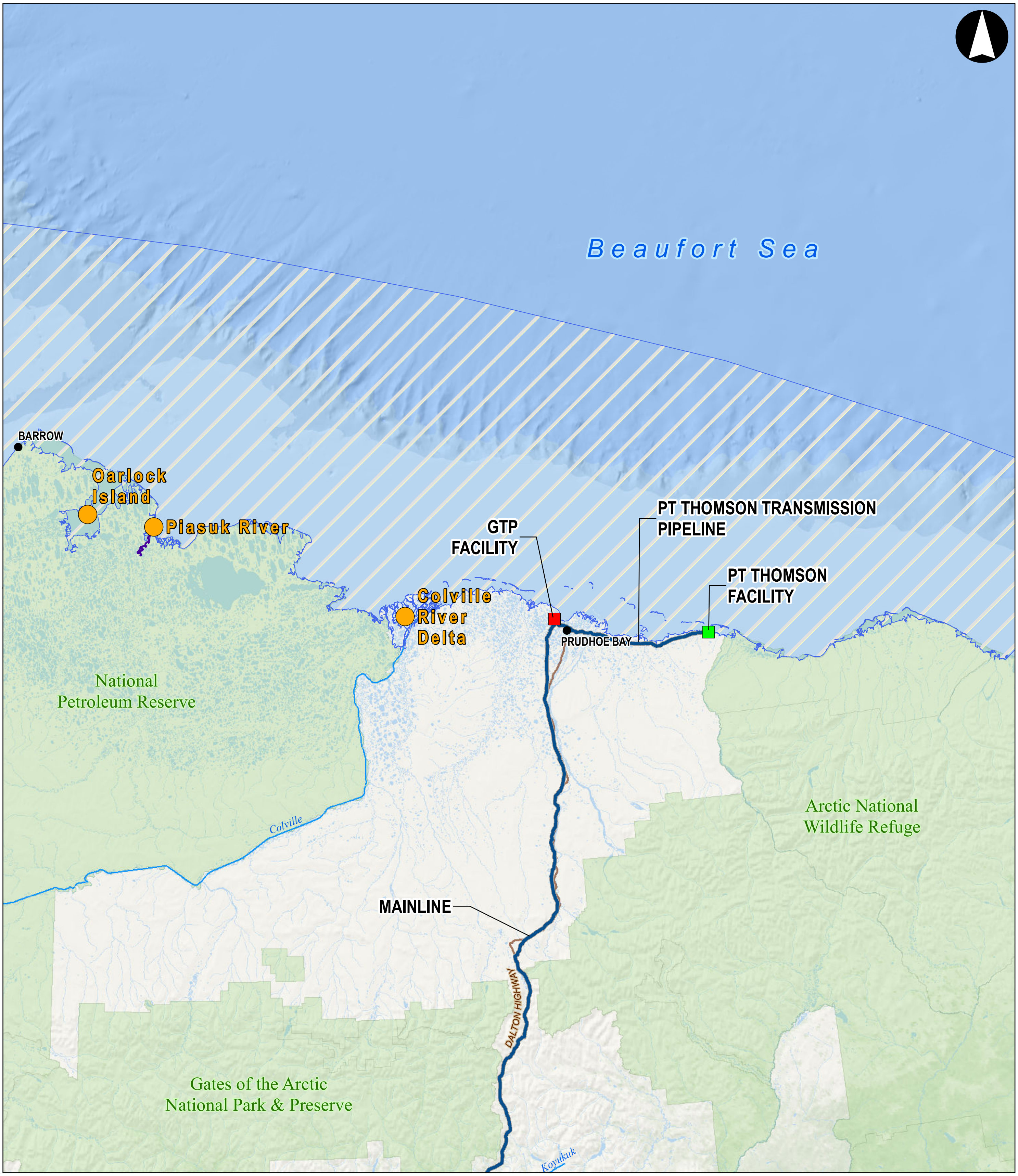
3.4.2.2.2 Spotted Seals

Spotted seals (*Phoca largha*) are silver to light gray with dark spots, and are often mistaken for Pacific harbor seals (NMFS, 2015a). They have a round head, narrow snout, and short flippers (NMFS, 2015a). The average adult is 5 feet long and weighs 140 to 250 pounds; males and females are similar (NMFS, 2015a). Spotted seals are sexually mature at 4 years of age, and they live 30 to 35 years (NMFS, 2015a). Females generally give birth to pups in mid-March (NMFS, 2015a).

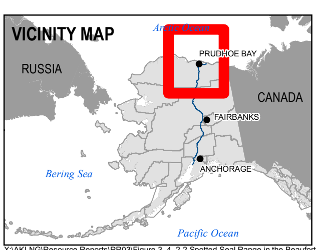
Spotted seals are distributed along the continental shelf of the Bering, Chukchi, and Beaufort seas (Figure 3.4.2-2; Allen and Angliss, 2014). They are an important subsistence resource. Spotted seals overwinter in the Bering Sea along the ice edge, making east-west movements along the ice edge (Allen and Angliss, 2014). During spring, the seals prefer the southern edge of the ice front and move northward, following the sea ice retreat, or into nearshore habitats. In summer and fall, spotted seals use coastal haulouts regularly, although they are generally associated with pack ice (Allen and Angliss, 2014). They forage on small schooling fish, shrimp, and octopus. The spotted seal is a subsistence resource for Alaska Natives (NMFS, 2015a).

Spotted seals in Alaskan waters are assigned to a single stock, the Alaska stock, which has been designated the Bering DPS, which includes spotted seals in areas in the Beaufort, Chukchi, and East Siberian seas (Boveng et al., 2009). A recent estimate based on aerial surveys in the Bering Sea indicated the population was 133,700 with a 95-percent confidence interval of 137,300 to 793,100 (Ver Hoef et al., 2014). No reliable population estimates or trends are available (Allen and Angliss, 2014).

A few spotted seals summer in the Beaufort Sea, where they haulout at Oarlock Island, the Piasuk River, and the Colville River delta (Green et al., 2007). The Colville River delta and nearby Sagavanirktok River historically supported as many as 400 to 600 spotted seals, but in recent years fewer than 20 seals have been seen at any one site (Johnson et al., 1999). Spotted seals were recorded during barging activities between Prudhoe Bay and Cape Simpson during 2005, 2006, and 2007 (Green and Negri, 2005, 2006; Green et al., 2007). Marine mammal observers sighted between 23 and 54 seals annually, with the peak distributions off the Colville and Piasuk rivers. Similarly, Savarese et al. (2010) surveyed the central Beaufort Sea from 2006 to 2008 and recorded 59 to 125 spotted seals annually. A few seals could occur near barge routes and near West Dock in summer.



VICINITY MAP



X:\AKLNG\Resource Reports\RR03\Figure 3_4_2-2 Spotted Seal Range in the Beaufort Sea.mxd

LEGEND

- Project Facility
- Existing Facility
- Alaska Place Names
- Alaska LNG Rev C2 Route
- Major Highways
- Major Rivers
- Spotted Seal Haulout Areas
- Spotted Seal Range
- State and Federal Conservation Lands

0 15 30 60 Miles

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SPOTTED SEAL RANGE IN THE BEAUFORT SEA

FIGURE 3.4.2-2

ALASKA LNG

3.4.2.2.3 Ringed Seal – Arctic Subspecies

Ringed seals (*Pusa* [*Phoca*] *hispida hispida*) are the most abundant and smallest of the Alaskan seals, weighing 110 to 150 pounds, with an average length of 4 feet (ADF&G, 2015a; NMFS, 2015a). They have a small head, short snout, clawed foreflippers, and a plump body (NMFS, 2015a). While coloring varies, a gray back with black spots and a light underside is most common. The seal's name is derived from the small, light-colored circles (e.g., rings) on its back (NMFS, 2015a). Males and females become sexually mature at 5 to 6 years of age, and breed in April to May (ADF&G, 2015a). Females give birth in March or April to a single pup, which is nursed for 2 months, enabling the pup to double its birth weight of 10 pounds (NMFS, 2015a; ADF&G, 2015a). Ringed seals consume various invertebrates, fish, and amphipods, including crustaceans, Arctic cod, and saffron cod (ADF&G, 2015a). Their life expectancy is 25 to 30 years (NMFS, 2015a). Ringed seals are circumpolar in distribution, occupying the Bering, Chukchi, and Beaufort seas in Alaska (ADF&G, 2015a). Adults breed in heavy shorefast ice and juveniles migrate south to the ice edge for the winter (ADF&G, 2015a). It is estimated there are at least 250,000 ringed seals in Alaskan waters; however, survey data are not corrected to account for seals under the ice (ADF&G, 2015a). Coastal Alaska Natives hunt ringed seals for subsistence at levels that appear to be sustainable and are not a factor in the ESA and MMPA designations (ADF&G, 2015a).

Ringed seals in Alaska waters belong to the Alaska stock, which comprises the portion of the Arctic subspecies *Phoca hispida* that occurs within the Bering, Chukchi, and Beaufort seas (Allen and Angliss, 2014). The Arctic ringed seal was listed as threatened (effective 26 February 2013) because ice projection models predict a reduction in sea ice habitat in the latter half of the century and snow production models predict a reduction in snow accumulation, which could compromise the ability of the seals to construct subnivean lairs (77 FR 76706). The reduction in available suitable ice habitat is expected to result in adverse demographic effects. On December 3, 2014, the NMFS announced their proposal to designate critical habitat for the Arctic ringed seal to include marine waters from the coastline to the U.S. Exclusive Economic Zone in the northern Bering, Chukchi, and Beaufort seas (79 FR 71714). On March 11, 2016, the United States District Court for the District of Alaska determined that the NMFS's listing decision was arbitrary and capricious. The Court vacated the listing rule and remanded the rule back to the NMFS for reconsideration.

Throughout their range, ringed seals have an affinity for ice-covered waters and are well-adapted to occupying both shorefast and pack ice (Kelly, 1988). They remain in contact with ice for most of the year, and use it as a platform for pupping and nursing in late winter to early spring; for molting in late spring to early summer; and for resting at other times of the year. Ringed seals in Alaska rarely haul out on land (Kelly 1988); although, land haulouts may be increasingly used because of increases in summer sea ice retreat. They are not known to haul out onshore in the Prudhoe Bay area. In Alaskan waters, during winter and early spring, ringed seals are abundant in the northern Bering Sea, Norton and Kotzebue Sounds, and throughout the Chukchi and Beaufort seas (Appendix G, Figure 3G-11). They occur as far south as Bristol Bay in years of extensive ice coverage, but generally are not abundant south of Norton Sound except in nearshore areas (Frost, 1985).

Ringed seals occur along marine transportation routes through the Bering, Chukchi, and Beaufort seas. Ringed seals are expected to occur near West Dock year-round.

3.4.2.2.4 Bearded Seal – Beringia DPS

Bearded seals (*Erignathus barbatus*) are the largest of all Arctic seals, ranging in color from silver-gray to dark brown, with small heads, long whiskers, and square-shaped foreflippers (ADF&G, 2015a). Adults are 7 to 8 feet long, weighing 575 to 800 pounds (females weigh more than males) (ADF&G, 2015a). Female and male bearded seals are sexually mature at 5 to 6 and 6 to 7 years of age, respectively; they breed in late May or early June (ADF&G, 2015a). Depending on prey availability, females can have up to one pup annually, which is born in late April or early May (ADF&G, 2015a). Pups are nursed for approximately 1 month, during which time their weight increases to 190 pounds (ADF&G, 2015a). Bearded seals consume benthic invertebrates (e.g., clams, snails, and shrimp) and fish (e.g., sculpins, flatfish, and cod) at depths of less than 150 to 200 m (ADF&G, 2015a). Their life expectancy is approximately 25 years (ADF&G, 2015a).

Bearded seals are circumpolar, occupying the Bering, Chukchi, and Beaufort seas in Alaska, and generally move with the pack ice as it advances in the winter and recedes in the summer (ADF&G, 2015a). Although, some bearded seals do not migrate south in the winter, but remain at the edge of the shorefast ice (ADF&G, 2015a). Adults rely on sea ice for feeding, pupping, and resting, while juveniles can be found in ice-free bays and estuaries (ADF&G, 2015a). The International Union for Conservation of Nature (IUCN) lists the species as “low risk – least concern” (ADF&G, 2015a). Population estimates are unavailable due to the difficulty in obtaining data (e.g., habitats are remote and survey data have not been corrected to account for seals under the ice) (ADF&G, 2015a). Coastal Alaska Natives hunt bearded seals for subsistence at levels that appear to be sustainable (ADF&G, 2015a).

Bearded seals in Alaska waters belong to the Alaska stock (Allen and Angliss, 2014) and the Beringia DPS. Bearded seals are an important subsistence resource. The bearded seal Beringia DPS was previously listed as threatened due to concern for the long-term survival of the population because of declines in sea-ice cover and quality in the Arctic, which is used by bearded seals for whelping and rearing pups, breeding, and haulout during molting (77 FR 76740). The Beringia DPS distribution extends over continental shelf waters of the Bering, Chukchi, Beaufort, and East Siberian seas (Allen and Angliss, 2014) (Appendix G, Figure 3G-07). On July 25, 2014, the United States District Court for the District of Alaska vacated the listing rule and remanded the rule back to NMFS for reconsideration. An appeal has been filed. Bearded seals remain protected under the MMPA.

Bearded seals overwinter in the Bering Sea, migrating north through the Bering Strait during April and May, as the sea ice retreats. Seasonal movements and distributions are tied to seasonal changes in sea ice conditions (Cameron et al., 2010). Bearded seals move north in late spring and summer, as the ice melts, and then move south in the fall, as sea ice forms (Cameron et al., 2010). A small number of bearded seals remain near coasts and may haulout along shorelines in the Bering, Chukchi, and Beaufort seas (Cameron et al., 2010); they are most common in the Beaufort Sea over the continental shelf during August through October.

Bearded seals occur along marine transportation routes through the Bering, Chukchi and Beaufort seas, and a small number bearded seals are expected to occur near West Dock.

3.4.2.2.5 Pacific Walrus

Pacific walruses (*Odobenus rosmarus divergens*) are large pinnipeds possessing two ivory tusks and a thick, tough hide (ADF&G, 2015a). Adult males (e.g., bulls) weigh up to 2 tons and are 7 to 12 feet long; females tend to be smaller at 5 to 10 feet long, weighing 1 ton or more (ADF&G, 2015a). Males can also be distinguished from females by their broad muzzle, heavier tusks, and "bosses" (e.g., large bumps) on their neck and shoulders (ADF&G, 2015a). Females and males become sexually mature at 6 to 7 and 8 to 10 years of age, respectively. Pacific walruses breed from January to March (ADF&G, 2015a). Females typically give birth every 2 years, on ice floes in the late spring, to one calf weighing approximately 140 pounds (ADF&G, 2015a). Calves stay with their mothers for two years, during which time their weight increases to approximately 750 pounds (ADF&G, 2015a). Walruses consume a variety of soft invertebrates, including snails, clams, tunicates, and sea cucumbers (ADF&G, 2015a). Males occasionally prey on seabirds and seals (ADF&G, 2015a). The life expectancy of a walrus is 40 years (ADF&G, 2015a). Pacific walruses winter on the Bering Sea pack ice (ADF&G, 2015a). In the spring, females and their calves migrate to the Chukchi Sea, while adult males migrate to Bristol Bay (ADF&G, 2015a). Return migrations occur in late fall (ADF&G, 2015a). A 2006 USFWS aerial survey estimated the Pacific walrus population at 129,000; however, that estimate is thought to be low due to counting difficulties, so the possible range is 55,000 to 507,000 (ADF&G, 2015a).

On February 10, 2011, the USFWS announced a 12-month finding on a petition to list the Pacific walrus (*Odobenus rosmaurs*) as endangered or threatened and to designate critical habitat under the ESA, as amended (76 FR 7634). After review of all the available scientific and commercial information, the USFWS determined that listing the Pacific walrus as endangered or threatened was warranted; but listing was precluded by higher priority species and the Pacific walrus was added to the candidate list (76 FR 7634). As a candidate for listing, the Pacific walrus receives no protection under the ESA, although walruses are protected under the MMPA. The USFWS will make a final ESA listing decision on Pacific walrus in September 2017. Pacific walruses are managed by the USFWS under the MMPA, with co-management agreements between USFWS and the Eskimo Walrus Commission, the Bristol Bay Native Association's Qayassiq Walrus Commission, and the State of Alaska, allowing for and monitoring subsistence harvest. Walruses are a culturally important subsistence resource, especially for Chukchi Sea communities, with an estimated annual subsistence harvest of 6,713 animals per year (ADF&G, 2015c; Allen and Angliss, 2014).

Pacific walruses range throughout the Bering and Chukchi seas, occasionally moving into the Beaufort Sea (Appendix G). Walruses are associated with pack ice edge, but they also use shoreline haulouts on islands and remote coastlines during summer ice-free periods. Hanna Shoal is located in the northeast Chukchi Sea (see Figure 17 in Appendix C) with depths as shallow as 60 feet and is one of the most biologically productive areas in the Chukchi Sea. It has been documented as an important Pacific walrus use area. The Hanna Shoal Walrus Use Area is where walrus concentrate in late summer to feed on the high benthic biomass and haul out on the ice flows. In the winter, Pacific walruses use the Bering Sea pack ice, especially in the area near and south of St. Lawrence Island (Garlich-Miller et al., 2011). In the summer (May or June), most females and calves migrate north with retreating sea ice into the Chukchi Sea. Males occasionally move into the Chukchi Sea, but more commonly migrate south to haulouts in Bristol Bay or the Gulf of Anadyr, in Russia (Garlich-Miller et al., 2011). When the extent of sea ice expands southward in the fall, Pacific walruses return to their winter range in the pack ice of the Bering Sea. Pacific walruses rarely occur in the Beaufort Sea during summer months; Ireland et al. (2009) reported an overall estimated density of 1.5 walruses per 1,000 square miles in the Beaufort Sea during vessel-based surveys in 2007. Walruses are observed most commonly in the Beaufort Sea during August and September, primarily in nearshore and shelf waters north and northeast of Point Barrow (Jay et al., 2012).

Walruses occur throughout the Bering and Chukchi seas and may be encountered by vessels in transit to West Dock in Prudhoe Bay (Aerts et al., 2008). Walruses are unlikely to be plentiful, but a few individuals could occur near West Dock at Prudhoe Bay.

3.4.2.2.6 Beluga Whale

Beluga whale (*Delphinapterus leucas*) adults are white, toothed, and have a large melon (e.g., bulbous structure on their forehead) (ADF&G, 2015a). They have a ridge down their back rather than a dorsal fin, are approximately 11 to 15 feet long and can weigh 1,000 to 3,300 pounds; females are smaller than males (ADF&G, 2015a). Females are sexually mature at 8 to 10 years of age (males mature slightly later), and give birth to a single calf every three years (ADF&G, 2015a). Mating occurs in the spring and calves are born 14 months later, during summer (ADF&G, 2015a). Calves are approximately 5 feet long at birth, weigh 90 to 130 pounds, are gray in color, and nurse for two years (ADF&G, 2015a). Their lifespan is 30 years (ADF&G, 2015a).

There are five stocks of Alaska beluga whales that include: Beaufort Sea, Bristol Bay, Cook Inlet (ESA-listed; see Section 3.5), Eastern Bering Sea, and Eastern Chukchi Sea stocks. Beluga whales from the Eastern Chukchi Sea and Beaufort Sea stocks winter in the Bering Sea and summer in the Eastern Chukchi or Beaufort seas (Appendix G; Allen and Angliss, 2014). Beluga whales from the Beaufort Sea and Eastern Chukchi Sea (Suydam, 2009) stocks overlap in distribution during summer and fall and individuals from either stock could occur in the Beaufort Sea. During winter, belugas occur in offshore waters associated with pack ice; in the spring, they move into warmer coastal estuaries, bays, and rivers where they molt and give birth (Allen and Angliss, 2014). Annual migrations may cover thousands of miles. Beluga whales are toothed whales that feed primarily on fish, squid, crabs, and clams. The beluga whale is a subsistence resource for Alaska Natives (ADF&G, 2015a).

The estimated populations and trends for the two beluga whale stocks are: Beaufort Sea stock: 32,453, unknown; and Eastern Chukchi Sea stock: 3,710, stable (Allen and Angliss, 2014). Neither of these stocks are designated as depleted; although, because these beluga whales are closely associated with sea ice, concerns exist about climate change and related effects on prey availability (Allen and Angliss, 2014).

A few individuals from the Eastern Chukchi Sea beluga whale stock may occur in the Beaufort Sea during the late summer and fall (Suydam et al., 2005). Funk et al. (2008) reported a group just offshore of the barrier islands near Simpson Lagoon, and Aerts et al. (2008) reported summer sightings of three groups of eight animals inside the barrier islands near Prudhoe Bay. Belugas pass relatively quickly with an average of 15 days through the Alaskan Beaufort Sea during their September migration (Richard et al., 2001). The westward routes ranged from coastal to over 400 miles offshore, with most passing at least 60 miles north of the Beaufort shoreline (Richard et al., 2001). Based on satellite tracking data and numerous aerial and boat-based marine mammal surveys in the Beaufort Sea, a few belugas may take a coastal route during their fall migration, but the majority of the population travels well offshore. Most belugas recorded during aerial surveys conducted in the Alaskan Beaufort Sea in the last two decades have been found over 40 miles from shore (Miller et al., 1999; Funk et al., 2008; Christie et al., 2010; Clarke and Ferguson, 2010; Brandon et al., 2011).

Cook Inlet beluga whales are discussed in Section 3.5.

3.4.2.2.7 Narwhal Whales

Narwhal whales' (*Monodon monoceros*) most notable feature is a long, clockwise-spiraled ivory tusk, which is actually a tooth, extending from the head of males and some females (NMFS, 2015a). Narwhals also have small rounded heads, no dorsal fin, short flippers, and convex tail flukes (MarineBio, 2015). Adults are light brown or pale gray, with white ventral surfaces, and some have spotted patterns (MarineBio, 2015). Males grow to approximately 15 feet, which is larger than the females, and weigh 3,500 pounds (MarineBio, 2015). Females usually give birth to one calf (cases of twins are rare), which is born in mid-July to August (MarineBio, 2015). They consume mollusks, crustaceans, squid, and fish (MarineBio, 2015). Their life expectancy is 50 years (MarineBio, 2015). Narwhals inhabit the Arctic Ocean; however, they are rarely found in the Bering, Chukchi, and Beaufort seas (NMFS, 2015c). According to a 2013 NMFS stock assessment, a population estimate for narwhals in Alaska was unavailable (NMFS, 2015c).

3.4.3 Alaska Game Management Units

Twenty-six Game Management Units (GMUs) were established pursuant to 5 AAC 92.450 as the framework for management and control of hunting by ADF&G through regulations specific to each GMU. The GMUs assist in managing large mammal populations, based on biologically relevant characteristics such as population density or herd distributions. Each GMU has specific regulations that describe the restrictions and instructions that apply for each subunit, including the seasons when hunting is allowed, what permits are required, where specific hunting is permitted, how many animals may be harvested each season, types of hunting that are permitted, and who is allowed to hunt. This information is subsequently used to frame the big game hunting seasons and regulations, bag limits per species, and appropriate hunting restrictions within each GMU. Additionally, the Dalton Highway Corridor Management Area (DHCMA) consists of those portions of GMUs 20, 24, 25, and 26 north of the Yukon River, extending for 5 miles on either side of the Dalton Highway (Figure 3.4.3-1).

The Project crosses through 8 of the 26 GMUs, including portions of 12 subunits. To harvest game or fur animals in Alaska, a valid state hunting or trapping license, permit, tag, or harvest ticket is required. There are five types of non-subsistence hunts: general season, drawing, permit, registration, and targeted. Hunting regulations, including season dates, game animals, and bag limits, vary by GMU and hunt type. Harvest tickets are required for most big game animals and may be acquired at any time during the year, but expire at the end of the regulatory year on June 30. General season and harvest ticket hunts do not require a permit. All other hunts require a permit and restrict harvest (ADF&G, 2015g).

Hunt types include:

- General season – Hunts are open to Alaska residents and nonresidents. General season hunts are the least restrictive hunts and require a license, tag, or harvest ticket;
- Drawing hunts – Available to both Alaska residents and nonresidents. These hunts require an application fee and are awarded by lottery. The application period for draw hunts is during November and December and must be submitted online. Applications may be submitted for up to six moose; only three may be bull hunts, but all six can be antlerless;

- Permit hunts – Take place in areas where hunter demand is higher than is sustainable for game population and can close early by emergency order;
- Registration hunts – Boundary-specific and do not generally limit the number of permits; however, they can be closed by emergency order if a harvest quota is met; and
- Targeted hunts – Similar to registration hunts, but require hunting applications for a specific time. These hunts are awarded by lottery.

The hunting season and bag limit vary by game species and GMU (Table 3.4.3-1). These hunts may be applied for at licensed vendors or online for moose, caribou, black bear, deer, and sheep (scientific names for game animals are presented in sections 3.4.4 and 3.4.5). Nonresidents hunting big game must purchase locking tags along with a license, tag, or harvest ticket. These tags are required to be locked on the animal immediately after the kill and must remain on the animal until it has been processed or exported. Resident hunters wishing to hunt brown bear or muskoxen must also buy locking tags in addition to a hunting license.

Hunting restrictions and instructions include specific seasons by area, sex, and hunt; bag limits; salvage requirements (e.g. intact sex); antler size or brow tine number; hide sealing requirements; use of motorized vehicles; proxy hunts; federal regulations; and the DHCMA. Detailed information regarding specific hunting and trapping regulations, area closures, special restrictions and regulations, bag limits, and harvesting instructions for each GMU can be found in the 2015–2016 Alaska Hunting and Trapping Regulations guides (ADF&G, 2015g, h).

Furbearers that can be taken with a trapping license include beaver, coyote, Arctic fox, red fox, fisher, lynx, marten, mink, weasel, muskrat, river otter, squirrel, marmot (Alaska or hoary marmot and woodchucks), wolf, and wolverine (ADF&G, 2015h). Fur animals (beaver, coyote, Arctic fox, red fox, lynx, squirrel, wolf, and wolverine) may also be taken using a gun with a hunting license (ADF&G, 2015g). Hunting and trapping seasons for fur animals and small game by GMU are summarized in Table 3.4.3-2. Snowshoe hares, porcupines, shrews, mice, and squirrels (including red, ground, and flying squirrels) may be hunted year-round.

Hunting waterfowl requires a state and federal duck stamp, a license, and proof of Harvest Information Program enrollment (ADF&G, 2015i). In some areas, a permit may also be required. The Project footprint crosses through the Northern and Gulf Coast Alaska Migratory Bird Hunting Zones (ADF&G, 2015i). Waterfowl, migratory bird, and upland game bird hunting seasons by GMU are summarized in Table 3.4.3-3. Snowy owls may be hunted in GMU 26 by Alaska residents year-round (ADF&G, 2015g). There are no open seasons for tundra swans in the GMUs crossed by the Project footprint (ADF&G, 2015i).

TABLE 3.4.3-1

Big Game General Hunting Seasons for Pipelines by Milepost and Aboveground Facilities for Game Management Subunits Crossed by the Project

GMU/Subunit[a]	Facilities	Black Bear[b]	Brown Bear	Caribou	Dall Sheep	Moose	Muskoxen
26B	PTTL MP 0 to 14.3	NCS	8/25–5/31	7/1– 6/30 VAR	8/10–9/20	NOS	NOS
26B – DHCMA: bow only	Mainline MP 14.3 to 169.9; CS2; CS4	NCS	8/25–5/31	7/1– 6/30 VAR	8/10–9/20	NOS	NOS
26B – Prudhoe Bay Closed Area	GTP; PBTL; PTTL MP 44.5 to 62.5; Mainline MP 0 to 9.8	Closed to Hunting	Closed to Hunting	Closed to Hunting	Closed to Hunting	Closed to Hunting	Closed to Hunting
25A – DHCMA: bow only	Mainline MP 169.9 to 177.4	NCS	8/10–6/30	Bulls: NCS Cows: 7/1–5/15	8/10–9/20	9/1–9/25	N/A
24A – DHCMA: bow only	Mainline MP 177.4 to 315.1; CS6	NCS	8/10–6/30	7/1–4/30 VAR	8/10–9/20	9/1–9/25	N/A
25D – DHCMA: bow only	Mainline MP 315.1 to 324.7	NCS	7/1–11/30 3/11–6/30	8/10–3/31	8/10–9/20	9/10–9/20 2/18–2/28	N/A
20F – DHCMA: bow only	Mainline MP 324.7 to 356.3; CS8	NCS	8/10–6/30	8/10–9/20 12/1–3/31 VAR	8/10–9/20	9/1–9/25 12/1–12/15	N/A
20B – DHCMA: bow only	Mainline MP 356.3 to 394.1	NCS	9/1–5/31	8/10–9/20	8/10–9/20	8/5–9/20 VAR	N/A
20B	Mainline MP 394.1 to 472.8; CS10	NCS	9/1–5/31	8/10–9/20	8/10–9/20	8/5–9/20 VAR	N/A
20C	Mainline MP 472.8 to 476.1, 489.1 to 532.1; CS12	NCS	8/10–6/30	NOS	8/10–9/20	9/1–9/25	N/A
20A	Mainline MP 476.1 to 489.1, 532.1 to 559.2	NCS	9/1–5/31	8/10–9/20	8/10–9/20	9/1–9/25	N/A
13E	Mainline MP 559.2 to 641.6; CS14; HS1	NCS	8/10– 6/15 NCS	8/20–9/10 10/21–3/31	8/10–9/20	9/1–9/20	N/A
16A	Mainline MP 641.6 to 720.9; CS16	NCS	NCS	8/10–9/20	8/10–9/20	8/10–8/17 8/20–9/25	N/A
16B	Mainline MP 720.9 to 777.6	NCS	NCS	8/10–9/30	8/10–9/20	8/20–9/25	N/A
15A	Mainline MP 777.6 to 806.6; Liquefaction Facility	NCS	9/1–5/31	NOS	8/10–9/20	8/20–9/25	N/A

Source: ADF&G, 2015g

Abbreviations: NOS = No open season, NCS = No closed season, N/A = Not applicable, VAR = Season highly variable within GMU depending on location

[a] GMUs arranged north to south; the Liquefaction Facility lies within GMU 15A.

[b] General hunting season with format month/day. Wolves and wolverines are both considered big game, because they are also commonly trapped they are presented in Table 3.4.3-2.

TABLE 3.4.3-2

Fur Animal, Furbearer, and Small Game General Hunting and Trapping Seasons for Pipelines by Milepost and Aboveground Facilities for Game Management Subunits Crossed by the Project

GMU/Subunit[1]	Facilities	Wolf[2]	Wolverine	Beaver	Coyote	Arctic Fox	Red Fox	Lynx	Marten	Mink/ Weasel	Muskrat	Otter
26B	PTTL MP 0 to 14.3	8/10–4/30 11/1–4/30	9/1–3/31 11/1–4/15	NOS NOS	NCS 11/1–4/15	9/1–4/30 11/1–4/15	9/1–3/15 11/1–4/15	11/1–4/15 11/1–4/15	N/A 11/1–4/15	N/A 11/1–4/15	N/A 11/1–6/10	N/A 11/1–4/15
26B – DHCMA: bow only	Mainline MP 14.3 to 169.9; CS2; CS4	8/10–4/30 11/1–4/30	9/1–3/31 11/1–4/15	NOS NOS	NCS 11/1–4/15	9/1–4/30 11/1–4/15	9/1–3/15 11/1–4/15	11/1–4/15 11/1–4/15	N/A 11/1–4/15	N/A 11/1–4/15	N/A 11/1–6/10	N/A 11/1–4/15
26B – Prudhoe Bay Closed Area	GTP; PBTL; PTTL MP 44.5 to 62.5; Mainline MP 0 to 9.8	Closed to Hunting	Closed to Hunting	Closed to Hunting	Closed to Hunting	Closed to Hunting	Closed to Hunting	Closed to Hunting	Closed to Hunting	Closed to Hunting	Closed to Hunting	Closed to Hunting
25A – DHCMA: bow only	Mainline MP 169.9 to 177.4	8/10–5/31 11/1–4/30	9/1–3/31 11/1–3/31	NOS 9/1–6/10	NCS 11/1–3/31	9/1–3/15 11/1–2/29	9/1–3/15 11/1–2/29	11/1–2/29 11/1–2/29	N/A 11/1–2/29	N/A 11/1–2/29	N/A 11/1–6/10	N/A 11/1–4/15
24A – DHCMA: bow only	Mainline MP 177.4 to 315.1; CS6	8/10–5/31 11/1–4/30	9/1–3/31 11/1–3/31	NOS 9/1–6/10	NCS 11/1–3/31	9/1–3/15 11/1–2/29	9/1–3/15 11/1–2/29	11/1–2/29 11/1–2/29	N/A 11/1–2/29	N/A 11/1–2/29	N/A 11/1–6/10	N/A 11/1–4/15
25D – DHCMA: bow only	Mainline MP 315.1 to 324.7	8/10–5/31 11/1–4/30	9/1–3/31 11/1–3/31	NOS 9/1–6/10	NCS 11/1–3/31	9/1–3/15 11/1–2/29	9/1–3/15 11/1–2/29	11/1–2/29 11/1–2/29	N/A 11/1–2/29	N/A 11/1–2/29	N/A 11/1–6/10	N/A 11/1–4/15
20F – DHCMA: bow only	Mainline MP 324.7 to 356.3; CS8	8/10–5/31 11/1–4/30	9/1–3/31 11/1–2/29	NOS 9/15–6/10	NCS 11/1–3/31	N/A	9/1–3/15 11/1–2/29	12/1–1/31 11/1–3/15	N/A 11/1–2/29	N/A 11/1–2/29	N/A 11/1–6/10	N/A 11/1–4/15
20B – DHCMA: bow only	Mainline MP 356.3 to 394.1	8/10–5/31 11/1–4/30	9/1–3/31 11/1–2/29	NOS 9/25–5/31	NCS 11/1–3/31	N/A	9/1–3/15 11/1–2/29	12/1–1/31 11/1–3/15	N/A 11/1–2/29	N/A 11/1–2/29	N/A 11/1–6/10	N/A 11/1–4/15
20B	Mainline MP 394.1 to 472.8; CS10	8/10–5/31 11/1–4/30	9/1–3/31 11/1–2/29	NOS 9/25–5/31	NCS 11/1–3/31	N/A	9/1–3/15 11/1–2/29	12/1–1/31 11/1–3/15	N/A 11/1–2/29	N/A 11/1–2/29	N/A 11/1–6/10	N/A 11/1–4/15
20C	Mainline MP 472.8 to 476.1, 489.1 to 532.1; CS12	8/10–5/31 11/1–4/30	9/1–3/31 11/1–2/29	NOS 9/15–6/10	NCS 11/1–3/31	N/A	9/1–3/15 11/1–2/29	12/1–1/31 11/1–3/15	N/A 11/1–2/29	N/A 11/1–2/29	N/A 11/1–6/10	N/A 11/1–4/15

TABLE 3.4.3-2

Fur Animal, Furbearer, and Small Game General Hunting and Trapping Seasons for Pipelines by Milepost and Aboveground Facilities for Game Management Subunits Crossed by the Project

GMU/Subunit[1]	Facilities	Wolf[2]	Wolverine	Beaver	Coyote	Arctic Fox	Red Fox	Lynx	Marten	Mink/ Weasel	Muskrat	Otter
20A	Mainline MP 476.1 to 489.1, 532.1 to 559.2	8/10–5/31 11/1–4/30	9/1–3/31 11/1–2/29	NOS 9/15–6/10	NCS 11/1–3/31	N/A	9/1–3/15 11/1–2/29	12/1–1/31 11/1–3/15	N/A 11/1–2/29	N/A 11/1–2/29	N/A 11/1–6/10	N/A 11/1–4/15
13E	Mainline MP 559.2 to 641.6; CS14; HS1	8/10–4/30 10/15–4/30	9/1–1/31 11/10–1/31	NOS 9/25–5/31	NCS 10/15–4/30	N/A	9/1–3/15 11/10–2/29	11/10–2/29 11/10–2/29	N/A 11/10–2/29	N/A 11/10–2/29	N/A 9/25–6/10	N/A 11/10–3/31
16A	Mainline MP 641.6 to 720.9; CS16	8/10–4/30 10/15–4/30	9/1–1/31 11/10–1/31	NOS 9/25–5/31	NCS 10/15–4/30	N/A	9/1–2/15 11/10–2/29	12/1–1/31 12/15–1/31	N/A 11/10–1/31	N/A 11/10–1/31	N/A 11/10–6/10	N/A 11/10–3/31
16B	Mainline MP 720.9 to 777.6	8/10–4/30 10/15–4/30	9/1–3/31 11/10–2/29	NOS 9/25–5/31	NCS 10/15–4/30	N/A	9/1–2/15 11/10–2/29	12/1–1/31 12/15–1/31	N/A 11/10–1/31	N/A 11/10–1/31	N/A 11/10–6/10	N/A 11/10–3/31
15A	Mainline MP 777.6 to 806.6; Liquefaction Facility	8/10–4/30 10/15–3/31	9/1–3/31 11/10–2/29	NOS 10/15–4/30	NCS 10/15–3/31	N/A	NOS 11/10–2/29	1/1–2/15 NOS	N/A 11/10–1/31	N/A 11/10–1/31	N/A 11/10–5/15	N/A 11/10–2/29

Source: ADF&G, 2015g, h

Abbreviations: NOS = No open season, NCS = No closed season, N/A = Not applicable

1 GMUs arranged north to south; the Liquefaction Facility lies within GMU 15A.

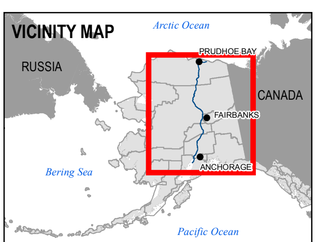
2 General hunting season on first line are followed by general trapping season on second line in each cell with format month/day. Wolves and wolverines are both considered big game, because they are also commonly trapped they are presented in Table 3.4.3-2.

TABLE 3.4.3-3

Upland Game Birds and Waterfowl General Hunting Seasons for Pipelines by Milepost and Aboveground Facilities for Game Management Subunits Crossed by the Project

GMU/ Subunit[1]	Facilities	Grouse[2]	Ptarmigan	Snipe	Sandhill Cranes	Waterfowl
26B	PTTL MP 0 to 14.3	N/A	8/10–4/30	9/1–12/16	9/1–12/16	9/1–12/16
26B – DHCMA: bow only	Mainline MP 14.3 to 169.9; CS2; CS4	N/A	8/10–4/30	9/1–12/16	9/1–12/16	9/1–12/16
26B – Prudhoe Bay Closed Area	GTP; PBTL; PTTL MP 44.5 to 62.5; Mainline MP 0 to 9.8	N/A	8/10–4/30	9/1–12/16	9/1–12/16	9/1–12/16
25A – DHCMA: bow only	Mainline MP 169.9 to 177.4	8/10–3/31	8/10–4/30	9/1–12/16	9/1–12/16	9/1–12/16
24A – DHCMA: bow only	Mainline MP 177.4 to 315.1; CS6	8/10–4/30	8/10–4/30	9/1–12/16	9/1–12/16	9/1–12/16
25D – DHCMA: bow only	Mainline MP 315.1 to 324.7	8/10–3/31	8/10–4/30	9/1–12/16	9/1–12/16	9/1–12/16
20F – DHCMA: bow only	Mainline MP 324.7 to 356.3; CS8	8/10–3/31	8/10–4/30	9/1–12/16	9/1–12/16	9/1–12/16
20B – DHCMA: bow only	Mainline MP 356.3 to 394.1	8/10–3/31	8/10–4/30	9/1–12/16	9/1–12/16	9/1–12/16
20B	Mainline MP 394.1 to 472.8; CS10	8/10–3/31	8/10–4/30	9/1–12/16	9/1–12/16	9/1–12/16
20C	Mainline MP 472.8 to 476.1, 489.1 to 532.1; CS12	8/10–3/31	8/10–4/30	9/1–12/16	9/1–12/16	9/1–12/16
20A	Mainline MP 476.1 to 489.1, 532.1 to 559.2	8/10–3/31	8/10–4/30	9/1–12/16	9/1–12/16	9/1–12/16
13E	Mainline MP 559.2 to 641.6; CS14; HS1	8/10–3/31	8/10–3/31	9/1–12/16	9/1–12/16	9/1–12/16
16A	Mainline MP 641.6 to 720.9; CS16	8/10–3/31	8/10–3/31	9/1–12/16	9/1–12/16	9/1–12/16
16B	Mainline MP 720.9 to 777.6	8/10–3/31	8/10–3/31	9/1–12/16	9/1–12/16	9/1–12/16
15A	Mainline MP 777.6 to 806.6; Liquefaction Facility	8/10–3/31	8/10–3/31	9/1–12/16	9/1–12/16	9/1–12/16

Source: ADF&G, 2015g, i
Abbreviations: N/A = Not applicable
1 GMUs arranged north to south; the Liquefaction Facility lies within GMU 15A.
2 General hunting season with format month/day.



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LEGEND

- Project Facility
- Existing Facility
- Alaska Place Names
- Alaska LNG Rev C2 Route
- Major Highways
- Major Rivers

Game Management Units
(Unit No. indicated on the map)

- I - Southeast
- II - Central
- III - Interior
- IV - Central (rural)
- V - Western Arctic

0 35 70 140 Miles

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PREPARED BY:	AGDC		
SCALE:	1:6,000,000		
DATE:	2017-03-07	SHEET:	1 of 1

STATE GAME MANAGEMENT UNITS

FIGURE 3.4.3-1

ALASKA LNG

3.4.4 Large Mammals

Big game mammals important to residents, subsistence hunters, and wildlife enthusiasts in the Project area include wolf, caribou, moose, Dall sheep, muskoxen, brown bear, and black bear (Table 3.4.4-1).

TABLE 3.4.4-1

Terrestrial Large Mammals Potentially Occurring in the Project Area by Ecoregion

Common Name	Scientific Name	Habitat	Location in Project Area		
			Arctic Tundra	Beringia Boreal	Alaska Range Transition
Black bear	*Ursus americanus*	Boreal, Coastal Forest; Tall, Low Shrub; Alpine Tundra; Riparian Zone; Rocks, Caves		√	√
Brown bear	*Ursus arctos*	Boreal, Coastal Forest; Tall, Low Shrub; Alpine, Arctic Tundra; Grass, Sedge; Riparian Zone; Rocks, Caves	√	√	√
Caribou	*Rangifer tarandus*	Boreal Forest; Low Shrub; Alpine, Arctic Tundra	√	√	√
Dall sheep	*Ovis dalli*	Alpine Tundra; Rocks, Caves		√	√
Moose	*Alces americanus*	Boreal, Coastal Forest; Tall Shrub; Alpine Tundra; Riparian Zone	√	√	√
Muskoxen	*Ovibos moschatus*	Alpine, Arctic Tundra	I		
Wolf	*Canis lupus*	Boreal, Coastal Forest; Tall, Low Shrub; Alpine, Arctic Tundra; Grasslands; Riparian Zone; Nearshore Coast; Rocks, Caves	√	√	√

Sources: ADF&G, 2014a; MacDonald and Cook, 2009.
Notes:
√ = documented or very likely to occur in the Project area.
I = introduced in the Project area.

3.4.4.1 Liquefaction Facility

Large mammals that may occur near the Liquefaction Facility include moose, black bear, wolf, caribou from the Kenai Peninsula herds, and brown bear (Table 3.4.4-1). These large mammals are described in the following sections, with additional information on their range and potential occurrence near the Liquefaction Facility and Interdependent Project Facilities.

3.4.4.1.1 Black Bear

Black bears (*Ursus americanus*) occur over most of the forested areas of the state, with an estimated 100,000 bears in Alaska. Habitats favored by black bears include riverine scrub, lowland broadleaf forest, lowland needleleaf forest, and upland broadleaf forest. The northern limit of black bears in Alaska is the Brooks Range.

June through July is when mating takes place. The cubs are born in their dens following a gestation period of about 7 months. The cubs are born blind and nearly hairless, weighing under a pound. One to four cubs may be born, but two cubs are most common. Cubs remain with their mothers through the first winter following birth. Black bears spend the winter months in a state of hibernation. Their body temperatures drop, their metabolic rate is reduced, and they sleep for long periods. Bears enter this dormancy period in the fall, after most food items become hard to find. They emerge in the spring when food is again available. Occasionally, in the more southern ranges, bears will emerge from their dens during winter. In the northern part of their range, black bears may be dormant for as long as seven to eight months. Females with cubs usually emerge later than lone bears. Dens may be found from sea level to alpine areas, in rock cavities, hollow trees, excavations, or even piled vegetation on the ground.

Black bears are opportunistic, although their foraging habits follow a pattern. Upon emerging in the spring, freshly sprouted green vegetation is their main food item, but they will eat nearly anything. Winter-killed animals are readily eaten and, in some areas, black bears have been found to be effective predators on new-born moose calves. As summer progresses, feeding shifts to salmon if they are available, but in areas without salmon, bears rely on vegetation, berries, ants, grubs, and other insects.

3.4.4.1.2 Brown Bear

Brown bears (*Ursus arctos*) occur throughout mainland Alaska. Brown bears are very adaptable and consume a wide variety of foods. Common foods include salmon, berries, grasses, sedges, cow parsnip, ground squirrels, carrion, and roots. In many parts of Alaska, brown bears are capable predators of moose and caribou, especially newborns. Bears may also be attracted to human camps and homes by improperly stored food and garbage, as well as by domestic animals.

Cubs are born in the den during January and February. Twins are most common, but litter sizes can range from one to four. Females and cubs emerge from dens in spring. The mating season is in the spring (May to July). Bears enter their dens around September to late October, depending on the geographic area, and remain there until spring. Pregnant females are usually the first to enter dens in the fall. These females, with their newborn cubs, are the last to exit dens. Adult males, on the other hand, enter dens later and emerge earlier than most other bears. In northern areas, bears may spend up to eight months in dens, while in areas with relatively mild winters, such as Kodiak, some male bears stay active all winter. Bears den in a variety of terrain ranging from pingos, streams, and lake banks at low elevations, to mountain slopes near the crest of the Brooks Range.

Bear populations in Alaska are considered healthy. Bear density within an area depends on the quality of the habitat. In areas of low productivity, such as on Alaska's North Slope, bear density may be as low as one bear per 300 square miles. Where food is abundant, bear density may be as high as one bear per square mile. In Interior Alaska, bear densities tend to be intermediate with about one bear per 15 to 25 square miles.

3.4.4.1.3 Caribou

Caribou (*Rangifer tarandus*) are distributed across Alaska and are managed as herds, which collectively encompass about 766,000 animals (Figure 3.4.4-1; ADF&G, 2011). Herds are defined based on their calving ranges (Skoog, 1968). South of the Brooks Range the Project footprint passes through habitats used by the Hodzana Hills (HH), Ray Mountains (RM), White Mountains (WH), Delta, Denali, Kenai Mountains (KM), and Kenai Lowlands (KL) caribou herds (Figure 3.4.4-1). The proposed Liquefaction Facility is within the range of the KL caribou herd (Figure 3.4.4-1).

Calving occurs in mid-late May in Interior Alaska, and in early June in northern and southwestern Alaska. Most adult cows are pregnant every year and give birth to one calf. After calving, caribou coalesce into large post-calving aggregations of primarily cows and calves, which are later joined by bulls forming even larger aggregations during late-June to early July in response to mosquito harassment. ADF&G takes advantage of these large aggregations to photograph and count the caribou in each herd. These aggregations grow and may split, reform, and move in response to weather and insects, generally moving into the direction of the prevailing winds. Summer aggregations of caribou in the Arctic may contain animals from one or more herds. As insects abate in late summer and early fall, caribou scatter to forage and rut (breed). For the WH, bulls spar during September, but actual rut, marked by serious fighting and breeding, occurs during mid to late October. Rut likely occurs during September for more southerly herds, based on calving dates. After the rut, caribou move to wintering areas. Like most herd animals, the caribou must keep moving to find adequate food. Large herds often migrate long distances (up to 400 miles) between summer and winter ranges. Smaller herds may not migrate at all. In summer (May through September), caribou eat the leaves of willows, sedges, flowering tundra plants, and mushrooms. They switch to lichens, dried sedges, and small shrubs in September. Caribou movements are probably triggered by changing weather conditions, such as the onset of cold weather or snowstorms. Once migration is triggered, caribou can travel up to 50 miles a day.

3.4.4.1.3.1 Kenai Peninsula Caribou Herds

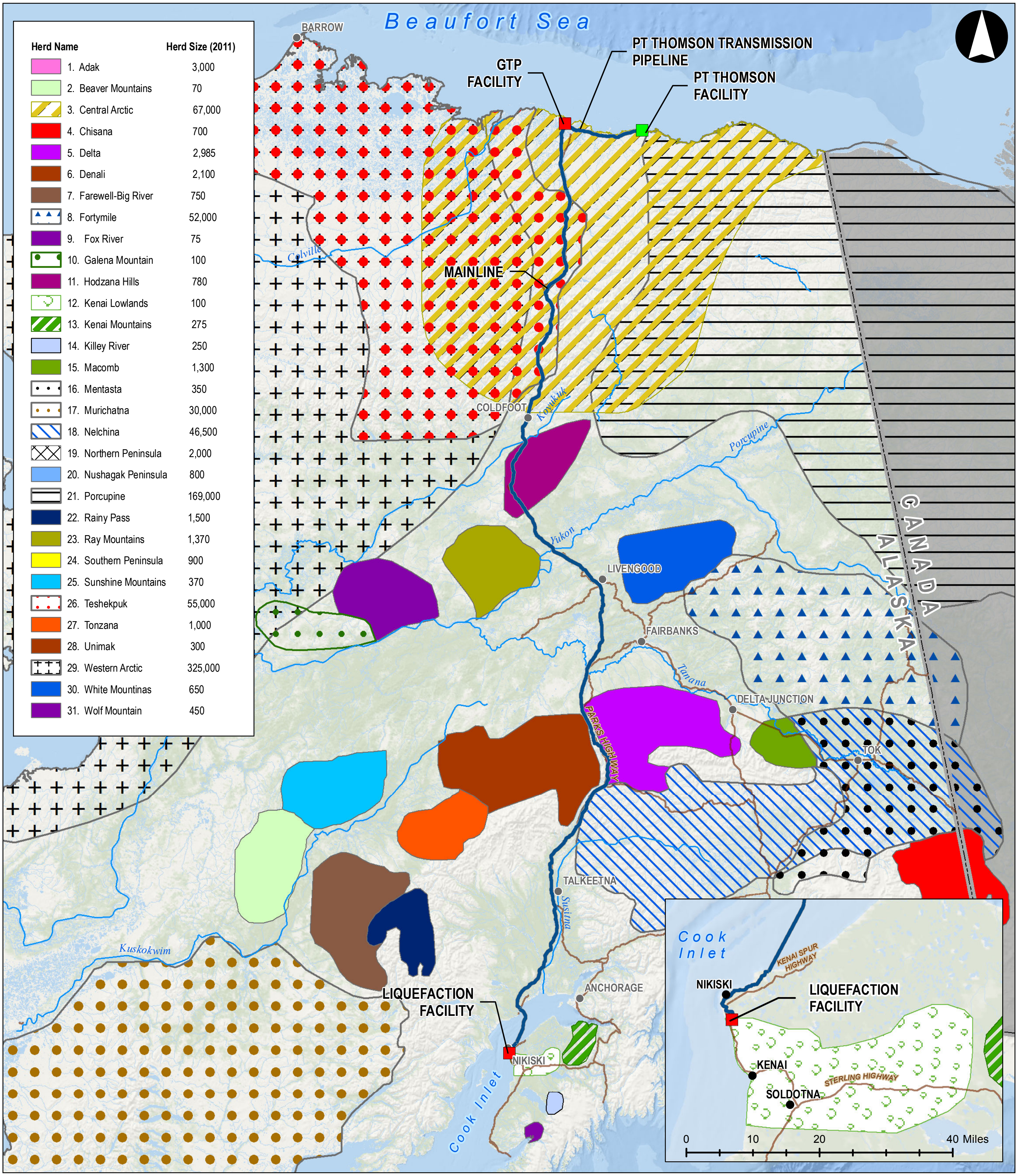
Caribou were once abundant on the Kenai Peninsula before a series of large fires in the late 1800s, which may have destroyed much of the lichen forage used by caribou as winter forage. It is likely that large-scale fires combined with unregulated hunting caused caribou to be extirpated from the Kenai Peninsula by the early 1900s. Reintroduction of caribou to the Kenai Peninsula began in the mid-1960s and established the KM and KL herds (McDonough, 2011).

Kenai Mountains Herd

The KM herd consists of about 300 caribou in GMU 7 that range over 540 square miles in the Chickaloon River, Big Indian Creek, and Resurrection Creek drainages. Past population fluctuations suggest that this herd may be limited to 300 to 400 animals due to limited winter range (McDonough, 2011). This herd is not located in the vicinity of any proposed facilities; however, it does range across road corridors that would likely be used for Project-related transportation to the Kenai Peninsula.

Kenai Lowlands Herd

The KL herd consists of 120 caribou that summer in GMU 15A, north of the Kenai Airport to the Swanson River and in the western portion of GMU 15B. This herd winters on the lower Moose River to the outlet of Skilak Lake and in the area around Browns Lake. The KL herd range encompasses about 463 square miles around the communities of Soldotna, Kenai, and Sterling. Growth of this herd has been limited by predation; free-ranging domestic dogs and coyotes kill calves in summer and wolves prey on all ages during winter. This herd is not currently hunted (McDonough, 2011). This herd ranges in the vicinity of the proposed Liquefaction Facility.



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LEGEND

- Project Facility
- Existing Facility
- Alaska Place Names
- Alaska LNG Rev C2 Route
- Major Highways
- Major Rivers

0 35 70 140 Miles

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ALASKA CARIBOU HERDS

FIGURE 3.4.4-1

ALASKA LNG

3.4.4.1.4 Moose

Alaska supports about 175,000 to 200,000 moose (*Alces americanus*) that are widely distributed across most of the state. Moose are especially abundant on timberline plateaus, along major rivers of Southcentral and Interior Alaska, and on recently burned areas that have dense stands of willow, aspen, and birch shrubs. Moose calve in the spring, with calves weaned in the fall. Breeding occurs in late September and early October. During fall and winter, moose consume willow birch and aspen twigs. During summer, moose feed on forbs, vegetation in shallow ponds, and the leaves of birch willow and aspen. Moose make seasonal movements between calving, rutting, and wintering areas, traveling from a few miles to as many as 60 miles. Suitable moose habitat is characterized by mixed forest elements, dominated by white spruce, black spruce, paper birch, quaking aspen, and balsam poplar. Shrub communities of alder and willow are most common in riparian sites and surrounding lakes and meadows. Dwarf shrubs such as resin birch (*Betula glandulosa*), Labrador tea (*Ledum decumbens*), crowberry (*Empetrum nigrum*), and blueberry (*Vaccinium uliginosum*) are common in the uplands (Bertram and Vivion, 2002).

In the Western Kenai Peninsula, the total population is about 5,000 to 6,000 moose (GMU 15A: 1,670 ± 264 [95 percent confidence interval]; 15B: 700 to 1,000; 15C: 2,500 to 3,500). Kenai moose populations are affected by severe winters. Moose populations in GMU 15A have been in decline, perhaps, in part, in response to loss of habitat quality because of vegetation succession in burn areas from 1969. Predation and collisions with automobiles are leading causes of declines in the GMU 15A population. The moose population in subunit 15B has been relatively stable for the past decade. Vehicle mortalities for the 2008–2009 season were 101 for GMU 15A, 41 for GMU 15B, and 40 for GMU 15C (Selinger, 2010).

3.4.4.1.5 Wolf

Wolves (*Canis lupus*) occur throughout mainland Alaska, with an estimated population of 7,000 to 11,000. Wolves are found within nearly all of their historic range, except in urban areas; although, they are found on the outskirts of Anchorage, Fairbanks, and Juneau. Wolves are social animals and usually live in packs that include parents and pups of the year. The average pack size is six or seven animals. Pack members often include some yearlings and other adults, and packs maintain territories. Packs of 20 to 30 wolves sometimes occur, and these larger packs may have two or three litters of pups from more than one female. Typically, one female wolf in a pack has a litter of about seven pups each year. Pups are born in dens. Most adult male wolves in Interior Alaska weigh from 85 to 115 pounds; females average 10 to 15 pounds lighter and rarely weigh more than 110 pounds. In most of mainland Alaska, moose and/or caribou are the primary prey for wolves, with Dall sheep, squirrels, snowshoe hares, beaver, and occasionally birds and fish as supplements in the diet. The rate at which wolves kill large mammals varies with prey availability and environmental conditions. A pack may kill a deer or moose every few days during the winter.

Wolves were extirpated from the Kenai Peninsula in the early 1900s due to large fires that impacted their prey and the use of poison by trappers. Bounties and extensive predator control programs during 1915 to 1960 may have prevented recolonization of wolves. By 1975 wolves had recolonized most available habitat throughout the Kenai Peninsula (Selinger, 2012). Wolves on the Kenai Peninsula were first noted as infested with dog louse (*Trichodectes canis*) in 1982 and infested wolves are now common (Selinger, 2012). Wolves were considered common on the Kenai Peninsula with a decreasing population trend based on indices developed from the 2012–2013 Trappers Survey (ADF&G, 2013b). Forty-one to 45 wolves in five packs were estimated from minimum counts for surveys in GMU 15A (Selinger, 2012).

3.4.4.2 Interdependent Project Facilities

In addition to the large mammals previously described in Section 3.4.4.1, Dall sheep and muskoxen may occur near Interdependent Project Facilities. Caribou from the Arctic and mountain herds may also occur near Interdependent Project Facilities. All of the large mammals described for the Liquefaction Facility are likely to occur near Interdependent Project Facilities (Table 3.4.4-1). Additional information on abundance and habitats used by large mammals near Interdependent Project Facilities are discussed in the following sections.

3.4.4.2.1 Caribou

Caribou (*Rangifer tarandus*) are distributed across Alaska and are managed as herds, which collectively encompass about 766,000 animals (Figure 3.4.4-1; ADF&G, 2011). Herds are defined based on their calving ranges (Skoog, 1968). South of the Brooks Range the Project footprint passes through habitats used by the HH, RM, WH, Delta, Denali, KM, and KL caribou herds (Figure 3.4.4-1). Caribou are nomadic and are the most abundant large mammal in the Arctic, where four herds are recognized: West Arctic (WAH), Teshekpuk (TCH), Central Arctic (CAH), and Porcupine (PCH) (Figure 3.4.4-1). The Project footprint would cross through the calving range for the CAH (Figure 3.4.4-1). Calving CAH caribou occur on either side of the Sagavanirktok River. The Mainline corridor would be located between these two calving ranges; the PTTL would cross through the eastern calving range (Figure 3.4.4-1). The calving ranges for the WAH, TCH, and PCH are not near the Project.

3.4.4.2.1.1 Arctic Caribou Herds

Central Arctic Herd (CAH)

The CAH was recognized as a discrete herd in the mid-1970s. This herd traditionally calves between the Colville and Kuparuk rivers and between the Sagavanirktok and Canning rivers. The summer range extends from Fish Creek, just west of the Colville River, eastward along the coast to inland within about 30 miles to the Katakturuk River in the Arctic NWR. The CAH winters in the northern and southern foothills and mountains of the Brooks Range. The CAH range overlaps with the PCH in the summer and winter.

The CAH increased from 5,000 animals in the 1970s, to 13,000 in the early 1980s, to 23,000 in the early 1990s, and then declined to 18,000 in the mid-1990s. Subsequently, the herd increased at a rate of 9.5 percent per year from 18,100 caribou in 1995 to 65,000 caribou in 2010, then declined to 50,753 in 2013 (Lenart, 2014). A decline in the CAH in the mid-1990s was attributed to decreased productivity related to cumulative effects from petroleum development in the calving area between the Colville and Kuparuk rivers that resulted in changes in calving distribution and increased energy expenditure during the insect season for cows exposed to oilfield infrastructure (Cameron et al., 2005). Productivity in this calving area, over the 30-year period from 1978 to 2008, has also been related to weather patterns reflecting the annual intensity of the Arctic Oscillation (Joly et al., 2011). Typical Arctic Oscillation weather patterns associated with decreased caribou productivity include: decreased sea-level pressure, increased winter and decreased summer temperatures, and increased annual precipitation, snowfall, winter cloudiness, and summer cloudiness (Joly et al., 2011). Herd increases are attributed to high parturition rates, high early summer calf survival, and low adult mortality (Lenart, 2011a). Other factors potentially responsible for the changes in herd numbers may include winter mortality and emigration or immigration (Cronin et al., 1997, 2000). The

Mainline corridor would cross the summer and winter range for the CAH; the PTTL would cross the east calving range for this herd (Figure 3.4-1).

Porcupine Caribou Herd (PCH)

The PCH migrates between Alaska and the Yukon and Northwest Territories in Canada. In the 1980s and 1990s, most of the PCH calved in the Arctic NWR, often on the coastal plain east of the Canning River. Since 2000, the PCH has primarily calved in the Yukon, with calving in five of nine years on the coastal plain between the Alaska-Canada border and the Babbage River. In 2010, 56 percent of radio-collared cows calved in the Arctic NWR, with 16 percent of these in the 1002 Area on the coastal plain east of the Canning River (Caikoski, 2011). In summer 2010, most PCH caribou were distributed across the northern foothills of the Brooks Range between the Jago and Hulahula rivers, but in late June and early July, a portion of the herd moved to the south side of the Brooks Range. Those caribou that stayed north of the Brooks Range moved west between the Canning River and Hulahula River drainages. In fall and winter, PCH disperse over a large area, including the Coleen and Middle Fork Chandalar river drainages near Arctic Village (Caikoski, 2011; Figure 3.4.4-1). The PCH reached a peak of 178,000 in 1989 and declined to 123,000 in 2001, during a period when many PCH caribou calved in the Yukon, then increased to 169,000 in 2010 (Caikoski, 2011). Prior to 2010, population estimates were considered minimum estimates. The most recent population estimate in 2013 was 197,000 (± 28,561; 95-percent confidence interval) (Caikoski, 2014). This herd is an important subsistence resource and is jointly management by the United States and Canada through the International Porcupine Caribou Board. A few PCH could range near the Project corridor during summer or winter; but this herd generally ranges well east of the Project corridor (Caikoski, 2014). The PTTL would be located west of the PCH calving range (Caikoski, 2014).

Teshekpuk Caribou Herd (TCH)

The TCH was recognized as a discrete herd from the WAH and CAH in 1978, based on calving distribution. The TCH primarily ranges on the coastal plain north of the Brooks Range during spring and summer. Intensive studies of this herd have shown high fidelity to calving areas surrounding Teshekpuk Lake, extensive use of coastal habitats between Cape Halkett and Barrow for insect relief, broad use of the coastal plain west of the Colville drainage in late summer, and highly variable use of winter ranges (Parrett, 2011; Person et al., 2007). During an attempted photo census on July 31, 2010, collared TCH cows were aggregated with collared cows from both the CAH and the WAH (Parrett, 2011). Movement and range overlap between these three herds continues, with potential for influencing the population estimates. Emigration has been primarily in the direction of TCH into WAH (Parrett, 2011); although CAH were mixed with TCH animals during both the 2011 and 2013 photo censuses (Parrett, 2014). The winter distribution of the TCH has been shifting in recent years and remains unpredictable; although, there is use of the central Brooks Range (Parrett, 2011). High (32 percent) adult female mortality was observed in 2012–2013 (Parrett, 2014). The most recent photo census for the TCH on July 16, 2013, indicates the herd was 39,000 ± (15-percent standard error) with an annual rate of decrease of about 18 percent (Parrett, 2014). The Project corridor would cross the summer and winter range for the TCH; the calving area for this herd is primarily located around Teshekpuk Lake, well west of the Project corridor.

Western Arctic Herd (WAH)

The WAH is the largest caribou herd in Alaska, ranging over 157,000 square miles. In spring, most mature cows travel north toward calving grounds in the Utukok Hills; bulls lag and generally move toward summer range in the Wulik Peaks and Lisburne Hills. Following calving, cows and calves move southwest toward the Lisburne Hills. Summer range consists of the Brooks Range and its northern foothills west of the Trans-Alaska pipeline. During summer, the WAH moves eastward through the Brooks Range. WAH caribou are more dispersed during fall as they move southwest toward wintering grounds. In the early 1970s, the WAH was estimated at 242,000 animals. The herd reached 400,000 in the 1990s and fluctuated around between 400,000 and 475,000 until it began to decline around 2007 (Dau, 2011). The current estimate is 325,000 (Dau, 2011). The Project corridor would skirt wintering areas used by the WAH (subarea 5 in the central Brooks Range, north of the Koyuktuk River and west of the Dalton Highway, subarea 6 in the Koyukuk drainage south of the Brook Range) (Dau, 2011). Average winter (November through March) densities in these sub areas were 2.7 and 2.1 caribou per square mile during winters of 2006 through 2010, respectively (Dau, 2011).

3.4.4.2.1.2 Mountain Caribou Herds

Hodzana Hills (HH) Herd

The HH herd, with about 780 caribou, is named for the area where these caribou calve. Small groups of caribou in the HH were previously considered part of the RM herd. Traditional ecological knowledge suggests that this herd is a relict population of once vast herds that migrated across western Alaska. This herd resides and calves primarily in the hills at the headwaters of the Dall, Kanuti, and Hodzana rivers, on the border of Units 24A and 25D (Hollis, 2011). In October 2006, a few groups were located south of Caribou Mountain on the west side of the Dalton Highway. Caribou groups observed along the Dalton Highway near Finger Mountain belong to the HH herd (Hollis, 2011). Caribou from the HH herd would occur in the Project corridor along the Dalton Highway near Finger Mountain.

Ray Mountains (RM) Herd

The RM herd, with about 1,850 caribou, calves in the RM around Kilo Hot Springs and winters to the north in the Kanuti and Kilolitna River area. Traditional ecological knowledge suggests that this herd is a relict population of once vast herds that migrated across western Alaska. During winter, this herd is primarily located on the northern slopes of the RM; during calving, it is located on the southern slopes of the RM in the upper Tozitna River drainages. Summer range is in the alpine areas of the RMs, frequently in the Spooky Valley area around Mount Henry Eakins and occasionally south of the upper Tozitna River (Hollis, 2011). Caribou from the RM Herd would normally range west of the Project corridor.

White Mountain (WM) Herd

The WM herd was recognized as a discrete herd in the late 1970s, with 100 to 200 caribou. The current herd size is 530 to 500 (Seaton, 2011a). This herd remains year-round in the WM. The White Mountains National Recreation Area, managed by BLM, encompasses most of the WM herd range. Calving is widespread and dispersed, similar to other small mountain herds (Barten et al., 2001). Calving is primarily in the higher elevations east of Beaver Creek, with some scattered calving west of Beaver Creek. Post-calving aggregations occur from mid-June to late July, east of Beaver Creek to Mount Prindle (Seaton, 2011a). The range of this herd is located about 15 miles east of the Project corridor; few if any WM herd caribou would be expected within the Project corridor.

Delta Herd

The Delta herd primarily ranges through the foothills of the central Alaska Range between the Parks and Richardson highways, north of the divide separating the Tanana and Susitna river drainages, much of which is within GMU 20A. This herd has also used the upper Nenana and Susitna river drainages north and south of the Denali Highway (Seaton, 2011b). The Delta herd has been the focus of research and intensive management with long-term studies of population dynamics, ecology, and predator-prey relationships. The Delta herd calves between the Delta and Little Delta rivers, into the foothills between Dry Creek and the Delta River, and the upper Wood River, Dick Creek, upper Wells Creek, upper Nenana, and upper Susitna drainages. During the remainder of the year the Delta herd is generally distributed among the northern foothills from the Delta to the Nenana River. Caribou from the Delta herd have been found south of the Alaska Range in the Susitna River drainage along the Denali Highway and south to Butte Lake. Mixing with the Nelchina herd in recent years has complicated accurate herd size estimates (Seaton, 2011b). Caribou from the Delta herd could occur in the Project corridor near the Parks Highway.

Denali Herd

The Denali herd, estimated at about 2,300 caribou, primarily uses DNPP for its range (Adams, 2013). This herd has been monitored continuously since 1984 (Adams, 2013). Seasonal ranges within the park used by this herd were described by Boertje (1985); the Denali herd calve in two areas—the Stampede and Cantwell calving areas—moving into summering and wintering areas in the Kantishna Hills, Stampede Hills, and north of Mount McKinley. The Cantwell calving is northwest of the Parks Highway and southwest of Cantwell (Boertje, 1985). The Denali herd is considered to be slowly increasing (National Park Service [NPS], 2013; Adams, 2013). Caribou from the Denali herd could occur within the Project corridor near DNPP along the Parks Highway.

Nelchina Herd

The Nelchina herd calves in the eastern Talkeetna Mountains from the Little Nelchina River north to Fog Lakes. This area is also used during postcalving and early summer. During summer and early fall caribou disperse, with fall distribution extending from the Denali Highway near Butte Lake, across the Alphabet Hills and to the Lake Louise flats. In 2009 and 2010, rutting was concentrated in the center of GMU 13. Winter range for the NCH extends from Cantwell in GMU 13E east across GMUs 11 and 12 into the Yukon Territory. The Nelchina herd has remained at more than 30,000 caribou since 2005; the current estimate is 45,000 (Schwanke, 2011). The Nelchina herd is important to large numbers of hunters because of its accessibility from the road system and proximity to Anchorage and Fairbanks. Caribou from the Nelchina herd could occur within the Project corridor near the Parks Highway.

3.4.4.2.2 Dall Sheep

Dall sheep (*Ovis dalli*) are found in Alaskan mountain ranges including the Kenai Mountains, the Chugach Mountains, the Alaska Range, the White Mountains, and the Central and Eastern Brooks Range. Dall sheep are found in relatively dry country and frequent a special combination of open alpine ridges, meadows, and steep slopes with extremely rugged "escape terrain" in the immediate vicinity. They use ridges, meadows, and steep slopes for feeding and resting. When danger approaches they flee to the rocks and crags to elude pursuers. They are generally high country animals but sometimes occur in Alaska in rocky gorges below timberline.

Lambs are born to ewes in late May or early June. As lambing time approaches, ewes seek solitude and protection from predators in the most rugged cliffs available on their spring ranges. Ewes form matrilineal groups with their offspring and show fidelity to annual ranges, while rams live in bands and travel more widely, mixing with ewe groups during the mating season in late November and early December. The diets of Dall sheep vary from range to range. During summer, food is abundant, and a wide variety of plants are consumed. Winter diet is much more limited and consists primarily of dry, frozen grass and sedge stems available when snow is blown off the winter ranges. Some populations use significant amounts of lichen and moss during winter. Many Dall sheep populations visit mineral licks during the spring and often travel many miles to eat the soil at these unusual geological formations.

Major rivers subdivide the landscape that potentially present barriers to sheep movement, thereby contributing to genetic sub-structuring of the population over time (Craig and Leonard, 2009). Suitable habitat for Dall sheep in the Project area is found within the BLM-managed Galbraith Lake (ACEC, refer to Section 3.4.8), and nearby mountain valleys of the Interior. Other habitat features, including mineral licks and escape terrain, have been shown to be essential components of Dall sheep habitat, which have led to their designation as ACECs (Craig and Leonard, 2009). Craig and Leonard (2009) studied the movements and habitat use of Dall sheep in five ACECs on BLM-managed land in the eastern Brooks Range, including the Galbraith Lake ACEC. All of the ACECs in the Craig and Leonard (2009) study were used by sheep year-round. Sheep were found to generally select summer habitats that were in the in the high terrain with rock and gravel surface that was sparsely vegetated. Lambing and ewes' habitats were commonly located in or near escape terrain.

Dall sheep populations in Alaska are generally considered to be healthy. Sheep numbers typically fluctuate irregularly in response to a number of environmental factors. Sheep populations tend to increase during periods of mild weather. Then, sudden population declines may occur as a result of unusually deep snow, summer drought, or other severe weather. Low birth rates, predation (primarily by wolves, coyotes, and golden eagles), and a difficult environment tend to keep Dall sheep population growth rates lower than many other big game mammals.

3.4.4.2.3 Moose

Moose habitats would be crossed by Interdependent Project Facilities from the Arctic Tundra to Cook Inlet (Table 3.4-1) primarily through portions of GMUs 26B, 24A, and 20F within the Dalton Highway Management Corridor north of the Yukon River; and portions of GMUs 20F, 20B, 20A, 20C, 13E, 16A, 16B, 14A, and 15A south of the Yukon River. Small portions or borders of GMU 25A, 25D, and 14C would also be crossed.

3.4.4.2.3.1 Arctic Tundra (Beaufort Coastal Plain Ecoregion, Brooks Foothills, GMU 26B)

Moose are not abundant in the Beaufort Coastal Plain Ecoregion, and are generally associated with narrow strips of riparian shrub habitats, except during calving and summer when some seasonal movements away from riparian corridors occur (Lenart, 2010). The Mainline would cross through moose wintering habitat in this GMU. The moose population in GMU 26B declined during the early 1990s due to a combination of disease, weather, predation, and insect harassment. The population gradually increased during the 2000s to about 570 moose in the spring of 2008 (Lenart, 2010). Low recruitment in 2008 and 2009 and potential high adult mortality led to decreased abundance; there were 450 moose in the spring 2010 trend counts (Lenart, 2010).

3.4.4.2.3.2 Beringia Boreal (Brooks Range, Ray Mountains, GMU 24A)

Local moose densities throughout GMU 24 are typical of Interior Alaska, ranging from 0.25 to two moose per square mile (Stout, 2010). The Mainline parallels the GMU 24A Middle Fork composition area with 0.87 moose per square mile in fall 2008—a total of about 100 moose (Stout, 2010). The Mainline crosses through moose winter habitat in the Fish Creek drainage. The majority of cows appear to be non-migratory in the upper Koyukuk drainage, with 40 percent moving more than 12 miles between summer and winter ranges (Stout, 2010).

3.4.4.2.3.3 Beringia Boreal (Ray Mountains, GMU 20F)

Moose densities have been low fluctuating from 0.25 and 0.50 moose per square mile for many years, presumably due to predation and habitat limitations (Hollis, 2010). Much of the habitat is mature black spruce that is poor-quality moose habitat; though, many riparian habitats, subalpine hills, and burns contain habitats of sufficient quality to sustain higher densities of moose (Hollis, 2010). The Mainline would cross through moose wintering habitat in riparian areas of the Yukon River and Hess Creek.

3.4.4.2.3.4 Beringia Boreal (Ray Mountains, Tanana-Kuskokwim Lowlands, GMU 20B)

Moose densities have increased in this subunit since the 1990s to an estimated 1.9 moose per square mile in 2008 (Seaton, 2010). Moose are distributed throughout this unit, with both migratory and non-migratory populations; from February to April some bull and cow moose migrate from the Chena and Salcha River drainages to summer range on the Tanana Flats in GMU 20A (Seaton, 2010). Browse surveys indicate that use of preferred browse is moderately high; consequently, antlerless harvests have been used in portions of central Unit 20B to limit moose population growth (Seaton, 2010). The moose-vehicle collision mortality has been substantial in some years, averaging 148 per year from 2002 to 2009 (range 122 to 189 per year) (Seaton, 2010). Habitat enhancement projects have included prescribed fire and regeneration of decadent willows by planting and crushing willows in recently logged areas (Seaton, 2010). The Mainline would cross through moose wintering and calving habitats in the Minto Lakes area, and the Tatalina, Chatanika, and Tanana river drainages.

3.4.4.2.3.5 Beringia Boreal and Coast Mountains Boreal (Tanana-Kuskokwim Lowlands, Alaska Range, GMU 20A and 20C)

The Mainline would generally follow along the border between the world-class moose resource in GMU 20A and the relatively low moose densities in GMU 20C (Young, 2010; Hollis, 2010). Most of DNPP is within GMU 20C. Moose densities remained at an estimated 2.5 to 3.1 moose per square mile in GMU 20A during 2005 to 2009, with an estimated decline of about 4 percent per year (± 2 percent per year Standard Error [SE]) in the cow segment of the population (Young, 2010). Several large fires over the past decade may improve productivity for the GMU 20A moose population, which is considered to be above habitat capacity (Young, 2010). Moose densities in GMU 20C are estimated at 0.58 moose per square mile within DNPP and 0.25 moose per square mile outside the park, based on 1991 and 1994 surveys, respectively (Hollis, 2010). Highway and train collisions are considered underreported for both of these GMUs, with a reported average of 11 moose per year (a range of 6 to 18 moose collision mortalities per year) (Hollis, 2010; Young, 2010). The Mainline would cross through calving, rut, and winter moose habitat in the valley along the border between GMU 20A and 20B.

3.4.4.2.3.6 Coast Mountains Boreal (Alaska Range and Cook Inlet Basin) (GMU 13E)

Fall moose density in GMU 13E was 0.9 moose per square mile in 2009 (Tobey and Schwanke, 2010). Moose are considered to be increasing throughout GMU 13 due to a combination of good productivity, mild winters, and lower wolf predation due to predator management (Tobey and Schwanke, 2010). Vehicle and train collisions are estimated at about 75 moose per year (Tobey and Schwanke, 2010). The Mainline would cross through rut and winter habitat along the Chulitna River drainage in GMU 13E.

3.4.4.2.3.7 Coast Mountains Boreal (Cook Inlet Basin, GMU 16A)

This moose population in GMU 16A on the west side of the Susitna River has fluctuated greatly (Peltier, 2010a). Severe winters and predation are factors; this is an area where intensive management is taking place (Peltier, 2010a). The population estimate is about 1,619 ± 197 in 2005 (Peltier, 2010a). About 15 moose per year are killed by cars (Peltier, 2010a). The Mainline preferred route would cross through winter habitat in the Susitna, Moose Creek, and Skwentna river drainages.

3.4.4.2.3.8 Coast Mountains Boreal (Cook Inlet Basin, GMU 16B)

This moose population in GMU 16B on the west side of the Susitna River does not appear to have recovered from the severe winter of 1999 to 2000, when deep snow and icing lead to high mortality (Peltier, 2010b). The population estimate was 4,323 ± 529 in 2009 (Peltier, 2010b). The Mainline preferred route would cross through calving, rut, and winter habitat in the Skwentna and Susitna river drainages in GMU 16B.

3.4.4.2.3.9 Coast Mountains Boreal (Cook Inlet Basin, GMU 14A)

The moose population in GMU 14A on the east side of the Susitna River and the Matanuska-Susitna Valley was estimated at 6,613 ± 727 (80-percent confidence interval) in 2007 and appears to have remained stable since 2001 (Peltier, 2010c). An average of 232 moose per year were killed by cars and trains in GMU 14A during 2000 to 2009 (a range of 132 to 382) (Peltier, 2010c).

3.4.4.2.4 Muskoxen

Muskoxen (*Ovibos moschatus*) occur in the Beaufort Coastal Plain Ecoregion. Muskoxen use coastal plain river corridors, floodplains, foothills, and bluff habitats year-round (Reynolds et al., 2002). Muskoxen have a low reproductive potential, usually producing a single calf (Lent, 1998). Females 3 or more years of age averaged 0.68 birth per female during 2007 to 2011 (Arthur and Del Vecchio, 2013). Calves are usually born from April through June (Lent, 1998). During 2007 through 2011, most muskoxen calves (58 percent) were born between May 1 and May 15, with 83 percent born by June 1; though, a small number of calves may be born throughout the summer (Arthur and Del Vecchio, 2013).

Muskoxen eat larger proportions of grasses and sedges and smaller proportions of forbs in coastal sites compared to inland sites (Arthur and Del Vecchio, 2013). During summer, muskoxen form relatively small groups and travel more widely than during winter, when groups tend to be larger and more sedentary (Lenart, 2011b). Radio-collared muskoxen used the Sagavanirktok River, the Sagavanirktok River delta, and the Canning River during 2007 to 2011 (Arthur and Del Vecchio, 2013).

The number of muskoxen in the area between the Colville and Canning rivers (GMU 26B) declined between 2003 and 2006, but remained stable at about 200 from 2007 through 2010 (Lenart, 2011b). While emigration from Artic NWR may have caused some of the decline in that area, reduced net productivity and recruitment were also evident (Reynolds et al., 2002; Lenart, 2003). Predation by brown bears has been identified as the most important factor limiting the growth of this population accounting for 57 percent of calf mortality and 62 percent of adult mortality with known causes (Arthur and Del Vecchio, 2013). Muskoxen are occasionally struck by vehicles on the Dalton Highway (Lenart, 2011b).

3.4.4.2.5 Wolf

Wolves were considered scarce in the Arctic Tundra Ecoregion and common in both the Interior boreal and Alaska Range regions with no changes in populations based on indices developed from the 2012 to 2013 Trappers Survey (ADF&G, 2013b). Estimated wolf density in GMUs crossed by the Project footprint are summarized in Table 3.4.4-2.

TABLE 3.4.4-2

Wolf Population Estimates for GMUs Crossed by the Project

GMU	Facility, MP Range	Population Density Estimate (No. of wolves, square miles [m^2], GMU, date)	Pack Estimates (GMU, date)
26B	GTP, PTTL MP 0 to MP 62.5, PBTL, Mainline 0 to 169.9	5 wolves/1,000 mi² (2003)	5 packs
25A	Mainline MP 169.9 to 177.4	9 to 14 wolves/1,000 mi²	72 to 93 Packs (GMU 25A, 25B, 25D; 1992)
24A	Mainline MP 177.4 to 315.1	17 wolves/1,000 mi² (GMU 24A, 24B, 1987-1991)	58 to 66 packs (GMU 24)
25D	Mainline MP 315.1 to 324.7	11 to 14 wolves/1,000 mi² (25D, 2009)	23 packs
20F	Mainline MP 324.7 to 356.3	12 to 20 wolves/1,000 mi² (1989, 1990)	10 to 20 packs (based on 20C, 20B)
20B	Mainline MP 356.3 to 472.8	16 to 25 wolves/1,000 mi² (1989, 1990)	20 to 30 packs
20C	Mainline MP 472.8 to 476.1, 489.1 to 532.1;	14 wolves/1,000 mi² (2012)	21 to 35 packs
20A	Mainline MP 476.1 to 489.1, 532.1 to 559.2	33 to 34 wolves/1,000 mi² (2008)	25 to 27 packs
13E	Mainline MP 559.2 to 641.6;	4 wolves/1,000 mi² (2010)	~5 packs
16A	Mainline MP 641.6 to 720.9	~10 wolves/1,000 mi² (1999)	2 to 3 packs
16B	Mainline MP 720.9 to 777.6	~10 wolves/1,000 mi² (1999)	14 to 16 packs
15A	Liquefaction Facility, Mainline MP 777.6 to 806.6	21 to 23 wolves/1,000 mi² (2010)	5 packs

Sources: ADF&G, 2000; ADF&G, 2009; ADF&G, 2012

3.4.5 Furbearers and Small Mammals

Furbearers and small mammals potentially occurring in the Project area with typical habitats and regional occurrence are listed in Table 3.4.5-1. Brief descriptions of these animals follow. The primary references for this information are MacDonald and Cook (2009), the ADF&G Species Home – Animals (2014d), and the AKNHP Animal Data Portal website (2014a). Their habitats are briefly described. In general, from north to south, the diversity of native furbearers and small mammals increases, with 20 species in the Arctic Tundra Ecoregion, 35 species in the Beringia Boreal Ecoregion, and 32 species in the Alaska Range Transition Ecoregion (MacDonald and Cook, 2009). Many furbearers and small mammals that occur within the proposed Project area are moderately to widely distributed throughout Alaska (MacDonald and Cook, 2009). The AKNHP tracks four furbearers and small mammals within the ecoregions crossed by the Project: Alaska marmot, Alaska tiny shrew, American water shrew, and little brown myotis. The Alaska tiny shrew is also a BLM Sensitive Species.

Two introduced small mammals, the house mouse (*Mus musculus*) and brown rat (*Rattus norvegicus*) generally occur in association with residential areas, refuse dumps, sewers, wharfs, and beaches, although their distribution and abundance in Alaska is not well known. House mice have been reported in the Project area from Fairbanks, Palmer, Eagle River, Anchorage, and Kasilof (MacDonald and Cook, 2009). Brown rats have been reported in the Project area from Fairbanks, Tanana, and Kenai (MacDonald and Cook, 2009). These animals have damaged sensitive Alaska ecosystems, especially seabird colonies in the Aleutian Islands; millions have been spent to eradicate rats from island seabird nesting colonies in the Aleutian Islands. They also carry diseases that are transmissible to humans and other wildlife. Rats are spread primarily by marine vessels, maritime shipping, and shipwrecks, but may also be transported by aircraft (Fritts, 2007). Wildlife regulations on rats prohibit transport, harboring, or release of live mice or rats (5 AAC 92.141).

TABLE 3.4.5-1

Furbearers and Small Mammals Potentially Occurring in the Project Area

Common Name	Scientific Name	Habitats	Status[a]	Location in Project Area[b] AT	IB	AR
RODENTS						
Squirrels						
Alaska Marmot	*Marmota broweri*	Alpine Tundra; Rocks, Caves	Unknown	√	√	
Arctic Ground Squirrel	*Spermophilus parryii*	Alpine, Arctic Tundra; Grass; Rocks, Caves; Sparse Vegetation	Locally Abundant	√	√	√
Hoary Marmot	*Marmota caligata*	Alpine Tundra; Rocks, Caves	Common		√	√
Northern Flying Squirrel	*Glaucomys sabrinus*	Boreal, Coastal Forest	Unknown		√	√
Red Squirrel	*Tamiasciurus hudsonicus*	Boreal, Coastal Forest, Artificial Structures	Common		C nc	C nc
Woodchuck	*Marmota monax*	Boreal Forest	Rare-Uncommon		√	
Beavers						
American Beaver	*Castor canadensis*	Marsh; Lakes and Ponds; Rivers and Streams; Riparian Zone	Common-Abundant		C nc	C nc
Mice and Voles						
Brown Lemming	*Lemmus trimucronatus*	Low Shrub; Alpine, Arctic Tundra; Grass, Sedge, Bog; Riparian Zone; Rocks, Caves	Scarce-Abundant	√	√	√
Collared Lemming	*Dicrostonyx groenlandicus*	Low Shrub; Alpine, Arctic Tundra; Rocks, Caves	Scarce-Abundant	√		
Common Muskrat	*Ondatra zibethicus*	Marsh; Lakes and Ponds; Rivers and Streams; Riparian Zone	Common, Abundant		S nc	S nc

TABLE 3.4.5-1

Furbearers and Small Mammals Potentially Occurring in the Project Area

Common Name	Scientific Name	Habitats	Status[a]	Location in Project Area[b]		
				AT	IB	AR
Meadow Jumping Mouse	*Zapus hudsonius*	Boreal, Coastal Forest; Alpine Tundra; Grass, Sedge, Marsh; Riparian Zone	Locally Abundant		√	√
Meadow Vole	*Microtus pennsylvanicus*	Grass, Sedge, Bog, Marsh; Riparian Zone	Common-Abundant		√	√
Northern Bog Lemming	*Synaptomys borealis*	Boreal, Coastal Forest; Tall, Low Shrub; Grass, Sedge, Bog, Marsh; Riparian Zone	Rare, Uncommon		√	√
Northern Red-backed Vole	*Myodes rutilus*	Boreal, Coastal Forest; Tall, Low Shrub; Alpine Tundra; Riparian Zone; Rocks, Caves; Sparse Vegetation; Artificial Structures	Very Common, Abundant	√	√	√
Root Vole	*Microtus oeconomus*	Tall, Low Shrub; Alpine, Arctic Tundra; Grass, Sedge, Bog Marsh; Riparian Zone; Rocks, Caves	Common	√	√	√
Singing Vole	*Microtus miurus*	Low Shrub; Alpine tundra; Grass; Riparian Zone; Rocks, Caves	Moderately Abundant	√	√	√
Taiga Vole	*Microtus xanthognathus*	Boreal Forest; Tall, Low Shrub; Grass; Riparian Zone	Unknown		√	
Mice, Rodents	*Various*	Trappers Survey		A nc	C nc	C nc
Porcupine						
North American Porcupine	*Erethizon dorsatum*	Boreal, Coastal Forest; Tall, Low Shrub; Alpine Tundra; Grass, Marsh; Riparian Zone; Rocks, Caves; Sparse Vegetation; Artificial Structures	Common	√	√	√
LAGOMORPHS – Pikas and Hares						
Collared Pika	*Ochotona collaris*	Alpine Tundra; Rocks, Caves; Sparse Vegetation	Locally Common		√	√
Snowshoe Hare	*Lepus americanus*	Boreal Forest; Tall Shrub; Riparian Zone	Common, Abundant	C -	C -	C nc
INSECTIVORA – Shrews						
Alaska Tiny Shrew	*Sorex yukonicus*	Boreal Forest; Tall Shrub; Grass; Riparian Zone; Rocks, Caves	Rare	√	√	√
American Water Shrew	*Sorex palustris*	Boreal, Coastal Forest; Tall Shrub; Grass, Marsh; Lakes and Ponds, Rivers and Streams, Riparian Zone	Local Uncommon		√	√
Barren Ground Shrew	*Sorex ugyunak*	Alpine, Arctic Tundra; Grass, Marsh; Riparian Zone; Rocks, Caves	Variable	√		
Cinereus Shrew	*Sorex cinereus*	Boreal, Coastal Forest; Tall, Low Shrub; Alpine Tundra; Grass, Sedge, Bog, Marsh; Riparian Zone; Rocks, Caves	Common	√	√	√
Dusky Shrew	*Sorex monticolus*	Boreal, Coastal Forest; Tall, Low Shrub; Alpine Tundra; Grass; Riparian Zone	Common, Abundant	√	√	√

TABLE 3.4.5-1

Furbearers and Small Mammals Potentially Occurring in the Project Area

Common Name	Scientific Name	Habitats	Status[a]	Location in Project Area[b]		
				AT	**IB**	**AR**
Pygmy Shrew	*Sorex hoyi*	Boreal Forest; Tall Shrub; Grass, Sedge, Bog, Marsh; Riparian Zone	Rare, Uncommon		√	√
Tundra Shrew	*Sorex tundrensis*	Boreal Forest; Tall Shrub; Alpine, Arctic Tundra; Riparian Zone	Uncommon-Common	√	√	√
BATS						
Little Brown Myotis	*Myotis lucifugus*	Boreal, Coastal Forest; Riparian Zone; Rocks, Caves; Artificial Structures	Common		√	√
CARNIVORES – Feline, Canine, Weasels						
American Marten	*Martes americana*	Boreal, Coastal Forest	Common		C -	S nc
American Mink	*Neovison vison*	Boreal, Coastal Forest; Grass, Marsh; Lakes & Ponds; Rivers & Streams; Riparian Zone	Common		S nc	S nc
Arctic Fox	*Vulpes lagopus*	Arctic Tundra; Fast, Pack Sea Ice	Common	S nc		
Canada Lynx	*Lynx canadensis*	Boreal Forest; Tall Shrub; Riparian Zone	Common, Abundant	C -	S -	C nc
Coyote	*Canis latrans*	Boreal, Coastal Forest; Tall, Low Shrub; Alpine Tundra; Grass; Riparian Zone; Sparse Vegetation	Locally Common		C nc	C nc
Ermine	*Mustela ermine*	Boreal, Coastal Forest; Tall, Low Shrub; Alpine, Arctic Tundra; Riparian Zone; Rocks, Cave	Common	C nc	C nc	C nc
Least Weasel	*Mustela nivalis*	Boreal Forest; Tall, Low Shrub; Arctic Tundra; Riparian Zone	Uncommon, Abundant	√	√	√
North American River Otter	*Lontra canadensis*	Lakes and Ponds; Rivers & Streams; Riparian Zone; Coastal Beaches	Common		A nc	A nc
Red Fox	*Vulpes*	Boreal, Coastal Forest; Tall, Low Shrub; Alpine Tundra; Grass; Riparian Zone; Sparse Vegetation	Common	C nc	S nc	C nc
Wolverine	*Gulo*	Boreal, Coastal Forest; Tall, Low Shrub; Alpine, Arctic Tundra	Uncommon	S nc	S nc	S nc
TOTAL				**20**	**35**	**32**

Sources: ADF&G, 2014a; MacDonald and Cook, 2009; AKNHP, 2014a

[a] State-wide status based primarily on MacDonald and Cook (2009)

[b] Ecoregions: AR – Alaska Range Transition; BB –BeringiaBoreal; AT – Arctic Tundra

Presence based on range maps published by AKNHP. Region-specific 2012–2013 abundance and population trend where reported are based on the Alaska Trappers Survey (ADF&G, 2013b).
Abundance: S = scarce, C = common, A = abundant;
Population Trend: nc = no change, - = decrease, + = increase
√ = documented or very likely to occur in the Project area.

3.4.5.1 Liquefaction Facility

The following species of small mammals could possibly occur in or near footprint associated with the Liquefaction Facility based on range maps from the AKNHP (AKNHP 2014a). Most small mammals potentially occurring near the Liquefaction Facility are widely distributed and could also occur near Interdependent Project Facilities.

3.4.5.1.1 Arctic Ground Squirrel

Arctic ground squirrels (*Spermophilus parryii*) are widely distributed and common throughout the Arctic, Subarctic alpine, and subalpine habitats in northern, eastern, and southwestern Alaska. They occur in tundra, along roadsides, subalpine brushy meadows, lakeshores, and sandbanks, where they dig extensive burrow systems that may be used for many years. They are social animals that live in colonies of 5 to 50 members. Arctic ground squirrels eat stems and leaves, seeds, fruits, and roots of grasses, sedges, woody plants, and mushrooms. They store their food in burrows for consumption in spring. They mate in May, with litters being born in late June. Both sexes reach maturity by their second spring.

3.4.5.1.2 Hoary Marmot

Hoary marmots (*Marmota caligata*) are found in similar habitats as the Alaska marmots, but they occur in the alpine areas of Alaska south of the Yukon River. Hoary marmots have a similar life history to the Alaska marmot, except hoary marmots den alone and mate after emerging from their dens in the spring.

3.4.5.1.3 Northern Flying Squirrel

The northern flying squirrel (*Glaucomys sabrinus yukonensis*) is a nocturnal gliding mammal that occurs as far north as Interior Alaska. Flying squirrels eat mushrooms, berries, and tree lichens. Forested habitats, with at least some mature coniferous trees, are needed for feeding and den sites. Den sites include tree cavities and clumps of abnormal branches caused by tree rust diseases, called witches' brooms. Witches' brooms are the most common denning sites in Interior Alaska and are used exclusively during winter. Flying squirrels in Alaska breed between March and late June, depending on the severity of the winter, with young being born from May to early July. They can reproduce at 1 year of age and few live past 4 years of age. Predators include owls, hawks, and carnivorous mammals.

3.4.5.1.4 Red Squirrel

Red squirrels (*Tamiasciurus hudsonicus*) are found in spruce forests over most of Alaska. They are active all year, staying in their nests only during severe cold spells or inclement weather. Red squirrels are solitary, except during mating in February and March. Young are born 36 to 40 days later and remain with their mother until the following winter. In summer, red squirrels spend most of their time cutting and storing green spruce cones in caches. They also eat mushrooms, seeds, berries, buds, fungi, and occasionally insects and bird eggs. Nests are either built in a hole in a tree trunk or made of tightly constructed mass of twigs, leaves, mosses, and lichens in the densest foliage of a tree. Main predators of the red squirrel include hawks, owls, and marten.

3.4.5.1.5 American Beaver

Beavers (*Castor canadensis*) are distributed over most of Alaska from near the crest of the Brooks Range south to the middle of the Alaska Peninsula. Beavers inhabit lakes, ponds, marshes, rivers, and streams, where they create wetland habitats that are used by many other animals. Beavers are managed as furbearers, and are considered common and abundant throughout their range in Alaska. After mating (which takes place in January or February), the female prepares for a new litter. Two to four kits, on average, are born anytime from late April to June. Their eyes are open at birth and the kits are covered with soft fur. They can swim at 4 days and dive at 2 months of age. The young beavers live with their parents until they are 2 years old. Beavers construct dams and lodges from felled trees, mud, plants, and sticks. Dens may be constructed in banks or as lodges in slower moving water. Dens and lodges are used year after year as a food cache, rearing area, and home. The life of a beaver colony is governed largely by food supply. Beavers eat not only bark, but also aquatic plants of all kinds, roots, and grasses. As they exhaust the food supply in the area, the beavers must forage farther from their homes, thus increasing the danger from predators. When an area is cleared of food, the family migrates to a new home. In Alaska, wolves, lynx, bears, and humans are important predators of beavers.

3.4.5.1.6 Common Muskrat

The muskrat (*Ondatra zibethicus*) are year-round residents throughout most of mainland Alaska south of the Brooks Range. They are considered widespread and common. They live in small family groups in small lakes, ponds, marshes, slow streams, sloughs, drainage ditches, and brackish estuaries. Ideal habitat for the muskrat is permanent wetlands with abundant vegetation that is deep enough to not freeze up in winter. Muskrats den in burrows and cone-shaped lodges constructed in wet areas. They are primarily herbivorous, feeding on roots and stems of aquatic plants, but may eat mussels, shrimp, and small fish. Females have two litters per year and give birth to seven to eight young per litter. Females reach maturity at 9 to 10 months. Young disperse in autumn or spring.

3.4.5.1.7 Meadow Jumping Mouse

The meadow jumping mouse (*Zapus hudsonius*) occurs from the Alaska Range south throughout Southcentral Alaska. They prefer moist lowland habitats with relatively thick vegetation of open grassy and brushy areas of marshes, meadow, swamps, and stream sides. They are typically solitary and active year-round, nesting in burrows that are underground, or under logs or grass clumps. Jumping mice eat invertebrates, seeds, leaves, buds, fruits, and subterranean fungi. Litter size can range from two to nine individuals, with females having two to three liters per year. Densities of meadow jumping mice can range from 3 to 19 per acre.

3.4.5.1.8 Meadow Vole

Meadow voles (*Microtus pennsylvanicus*) are found in Interior and Southcentral Alaska west to Bristol Bay. *Microtus* voles live in colonies of a few to 300 individuals in grassy meadows where they build runways through the grasses or snow, or dig underground burrows between food and nesting chambers. They do not hibernate, but feed on grasses and seeds throughout the year. They live about one year, with young starting to breed at 3 to 6 weeks. Voles can become very numerous over short periods of time. Females can have up to six litters of four to eight young each per year.

3.4.5.1.9 Northern Bog Lemming

The northern bog lemming (*Synaptomy borealis*) is distributed across forested Alaska, although distributions are localized and poorly documented. They are usually uncommon to rare, but can become numerous. Bog lemmings inhabit open habitats, including damp meadows, marshes, bogs, and fens that have an abundance of grasses, sedges, mosses, and low shrubs. They live in burrows among sedges and grasses, where moisture levels are high. Bog lemmings feed on green parts of low vegetation and likely on slugs and snails. Breeding occurs from May to August, with litters ranging from two to eight.

3.4.5.1.10 Northern Red-backed Vole

Northern red-backed vole (*Clethrionmys rutilus*) occurs throughout mainland Alaska. They are solitary or live in small family groups in grassy meadows or forested habitats. They do not build runways, but will use runways built by *Microtus* voles. Red-backed voles are omnivorous and will eat grass, seeds, fruit, lichens, fungi, insects, and meat. Red-backed voles breed from late winter until August. Litters can range from 2 to 11, and young reach maturity in 2 to 4 months. Most red-backed voles live 10 to 12 months. Voles are the base of the food chain for many animals and birds in Alaska, including weasels, marten, foxes, coyotes, all owls, most hawks, inland breeding gulls, and jaegers.

3.4.5.1.11 Root Vole

Root voles (*Microtus oeconomus*) occur throughout Alaska. This vole is a widespread and abundant rodent that prefers damp, densely vegetated areas along the edges of lakes, streams and marshes, but also occurs in tundra, taiga, forest-steppe and even semi-desert habitats.

3.4.5.1.12 Singing Vole

Singing voles (*Microtus miurus*) have a poorly known distribution, but have been found on the North Slope, Seward Peninsula, and Brooks Range. They appear to be absent in the Interior, but found again in the Alaska Range south to the Kenai Peninsula. They are found on high, well-drained slopes, willow stands, wet tundra and stream banks, alpine areas, and Subarctic tundra.

3.4.5.1.13 North American Porcupine

Porcupines (*Erethizon dorsatum*) occur in most of the forested areas in the state. They are solitary and primarily nocturnal, sleeping in a tree or hollow during the day. Porcupines are chiefly arboreal, feeding on the inner bark of spruce, birch, and hemlock and spruce needles in winter. They feed on buds and young green leaves of birch, aspen, cottonwood, and willow in spring and summer. They seek out salt sources. They do not build a nest, but use natural cavities, hollow logs, or thick vegetation as dens. Breeding takes place in fall and a single young is born in the spring. Young stay with their mother during the summer, but are fully weaned and disperse by October. Porcupines can live up to 18 years in the wild.

3.4.5.1.14 Snowshoe Hare

Snowshoe hares (*Lepus americanus*) are distributed over the state except for the lower Kuskokwim Delta, the Alaska Peninsula, and the area north of the Brooks Range. Snowshoe hares are found in mixed spruce forests, wooded swamps, and brushy areas. They do not dig burrows or build nests, but use natural shelters and depressions and rest under branches or bushes. They travel on well-established trails or runways, which become deeply worn in the snow or forest floor. Winter trails follow the same pathways as summer trails. Snowshoe hares breed at about 1 year of age and have two to three litters per year. Breeding begins in mid-May and lasts through August. Gestation is 36 to 37 days. In Interior Alaska, first litters are born around the middle of May and average about four leverets (young hares). The second litter, in years of increasing abundance, often averages six young, and occasionally a third litter. They feed on a wide variety of plant material—grasses, buds, twigs, and leaves in the summer and spruce twigs and needles, bark, and buds of hardwood such as aspen and willow in the winter. Populations of snowshoe hare are subject to cycles of high abundance and scarcity. Hare populations will build up over a period of years to peak abundance with as many as 600 animals per square mile, followed by a sudden decline to a very low level. Possible reasons for these cycles may include over-browsed food supply, predators, and shock disease due to stress, parasites, or a combination of these factors.

3.4.5.1.15 American Water Shrew

The American water shrew (*Sorex palustris*) is a large, semiaquatic, blackish-gray shrew with a long bicolored tail and large hind feet fringed with short stiff hairs. Total length is 5.5 to 6.3 inches, including a 2.4 to 3.1-inch tail. Water shrews occur from southeast Alaska north through Prince William Sound and the Kenai Peninsula. Water shrews are most abundant along small cold streams with thick overhanging riparian growth. They are also found around lakes, ponds, marshes, bogs, and other lentic habitats. Water shrews are rarely far from water. Nest sites are near water in underground burrows, rafted logs, beaver lodges, and other areas providing shelter. Like other shrews, the water shrew seems to be an opportunistic predator, and their diet varies greatly with geographic area and likely with season. They are primarily dependent upon aquatic insects, but also eat various other invertebrates and may take small vertebrates (fish, amphibians) when available. Water shrews hunt under and on top of water.

3.4.5.1.16 Cinereus Shrew

The cinereus shrew (*Sorex cinereus*) is a medium-sized shrew that is common and abundant throughout most of mainland Alaska. The breeding season may last from March through September, usually with two litters, maybe three per year. Gestation lasts 18 days. Litter size is 2 to 10 (average around 7). Nest sites are typically in shallow burrows or above ground in logs and stumps. Cinereus shrews are especially abundant in riparian areas with dense ground cover. Annual fluctuations in population size are large; density estimates range from 1 to 12 shrews per acre.

3.4.5.1.17 Dusky Shrew

The dusky shrew (*Sorex monticolus*) is widely distributed from the Brooks Range south throughout mainland Alaska. They are found in many different habitats, from coastal and boreal forests to riparian shrub thickets in the mountains and in the Subarctic tundra-taiga transition at higher latitudes. The breeding season extends from April through August, with an average litter size of about five, ranging up to seven. These shrews may have two or more litters per year. Most individuals do not live longer than 18 months. Dusky shrews apparently are not territorial in the breeding season and may move widely. In late summer, discrete territories are established and the daily movements of neighboring animals do not overlap. Dusky shrews feed primarily on insects and other small invertebrates (worms, sow bugs, mollusks, etc.), and some vegetable matter. The population size is unknown, but is suspected to be large and secure.

3.4.5.1.18 Pygmy Shrew

Pygmy shrews (*Sorex hoyi*) are distributed throughout much of Southcentral and Interior Alaska to just north of the Yukon River, south to northern Prince William Sound and the Kenai Peninsula. They are found in a variety of habitats, but appear to prefer grassy openings of boreal forest. Moist habitats are preferred over dry areas. Females give birth to one litter of three to eight per year. Juveniles are able to breed in their second summer; however, their life span is 16 to 17 months. They are primarily dependent on invertebrates including insect larvae, beetles, and spiders. Their population size is unknown.

3.4.5.1.19 Tundra Shrew

Tundra shrews (*Sorex tundrensis*) are distributed throughout mainland Alaska, except the Kenai Peninsula and Southcentral coastal area. Habitats include dense tundra and shrub tundra vegetation made up of grasses and shrubs (e.g., alder, dwarf birch, and willows) on hillsides and other well-drained sites. In Alaska, tundra shrews feed on insect larvae, earthworms, and some plant material. The population size is unknown, although high numbers have been reported in the Arctic.

3.4.5.1.20 Little Brown Myotis

The little brown myotis or bat (*Myotis lucifugus*) is widely distributed across Alaska in summer. They occur in numerous habitats, but generally associate with coastal forested habitats and Interior riparian forests. Bats use echolocation to find and capture insects while hunting at night. The lack of darkness during summer at high latitudes reduces that amount of time available for foraging. Little brown bats usually mate during August through October. Ovulation and fertilization are delayed until spring, and gestation lasts 50 to 60 days. Females give birth to a single pup in their first or second year. They may use buildings for roosts and maternity colonies. Maternity colonies range in size from 70 to 200 in Interior Alaska. The young are weaned and become capable of flying on their own within about three weeks. In Southeast Alaska, pregnant females have been captured as early as June 4 and as late as July 2; juvenile bats have been captured or collected from mid-June through late August. A spike in observations of bats in mid-August suggests young bats emerge in August in more northern reaches of the state. Whether little brown bats in Interior Alaska migrate to milder climates to hibernate is unknown. Observation of bats in Fairbanks in early October and near the Tanana River in early May suggest that they may hibernate in the vicinity. The population size and status of little brown bats in Alaska is unknown. They are apparently widespread, but in low numbers.

3.4.5.1.21 American Marten

American martens (*Martes americana*) are a carnivorous, furbearing member of the weasel family. Martens are usually found in the uplands and inhabit most forested regions in Alaska. Mating occurs in July and August, with a six-month delayed implantation. The litter, averaging three young, is born in April or May. Juvenile martens usually disperse from their mother's territory during the autumn. Martens depend heavily on meadow voles and red-backed voles or mice for food over much of Alaska. Fluctuations in food availability often create corresponding fluctuations in marten populations. Martens also forage on berries, especially blueberries, small birds, eggs, and vegetation. The population size of American martens in Alaska is unknown, but populations are likely large because martens are widespread and widely trapped.

3.4.5.1.22 American Mink

Mink (*Neovison vison*) are found throughout most of mainland Alaska in close association with water, preferring saltwater beaches, riparian habits of lakeshores, marshes, and stream banks. Mink breed from March through April, depending on latitude. In mink and other weasels, the fertilized egg does not attach to the uterus to develop right away, as in most mammals. Fetal development takes about 30 days to complete. In Interior and western Alaska, most births occur during June. Litter size varies from 4 to 10 kits. The den is generally a burrow or hollow log near a pond or a stream. In most cases, the den used has been constructed and deserted by other animals. Mink will eat almost anything they can catch and kill, including fish, birds, bird eggs, insects, crabs, clams, and small mammals.

3.4.5.1.23 Canada Lynx

Canada lynx (*Lynx canadensis*) inhabit much of Alaska's forested terrain and use a variety of habitats, including spruce and hardwood forests, and both subalpine and successional communities. The best lynx habitat in Alaska occurs where fires or other factors create and maintain a mixture of vegetation types with an abundance of early successional growth. Mating occurs in March and early April, and kittens are born about 63 days later under a natural shelter, such as a spruce felled by wind, a rock ledge, or a log jam. Lynx kittens' eyes open at about 1 month of age, and they are weaned when 2 to 3 months old. Most litters include two to four kittens, but sometimes as many as six are born and survive. The production and survival of lynx kittens is strongly influenced by cyclic changes in snowshoe hare and other small game populations. The primary prey of lynx in most areas is the snowshoe hare, which undergoes an 8- to 11-year cycle of abundance. This cycle appears to be caused by the interaction of hares with their food and predators. Lynx numbers fluctuate with those of hares and other small game, but lag one or two years behind. Lynx are considered common in the areas where they occur.

3.4.5.1.24 Coyote

Coyotes (*Canis latrans*) are members of the dog family, averaging 22 to 33 pounds, or about one-third the size of wolves. Males are slightly heavier than females. Few records of the coyote north of the Yukon River exist, although they do occur in this area. Portions of the state with the highest densities of coyotes are the Kenai Peninsula, and the Matanuska and Susitna valleys. Coyotes breed between January and March. Shortly before whelping, one or more dens are prepared for the litter. Coyotes give birth to an average of five to seven blind and helpless pups. Coyotes den in a variety of protected places and frequently take over the dens of other animals. It is not unusual for coyotes to move their pups to other dens. Family units may begin to break up as early as August. In Alaska, coyotes are found mostly as mated pairs with an established territory. In Interior Alaska, territories may be about 15 square miles. Coyotes are absent or scarce where wolves are abundant, and foxes are similarly less abundant where coyotes are numerous. Coyotes are opportunistic; snowshoe hares, microtine rodents (voles), and carrion comprise the bulk of their diet, while marmots, ground squirrels, muskrats, fish, insects, and even Dall sheep are also taken.

3.4.5.1.25 Ermine

Ermine (*Mustela ermine*) occur through the Alaska mainland. Ermine pelage is reddish-brown above and creamy white below in summer, and changes to completely white in winter with the tip of the tail remaining black in all seasons. Ermine resemble the long-tailed weasel (*Mustela frenata*) in general appearance and coloration, but are smaller, have a shorter tail, and have white fur on the inner side of the hind legs. Least weasels (*Mustela nivalis*) are also similar in appearance to ermine, but are smaller and do not have any black on the tail. Ermine mate in late spring to early summer. One litter of four to 13 (average of six) young is born, usually in April or May. Females care for young alone. Dens are located in hollow logs or under logs, stumps, roots, brush piles, or rocks. Snow provides vital insulation against extreme air temperatures. Ermine are carnivores that consume mainly small mammals, especially voles and mice. Ermine are adapted to a wide variety of habitats, but prefer wooded areas with thick understory near watercourses, and often occupy early successional or forest-edge habitats, wet meadows, marshes, ditches, riparian woodlands, or river banks with high densities of small mammals and adequate subnivean foraging space. Shrews, rabbits, and occasionally other small vertebrates and insects may also be taken. Ermine foraging strategies are particularly well-adapted to northern environments where prolonged snow cover gives small predators able to access under snow tunnels a competitive advantage, and where voles are the most abundant prey.

3.4.5.1.26 Least Weasel

Least weasels (*Mustela nivalis*) are found throughout mainland Alaska. They are solitary, except during breeding season and when females have young. Least weasels occur in a variety of habitats, including forest, brush, and open tundra habitats. In the Beaufort Coastal Plain Ecoregion, weasels typically live in areas with topographic relief, such as slopes, rock slides, and streambeds. They also use meadows, marshes, and riparian areas where small rodents are available. Least weasels may breed throughout the year, but breeding occurs primarily in spring and late summer. Young are born in abandoned underground burrows made by other mammals. When rodents are plentiful, least weasels may breed in winter under snow. Gestation lasts 34 to 37 days, including the 10 to 12 days between fertilization and implantation. Litter size averages four to five in temperate zones, higher in Arctic latitudes; with two litters per year common. Young are tended by both parents. Family groups break up when young are about 9 to 12 weeks old. Reproductive output increases when food is abundant (more young are born, greater survival). Least weasels are specialist predators of small mammals, especially voles, lemmings, and other mice. When small rodents are scarce, they may consume other small vertebrates, insects, or worms. Their population density fluctuates with rodent populations.

3.4.5.1.27 North American River Otter

The North American river otter (*Lontra canadensis*) is found throughout mainland Alaska, with the exception of the area adjacent to the Arctic coast east of Point Lay. River otters in Alaska breed in spring, usually in May. Adults weigh 15 to 35 pounds and are 40 to 60 inches in length. On average, females are about 25 percent smaller than males. Mating can take place in or out of the water. One to six pups (usually two or three) are born the next year, any time from late January to June, following a gestation period of 9 to 13 months. River otters in Alaska hunt on land, in freshwater, and in saltwater. They eat snails, mussels, clams, sea urchins, insects, crabs, shrimp, octopi, frogs, a variety of fish, and occasionally birds, mammals, and vegetable matter.

3.4.5.1.28 Red Fox

The red fox (*Vulpes vulpes*) is recognized by its reddish coat, its white-tipped tail, and black “stockings,” although many color variations exist. Red foxes prefer broken country, extensive lowland marshes, and crisscrossed hills and draws. The species is most abundant south of the Arctic tundra, although red foxes are also present in tundra regions, which it shares with the Arctic fox. Where the ranges of these two foxes overlap, the red fox is dominant. In these areas, red foxes have been observed digging Arctic foxes from their dens and killing them. Red foxes breed during February and March. A litter of 4 pups is common, though a litter of 10 is not a rarity. Both parents care for the young. The family unit endures until autumn, when it breaks up and each animal is on its own. The den is a hole in the earth, 15 to 20 feet long, usually located on the side of a knoll; it may have several entrances. Sometimes foxes dig their own dens. More often, though, they appropriate and enlarge the home sites of small burrowing animals, such as marmots. The red fox is omnivorous. Although it may eat muskrats, squirrels, hares, birds, eggs, insects, vegetation, and carrion, voles seem to be its preferred food. Foxes cache excess food when available.

3.4.5.1.29 Wolverine

Wolverines (*Gulo gulo*) are found throughout Alaska, but tend to avoid some areas or exist at lower densities because the habitat is not suitable for denning or is highly developed/used by people. They are primarily solitary creatures throughout most of the year. Wolverines travel extensively in search of food. In general, males have larger home ranges than females; females not accompanied by kits have larger ranges compared to females with kits. Home range size and use changes with season of the year. In Alaska, resident male home range sizes are large, ranging between 200 and 260 square miles. Resident females have home ranges as large as 115 square miles. Home range size and use patterns are thought to be a response to the availability of food resources or for adult females the presence of persistent snow cover for denning. Movements of 40 miles in a day have been documented. Studies in Southcentral Alaska found that wolverines preferred higher elevations during the summer and lower elevations during the winter due to varying food availability. Denning areas typically consist of fell fields with deep snow cover. Few wolverines live longer than 5 to 7 years in the wild, although some may survive to 12 or 13 years of age. Primary natural mortality factors include starvation, being killed by larger predators like wolves, and being killed by other wolverines.

3.4.5.2 Interdependent Project Facilities

Many of the furbearers and small mammals discussed under the Liquefaction Facility section are widely distributed and could also occur near Interdependent Project Facilities in the Alaska Range Transition, Beringia Boreal, and Arctic Tundra ecoregions based on their ranges (Table 3.4.5-1; ADF&G, 2014a). In addition, Alaska marmot, woodchuck, collared lemming, brown lemming, singing vole, taiga vole, collared pike, Alaska tiny shrew, barren ground shrew, and Arctic fox could occur near Interdependent Project Facilities (Table 3.4.5-1).

3.4.5.2.1 Alaska Marmot

The Alaska marmot (*Marmota broweri*) makes its summer home in talus slopes, boulder fields, and rock outcrops north of the Yukon River in alpine areas of the Brooks Range and the Ray Mountains in the Project area. They are social animals; although each family has their own separate burrow, their burrows are located close together, forming a colony. True hibernators, Alaska marmots create a special winter den with a single entrance that is usually plugged in September after all colony members are inside. No animals can leave until the plug thaws in early May. These dens are relatively permanent, with some being used for more than 20 years. Alaska marmots mate before they emerge from their winter dens and two to six young are born about a month later in late May or June. Young disperse after their first year and may live 10 years or more. They feed on grasses, flowering plants, berries, roots, mosses and lichens, attaining their maximum weight in late summer prior to hibernation. Population is considered low, but stable, throughout their range.

3.4.5.2.2 Woodchuck

Woodchucks (*Marmota monax*) dig their dens in wind deposited soils along river valleys in the dry lowlands of Interior Alaska. Like the hoary marmot, woodchucks den alone and mate after emerging from their dens in April or May. Woodchuck dens may be up to 30 feet long and end in a chamber with a large grass nest. Most marmot dens, including woodchucks, have a main entrance and several concealed entrances. Woodchucks live for two to six years, with mating occurring once each year in early spring. Females give birth to two to six young in the late spring to early summer.

3.4.5.2.3 Collared Lemming

The collared lemming (*Dicrostonyx groenlandicus*) is not a true lemming, but it looks very similar to a brown lemming in the summer. Collared lemmings inhabit dry, sandy, or gravelly areas above timberline. This lemming is the only true rodent that turns white during the winter and grows enlarged claws like snow shovels that are used to dig through wind-packed snow. They also build networks of tunnels and consume mostly plants, like the brown lemming. Collared lemmings have a rapid breeding cycle and short life cycle. Mating usually occurs from March through September, with females having up to three litters per year, with an average of four to five young per litter. Few collared lemmings live beyond 1 year of age.

3.4.5.2.4 Brown Lemming

The brown lemming (*Lemmus trimucronatus*) is the only true lemming in Alaska. Brown lemmings are found throughout North America and Siberia in open tundra areas, often in low-lying, flat meadow habitats dominated by sedges, grasses, and mosses. Lemmings are active day and night all year long, forming networks of trails a few inches below the land or snow surface. Foods include tender shoots of grasses and sedges in summer and frozen, but still green plant material, moss shoots, and bark and twigs of willow and dwarf birch. Breeding may occur during winter, but is usually restricted to summer. Lemmings are known for their wide population fluctuations, reaching peak abundance every three to five years. All lemmings are staple prey for larger animals, including weasels, foxes, wolves, wolverines, mink, marten, owls, hawks, gulls, and jaegers. The brown lemming range encompasses mainland Alaska except the Kenai Peninsula and the Chugach Mountains (Gotthard, 2012).

3.4.5.2.5 Singing Vole

Singing voles (*Microtus miurus*) have a poorly known distribution, but have been found on the North Slope, Seward Peninsula, and Brooks Range. They appear to be absent in the Interior, but found again in the Alaska Range south to the Kenai Peninsula. They are found on high, well-drained slopes, willow stands, wet tundra and stream banks, alpine areas, and Subarctic tundra.

3.4.5.2.6 Arctic Fox

The Arctic fox (*Vulpes lagopus*) is found in treeless coastal areas of Alaska from the Aleutian Islands north to Point Barrow and east to the Canada border. Arctic foxes prefer tundra habitat, usually near rocky shores, and have been observed ranging far out onto pack ice in winter. They weigh from 6 to 10 pounds. Pups are born in dens excavated by the adults in sandy, well-drained soils of low mounds and river cutbanks. Dens extend from 6 to 12 feet underground and are used repeatedly. Mating occurs in early March and early April. Gestation lasts 52 days. Litters average 7 pups, but may contain as many as 15 pups. Both parents aid in bringing food to the den and in rearing the pups. Pups first emerge from the den at about 3 weeks old and begin to hunt and range away from the den at about 3 months. Family units gradually break up during September and October. During midwinter, foxes lead a mostly solitary existence, except when congregating at the carcasses of marine mammals, caribou, or reindeer. Arctic foxes attain sexual maturity at 9 to 10 months, but many die in their first year.

3.4.5.2.7 Taiga Vole

The taiga vole (*Microtus xanthognathus*) is only found in Interior Alaska on the Yukon and Kuskokwim river drainages. It prefers boreal forested habitat near water or bogs. Although not commonly encountered, they can be locally abundant.

3.4.5.2.8 Collared Pika

Collared pikas (*Ochotona collaris*) live in colonies in mountainous terrain, old rock slides, talus slopes, or around large boulders, usually with a meadow or patches of vegetation in the vicinity. Small burrows at the edge of rock piles and the presence of small (BB-size), dark, oval droppings indicate the existence of a pika colony. The presence of their "hay piles" will positively identify the colony. The peak of the breeding season occurs in May and early June as snow begins to melt and the first green plants of the season start to appear. Female pikas can breed and produce young at about 1 year of age. The young are born blind and nearly hairless after a 30-day gestation period. Litters of one to four are cared for by the mother. Pikas are generalist herbivores, feeding on the stems and leaves of various grasses, forbs, and small shrubs. Pikas do not hibernate, and their survival during the winter is dependent on the success of their haying season. Each pika may make several haystacks within its territorial boundaries, which by late August may be up to 2 feet high and 2 feet wide.

3.4.5.2.9 Barren Ground Shrew

Barren ground shrews (*Sorex ugyunak*) appear to be restricted to the northern region, from the Brooks Range northward to the Arctic coast. They favor low sedge-grass meadows and thickets of dwarf willow and birch; often in damp to wet vegetation with grasses and sedges. Their diet is likely similar to other shrews in Alaska as invertivores eating primarily insects and other invertebrates, also carrion, small vertebrates, and occasionally seeds. Barren ground shrews are widespread in Arctic Alaska north of tree line. Their abundance fluctuates.

3.4.5.2.10 Alaska Tiny Shrew

The Alaska tiny shrew (*Sorex yukonicus*) may be widespread, but is rare in Subarctic Alaska. This shrew has been collected over a wide range of habitat types, including wetlands, bogs, and coniferous and mixed forests and riparian habitats. Shrews in general tend to have several litters of five to eight offspring per year. Shrews rarely live beyond 18 months.

3.4.6 Bird Resources

Bird resources are described by occurrence within Alaska ecoregions within the Project area. Ecoregions potentially crossed by the Project footprint include the Alaska Range Transition, Beringia Boreal, and Arctic Tundra ecoregions (Figure 3.3.1-1), as described in Section 3.3.1.

IBAs are sites that have been determined to provide essential habitat to one or more species of birds during some portion of their year (Audubon, 2014). For an area to qualify as an IBA, it must support a large concentration of birds, provide habitat for a threatened or rare species, or provide habitat for a bird species with a very limited or restricted range. IBAs are ranked as significant on their importance to a bird species at either the global, continental, or state level. IBAs may occur on public or private lands, or both, and may or may not already be protected (Audubon, 2014). IBAs within each ecoregion crossed by the Project footprint are discussed below and detailed in Section 3.4.9.2.4 Audubon Important Bird Areas (IBAs), depicted in Figure 3.4.6-1, and listed in Table 3.4.9-4.

Numerous national and state refuges, as well as IBAs, that provide importation migration and nesting habitats occur near or crossed by the Project footprint are described below.

3.4.6.1 Liquefaction Facility

3.4.6.1.1 Cook Inlet Basin Ecoregion Birds

Cook Inlet creates this ecoregion, influencing the climate and adding maritime character. Gently sloping lowlands contain numerous small lakes and wetlands, as well as mixed forested upland habitats. Wetland habitats range from low scrub bogs to wet graminoid marshes (ADF&G, 2006).

The varied habitats found in this ecoregion support diverse bird communities. Shorebirds and waterfowl inhabit the numerous lakes, ponds, and wetlands. Trumpeter swans, red-necked grebes, common and Pacific loons, green-winged teal, northern pintail, and common and Barrow’s goldeneye commonly nest on lakes and ponds in the region. Many landbirds migrate, breed, or reside within the region. Common nesting passerines include alder flycatcher, tree swallow, violet-green swallow, bank swallow, ruby-crowned kinglet, hermit thrush, American robin, varied thrush, yellow-rumped warbler, orange-crowned warbler, fox sparrow, white-crowned sparrow, and dark-eyed junco. Common resident birds include black-capped chickadee, black-billed magpie, com mon raven, boreal chickadee, great horned owl, and willow ptarmigan.

Cook Inlet supports large numbers of breeding or migrating shorebirds, including western sandpipers, dunlins, rock sandpipers, long- and short-billed dowitchers, and Hudsonian godwits (ADF&G, 2006). Colonial nesting seabirds such as black-legged kittiwakes and common murres nest along Cook Inlet shores (ADF&G, 2006). The numerous salmon runs that occur in the ecoregion attract bald eagles and common ravens.

The Cook Inlet Basin Ecoregion supports the entire populations of some birds. Nearly the entire population of Wrangell Island snow geese migrates across the mouth of the Kenai River and Trading Bay each spring, and the entire population of tule greater white-fronted geese nests in the boreal forest wetlands on the western side of upper Cook Inlet (ADF&G, 2006; AKNHP, 2014a; Densmore et al., 2006). Concentrations of molting and nesting Tule geese also occur in Redoubt Bay, Trading Bay, and Susitna Flats (AKNHP, 2014a). IBAs in the Cook Inlet Basin include Susitna Flats, Goose Bay, Anchorage Coastal IBA, and

Swanson Lakes IBA. Additional information on birds and important bird habitats in the Cook Inlet Basin Ecoregion is presented in Section 3.4.6.2.3.3.

3.4.6.2 Interdependent Project Facilities

3.4.6.2.1 Arctic Tundra Ecoregion Birds

The Arctic Tundra Ecoregion, from north to south, consists of the Beaufort Coastal Plain Ecoregion, the Brooks Range Foothills, and the Brooks Range Ecoregions. The Beaufort Coastal Plain Ecoregion of northern Alaska is a complex landscape of lakes, streams, and wetlands scattered across low relief tundra that is underlain by permafrost. The plain gradually gains elevation from the coast southward to the gently rolling foothills of the Brooks Range, changing to the steep mountains of the Alaska Range. Part of the Beaufort Sea Nearshore Global IBA and the Northeast Arctic Coastal Plain are located in this ecoregion. More than 100 species of birds have been recorded as regularly occurring in this ecoregion (Table 3.4.6-1). Most nesting shorebirds, geese, ducks, loons, and gulls are more common in the Beaufort Coastal Plain Ecoregion, while nesting raptors and nesting passerines are more prevalent in the Brooks Range Foothills and Brooks Range ecoregions (Armstrong, 2008; AKNHP, 2014a).

Most birds in the Arctic Tundra Ecoregion are migratory, typically present from May to September (Table 3.4.6-1). There are four major North American flyways: the Atlantic, the Mississippi, the Central, and the Pacific. The Arctic Tundra Ecoregion not only supports breeding waterfowl from all four flyways in North America, but also breeding waterfowl from several international flyways. In addition to migratory birds, the Arctic Tundra Ecoregion supports two resident birds: rock and willow ptarmigan, and three migratory birds: snowy owl, common raven, and gyrfalcon. Rock ptarmigan and willow ptarmigan are widespread in the Beaufort Coastal Plain Ecoregion, particularly inland from the coast (Johnson and Herter, 1989). Most rock ptarmigan were seen in the moist non-patterned habitats in the Project area (Woodward-Clyde Consultants and ABR, 1983). A few ptarmigan of either species may overwinter in the Beaufort Coastal Plain Ecoregion, but most winter in the foothills of the Brooks Range (Johnson and Herter, 1989). Snowy owls are locally common breeders on the coastal plain during years when small mammals are abundant, but less commonly occur during the winter in the Arctic Tundra Ecoregion. Gyrfalcons are not migratory and use the open tundra and mountains for hunting prey. Gyrfalcons prey on large birds, such as ptarmigan, and some mammals ranging in size from voles to hares. They nest on rocky ledges, with breeding pairs utilizing abandoned nests of other birds, particularly golden eagles and common ravens (ADF&G, 2017).

A common raven population has developed near oil and gas oil field facilities and abandoned military sites along the Beaufort Coastal Plain Ecoregion. These buildings and other structures provide the ability to nest year-round. Although food waste is burned, the landfills near the oil and gas developments provide a year-round food source including the winter months (Johnson and Herter 1989; Powell and Backensto 2009). Common ravens are the earliest breeding birds; nesting begins by early April and young fledge by mid-June (Johnson and Herter, 1989). Ravens range widely across the tundra in search of food (e.g., bird eggs, small mammals, and carrion) and have been observed taking eggs of waterbirds (e.g., ducks or shorebirds) in the oil fields.

3.4.6.2.1.1 Important Bird Habitats in the Arctic Tundra Ecoregion and Beaufort Coastal Plain Ecoregion

The Arctic NWR (ANWR) consists of over 19 million acres established to preserve unique wildlife, wilderness, and recreational values. This refuge is located about approximately 0.2 mile to the east of the Project area in the Arctic Tundra Ecoregion, which includes the Beaufort Coastal Plain, Brooks Foothills, and Brooks Range Ecoregions (Figure 3.4.6-1). More than 200 migratory and resident bird species have been observed on the refuge, with migratory birds traveling from all over the world to breed there. Numbers of snow geese on the refuge can range from 13,000 to more than 300,000 birds. Figure 3.4.6-1 includes areas the BLM has identified as zones of restricted activity. Zones of restricted activity are key fish and wildlife areas identified by BLM that may be restricted during periods of fish and wildlife breeding, nesting, spawning, lambing or calving activity and during major migrations of fish and wildlife. BLM provides written notice of such restrictive action with a list of areas where such actions may be required, together with the anticipated dates of restriction..

The Northeast Arctic Coastal Plain IBA is located approximately 23 miles east of the Project footprint and PTTL. The IBA is located at the Arctic National Wildlife Refuge (ANWR) from the Canadian border west to Camden Bay and from the Beaufort Sea coast south to the foothills of the Brooks Range (Figure 3.4.6-1).

Another important bird habitat in the Beaufort Coastal Ecoregion is near the Mainline route from MP 21 to MP 41 and along the TAPS ROW (Figure 3.4.6-1). The area is designated as a zone of restricted activity by the BLM and the State of Alaska and includes all fish streams and peregrine falcon use areas along the TAPS pipeline systems. Zones of restricted activity are based on a stipulation that states that "Permittees' activities in connection with the TAPS system in key fish and wildlife areas may be restricted by the Authorized Officer during periods of fish and wildlife breeding, nesting, spawning, lambing or calving activity and during major migrations of fish and wildlife. In addition to peregrine falcons, this area is an important nesting and rearing locale to gyrfalcons and rough legged hawks (BLM, 2002).

TABLE 3.4.6-1

Arctic Tundra Ecoregion Birds Potentially Occurring in the Project Area

Common Name	Scientific Name	Status [a]	Relative Abundance [b]
Waterfowl			
Geese and Swans			
Emperor Goose [c]	*Chen canagica*	Visitant	Rare
Greater White-fronted Goose	*Anser albifrons*	Breeder	Common
Pacific Black Brant [c]	*Branta bernicla nigricans*	Breeder	Common
Snow Goose	*Chen caerulescens*	Breeder	Uncommon
Taverner's Cackling Goose [c]	*Branta hutchinsii taverneri*	Breeder	Uncommon
Trumpeter Swan [c]	*Cygnus buccinator*	Breeder	Rare
Tundra Swan	*Cygnus columbianus*	Breeder	Uncommon
Ducks			
American Wigeon	*Anas americana*	Breeder	Uncommon
Common Eider [c]	*Somateria mollissima*	Breeder	Common
Greater Scaup	*Aythya marila*	Breeder	Uncommon

TABLE 3.4.6-1

Arctic Tundra Ecoregion Birds Potentially Occurring in the Project Area

Common Name	Scientific Name	Status [a]	Relative Abundance [b]
Green-winged Teal	*Anas crecca*	Breeder	Uncommon
Harlequin Duck	*Histrionicus*	Breeder	Rare
King Eider [c]	*Somateria spectabilis*	Breeder	Uncommon
Long-tailed Duck [c]	*Clangula hyemalis*	Breeder	Common
Mallard	*Anas platyrhynchos*	Breeder	Rare
Northern Pintail	*Anas acuta*	Breeder	Common
Northern Shoveler	*Anas clypeata*	Breeder	Rare
Pacific Black Scoter [c]	*Melanitta americana*	Breeder	Rare
Red-breasted Merganser	*Mergus serrator*	Breeder	Rare
Spectacled Eider [c, d]	*Somateria fischeri*	Breeder	Uncommon
Steller's Eider [c, d]	*Polysticta stelleri*	Visitant	Uncommon
Surf Scoter	*Melanitta perspicillata*	Breeder	Uncommon
White-winged Scoter [c]	*Melanitta fusca deglandi*	Breeder	Uncommon
Grouse and Ptarmigan			
Rock Ptarmigan	*Lagopus muta*	Resident	Uncommon
Willow Ptarmigan	*Lagopus*	Resident	Common
Loons and Grebes			
Common Loon	*Gavia immer*	Breeder	Rare
Pacific Loon	*Gavia pacifica*	Breeder	Common
Red-necked Grebe	*Podiceps grisegena*	Breeder	Uncommon
Red-throated Loon [c, e]	*Gavia stellata*	Breeder	Common
Yellow-billed Loon [c, e]	*Gavia adamsii*	Breeder	Uncommon
Albatross, Shearwaters, and Petrels			
Short-tailed Shearwater	*Puffinus tenuirostris*	Visitant	Uncommon
Raptors			
Golden Eagle [c]	*Aquila chrysaetos*	Breeder	Uncommon
Gyrfalcon [c]	*Falco rusticolus*	Breeder	Uncommon
Merlin	*Falco columbarius*	Visitant	Rare
Northern Harrier [c]	*Circus cyaneus*	Breeder	Rare
Peregrine Falcon [c, e]	*Falco peregrinus*	Breeder	Rare
Rough-legged Hawk [c]	*Buteo lagopus*	Breeder	Common
Rails, Coots, and Cranes			
Lesser Sandhill Crane [c]	*Grus canadensiscanadensis*	Breeder	Uncommon
Shorebirds			
American Golden Plover [c, f]	*Pluvialis dominica*	Breeder	Common
Baird's Sandpiper	*Calidris bairdii*	Breeder	Common
Bar-tailed Godwit [c, e, f]	*Limosa lapponica baueri*	Breeder	Uncommon
Black-bellied Plover [c]	*Pluvialis squatarolasquatarola*	Breeder	Uncommon
Bristle-thighed Curlew [c]	*Numenius tahitiensis*	Visitant	Rare
Buff-breasted Sandpiper [c, e, f]	*Calidris subruficollis*	Breeder	Rare
Curlew Sandpiper	*Calidris ferruginea*	Breeder	Rare
Dunlin [c, e, f]	*Calidris alpina articola*	Breeder	Uncommon

TABLE 3.4.6-1

Arctic Tundra Ecoregion Birds Potentially Occurring in the Project Area

Common Name	Scientific Name	Status [a]	Relative Abundance [b]
Hudsonian Godwit [c]	*Limosa haemastica*	Visitant	Rare
Least Sandpiper	*Calidris minutilla*	Breeder	Uncommon
Long-billed Dowitcher [c]	*Limnodromus scolopaceus*	Breeder	Common
Pacific Golden Plover [c]	*Pluvialis fulva*	Breeder	Common
Pectoral Sandpiper [c]	*Calidris melanotos*	Breeder	Common
Red Knot [c, e, f]	*Calidris canutus roselaari*	Breeder	Rare
Red-necked Phalarope	*Phalaropus lobatus*	Breeder	Common
Red-necked Stint	*Calidris ruficollis*	Breeder	Rare
Red Phalarope [c]	*Phalaropus fulicarius*	Breeder	Common
Ruddy Turnstone	*Arenaria interpres*	Breeder	Uncommon
Sanderling [c, f]	*Calidris alba rubida*	Breeder	Rare
Semipalmated Plover	*Charadrius semipalmatus*	Breeder	Uncommon
Semipalmated Sandpiper [c]	*Calidris pusilla*	Breeder	Common
Spotted Sandpiper [c]	*Actitis mascularius*	Breeder	Uncommon
Stilt Sandpiper	*Calidris himantopus*	Breeder	Rare
Upland Sandpiper [c, f]	*Bartramia longicauda*	Breeder	Uncommon
Western Sandpiper [c]	*Calidris mauri*	Breeder	Uncommon
Whimbrel [c, e, f]	*Numenius phaeopus rufiventris*	Breeder	Uncommon
White-rumped Sandpiper	*Calidris fuscicollis*	Breeder	Rare
Wilson's Snipe	*Gallinago delicata*	Breeder	Common
Seabirds			
Arctic Tern [c, e]	*Sterna paradisaea*	Breeder	Uncommon
Black Guillemot [c]	*Cepphus grylle*	Breeder	Uncommon
Black-legged Kittiwake [c]	*Rissa tridactyla*	Migrant	Common
Crested Auklet	*Aethia cristatella*	Visitant	Rare
Glaucous Gull [c]	*Larus hyperboreus*	Breeder	Common
Herring Gull [c]	*Larus argentatus*	Breeder	Rare
Iceland Gull	*Larus glaucoides*	Visitant	Rare
Ivory Gull	*Pagophila eburnea*	Migrant	Uncommon
Long-tailed Jaeger [c]	*Stercorarius longicaudus*	Breeder	Common
Mew Gull [c]	*Larus canus brachyrhynchus*	Breeder	Rare
Parasitic Jaeger	*Stercorarius parasiticus*	Breeder	Common
Pomarine Jaeger [c]	*Stercorarius pomarinus*	Breeder	Uncommon
Ross's Gull	*Rhodostethia rosea*	Migrant	Common
Sabine's Gull [c]	*Xema sabini*	Breeder	Common
Slaty-backed Gull	*Larus schistisagus*	Visitant	Rare
Thick-billed Murre [c]	*Uria lomvia arra*	Migrant	Rare
Owls			
Short-eared Owl [c]	*Asio flammeus*	Breeder	Common
Snowy Owl [c]	*Bubo scandiacus*	Breeder	Uncommon
Passerines			
American Dipper	Cinclus mexicanus	Breeder	Rare

TABLE 3.4.6-1

Arctic Tundra Ecoregion Birds Potentially Occurring in the Project Area

Common Name	Scientific Name	Status [a]	Relative Abundance [b]
American Pipit [c]	*Anthus rubescens*	Breeder	Common
American Robin	*Turdus migratorius*	Breeder	Rare
American Tree Sparrow	*Spizella arborea*	Breeder	Uncommon
Arctic Warbler [c]	*Phylloscopus borealis*	Breeder	Common
Bluethroat	*Luscinia svecica*	Breeder	Uncommon
Cliff Swallow	*Petrochelidon pyrrhonota*	Breeder	Uncommon
Common Raven	*Corvus corax*	Resident	Common
Common Redpoll [c]	*Acanthis flammea*	Breeder	Uncommon
Dark-eyed Junco [c]	*Junco hyemalis*	Breeder	Rare
Eastern Yellow Wagtail	*Motacilla tschutschensis*	Breeder	Uncommon
Fox Sparrow [c]	*Passerella iliaca*	Breeder	Uncommon
Golden-crowned Sparrow [c]	*Zonotrichia atricapilla*	Visitant	Rare
Gray-cheeked Thrush	*Catharus minimus*	Breeder	Common
Gray-crowned Rosy-Finch [c]	*Leucosticte tephrocotis irvingi*	Breeder	Rare
Gray-headed Chickadee	*Poecile cinctus*	Resident	Rare
Hoary Redpoll [c]	*Acanthis hornemanni*	Breeder	Common
Horned Lark [c]	*Eremophila alpestris arcticola*	Breeder	Uncommon
Lapland Longspur [c]	*Calcarius lapponicus*	Breeder	Common
Northern Shrike [c]	Lanius excubitor	Breeder	Uncommon
Northern Wheatear	*Oenanthe*	Breeder	Uncommon
Pine Grosbeak [c]	Pinicola enucleator	Visitant	Rare
Rusty Blackbird [c]	*Euphagus carolinus*	Breeder	Rare
Savannah Sparrow [c]	*Passerculus sandwichensis*	Breeder	Common
Say's Phoebe	*Sayornis saya*	Breeder	Uncommon
Smith's Longspur [c, e]	*Calcarius pictus*	Breeder	Uncommon
Snow Bunting [c]	*Plectrophenax nivalis*	Breeder	Common
White-crowned Sparrow [c]	*Zonotrichia leucophrys*	Breeder	Uncommon
White Wagtail	Motacilla alba	Migrant	Rare
Wilson's Warbler [c]	*Cardinella pusilla pileolata*	Breeder	Casual
Yellow Warbler [c]	*Setophaga petechia*	Breeder	Rare

Source: Armstrong, 2008; AKNHP, 2014a; ADF&G 2015c

[a] Status: Resident, year-round resident; Breeder, breeding species (migratory); Migrant, nonbreeder traveling; Nonbreeding, overwintering species; Visitant, outside its normal range.

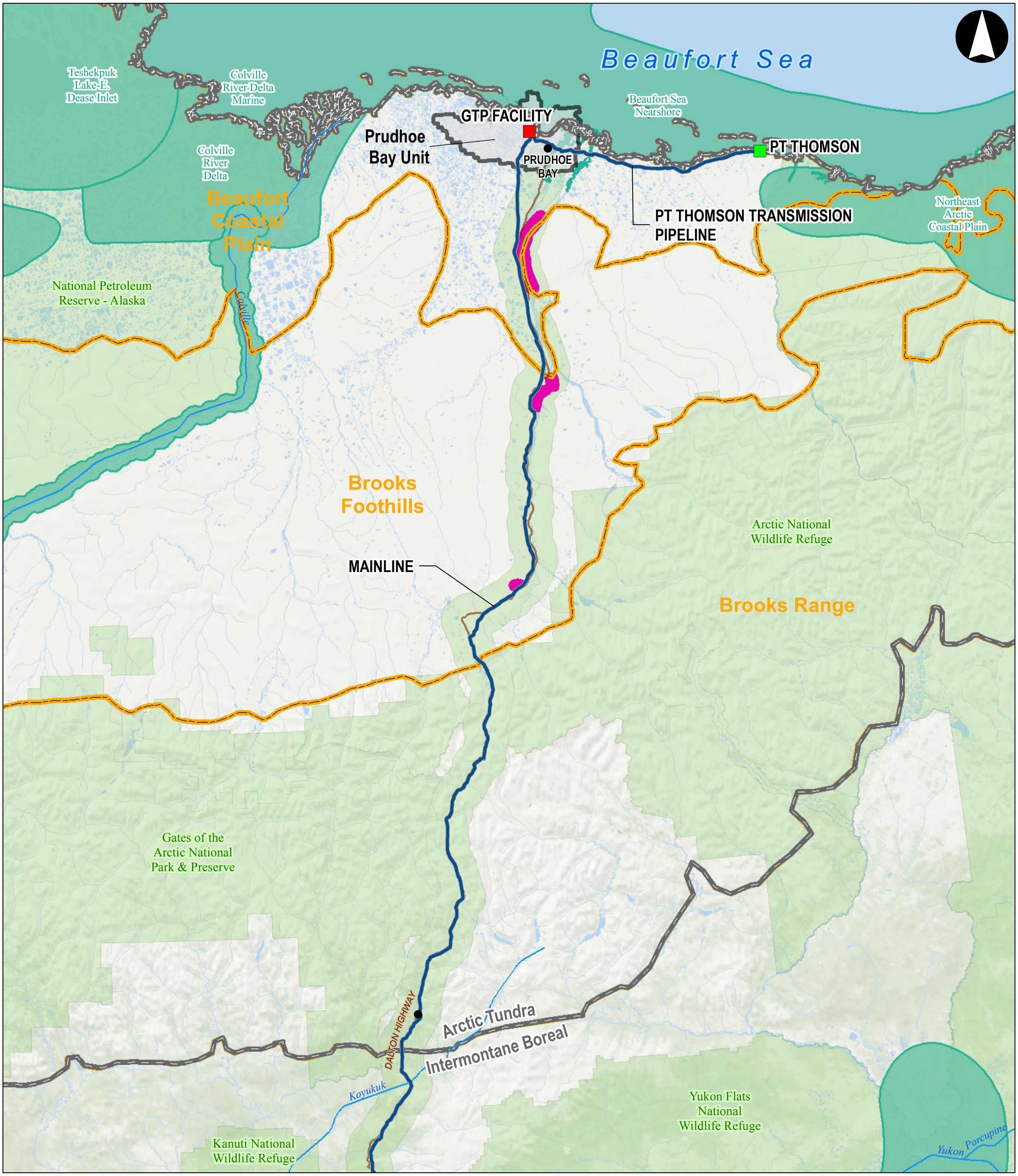
[b] Relative Abundance: Common, certain to be seen or heard in suitable habitat; Uncommon, locally distributed or occurring in low numbers; Rare, species occurs regularly in region but in very small numbers, sighting likelihood poor; Occasional, seen a few times in a 5-year period; Accidental, seen once to twice and may not be seen again.

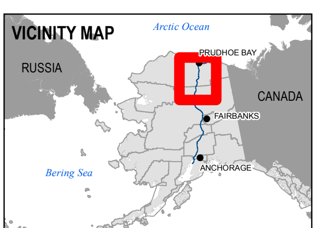
[c] ADF&G Species of Greatest Conservation Need (ADF&G 2015c).

[d] ESA candidate, or proposed species (USFWS, 2014a).

[e] Bird of Conservation Concern (USFWS, 2008).

[f] Species of High Concern or Highly Imperiled according to the Alaska Shorebird Group: Alaska Shorebird Conservation Plan II (ASG, 2008).





LEGEND

- Project Facility
- Existing Facility
- Alaska LNG Rev C2 Route
- Major Highways
- Major Rivers
- Prudhoe Bay Unit
- Ecoregion Boundary
- Arctic Tundra Subecoregions
- State and Federal Conservation Lands
- Important Bird Area
- Zones of Restricted Activity

0 5 10 20 30 40 Miles

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SCALE:	1:2,000,000		
DATE:	2017-03-16	SHEET:	1 of 1

IMPORTANT BIRD HABITATS IN THE ARCTIC TUNDRA ECOREGION OF THE PROJECT

FIGURE 3.4.6-1

ALASKA LNG

X:\AKLNG\Resource Reports\RR03\Figure 3_4_6-1 Important Bird Habitats in the Arctic Tundra Ecoregion of the Project.mxd

3.4.6.2.1.2 Beaufort Coastal Plain Ecoregion Birds

The Beaufort Coastal Plain Ecoregion provides important habitat for millions of nesting and migrating shorebirds and waterfowl (Johnson et al., 2007; Bart et al., 2012). Shorebirds are the most abundant and diverse group of avifauna in this ecoregion (Saalfeld et al., 2013). Coastal wetlands, wet meadows, and riparian habitats are particularly important to nesting waterbirds and shorebirds throughout the region (Brown et al., 2007). Eight species of shorebirds and six species of waterfowl are common to abundant breeders within the Project area (Table 3.4.6-1).

Representative birds in this ecoregion include common eiders, northern pintail, greater white-fronted goose, Pacific loon, American golden-plover, pectoral and semipalmated sandpiper, red-necked and red phalaropes, glaucous gulls, Arctic terns, loons, Lapland longspur, and snowy owls (Clough et al., 1987; Pitelka, 1974).

Arctophila ponds and lakes, those with pendant grass (*Arctophila fulva*) in the center surrounded by a fringe of *Carex aquatilis* or *A. fulva* toward the shore, drained-lake basin complex wetlands, and coastal wetlands (saline-influenced habitats) are used most intensively by waterbirds along the Beaufort Coastal Plain Ecoregion. Researchers have also observed greater use of wetlands containing *Arctophila* by various waterbirds than other habitats. Deep, open lakes are important to diving waterbirds that nest on the Beaufort Coastal Plain Ecoregion (e.g., loons, long-tailed duck, and scaup) because of the availability of prey such as invertebrates and fish. Larger lakes are used annually by large numbers of molting geese. Coastal wetlands have been identified as important habitat for nesting and staging shorebirds, waterfowl, and Lapland longspurs. Tidal, riverine mudflats are used extensively by staging shorebirds prior to fall migration (Powell et al. 2010). The Sagavanirktok River corridor contains an extensive riparian shrub habitat; this habitat type is important for a variety of passerines, most of which have a limited distribution in the Beaufort Coastal Plain Ecoregion. Dry tundra, usually limited in distribution in this area, is used preferentially by some birds, such as golden-plovers and the buff-breasted sandpiper (BLM, 2012).

A portion of the Beaufort Sea Nearshore Global IBA is located in the Beaufort Coastal Plain Ecoregion and occupies the pelagic open-water habitat (Figure 3.4.6-1). The area was identified as an IBA for glaucous gulls and long-tailed ducks. It contains an estimated breeding population of 19,990 glaucous gulls and a molting population of 293,157 long-tailed ducks.

Spectacled eider are located in the Beaufort Coastal Plain Ecoregion and are federally listed as threatened throughout its range, and the Alaska-breeding Steller's eider is also federally listed as threatened, discussion of these listed species are presented in Section 3.5.1. The yellow-billed loon, previously a candidate for listing under the ESA, is also present along the Beaufort Coastal Plain Ecoregion during the nesting season.

Pacific loons are widespread in the Beaufort Coastal Plain Ecoregion. They prefer deeper aquatic grass (*Arctophila fulva*) wetlands, with deep, open lakes used in the brood-rearing period. Red-throated loons are present with scattered distribution. Red-throated loons prefer shallow *Arctophila* lakes that are smaller than 3 acres, as well as beaded stream habitat for nesting (BLM, 2012).

Aerial breeding-pair surveys in the Beaufort Coastal Plain Ecoregion indicate that 60 percent of the tundra swans in Alaska use the Beaufort Coastal Plain Ecoregion for nesting. High-density areas are mainly to the west of the Project area in the Colville River Delta area. Spring-migrant swans that nest along the Beaufort

Coastal Plain Ecoregion follow the Beaufort Sea coast from the east, arriving from mid- to late May and remaining until early October. A variety of aquatic habitats are chosen for nesting; the most important appear to be deeper *Arctophila* wetlands. Following the hatch, the young are attended by both parents. *Arctophila* and *Carex* wetlands and deeper open lakes appear to be the most important brood-rearing habitats. Family groups move considerable distances between lakes (Earnst, 2004).

Breeding, non-breeder, and failed-breeder components of the brant population occupy coastal habitats during the spring, summer, and fall months. Breeding pairs arrive in late May to early June and begin the nesting cycle in early June. Moist sedge-grass meadow tundra in drained lake basins is the preferred nesting habitat in the central Beaufort Coastal Plain Ecoregion; brackish water habitats, saltmarsh, and *Arctophila* wetlands are also used. Brood-rearing brant use larger lakes without emergent vegetation and coastal fringe areas, particularly tidal slough and tide flat habitats. Brant breed in traditional colonies located primarily within 3 miles of the coast, but also as much as 18 to 24 miles inland (BLM, 2012).

Although greater white-fronted geese are widespread at low to moderate densities in the Project area, they are the most abundant goose nesting in the Beaufort Coastal Plain Ecoregion. Aerial surveys from 1986 to 2006 indicate that the white-fronted goose comprise about 80 percent of the goose population observed in the Beaufort Coastal Plain Ecoregion. Higher concentrations of white-fronted geese occur west of the Project area in the National Petroleum Reserve-Alaska (NPR-A) (Conant et al., 2007).

Of the 15 duck species that occur in the Project area, pintails and long-tailed ducks are the most common ducks breeding in the Beaufort Coastal Plain Ecoregion. On average, these two species comprise approximately 84 percent of the nesting ducks observed. Other ducks using the Beaufort Coastal Plain Ecoregion include three species of scoters, American widgeon, king eider, green-winged teal, mallard, northern shoveler, red breasted merganser, common eider, goldeneye, bufflehead, Steller's eider, and spectacled eider (Conant et al., 2007). Wetland habitat use is varied among species in this group, but appears strongly related to food abundance associated with emergent vegetation in aquatic habitats. The most preferred habitat types include shallow *Carex* and *Arctophila* wetlands, deep *Arctophila* lakes, beaded streams, and deep, open lakes (BLM, 2012).

Spring migrant long-tail ducks follow leads in the ice along the Beaufort coast, arriving in the Project area in late May. Inland routes also are used. At this time, long-tail ducks congregate on open water of large lakes and use deep *Arctophila* wetlands as available. Egg laying is not initiated until late June. Long-tail ducks disperse to shallow *Carex* and *Arctophila* ponds, and deep, *Arctophila* ponds for nesting. They frequently nest in clusters or colonies. Males leave the nesting area during hatch and, together with nonbreeders and failed breeders, move to large Beaufort Coastal Plain Ecoregion lakes and nearshore Beaufort Sea waters to molt and often form extensive congregations up to 50,000 individuals. Females lead the young to deep *Arctophila*, deep-open, or shallow *Carex* lakes with open water shortly after hatch, and molt on deep-open lakes when the young are almost ready to fly (BLM, 2012).

Shorebirds in the Beaufort Coastal Plain Ecoregion use a range of habitats for nesting, brood-rearing, and staging for migration (Johnson et al., 2007). The birds begin to arrive in late May, and most are present by early June. Coastal habitats are not used as migration staging areas by shorebirds during spring and early summer because shorefast ice prohibits access to these areas at that time. After the birds arrive in the spring, they disperse to breeding territories in areas free of snow (Johnson and Herter, 1989). After the nesting season, in mid- to late summer, many shorebirds move to the Beaufort Sea coast to feed in intertidal flats and coastal tundra prior to fall migration to wintering areas (Andres, 1994; Smith and Connors, 1993).

The most common breeding shorebirds in the central Beaufort Coastal Plain Ecoregion region are pectoral sandpiper, semipalmated sandpiper, long-billed dowitcher, red phalarope, and dunlin (Johnson et al., 2007). Other shorebirds are locally abundant, such as the Baird's sandpiper and American golden-plover (Rodrigues, 2002a, b). However, interannual abundance and diversity of shorebirds varies considerably (Johnson et al., 2007).

Passerines include white-crowned sparrow, Savannah sparrow, yellow wagtail, Lapland longspur, hoary and common redpolls, and snow bunting. These landbirds are usually omnivorous, with diets dependent on the availability of food items. Willow and rock ptarmigan are the only gallinaceous birds found in the Beaufort Coastal Plain Ecoregion and are year-round residents (Brewer et al., 2000; Clough et al., 1987).

Among predatory birds of the Beaufort Coastal Plain is the snowy owl and short-eared owl, which hunt waterbirds, lemmings, and other small rodents. Annual populations of owls vary, and breeding typically occurs during years of high lemming populations (USFWS, 2010d).

3.4.6.2.1.3 Brooks Foothills Ecoregion Birds

The most common birds in the Brooks Foothills are the hoary and common redpolls, savannah sparrow, jaegers, phalaropes, Wilson's snipe, green-winged teal, and northern pintail (Kessel and Gibson, 1978; Pitelka, 1974). Many passerines use the Brooks Foothills Ecoregion to take advantage of the drier uplands and scrub-shrub habitat. Riparian willow stands support the highest-nesting densities and diversity of passerines. Permafrost also prevents surface drainage so soils are typically saturated and have thick organic horizons. Due to the abundance of thaw lakes and saturated soils, nearly the entire region supports wetland communities and is important for a wide variety of shorebirds, ducks, geese and swans. Vegetation is dominated by wet sedge tundra on flooded soils and by tussock tundra and sedge-Dryas tundra on gentle ridges (BLM, 2012) . However, willow and rock ptarmigan are more abundant, especially in shrub-brush habitat along rivers and streams. Raptors, including the peregrine falcon, gyrfalcon, and rough-legged hawk, are common foragers in the foothills and nest on the cliffs and bluffs along the Sagavanirktok River. Migrating raptors arrive in mid-April, and nestlings are fledged in concert with other birds that serve as prey. Common ravens are residents in this ecoregion (Brewer et al., 2000; Clough et al., 1987).

Many passerines use the Brooks Foothills Ecoregion to take advantage of the drier uplands and scrub-shrub habitat.

3.4.6.2.1.4 Brooks Range Ecoregion Birds

Common birds found in the Brooks Range Ecoregion include several species of ducks, grebes, raptors, falcons, shorebirds, gulls, terns, owls, flycatchers, shrikes, larks, swallows, thrush, finches, and waxwings (USFWS, 2014d). The Brooks Range Ecoregion has several habitats that support the vast species of birds. Because of highly credible hillslope sediments, shallow soils, high winds, and harsh climate in this ecoregion, vegetation cover is sparse and generally limited to valleys and lower hillslopes (USGS, 1995). Upper and intermediate slopes contain alpine heath communities, lower slopes have moist sedge tussock expanses, and shrub communities form along major rivers (ADF&G 2006). Alpine tundra communities of the Brooks Range ecoregion occur in mountainous areas and along well-drained, rocky ridges, which are important nesting habitat for raptors. The coarse soil is rocky and dry, and much of the area is a community of low, mat-forming heather vegetation. Exposed outcrops and talus slopes sustain sparse islands of cushion plants and lichens among the rocks. The high brush community, found in areas that have not been disturbed for several decades, includes willows, a few herbs, a variety of mosses and lichens (ADNR, 2014b).

Most birds found in the Brooks Range are limited to lower elevations. The diversity of passerines found at the lower elevations of the Brooks Range Ecoregion is similar to the adjoining Arctic Foothills. With increasing distance southward and a corresponding increase in altitude, the diversity and abundance of birds decreases dramatically. The Brooks Range offers warmer summer conditions and more protected microsites, which allow for a greater development of shrubs and for the development of some of the northern-most stands of trees. The terrain is diverse, including cliffs, canyons, alpine tundra, riverine gravel bars, medium-to-tall shrub thickets, coniferous forest, and scattered wetlands and marshes (Brewer et al., 2000).

Birds common to the area include wheatear, gray-cheeked thrush, yellow wagtail, American pipit, Bohemian waxwing, northern shrike, yellow-rumped warbler, Smith's longspur, swallows, rock and willow ptarmigan, common raven, and tree, fox, owls, and white-crowned sparrows in the lower and middle elevations. Additionally, several types of raptors occur in the area such as peregrine falcons, gyrfalcons, golden eagles, merlin, northern harrier, and rough-legged hawks (Table 3.4.6-1) .

3.4.6.2.2 Beringia Boreal Ecoregion Birds

The Beringia Boreal ecoregion from north to south along the Project corridor crosses the Ray Mountains, Kobuk Ridges and Valleys, Yukon-Tanana Uplands, and the Tanana-Kuskokwim Lowlands Ecoregions. Forty-five species of birds commonly occur in this ecoregion, of which the majority (approximately 80 percent) are migratory (Table 3.4.6-2, Figures 3.3.1-1 and 3.4.6-2). Passerines become more common as the diversity of habitats increases.

3.4.6.2.2.1 Important Bird Habitats in the Beringia Boreal Ecoregion

This area supports breeding waterfowl from the Pacific, Central, and Atlantic Flyways (ADF&G, 1986b). Many waterfowl breeding in the Arctic Tundra region also use this area for resting and staging en route to or from their breeding grounds farther north. Waterfowl in this area typically arrive shortly before breakup in April or May and stay through freeze-up in October (ADF&G, 1986b). Important waterfowl breeding and staging areas in the Beringia Boreal Ecoregion include Minto Flats, Lake Minchumina, upper Kantishna River, Bearpaw River drainage, Fish Lake Wetlands, Shaw Creek flats, Lake Mansfield, Fish Lake, the Wolf Lake wetlands, Dot Lake-Sam Creek, Billy Creek wetlands, Mineral Lakes, and the Salchaket Slough and its tributaries (ADF&G. 1986b). Of these, the upper Kantishna River and Salchaket Slough and tributaries occur in the closest proximity to the Project area.

Kanuti NWR is located approximately 20 miles to the west of the Project area in the Kobuk Ridges and Valleys and Ray Mountains ecoregions. Protecting migratory bird breeding habitat is central to the mission of this refuge. Nearly 130 species of birds occur in the refuge, with the majority using this area for nesting. Wetland habitats in the refuge are particularly important for the migratory birds that breed here.

Yukon Flats NWR is located east of the Project area (Figure 3.4.6-2) along with Yukon Flats West IBA. This refuge contains a diversity of high-quality bird habitats, resulting in a diversity of birds. More than 150 species of birds can be found in the refuge during spring and summer, including ducks, loons, geese, swans, shorebirds, and passerines. Yukon Flats has the highest breeding densities of waterfowl in Alaska, supporting up to 2 million ducks annually.

The Project footprint is close to the Minto Flats State Game Refuge and Minto Flats IBA. This refuge contains some of the highest-quality waterfowl habitats in Alaska, providing abundant nesting, foraging, and staging habitat for migratory waterfowl. It sustains the largest trumpeter swan breeding population in North America and it also supports high density duck nesting habitat that produces 150,000 more ducks annually (USFWS, 2006). Minto Flats is also an important spring and fall waterfowl staging area, particularly for geese and swans (Figure 3.4.6-2). Sandhill cranes, loons, and bald eagles regularly nest in the refuge, and peregrine falcons have historically nested adjacent to the refuge. Grouse and ptarmigan use the refuge in large numbers during winter, and small owls and overwintering passerines are also common.

TABLE 3.4.6-2

Beringia Boreal Ecoregion Birds Potentially Occurring within the Project Area

Common Name	Scientific Name	Status [a]	Relative Abundance [b]
Waterfowl			
Geese and Swans			
Greater White-fronted Goose	*Anser albifrons*	Breeder	Uncommon
Lesser Canada Goose	*Branta canadensis parvipes*	Breeder	Common
Snow Goose	*Chen caerulescens*	Migrant	Common
Taverner's Cackling Goose [c]	*Branta hutchinsii taverneri*	Migrant	Rare
Trumpeter Swan [c]	*Cygnus buccinator*	Breeder	Uncommon
Tundra Swan	*Cygnus columbianus*	Breeder	Uncommon
Ducks			
American Wigeon	*Anas americana*	Breeder	Common
Barrow's Goldeneye	*Bucephala islandica*	Breeder	Common
Blue-winged Teal	*Anas discors*	Breeder	Rare
Bufflehead	*Bucephala albeola*	Breeder	Common
Canvasback	*Aythya valisineria*	Breeder	Uncommon
Common Goldeneye	*Bucephala clangula*	Breeder	Common
Common Merganser	*Mergus merganser*	Breeder	Common
Eurasian Wigeon	*Anas penelope*	Visitant	Casual
Gadwall	*Anas strepera*	Rare	Visitant
Greater Scaup	*Aythya marila*	Breeder	Common
Green-winged Teal	*Anas crecca*	Breeder	Common
Harlequin Duck	*Histrionicus*	Breeder	Uncommon
Hooded Merganser	*Lophodytes cucullatus*	Visitant	Rare
Lesser Scaup	*Aythya affinis*	Breeder	Common
Long-tailed Duck [c]	*Clangula hyemalis*	Breeder	Uncommon
Mallard	*Anas platyrhynchos*	Breeder	Common
Northern Pintail	*Anas acuta*	Breeder	Common
Northern Shoveler	*Anas clypeata*	Breeder	Common

TABLE 3.4.6-2

Beringia Boreal Ecoregion Birds Potentially Occurring within the Project Area

Common Name	Scientific Name	Status [a]	Relative Abundance [b]
Pacific Black Scoter [c]	*Melanitta americana*	Breeder	Rare
Red-breasted Merganser	*Mergus serrator*	Breeder	Rare
Redhead	*Aythya americana*	Breeder	Rare
Ringed-neck Duck	*Aythya collaris*	Breeder	Uncommon
Surf Scoter	*Melanitta perspicillata*	Breeder	Common
White-winged Scoter [c]	*Melanitta fusca*	Breeder	Common
Grouse and Ptarmigan			
Rock Ptarmigan	*Lagopus muta*	Resident	Common
Ruffed Grouse	*Bonasa umbellus*	Resident	Common
Sharp-tailed Grouse	*Tympanuchus phasianellus*	Resident	Uncommon
Spruce Grouse	*Falcipennis canadensis*	Resident	Common
White-tailed Ptarmigan	*Lagopus leucura*	Resident	Uncommon
Willow Ptarmigan	*Lagopuslagopus*	Resident	Common
Loons and Grebes			
Common Loon	*Gavia immer*	Breeder	Common
Horned Grebe [d]	*Podiceps auritus*	Breeder	Common
Pacific Loon	*Gavia pacifica*	Breeder	Common
Red-necked Grebe	*Podiceps grisegena*	Breeder	Common
Red-throated Loon [c]	*Gavia stellata*	Breeder	Uncommon
Cormorants			
Double-crested Cormorant	*Phalacrocorax auritus*	Visitant	Accidental
Raptors			
Alaska Red-tailed Hawk [c]	*Buteo jamaicensis alascensis*	Breeder	Common
American Kestrel	*Falco sparverius*	Breeder	Common
Bald Eagle [c]	*Haliaeetus leucocephalus*	Breeder	Uncommon
Golden Eagle	*Aquila chrysaetos*	Resident	Common
Gyrfalcon [c]	*Falco rusticolus*	Resident	Uncommon
Merlin	*Falco columbarius*	Breeder	Uncommon
Northern Goshawk	*Accipiter gentilis*	Resident	Uncommon
Northern Harrier [c]	*Circus cyaneus*	Breeder	Uncommon
Osprey	*Pandion haliaetus*	Breeder	Rare
Peregrine Falcon [c, d]	*Falco peregrinus*	Breeder	Rare
Rough-legged Hawk [c]	*Buteo lagopus*	Breeder	Uncommon
Sharp-shinned Hawk	*Accipiter striatus*	Breeder	Common
Swainson's Hawk	*Buteo swainsoni*	Breeder	Rare
Rails, Coots, and Cranes			
American Coot	*Fulica americana*	Breeder	Rare
Lesser Sandhill Crane [c]	*Grus canadensiscanadensis*	Breeder	Uncommon
Shorebirds			
American Golden-Plover [c, e]	*Pluvialis dominica*	Breeder	Common
Baird's Sandpiper	*Calidris bairdii*	Migrant	Uncommon
Bar-tailed Godwit [c]	*Limosa lapponica baueri*	Visitant	Rare

TABLE 3.4.6-2

Beringia Boreal Ecoregion Birds Potentially Occurring within the Project Area

Common Name	Scientific Name	Status [a]	Relative Abundance [b]
Bering Sea Rock Sandpiper [c]	*Calidris ptilocnemis tschuktschorum*	Visitant	Rare
Black-bellied Plover [c]	*Pluvialis squatarola*	Visitant	Rare
Buff-breasted Sandpiper [c]	*Calidris subruficollis*	Migrant	Rare
Dunlin [c]	*Calidris alpina articola*	Migrant	Common
Greater Yellowlegs	*Tringa melanoleuca*	Breeder	Rare
Hudsonian Godwit [c, d, e]	*Limosa haemastica*	Visitant	Rare
Killdeer [c]	*Charadrius vociferus*	Breeder	Rare
Least Sandpiper	*Calidris minutilla*	Breeder	Uncommon
Lesser Yellowlegs [c, d, e]	*Tringa flavipes*	Breeder	Common
Long-billed Dowitcher [c]	*Limnodromus scolopaceus*	Breeder	Uncommon
Marbled Godwit [c]	*Limosa fedoa beringea*	Visitant	Occasional
Pectoral Sandpiper [c]	*Calidris melanotos*	Migrant	Common
Pribilof Rock Sandpiper [c, d, e]	*Calidris ptilocnemis*	Visitant	Rare
Red-necked Phalarope	*Phalaropus lobatus*	Breeder	Common
Rock Sandpiper	*Calidris ptilocnemis*	Visitant	Rare
Ruddy Turnstone	*Arenaria interpres*	Visitant	Rare
Sanderling [c, e]	*Calidris alba rubida*	Migrant	Rare
Semipalmated Plover	*Charadrius semipalmatus*	Breeder	Common
Semipalmated Sandpiper [c]	*Calidris pusilla*	Migrant	Common
Solitary Sandpiper [c, d, e]	*Tringa solitaria cinnomomea*	Breeder	Uncommon
Spotted Sandpiper [c]	*Actitis macularius*	Breeder	Common
Stilt Sandpiper	*Calidris himantopus*	Migrant	Rare
Surfbird [c, e]	*Calidris virgata*	Breeder	Uncommon
Upland Sandpiper [c, d, e]	*Bartramia longicauda*	Breeder	Uncommon
Wandering Tattler [c]	*Tringa incana*	Breeder	Uncommon
Western Sandpiper [c, e]	*Calidris mauri*	Migrant	Rare
Whimbrel [c, d, e]	*Numenius phaeopus rufiventris*	Breeder	Common
Wilson's Phalarope	*Phalaropus tricolor*	Breeder	Occasional
Wilson's Snipe	*Gallinago delicata*	Breeder	Common
Seabirds			
Arctic Tern [c]	*Sterna paradisaea*	Breeder	Uncommon
Bonaparte's Gull	*Chroicocephalus philadelphia*	Breeder	Uncommon
Glaucous Gull [c]	*Larus hyperboreus*	Visitant	Rare
Glaucous-winged Gull [c]	*Larus glaucescens*	Visitant	Rare
Herring Gull [c]	*Larus argentatus*	Breeder	Uncommon
Long-tailed Jaeger [c]	*Stercorarius longicaudus*	Breeder	Common
Mew Gull [c]	*Larus canus brachyrhynchus*	Breeder	Common
Parasitic Jaeger	*Stercorarius parasiticus*	Breeder	Rare
Doves and Pigeons			
Mourning Dove	*Zenaida macroura*	Visitant	Rare
Rock Pigeon	*Columba livia*	Resident	Common

TABLE 3.4.6-2

Beringia Boreal Ecoregion Birds Potentially Occurring within the Project Area

Common Name	Scientific Name	Status [a]	Relative Abundance [b]
Owls			
Boreal Owl [c]	*Aegolius funereus*	Resident	Common
Great Gray Owl	*Strix nebulosa*	Resident	Uncommon
Great Horned Owl	*Bubo virginianus*	Resident	Common
Northern Hawk Owl [c]	*Surnia ulula*	Resident	Common
Short-eared Owl [c]	*Asio flammeus*	Breeder	Common
Snowy Owl [c]	*Bubo scandiacus*	Visitant	Rare
Kingfishers			
Belted Kingfisher [c]	*Megaceryle alcyon*	Breeder	Common
Woodpeckers			
American Three-toed Woodpecker [c]	*Picoides dorsalis*	Resident	Uncommon
Black-backed Woodpecker [c]	*Picoides arcticus*	Resident	Rare
Downy Woodpecker	*Picoides pubescens*	Resident	Uncommon
Hairy Woodpecker [c]	*Picoides villosus sitkensis*	Resident	Uncommon
Northern Flicker [c]	*Colaptes auratus luteus*	Breeder	Common
Passerines			
Alder Flycatcher [c]	*Empidonax alnorum*	Breeder	Common
American Dipper	*Cinclus mexicanus*	Resident	Uncommon
American Pipit [c]	*Anthus rubescens*	Breeder	Common
American Robin	*Turdus migratorius*	Breeder	Common
American Tree Sparrow	*Spizella arborea*	Breeder	Common
Arctic Warbler [c]	*Phylloscopus borealis*	Breeder	Common
Bank Swallow [c]	*Riparia*	Breeder	Common
Black-billed Magpie	*Pica hudsonia*	Resident	Uncommon
Black-capped Chickadee	*Poecile atricapillus*	Resident	Common
Blackpoll Warbler [c]	*Setophaga striata*	Breeder	Uncommon
Bohemian Waxwing [c]	*Bombycilla garrulus*	Breeder	Common
Boreal Chickadee [c]	*Poecile hudsonicus*	Resident	Common
Brewer's Sparrow	*Spizella breweri*	Breeder	Rare
Brown Creeper [c]	*Certhia americana occidentalis*	Resident	Rare
Chipping Sparrow [c]	*Spizella passerina*	Breeder	Uncommon
Cliff Swallow	*Petrochelidon pyrrhonota*	Breeder	Common
Common Raven	*Corvus corax*	Resident	Common
Common Redpoll [c]	*Acanthis flammea*	Resident	Common
Dark-eyed Junco [c]	*Junco hyemalis*	Breeder	Common
European Starling	*Sturnus vulgaris*	Breeder	Rare
Fox Sparrow [c]	*Passerella iliaca*	Breeder	Common
Golden-crowned Kinglet [c]	*Regulus satrapa*	Visitant	Rare
Golden-crowned Sparrow [c]	*Zonotrichia atricapilla*	Breeder	Uncommon
Gray-cheeked Thrush	*Catharus minimus*	Breeder	Common
Gray-crowned Rosy-Finch [c]	*Leucosticte tephrocotis irvingi*	Breeder	Uncommon

TABLE 3.4.6-2

Beringia Boreal Ecoregion Birds Potentially Occurring within the Project Area

Common Name	Scientific Name	Status [a]	Relative Abundance [b]
Gray-headed Chickadee [c]	*Poecile cintus lathami*	Resident	Rare
Gray Jay [c]	*Perisoreus canadensis*	Resident	Common
Hammond's Flycatcher	*Empidonax hammondii*	Breeder	Common
Hermit Thrush [c]	*Catharus guttatus*	Breeder	Uncommon
Hoary Redpoll [c]	*Acanthis hornemanni*	Nonbreeding	Common
Horned Lark [c]	*Eremophila alpestris arcticola*	Breeder	Common
Lapland Longspur [c]	*Calcarius lapponicus*	Breeder	Common
Lincoln's Sparrow [c]	*Melospiza lincolnii*	Breeder	Common
Mountain Bluebird	*Sialia currucoides*	Breeder	Rare
Northern Shrike [c]	*Lanius excubitor*	Resident	Uncommon
Northern Waterthrush	*Parkesia noveboracensis*	Breeder	Common
Northern Wheatear	*Oenanthe*	Breeder	Uncommon
Olive-sided Flycatcher [c, d]	*Contopus cooperi*	Breeder	Uncommon
Orange-crowned Warbler [c]	*Oreothlypis celata*	Breeder	Common
Pine Grosbeak [c]	*Pinicola enucleator*	Resident	Uncommon
Pine Siskin [c]	*Spinus pinus*	Breeder	Rare
Red-winged Blackbird [c]	*Agelaius phoeniceus*	Breeder	Uncommon
Ruby-crowned Kinglet [c]	*Regulus calendula grinnelli*	Breeder	Uncommon
Rusty Blackbird [c, d]	*Euphagus carolinus*	Breeder	Uncommon
Savannah Sparrow [c]	*Passerculus sandwichensis*	Breeder	Common
Say's Phoebe	*Sayornis saya*	Breeder	Uncommon
Smith's Longspur [c, d]	*Calcarius pictus*	Breeder	Rare
Snow Bunting [c]	*Plectrophenax nivalis*	Breeder	Uncommon
Swainson's Thrush [c]	*Catharus ustulatus*	Breeder	Common
Townsend's Solitaire	*Myadestes townsendi*	Breeder	Rare
Townsend's Warbler [c]	*Setophaga townsendi*	Breeder	Common
Tree Swallow [c]	*Tachycineta bicolor*	Breeder	Common
Varied Thrush [c]	*Ixoreus naevius meruloides*	Breeder	Common
Violet-green Swallow	*Tachycineta thalassina*	Breeder	Common
Western Wood-Pewee [c]	*Contopus sordidulus*	Breeder	Uncommon
White-crowned Sparrow [c]	*Zonotrichia leucophrys*	Breeder	Common
White-winged Crossbill [c]	*Loxia leucoptera*	Resident	Uncommon
Wilson's Warbler [c]	*Cardellina pusilla pileolata*	Breeder	Common
Yellow-bellied Flycatcher	*Empidonax flaviventris*	Breeder	Rare
Yellow-rumped Warbler	*Setophaga coronata*	Breeder	Common
Yellow Warbler [c]	*Setophaga petechia*	Breeder	Common

TABLE 3.4.6-2

Beringia Boreal Ecoregion Birds Potentially Occurring within the Project Area

Common Name	Scientific Name	Status [a]	Relative Abundance [b]

Sources: Armstrong, 2008; AKNHP, 2014a; ADF&G 2015c

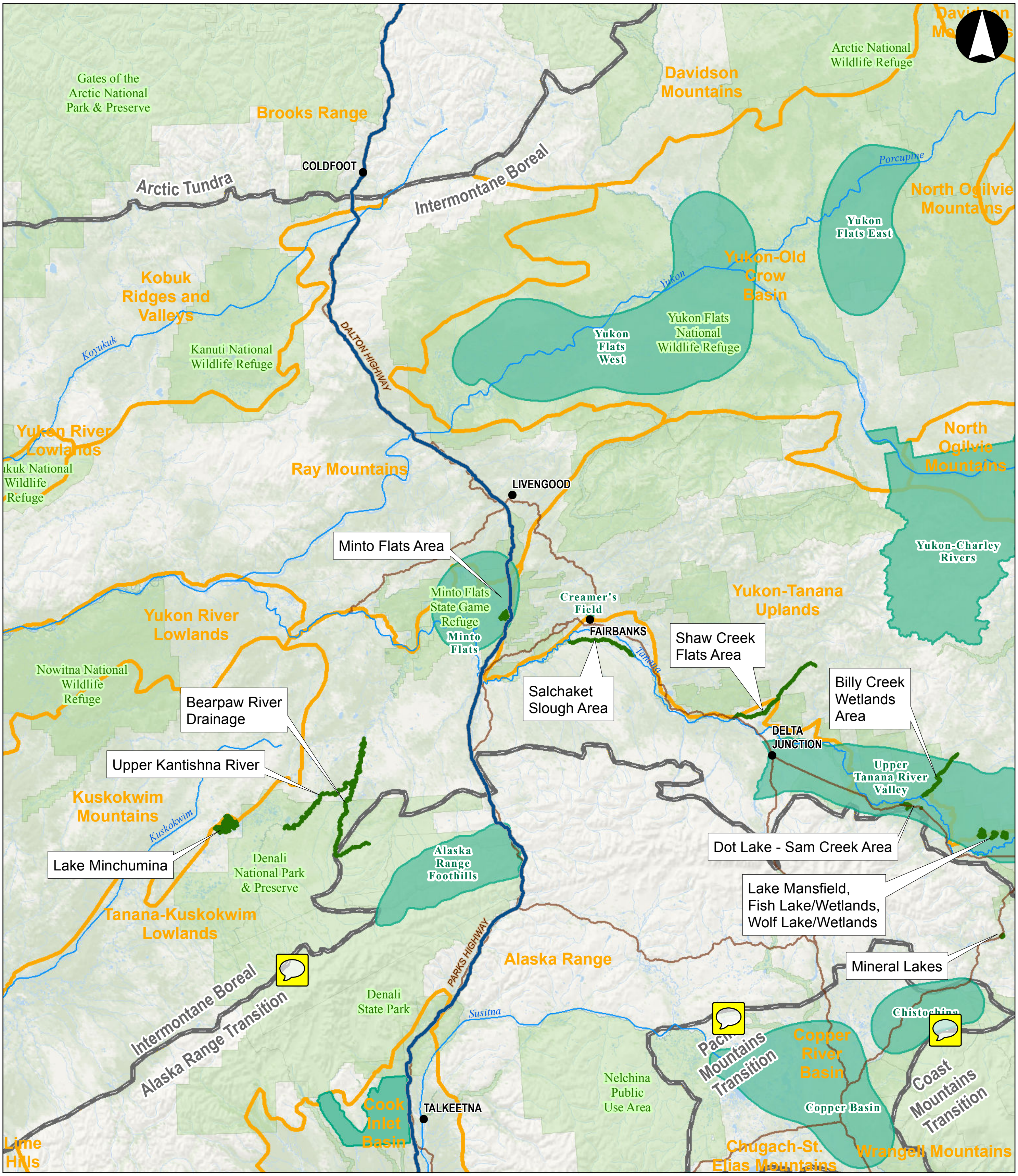
[a] Status: Resident, year-round resident; Breeder, breeding species (migratory); Migrant, nonbreeder traveling; Nonbreeding, overwintering species; Visitant, outside its normal range.

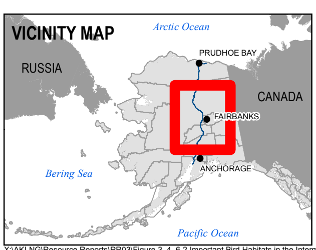
[b] Relative Abundance: Common, certain to be seen or heard in suitable habitat; Uncommon, locally distributed or occurring in low numbers; Rare, species occurs regularly in region but in very small numbers, sighting likelihood poor; Occasional, seen a few times in a five-year period; Accidental, seen once to twice and may not be seen again.

[c] ADF&G Species of Greatest Conservation Need (ADF&G 2015c).

[d] Bird of Conservation Concern (USFWS, 2008).

[e] Species of High Concern or Highly Imperiled according to the Alaska Shorebird Group: Alaska Shorebird Conservation Plan II (ASG, 2008).





LEGEND

- Alaska Place Names
- Alaska LNG Rev C2 Route
- Major Highways
- Major Rivers
- Ecoregion Boundary
- Subecoregion
- State and Federal Conservation Lands
- Important Bird Area
- Important Waterbodies

0 10 20 40 60 80 Miles

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SCALE:	1:3,000,000
DATE:	2017-03-31 SHEET: 1 of 1

IMPORTANT BIRD HABITATS IN THE INTERMONTANE BOREAL ECOREGION OF THE PROJECT

FIGURE 3.4.6-2

ALASKA LNG

X:\AKLNG\Resource Reports\RR03\Figure 3_4_6-2 Important Bird Habitats in the Intermontane Boreal Ecoregion of the Project.mxd

3.4.6.2.2.2 Kobuk Ridges and Valleys Ecoregion Birds

The Project would cross a small section in the northeastern corner of the Kobuk Ridges and Valleys Ecoregion (Figure 3.3.1-1 and 3.4.6-2). This portion of the ecoregion consists of mountain ridges just south of the Brooks Range. Forests and woodlands dominate much of the area. Trees become increasingly sparse in the west. Tall and short shrub communities of birch, willow, and alder occupy ridges (BLM, 2014b). Golden eagles and peregrine falcons nest on the mountainous high rocky ledges. The migratory American pipit, resident rock ptarmigan, and white-tailed ptarmigan nest in the alpine tundra. The increased abundance and diversity of birds, including gray jays, boreal chickadees, boreal owls, and great gray owls that are found in the lower elevation boreal forests in this ecoregion (ADF&G, 2006) would most likely not occur in the section of this ecoregion crossed by the Project. Table 3.5.3-3 lists birds of conservation for Kobuk Ridges and Valleys Ecoregion.

3.4.6.2.2.3 Ray Mountains Ecoregion Birds

The Ray Mountains are located south of the Brooks Range and north of the Yukon River valley. The Ray Mountains are compact, east-west oriented ranges. Permafrost is thin to moderately thick throughout much of the area. Dominant vegetation include black and white spruce, birch, aspen, balsam poplar, alder, willows on the floodplains, and shrub birch and lichen at higher elevations (BLM, 2014b). Birds most commonly found in the Ray Mountains include olive-sided flycatchers, blackpoll warblers, boreal owls, great gray owls, rusty blackbirds, rock and willow ptarmigan. Decreasing abundance of birds is found with increasing elevation. Most passerines are migratory and use this region as nesting or resting and as staging grounds during their migration. Nesting and brood rearing are likely to occur in June and July, respectively, with migratory birds leaving by mid- to late September (Brewer et al., 2000). This ecoregion also supports a diverse complement of migratory and resident raptors. Common ravens are common residents. Table 3.5.3-3 lists birds of conservation for Ray Mountains.

3.4.6.2.2.4 Yukon-Tanana Uplands Ecoregion Birds

The Yukon-Tanana Uplands Ecoregion consists of rounded mountains between the Yukon and Tanana rivers, with deep, narrow valleys cut by the rivers into the uplands. The Project corridor would occur just inside the western border of this ecoregion. The open-mixed deciduous-coniferous forest supports a large variety of birds, including Smith's longspurs, gray jays, boreal chickadee, northern flicker, red-tailed hawk, and boreal owls (ADF&G, 2006). Peregrine falcons nest in the cliffs of the region.

3.4.6.2.2.5 Tanana-Kuskokwim Lowlands Ecoregion Birds

The Tanana-Kuskokwim Lowlands comprise the alluvial plains between the Ray Mountains and Lime Hills of the Alaska Range. Numerous meandering rivers and lakes occur in the lowlands, with boreal forests dominated by black spruce, white spruce, and balsam poplar. The lowland habitats in this ecoregion provide waterbird resting, migration staging, and breeding habitats. About 10 percent of Alaska's duck populations are produced here (USFWS, 2003). The principal waterbirds include common loon, horned and red-necked grebes, trumpeter swans, sandhill cranes, several species of geese, and common goldeneyes, green-winged teal, scaup, American wigeon, and mallard (USFWS, 2003). The Upper Tanana River Valley serves as a prominent migration corridor for the Pacific, Central, and Mississippi flyways. Between 200,000 and 300,000 sandhill cranes, approximately half of the mid-continental population, migrate through the region stopping along the Tanana River during their spring and fall migrations. Table 3.5.3-3 lists birds of conservation for the Tanana-Kuskokwim Lowlands.

Open, mixed deciduous-conifer forests support a large variety of birds. Ruffed grouse, belted kingfisher, alder, Hammond's and olive-sided flycatchers, blackpoll warbler, boreal owl, great gray owl, and rusty blackbird commonly occur in drier areas within the ecoregions (ADF&G, 2006).

3.4.6.2.3 Coast Mountains Boreal Ecoregion Birds

The Project would cross the Alaska Range and Cook Inlet Basin ecoregions within the Coast Mountains Boreal Ecoregion (Figure 3.3.1-1). With about 200 regularly occurring bird species, the Coast Mountains Boreal Ecoregion supports the greatest diversity of birds in the Project area (Table 3.4.6-3).

Fifty-five resident birds occur in this ecoregion (Table 3.4.6-3). Resident birds likely to occur in subalpine and alpine habitats include willow and rock ptarmigan. Resident birds commonly found on beaches and mudflats include mew and glaucous-winged gulls. Most resident birds occur in forested habitats in this ecoregion. Common forest residents include gray and Steller's jays, black-billed magpie, common raven, black-capped and boreal chickadee, Bohemian waxwing, song sparrow, common redpoll, and pine siskin.

Most birds in this ecoregion are migratory, with the largest concentrations of ducks, geese, and shorebirds in this region occurring during spring and fall migrations (ADF&G, 1985; Audubon, 2014). This area supports breeding waterfowl from the Pacific, Central, and Atlantic Flyways (ADF&G, 1986b). The coastal shorelines and mudflats in Cook Inlet are important resting and feeding habitats for migratory birds. Most waterbirds and shorebirds stopping in the region continue northward and westward to breed, although many waterfowl remain in the coastal and upland habitats of this ecoregion to nest. A few birds, such as rock sandpipers and Steller's eiders, migrate to this ecoregion to overwinter.

Roughly 25 percent of the bald eagle population in the state occurs in Southcentral Alaska (ADF&G, 1985). The highest concentrations of bald eagles are found near the highly productive coastal areas and along inland rivers and lakes. Densities of bald eagles decline away from the coast toward interior portions of this region.

3.4.6.2.3.1 Important Bird Habitats in the Coastal Mountains Boreal Ecoregion

The Coastal Boreal Ecoregion contains the smaller level Alaska Range and Cook Inlet Basin Ecoregions. The Alaska Range Foothills State IBA occurs adjacent to the Project area in the Alaska Range Ecoregion within the northeastern portion of DNPP. This IBA contains one of the highest reported densities of nesting golden eagles in North America. Substantial numbers of gyrfalcons and other subalpine birds, such as willow ptarmigan and rock ptarmigan, also nest here (Audubon, 2014).

The Kahiltna Flats-Petersville Road Global IBA is also located in the Alaska Range Ecosystem contains one of the largest concentrations of nesting trumpeter swans. Wetlands also support large numbers of molting greater white-fronted geese. This IBA supports significant multi-species assemblages and concentrations of migratory landbirds, including eight Partners in Flight priority species (Audubon, 2014). These landbirds include the gray-cheeked thrush, golden-crowned sparrow, varied thrush, bohemian waxwing, Arctic warbler, white-winged crossbill, blackpoll warbler, and olive-sided flycatcher.

The Susitna Flats State Game Refuge is located in the Cook Inlet Basin Ecoregion and was primarily established for the spring and fall concentration of migrating waterfowl and shorebirds that occur there. As many as 100,000 waterfowl use the refuge as a staging area in the spring. Several thousand lesser sandhill cranes and up to 8,000 swans use the Refuge for migrating and nesting. Common shorebirds that use the Refuge include red-necked phalarope, dowitchers, godwits, whimbrels, snipe, yellowlegs, sandpipers, plovers, and dunlin. Approximately 10,000 duck, primarily mallards, pintail, and green-winged teal nest in the coastal wetlands of the refuge. Tule geese, a subspecies of greater-white fronted goose, nest and stage on the refuge (Audubon, 2014).

The Susitna Flats Global IBA was designated on the Susitna Flats State Game Refuge for its importance to breeding Hudsonian godwits and overwintering rock sandpipers, two Species of Special Concern (Audubon, 2014). Virtually the entire population of the nominate race of the rock sandpiper (*Calidris ptilocnemis ptilocnemis*) overwinters on this IBA.

Goose Bay State Game Refuge is located approximately 20 miles east of the proposed Mainline route. It provides an important spring and fall staging area for waterbird species. More than 20,000 geese, primarily Canada and snow geese, as well as several thousand trumpeter and tundra swans, stop to rest and feed in the refuge in the spring (mid-April to mid-May). Nesting waterbirds commonly found in the Refuge include mallards, green-winged teal, northern pintail, northern shovelers, snipe, sandhill cranes, whimbrel, greater yellowlegs, and short-billed dowitchers.

Goose Bay Continental IBA occurs within the Goose Bay State Game Refuge. This IBA was identified for its importance to migrating snow geese. During spring, when breakup is late and estuarine habitats in southern Cook Inlet are unavailable, this area is extremely important to migrating geese. It is also readily used by shorebirds.

The Anchorage Coastal Wildlife Refuge, located approximately 32 miles east of the proposed Mainline route supports at least 130 species of birds with its extensive tidal flats, marsh communities, and alder bog forests. Waterbirds commonly found during migration on this Refuge include the lesser Canada goose, mallards, northern pintails, northerner shovelers, American widgeon, canvasbacks, red-necked grebes, horned grebes, yellowlegs, red-necked phalarope, trumpeter and tundra swans, snow geese, and short-eared owls.

The Anchorage Coastal Continental IBA includes the entire coastal wetlands between Ship Creek and Potter Marsh. The southern half of this IBA occurs within the Anchorage Coastal Wildlife Refuge. This IBA was identified for its importance to migrating Hudsonian godwit, sandhill crane, short-billed dowitcher, and snow goose. More than 10,000 of these birds use this site for resting and staging during spring and fall migration. Approximately 160 species occur annually on this IBA as migrants or breeders, including several species of conservation concern (Audubon, 2014). Species of conservation concern include peregrine falcon, olive-sided flycatcher, trumpeter swan, and surfbird.

The Kenai NWR, located approximately 6 miles from the proposed Liquefaction Facility and about 5 miles from the Mainline where it crosses the Cook Inlet shoreline, contains hundreds of lakes and ponds, and has one of the highest densities of nesting common loons in North America (USFWS, 2010a). Trumpeter swans and bald eagles frequent these areas. The Chickaloon Watershed and estuary, located on the Upper Cook Inlet portion of this NWR, is a major waterfowl and shorebird migratory staging area. Common breeding songbirds in the forests of the refuge include dark-eyed junco, yellow-rumped warbler, orange-crowned warbler, Swainson’s thrush, boreal chickadee, ruby-crowned kinglet, alder flycatcher, gray jay, and American robin (USFWS, 2010a).

A portion of the Kenai NWR is designated as the Swanson Lakes Global IBA for its importance to trumpeter swans and migrating greater white-fronted geese (Audubon, 2014). This IBA also supports red-throated loons, a species of conservation concern, and significant multispecies assemblages and concentrations of migratory landbirds, including nine Partners in Flight priority species (Audubon, 2014). These landbirds include the gray-cheeked thrush, golden-crowned sparrow, varied thrush, bohemian waxwing, rusty blackbird, Townsend’s warbler, white-winged crossbill, blackpoll warbler, and olive-sided flycatcher.

Trading Bay State Game Refuge along the shoreline and intertidal flats on the western side of Cook Inlet south of the Project area encompasses prime waterbird and shorebird habitat. Thousands of migrating and nesting waterbirds use the wetland habitats on this refuge each year. Large concentrations of Canada geese, lesser snow geese, Pacific white-fronted geese, Tule white-fronted geese, and trumpeter and tundra swans rest and feed in a narrow band of ice-free coast in this refuge each spring. Nesting waterbirds in the refuge include trumpeter swans, mallard, northern pintail, green-winged teal, American wigeon, northern shoveler, common eider, red-breasted merganser, scoters, scaup, and goldeneye. Bald eagles and Tule geese are also known to nest within the refuge.

Trading Bay is a globally recognized IBA. The entire population of Wrangell Island snow geese use this IBA as a staging area during spring migration each year. This IBA also supports large numbers of the nominal race of rock sandpiper (*Calidris ptilocnemis ptilocnemis*) and western sandpiper. Species of conservation concern occurring here include the Hudsonian Godwit, red-throated loon, whimbrel, golden plover, and trumpeter swan (Audubon, 2014).

Redoubt Bay Critical Habitat Area (CHA) is located on the western side of Cook Inlet approximately 13 miles from the proposed Liquefaction Facility site, and encompasses the low-lying expanse of wetlands and riparian habitats. This CHA provides spring and fall feeding and resting habitats for hundreds of thousands of waterfowl, geese, and swans. Several tens of thousands of ducks also nest in this area. During spring, summer, and early fall, the Redoubt Bay CHA supports the largest concentration of Tule white-fronted geese in the world.

The Kachemak Bay Global IBA occurs in the Kachemak Bay CHA. This area supports great concentrations of birds during spring and fall migration, when large flocks of geese, ducks, and shorebirds rest, feed, and stage in the bay and its associated wetlands. Fox River Flats, at the head of the bay, has the highest concentration of migrating birds. Islands in Outer Kachemak Bay and nearby waters provide habitat for important seabird rookeries for tufted puffins, horned puffins, pigeon guillemots, black-legged kittiwakes, glaucous-winged gulls, and common murres. More than 90 percent of the overwintering seabird and waterfowl populations of Lower Cook Inlet occur in Kachemak Bay. The head of the bay provides important migrating and overwintering habitat for the threatened Steller’s eider. This area was identified as a global IBA for the following species: Kittlitz's murrelet, white-winged scoter, black scoter, pelagic cormorant, and marbled murrelet.

The Lower Cook Inlet Global IBA occurs in pelagic open-water habitat. This IBA was identified for its importance to glaucous-winged gulls. An estimated 9,445 nonbreeding glaucous-winged gulls regularly use this area.

The Kamishak Bay Global IBA occurs in the Western Cook Inlet-Shelikof Strait area. This bay was designated as an IBA for the glaucous-winged gull. An estimated 9,460 breeding glaucous-winged gulls occur here regularly (Audubon, 2014).

The Barren Islands Colonies State IBA contains six seabird colonies composed of 14 seabird species and an estimated 401,308 birds (Audubon, 2014). Large numbers of pelagic cormorant, glaucous-winged gull, black-legged kittiwake, tufted puffin, and fork-tailed storm-petrel nest on these islands.

The Tuxedni Wilderness Area of the Alaska Maritime NWR consists of two islands at the mouth of Tuxedni Bay on the southwestern side of Cook Inlet. The largest seabird colony in Cook Inlet is found on these islands. These islands were originally established as a refuge for seabirds, bald eagles, and peregrine falcons in 1909. Other species protected in this Wilderness Area include large colonies of seabirds, black-legged kittiwakes, horned puffins, common murres, pigeon guillemots, and glaucous-winged gulls, leatherback sea turtles, Steller’s sea lions, bowhead whales, humpback whales, Steller’s eiders, lynx, and otters.

Located within the Tuxedni NWR, Tuxedni Bay IBA supports up to 20 percent of the 1.2 million shorebirds using western Cook Inlet intertidal areas. Large numbers of western sandpipers use the bay during spring migration. Scoters concentrate in this area for molting and feeding during summer and fall. Species of conservation concern include: black scoter, black oystercatcher, black turnstone, surfbirds, and whimbrels.

TABLE 3.4.6-3

Alaska Range Transition Ecoregion Birds Potentially Occurring in the Project Area

Common Name	Scientific Name	Status [a]	Relative Abundance [b]
Waterfowl			
Geese and Swans			
Canada Goose	*Branta canadensis*	Breeder	Common
Emperor Goose [c]	*Chen canagica*	Visitant	Uncommon
Greater White-fronted Goose	*Anser albifrons*	Breeder	Rare
Pacific Black Brant [c]	*Branta bernicla nigricans*	Migrant	Common
Snow Goose	*Chen caerulescens*	Migrant	Common
Taverner’s Cackling Goose [c]	*Branta hutchinsii taverneri*	Migrant	Uncommon
Trumpeter Swan [c]	*Cygnus buccinator*	Breeder	Uncommon
Tule Greater White-fronted Goose [c]	*Anser albifrons elgasi*	Breeder	Rare
Tundra Swan	*Cygnus columbianus*	Migrant	Common
Ducks			
American Wigeon	*Anas americana*	Breeder	Common
Barrow’s Goldeneye	*Bucephala islandica*	Breeder	Common
Blue-winged Teal	*Anas discors*	Breeder	Rare
Bufflehead	*Bucephala albeola*	Breeder	Uncommon

TABLE 3.4.6-3

Alaska Range Transition Ecoregion Birds Potentially Occurring in the Project Area

Common Name	Scientific Name	Status [a]	Relative Abundance [b]
Canvasback	*Aythya valisineria*	Breeder	Uncommon
Common Eider [c]	*Somateria mollissima*	Breeder	Uncommon
Common Goldeneye	*Bucephala clangula*	Breeder	Rare
Common Merganser	*Mergus merganser*	Resident	Common
Eurasian Wigeon	*Anas penelope*	Visitant	Casual
Gadwall	*Anas strepera*	Breeder	Uncommon
Greater Scaup	*Aythya marila*	Resident	Common
Green-winged Teal	*Anas crecca*	Breeder	Common
Harlequin Duck	*Histrionicus*	Breeder	Common
Hooded Merganser	*Lophodytes cucullatus*	Breeder	Rare
King Eider	*Somateria spectabilis*	Nonbreeding	Uncommon
Lesser Scaup	*Aythya affinis*	Migrant	Rare
Long-tailed Duck [c]	*Clangula hyemalis*	Breeder	Common
Mallard	*Anas platyrhynchos*	Resident	Common
Northern Pintail	*Anas acuta*	Breeder	Common
Northern Shoveler	*Anas clypeata*	Breeder	Common
Pacific Black Scoter [c]	*Melanitta americana*	Breeder	Uncommon
Red-breasted Merganser	*Mergus serrator*	Breeder	Common
Redhead	*Aythya americana*	Breeder	Rare
Ringed-neck Duck	*Aythya collaris*	Breeder	Rare
Steller's Eider [c, e]	*Polysticta stelleri*	Nonbreeding	Common
Surf Scoter	*Melanitta perspicillata*	Breeder	Common
White-winged Scoter [c]	*Melanitta fusca*	Breeder	Common
Grouse and Ptarmigan			
Rock Ptarmigan	*Lagopus muta*	Resident	Common
Spruce Grouse	*Falcipennis canadensis*	Resident	Uncommon
White-tailed Ptarmigan	*Lagopus leucura*	Resident	Uncommon
Willow Ptarmigan	*Lagopus*	Resident	Uncommon
Loons and Grebes			
Common Loon	*Gavia immer*	Breeder	Uncommon
Horned Grebe [f]	*Podiceps auritus*	Breeder	Uncommon
Pacific Loon	*Gavia pacifica*	Breeder	Uncommon
Red-necked Grebe	*Podiceps grisegena*	Breeder	Uncommon
Red-throated Loon [c]	*Gavia stellata*	Breeder	Common
Yellow-billed loon [c]	*Gavia adamsii*	Visitant	Rare
Albatross, Petrels, and Shearwaters			
Fork-tailed Storm Petrel [c]	*Oceanodroma furcata*	Breeder	Common
Leach's Storm-Petrel	*Oceanodroma leucorhoa*	Breeder	Uncommon
Northern Fulmar [c]	*Fulmarus glacialis rodgersii*	Nonbreeding	Common
Short-tailed Shearwater	*Puffinus tenuirostris*	Nonbreeding	Uncommon
Sooty Shearwater	*Puffinus griseus*	Nonbreeding	Common

TABLE 3.4.6-3

Alaska Range Transition Ecoregion Birds Potentially Occurring in the Project Area

Common Name	Scientific Name	Status [a]	Relative Abundance [b]
Cormorants			
Double-crested Cormorant	*Phalacrocorax auritus*	Resident	Common
Red-faced Cormorant [c]	*Phalacrocorax urile*	Breeder	Common
Raptors			
Alaska Red-tailed Hawk [c]	*Buteo jamaicensis alascensis*	Breeder	Rare
American Kestrel [c]	*Falco sparverius*	Migrant	Rare
Bald Eagle [c]	*Haliaeetus leucocephalus*	Breeder	Common
Golden Eagle [c]	*Aquila chrysaetos*	Resident	Uncommon
Gyrfalcon [c]	*Falco rusticolus*	Resident	Rare
Merlin	*Falco columbarius*	Breeder	Uncommon
Northern Goshawk	*Accipiter gentilis*	Resident	Uncommon
Northern Harrier [c]	*Circus cyaneus*	Breeder	Uncommon
Osprey	*Pandion haliaetus*	Breeder	Rare
Peregrine Falcon [c, f]	*Falco peregrinus*	Resident	Rare
Rough-legged Hawk [c]	*Buteo lagopus*	Migrant	Rare
Sharp-shinned Hawk	*Accipiter striatus*	Resident	Uncommon
Rails, Coots, and Cranes			
American Coot	*Fulica americana*	Visitant	Rare
Lesser Sandhill Crane [c]	*Grus canadensis*	Breeder	Uncommon
Shorebirds			
American Golden-Plover [c, d]	*Pluvialis dominica*	Migrant	Common
Baird's Sandpiper	*Calidris bairdii*	Migrant	Uncommon
Bar-tailed Godwit [c]	*Limosa lapponica baueri*	Visitant	Rare
Bering Sea Rock Sandpiper [c]	*Calidris ptilocnemis tschuktschorum*	Winter	Common
Black-bellied Plover [c]	*Pluvialis squatarola*	Migrant	Common
Black Turnstone [c]	*Arenaria melanocephala*	Migrant	Common
Buff-breasted Sandpiper [c]	*Calidris subruficollis*	Migrant	Occasional
Dunlin [c]	*Calidris alpine articola*	Migrant	Common
Greater Yellowlegs	*Tringa melanoleuca*	Breeder	Common
Hudsonian Godwit [c, d, f]	*Limosa haemastica*	Breeder	Uncommon
Killdeer [c]	*Charadrius vociferus*	Breeder	Rare
Least Sandpiper	*Calidris minutilla*	Breeder	Common
Lesser Yellowlegs [c, d, f]	*Tringa flavipes*	Breeder	Common
Long-billed Dowitcher [c]	*Limnodromus scolopaceus*	Migrant	Common
Marbled Godwit [c]	*Limosa fedoa beringea*	Visitant	Occasional
Pacific Golden-Plover [c]	*Pluvialis fulva*	Migrant	Uncommon
Pectoral Sandpiper [c]	*Calidris melanotos*	Migrant	Common
Pribilof Rock Sandpiper [c, d, f]	*Calidris ptilocnemis*	Winter	Common
Red Knot [c, f]	*Calidris canutus roselaari*	Migrant	Common
Red-necked Phalarope	*Phalaropus lobatus*	Breeder	Common
Red Phalarope [c]	*Phalaropus fulicarius*	Migrant	Common

TABLE 3.4.6-3

Alaska Range Transition Ecoregion Birds Potentially Occurring in the Project Area

Common Name	Scientific Name	Status [a]	Relative Abundance [b]
Ruddy Turnstone	*Arenaria interpres*	Migrant	Common
Sanderling [c, d]	*Calidris alba rubida*	Migrant	Uncommon
Semipalmated Plover	*Charadrius semipalmatus*	Breeder	Common
Semipalmated Sandpiper [c]	*Calidris pusilla*	Migrant	Uncommon
Short-billed Dowitcher [c, d, f]	*Limnodromus griseus caurinus*	Breeder	Common
Solitary Sandpiper [c, d, f]	*Tringa solitaria cinnomomea*	Breeder	Rare
Spotted Sandpiper [c]	*Actitis macularius*	Breeder	Common
Surfbird [c, d]	*Calidris virgata*	Breeder	Uncommon
Upland Sandpiper [c, d, f]	*Bartramia longicauda*	Breeder	Uncommon
Wandering Tattler [c]	*Tringa incana*	Breeder	Uncommon
Western Sandpiper [c, d]	*Calidris mauri*	Migrant	Common
Whimbrel [c, d, f]	*Numenius phaeopus rufiventris*	Breeder	Uncommon
Wilson’s Phalarope	*Phalaropus tricolor*	Breeder	Occasional
Wilson’s Snipe	*Gallinago delicata*	Breeder	Common
Seabirds			
Arctic Tern [c]	*Sterna paradisaea*	Breeder	Common
Aleutian Tern [c]	*Onychoprion aleuticus*	Breeder	Uncommon
Black-legged Kittiwake [c]	*Rissa tridactyla pollicarus*	Breeder	Common
Bonaparte’s Gull	*Chroicocephalus philadelphia*	Breeder	Common
Cassin’s Auklet [c]	*Ptychoramphus aleuticus*	Resident	Rare
Glaucous Gull [c]	*Larus hyperboreus*	Visitant	Rare
Glaucous-winged Gull [c]	*Larus glaucescens*	Resident	Common
Herring Gull [c]	*Larus argentatus*	Resident	Uncommon
Iceland Gull	*Larus glaucoides*	Visitant	Rare
Long-tailed Jaeger [c]	*Stercorarius longicaudus*	Breeder	Rare
Marbled Murrelet [c]	*Brachyramphus marmoratus*	Breeder	Common
Mew Gull [c]	*Larus canus brachyrhynchus*	Resident	Common
Parasitic Jaeger	*Stercorarius parasiticus*	Breeder	Common
Pigeon Guillemot [c]	*Cepphus columba*	Resident	Common
Pomarine Jaeger [c]	*Stercorarius pomarinus*	Migrant	Common
Ring-billed Gull	*Larus delawarensis*	Resident	Rare
Sabine’s Gull [c]	*Xema sabini*	Visitant	Uncommon
Doves and Pigeons			
Mourning Dove	*Zenaida macroura*	Visitant	Rare
Rock Pigeon	*Columba livia*	Resident	Common
Owls			
Boreal Owl [c]	*Aegolius funereus*	Resident	Uncommon
Great Gray Owl	*Strix nebulosa*	Resident	Rare
Great Horned Owl	*Bubo virginianus*	Resident	Common
Northern Hawk Owl [c]	*Surnia ulula*	Resident	Uncommon
Northern Saw-whet Owl	*Aegolius acadicus*	Resident	Rare
Short-eared Owl [c]	*Asio flammeus*	Breeder	Uncommon

TABLE 3.4.6-3

Alaska Range Transition Ecoregion Birds Potentially Occurring in the Project Area

Common Name	Scientific Name	Status [a]	Relative Abundance [b]
Snowy Owl [c]	*Bubo scandiacus*	Visitant	Rare
Western Screech-Owl [c]	*Megascops kennicottii*	Resident	Accidental
Kingfishers			
Belted Kingfisher [c]	*Megaceryle alcyon*	Breeder	Uncommon
Woodpeckers			
American Three-toed Woodpecker [c]	*Picoides dorsalis*	Resident	Uncommon
Black-backed Woodpecker [c]	*Picoides arcticus*	Resident	Rare
Downy Woodpecker	*Picoides pubescens*	Resident	Uncommon
Hairy Woodpecker [c]	*Picoides villosus sitkensis*	Resident	Uncommon
Northern Flicker [c]	*Colaptes auratus luteus*	Breeder	Uncommon
Passerines			
Alder Flycatcher [c]	*Empidonax alnorum*	Breeder	Uncommon
American Dipper	*Cinclus mexicanus*	Resident	Common
American Pipit [c]	*Anthus rubescens*	Breeder	Common
American Robin	*Turdus migratorius*	Breeder	Common
American Tree Sparrow	*Spizella arborea*	Breeder	Rare
Arctic Warbler [c]	*Phylloscopus borealis*	Breeder	Common
Bank Swallow [c]	*Riparia*	Breeder	Common
Barn Swallow [c]	*Hirundo rustica*	Breeder	Uncommon
Black-billed Magpie	*Pica hudsonia*	Resident	Common
Black-capped Chickadee	*Poecile atricapillus*	Resident	Common
Blackpoll Warbler [c]	*Setophaga striata*	Breeder	Rare
Bohemian Waxwing [c]	*Bombycilla garrulus*	Resident	Uncommon
Boreal Chickadee [c]	*Poecile hudsonicus*	Resident	Uncommon
Brown Creeper [c]	*Certhia americana occidentalis*	Resident	Uncommon
Chipping Sparrow [c]	*Spizella passerina*	Breeder	Rare
Cliff Swallow	*Petrochelidon pyrrhonota*	Breeder	Uncommon
Common Raven	*Corvus corax*	Resident	Common
Common Redpoll [c]	*Acanthis flammea*	Resident	Common
Dark-eyed Junco [c]	*Junco hyemalis*	Breeder	Common
European Starling	*Sturnus vulgaris*	Resident	Rare
Fox Sparrow (sooty) [c]	*Passerella iliaca annectens*	Breeder	Common
Fox Sparrow (sooty) [c]	*Passerella iliaca insulariis*	Breeder	Common
Fox Sparrow (sooty) [c]	*Passerella iliaca sinuosa*	Breeder	Common
Golden-crowned Kinglet [c]	*Regulus satrapa*	Resident	Uncommon
Golden-crowned Sparrow [c]	*Zonotrichia atricapilla*	Breeder	Common
Gray-cheeked Thrush	*Catharus minimus*	Breeder	Uncommon
Gray-crowned Rosy-Finch [c]	*Leucosticte tephrocotis irvingi*	Breeder	Uncommon
Gray Jay [c]	*Perisoreus canadensis*	Resident	Uncommon
Hammond's Flycatcher	*Empidonax hammondii*	Breeder	Common
Hermit Thrush [c]	*Catharus guttatusguttatus*	Breeder	Common

TABLE 3.4.6-3

Alaska Range Transition Ecoregion Birds Potentially Occurring in the Project Area

Common Name	Scientific Name	Status [a]	Relative Abundance [b]
Hoary Redpoll [c]	*Acanthis hornemanni*	Nonbreeding	Rare
Horned Lark [c]	*Eremophila alpestris arcticola*	Breeder	Rare
Lapland Longspur [c]	*Calcarius lapponicus*	Breeder	Rare
Lincoln's Sparrow [c]	*Melospiza lincolnii*	Breeder	Common
Northern Shrike [c]	*Lanius excubitor*	Resident	Uncommon
Northern Waterthrush	*Parkesia noveboracensis*	Breeder	Uncommon
Northern Wheatear	*Oenanthe*	Breeder	Rare
Olive-sided Flycatcher [c, f]	*Contopus cooperi*	Breeder	Rare
Orange-crowned Warbler [c]	*Oreothlypis celata*	Breeder	Common
Pacific Wren [c]	*Troglodytes pacificus helleri*	Resident	Uncommon
Pacific Wren [c]	*Troglodytes pacificus*	Resident	Uncommon
Pine Grosbeak [c]	*Pinicola enucleator*	Resident	Uncommon
Pine Siskin [c]	*Spinus pinus*	Resident	Common
Red-breasted Nuthatch	*Sitta canadensis*	Resident	Rare
Red-winged Blackbird [c]	*Agelaius phoeniceus*	Breeder	Rare
Ruby-crowned Kinglet [c]	*Regulus calendula grinnelli*	Breeder	Common
Rusty Blackbird [c, f]	*Euphagus carolinus*	Resident	Rare
Savannah Sparrow [c]	*Passerculus sandwichensis*	Breeder	Common
Say's Phoebe	*Sayornis saya*	Breeder	Rare
Smith's Longspur [c, f]	*Calcarius pictus*	Breeder	Rare
Snow Bunting [c]	*Plectrophenax nivalis*	Breeding	Rare
Song Sparrow [c]	*Melospiza melodia caurina*	Resident	Common
Song Sparrow [c]	*Melospiza melodia insignis*	Resident	Common
Song Sparrow [c]	*Melospiza melodia kenaiensis*	Resident	Common
Steller's Jay [c]	*Cyanocitta stelleri*	Resident	Common
Swainson's Thrush [c]	*Catharus ustulatus*	Breeder	Uncommon
Townsend's Solitaire	*Myadestes townsendi*	Breeder	Rare
Townsend's Warbler [c]	*Setophaga townsendi*	Breeder	Common
Tree Swallow [c]	*Tachycineta bicolor*	Breeder	Common
Varied Thrush [c]	*Ixoreus naevius meruloides*	Breeder	Common
Violet-green Swallow	*Tachycineta thalassina*	Breeder	Common
Western Wood-Pewee [c]	*Contopus sordidulus*	Breeder	Uncommon
White-crowned Sparrow [c]	*Zonotrichia leucophrys*	Breeder	Uncommon
White-winged Crossbill [c]	*Loxia leucoptera*	Resident	Uncommon
Wilson's Warbler [c]	*Cardellina pusilla pileolata*	Breeder	Common
Yellow-rumped Warbler	*Setophaga coronata*	Breeder	Common
Yellow Warbler [c]	*Setophaga petechia*	Breeder	Uncommon

TABLE 3.4.6-3

Alaska Range Transition Ecoregion Birds Potentially Occurring in the Project Area

Common Name	**Scientific Name**	**Status [a]**	**Relative Abundance [b]**

Sources: Armstrong, 2008; AKNHP, 2014a; ADF&G, 2015c

[a] Status: Resident, year-round resident; Breeder, breeding species (migratory); Migrant, nonbreeder traveling; Nonbreeding, overwintering species; Visitant, outside its normal range.

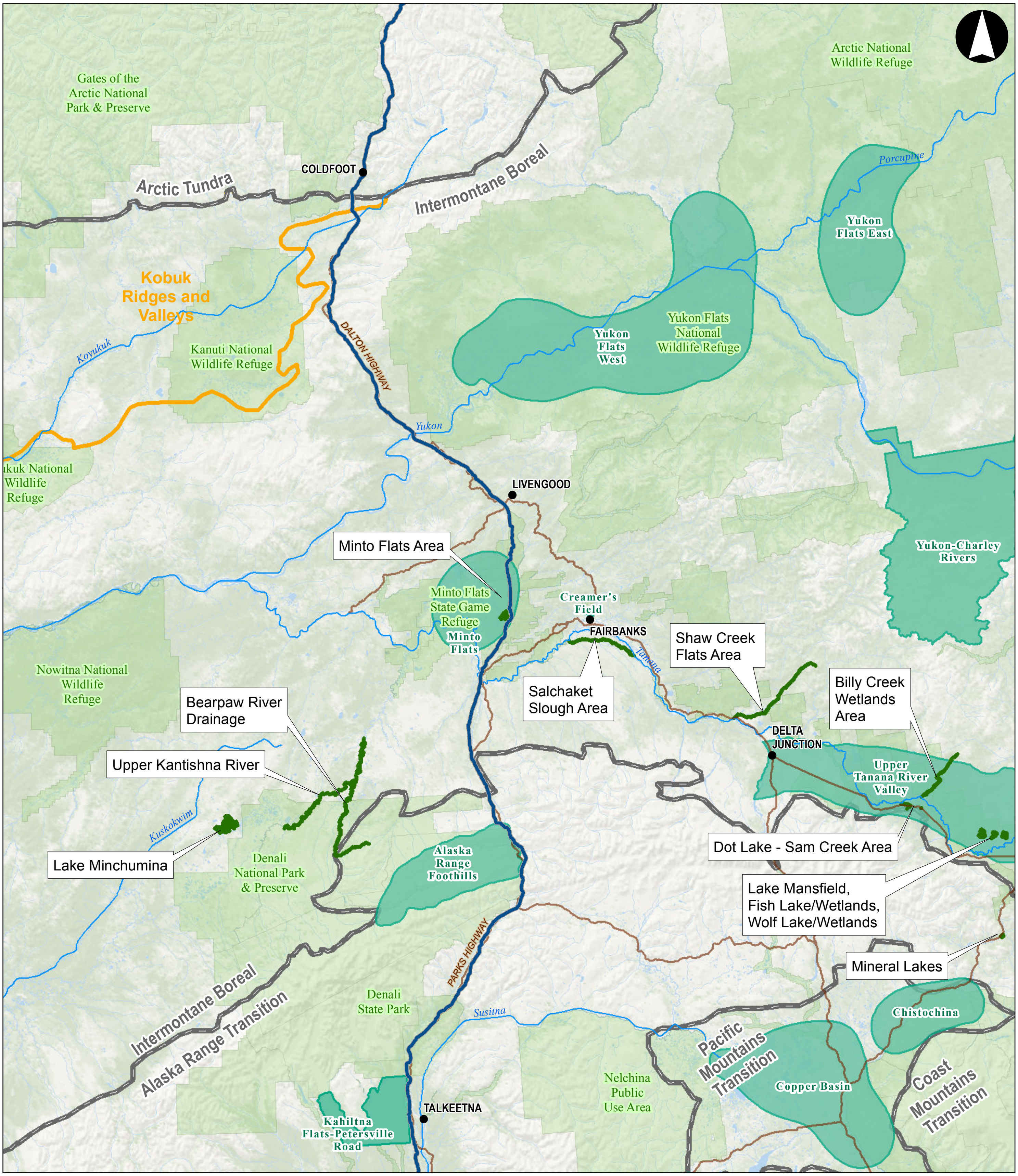
[b] Relative Abundance: Common, certain to be seen or heard in suitable habitat; Uncommon, locally distributed or occurring in low numbers; Rare, species occurs regularly in region but in very small numbers, sighting likelihood poor; Occasional, seen a few times in a five-year period; Accidental, seen once to twice and may not be seen again.

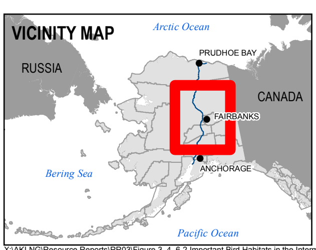
[c] ADF&G Species of Greatest Conservation Need (ADF&G, 2015c).

[d] Species of High Concern or Highly Imperiled according to the Alaska Shorebird Group: Alaska Shorebird Conservation Plan II (ASG, 2008).

[e] ESA listed, candidate, or proposed species (USFWS, 2014a).

[f] Bird of Conservation Concern (USFWS, 2008).





LEGEND

- Alaska Place Names
- Alaska LNG Rev C2 Route
- Major Highways
- Major Rivers
- Ecoregion Boundary
- Kobuk Ridges and Valleys Subecoregion
- State and Federal Conservation Lands
- Important Bird Area
- Important Waterbodies

0 10 20 40 60 80 Miles

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DATE:	2017-03-16	SHEET:	1 of 1

IMPORTANT BIRD HABITATS IN THE INTERMONTANE BOREAL ECOREGION OF THE PROJECT

FIGURE 3.4.6-2

ALASKA LNG

X:\AKLNG\Resource Reports\RR03\Figure 3_4_6-2 Important Bird Habitats in the Intermontane Boreal Ecoregion of the Project.mxd

3.4.6.2.3.2 Alaska Range Ecoregion Birds

The Alaska Range Ecoregion contains steep mountains covered with glaciers, rocky slopes, and ice fields. Vegetation is sparse, with dwarf shrub communities dominating windswept areas, and willow, birch, and alder shrub communities occurring on lower slopes and valley bottoms (ADF&G, 2006). About 7 percent of this ecoregion consists of wetlands. Although not abundant in wetlands, this ecoregion includes important habitats for willow ptarmigan, white-tailed ptarmigan, different species of geese and swans, and birds of prey (Audubon, 2017). Table 3.5.3-3 lists birds of conservation concern for the Alaska Range ecoregion that includes horned grebe, red-throated loons, Hudsonian godwit, two species of sandpiper, whimbrel, Arctic tern, olive-sided flycatcher, rusty blackbird, and Smith's longspur.

Cliffs and alpine habitats of this ecoregion provide ideal habitat for nesting raptors, including golden eagles, gyrfalcon, and peregrine falcon. Shorebirds, such as American golden plover, surfbird, least sandpiper and Baird's sandpiper, and the passerine Smith's longspur, nest in alpine tundra habitats. Migratory Say's phoebe, horned lark, northern wheatear, American pipit, Lapland longspur, snow bunting and gray-crowned rosy finch, as well as resident willow ptarmigan and rock ptarmigan, also nest in the alpine tundra (NPS, 2014).

3.4.6.2.3.3 Cook Inlet Basin Ecoregion Birds

Cook Inlet creates this ecoregion, influencing the climate and adding maritime character. Gently sloping lowlands contain numerous small lakes and wetlands, as well as mixed forested upland habitats. Wetland habitats range from low scrub bogs to wet graminoid marshes (ADF&G, 2006).

The diverse habitats found in this ecoregion support diverse bird communities. Shorebirds and waterfowl inhabit the numerous lakes, ponds, and wetlands. Trumpeter swans, red-necked grebes, common and Pacific loons, green-winged teal, northern pintail, and common and Barrow's goldeneye commonly nest on lakes and ponds in the region. Many landbirds migrate, breed, or reside within the region. Common nesting passerines include alder flycatcher, tree swallow, violet-green swallow, bank swallow, ruby-crowned kinglet, hermit thrush, American robin, varied thrush, yellow-rumped warbler, orange-crowned warbler, fox sparrow, white-crowned sparrow, and dark-eyed junco. Common resident birds include black-capped chickadee, black-billed magpie, common raven, boreal chickadee, great horned owl, and willow ptarmigan.

Cook Inlet supports large numbers of breeding or migrating shorebirds, including western sandpipers, dunlins, rock sandpipers, long- and short-billed dowitchers, and Hudsonian godwits (ADF&G, 2006). Colonial nesting seabirds, such as black-legged kittiwakes and common murres, nest along Cook Inlet shores (ADF&G, 2006). The numerous salmon runs that occur in the ecoregion attract bald eagles and common ravens.

The Cook Inlet Basin Ecoregion supports the entire populations of some birds. Nearly the entire population of Wrangell Island snow geese migrate across the mouth of the Kenai River and Trading Bay each spring and the entire population of tule greater white-fronted geese nest in the boreal forest wetlands on the western side of Upper Cook Inlet (ADF&G, 2006; AKNHP, 2014a; Densmore et al., 2006). Concentrations of molting and nesting Tule geese also occur in Redoubt Bay, Trading Bay, and Susitna Flats (AKNHP, 2014a).

The Cook Inlet region is an important wintering area for many seabirds, including murres, gulls, kittiwakes, cormorants, murrelets, and puffins. Lower Cook Inlet is one of the most productive areas in Alaska for seabirds, with 2.2 million seabirds foraging in the area in July 1992 (Piatt, 1994; cited in ADNR, 2014). Shallow coastal habitats are particularly important for seabirds at sea, as these areas have high densities of forage fish. Shelikof Strait is important to migrating and overwintering waterfowl and nesting seabirds.

3.4.6.3 Birds of Prey

Raptors present in the Project area include the osprey, bald eagle, northern harrier, northern goshawk, sharp-shinned hawk, rough-legged hawk, golden eagle, American kestrel, merlin, Swainson's hawk, Western and Harlans's red-tailed hawk, American and Arctic peregrine falcons, and the gyrfalcon. Owls that are known to be present in the Project area include the great horned owl, great grey owl, northern hawk owl, snowy owl, short-eared owl, boreal owl, and saw-whet owl. Although none of these species are currently listed as threatened or endangered under the ESA, raptors are of special concern to resource managers and regulatory agencies. These birds are also protected under the Migratory Bird Treaty Act (MBTA), 16 U.S.C. §§ 703-712, as amended, and bald and golden eagles are specifically afforded additional protection under the Bald and Golden Eagle Protection Act (BGEPA). A draft *Avian Protection Plan* is included in Appendix E.

The Project area is located within important raptor nesting habitats. The Project corridor is aligned with several other pipeline and utility corridors constructed or proposed during the past 32 years, and extensive biological surveys, including location and identification of raptor nest sites, have been conducted in the vicinity of the Project area over the past 30 years. Raptor nest surveys were conducted during planning, construction, and reauthorization of the TAPS, which the Mainline would parallel from Prudhoe Bay to Livengood. These surveys were conducted in 1979 and periodically from 1993 to 2002. In 2001, an aerial survey was conducted to identify raptor nests along the proposed Alaska Gas Producers Pipeline Team route, which corresponds with the Mainline for most of its length in Alaska. The Alaska Gas Producers Pipeline Team report also included a compilation of data from previous nest identification efforts completed by Ritchie, Timm, White, and others (Ritchie and Palmer, 2002). Craig and Hamfler (2003) conducted cliff-nesting raptors surveys in the Dalton Highway Management Unit from 1999 through 2003. Additional raptor surveys were conducted for the APP in 2012. Periodic nest surveys have also been conducted by resource agencies on discrete sections of the Project area between 1991 and 2003 (Timm and Johnson, 2006); however, data from the most recent agency-conducted surveys have not yet been released.

Some tree-nesting owls, merlins, American kestrels, and ground-nesting raptor species, including the northern harrier, snowy owl, and short-eared owl, were not included in the surveys. Several tree and cliff-nesting raptor species exhibit strong nest fidelity and return year after year to the same nesting area or structure. For this reason, nest surveys that have been previously conducted were used to assist in identifying nesting sites relative to the Project area.

Cliff-nesting raptors are sparsely distributed in uplands and along river courses south of Atigun Pass (Ritchie and Palmer, 2002). Peregrine falcon nests are widespread throughout the Project area, while golden eagle nests are more common south of Atigun Pass, in the cliff habitat of the mountains; bald eagle nests are most common south of the Alaska Range. Preliminary raptor nest data reflect these characteristic distributions of peregrine falcons, golden eagles, and bald eagles (Table 3.4.6-4). Preliminary surveys of the Project area in 2015 identified 57 active raptor nests and two active common raven nests (Table 3.4.6-4). Bald eagles and peregrine falcons made up the majority (78 percent) of the active nests identified (Table

3.4.6-4). Preliminary raptor nest data, including cliff-nesting and tree-nesting raptors, based on 2015 surveys is summarized in Table 3.4.6-5. Preliminary data on bald and golden eagle nests indicate that 78 nest sites may occur within 0.5 mile of Project components. Of the 78 eagle nest sites, 27 were active bald eagle nests (Table 3.4.6-6).

TABLE 3.4.6-4

Raptor Nests[a] Identified within the Study Corridor[b] by Ecoregions

Ecoregion[d]	Spread MPs	Bald Eagle		Golden Eagle		Gyrfalcon		Peregrine Falcon	Rough-legged Hawk		Common Raven	Other[c]		Total
		A	I	A	I	A	I	Active	A	I	Active	A	I	
BCP	0 to 62	0	0	0	0	0	0	2	0	0	0	0		2
BF	62 to 143	0	0	1	0	1	1	12	5	2	1	4	11	38
BR	143 to 252	0	0	4	26	0	1	2	0	0	1	1	32	68
KRV	252 to 257	0	0	0	0	0	0	0	0	0	0	0	0	0
RM	257 to 430	0	0	1	0	0	0	2	0	0	0	0	3	6
TKL	430 to 516	0	0	0	0	0	0	0	0	0	0	0	0	0
YTU	412 to 466	1	0	0	0	0	0	0	0	0	0	0	0	1
AR	516 to 616	2	1	0	9	0	0	0	0	0	0	0	0	2
CIB	616 to 806	24	19	0	0	0	0	0	0	0	0	0	0	43
TOTAL		**27**	**19**	**6**	**26**	**1**	**2**	**18**	**5**	**2**	**2**	**5**	**46**	160

Sources: Preliminary Project Survey Data – FN_RAPTOR_SFS2014_P_prj; FN_RAPTOR_SFS2015_P

[a] Includes identified and probable nests for each species, classified as either active (A), or Inactive or Unknown (I).

[b] The Study Corridor includes the area within 1 mile on either side of the Project footprint.

[c] Unidentified nests were included in the "Other" category.

[d] Ecoregions: BCP = Beaufort Coastal Plain, BF = Brooks Foothills, BR = Brooks Range, KRV = Kobuck Ridge and Valley, RM = Ray Mountains, TKL = Tanana-Kuskokwim Lowlands.

TABLE 3.4.6-5

Raptor Nests Identified within 0.5 miles of Summer Construction Spreads

Start MP	End MP	Length (mile)	Bald Eagle [a,b]		Golden Eagle [a,b]		Peregrine Falcon [a,b]	Rough-legged Hawk [a,b]		Other [a,b,c]		Total
			A	I	A	I	Active	A	I	A	I	
56.6	114.7	58.1	0	0	0	0	4	0	1	1	1	7
168.6	170.2	1.6	0	0	0	0	0	0	0	0	0	0
170.2	177.7	7.5	0	0	0	0	0	0	0	0	0	0
182.1	208.9	26.7	0	0	0	0	0	0	0	1	5	6
251.2	281.4	30.2	0	0	0	0	0	0	1	0	0	1
281.4	314.9	33.4	0	0	0	0	0	0	0	0	0	0

TABLE 3.4.6-5

Raptor Nests Identified within 0.5 miles of Summer Construction Spreads

Start MP	End MP	Length (mile)	Bald Eagle [a,b]		Golden Eagle [a,b]		Peregrine Falcon [a,b]	Rough-legged Hawk [a,b]		Other [a,b,c]		Total
			A	I	A	I	Active	A	I	A	I	
314.9	326.7	11.8	0	0	0	0	0	0	0	0	0	0
326.7	340.3	13.6	0	0	0	0	0	0	0	0	0	0
340.3	347.8	7.5	0	0	0	0	0	0	0	0	0	0
355.8	376.4	20.6	0	0	0	0	0	0	0	0	0	0
382.3	400.7	18.4	0	0	0	0	0	0	0	0	0	0
520.8	532.0	11.1	0	0	0	1	0	0	0	0	0	1
532.0	535.0	3.1	0	0	0	0	0	0	0	0	0	0
535.0	538.7	3.7	0	0	0	2	0	0	0	0	0	2
538.7	542.9	4.2	0	0	0	0	0	0	0	0	0	0
542.9	566.8	23.9	0	0	0	0	0	0	0	0	0	0
566.8	607.4	40.6	0	0	0	0	0	0	0	0	0	0
607.4	665.9	58.5	3	4	0	0	0	0	0	0	0	7
745.9	766.0	20.1	1	1	0	0	0	0	0	0	0	2
793.3	806.6	13.3	0	2	0	0	0	0	0	0	0	2
TOTAL			**4**	**7**	**0**	**3**	**4**	**0**	**2**	**2**	**6**	**28**

Sources: Preliminary Project Survey Data – FN_RAPTOR_SFS2014_P_prj; FN_RAPTOR_SFS2015_P

[a] Includes identified and probable nests for each species, classified as either active (A), or Inactive or Unknown (I).

[b] Includes identified nests within 0.5 mile of the Project footprint, including the LNG Facility and Interdependent Facilities (pipelines, above ground facilities, and infrasatructure),

[c] Unidentified nests were included in the "Other" category.

TABLE 3.4.6-6

Preliminary Eagle Nests within 0.5 Mile of the Project Centerline

Common Name	Approximate Mainline Milepost	Nest Activity[a]	Birds (No.)	Nest Substrate	Tree Type	Nest Age	Summer/ Winter Construction
Probable Golden Eagle	MP 532	Unknown	0	Cliff	N/A	New	Summer
Probable Golden Eagle	MP 542	Unknown	0	Cliff	N/A	Historic	Summer
Probable Golden Eagle	MP 542	Unknown	0	Cliff	N/A	Historic	Summer
Bald Eagle	MP 614	Active	1	Tree	Balsam Poplar	New	Summer
Bald Eagle	MP 615	Active	1	Tree	Balsam Poplar	New	Summer
Bald Eagle	MP 616	Inactive	1	Tree	Balsam Poplar	New	Summer
Bald Eagle	MP 619	Inactive	0	Tree	Balsam Poplar)	New	Summer
Bald Eagle	MP 624	Inactive	0	Tree	Balsam Poplar	New	Summer
Bald Eagle	MP 632	Inactive	0	Tree	Balsam Poplar	New	Summer
Bald Eagle	MP 632	Active	1	Tree	Balsam Poplar	New	Summer
Bald Eagle	MP 652	Active	2	Tree	Balsam Poplar	Historic	Summer

TABLE 3.4.6-6

Preliminary Eagle Nests within 0.5 Mile of the Project Centerline

Common Name	Approximate Mainline Milepost	Nest Activity[a]	Birds (No.)	Nest Substrate	Tree Type	Nest Age	Summer/ Winter Construction
Bald Eagle	MP 721	Active	1	Tree	Balsam Poplar	New	Winter
Bald Eagle	MP 721	Active	1	Tree	Balsam Poplar	Historic	Winter
Bald Eagle	MP 725	Inactive	0	Tree	Balsam Poplar	New	Winter
Bald Eagle	MP 725	Active	1	Tree	Balsam Poplar	New	Winter
Bald Eagle	MP 725	Inactive	0	Tree	Balsam Poplar	New	Winter
Bald Eagle	MP 762	Active	2	Tree	Balsam Poplar	New	Summer
Bald Eagle	MP 764	Inactive	0	Tree	Balsam Poplar	Historic	Summer
Bald Eagle	MP 797	Inactive	0	Tree	Balsam Poplar	Historic	Summer
Bald Eagle	MP 801	Inactive	0	Tree	Balsam Poplar	New	Summer

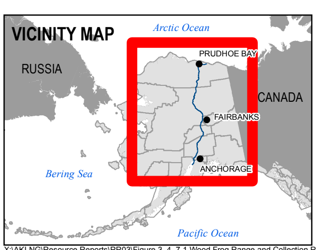
Sources: Preliminary Project Survey Data – FN_RAPTOR_SFS2014_P_prj; FN_RAPTOR_SFS2015_P; PRJ_CONSTRUCTION_SPREADLINES_REVC2_L

[a] Includes identified and probable nests for golden eagles, classified as either active (A), Inactive (I), or Unknown (UK).

3.4.7 Amphibians and Reptiles

No terrestrial reptiles are present in the Project area. One amphibian, the wood frog (*Lythobates* [*Rana*] *sylvatica*), is present in the Project area from Anaktuvuk Pass at the crest of the Brooks Range south throughout Interior and Southcentral Alaska (Figure 3.4.7-1). Wood frogs hibernate in shallow bowl-shaped depressions under a layer of dead vegetation (duff) with snow cover providing extra insulation (Broderson and Tessler, 2008). Wood frogs use diverse vegetation types from grassy meadows to open forests, muskeg, and tundra. They hibernate under the snow in depressions in forest litter (AKNHP, 2014b). In early spring (April and May), wood frogs emerge from dormancy and migrate up to 600 feet to shallow breeding ponds, where they breed in permanent or ephemeral waters (AKNHP, 2014b). Development from egg to tadpole to frog occurs very rapidly to ensure complete metamorphosis before the waterbody dries out or freezes. Although development and growth rate depend on water temperature and food availability, eggs generally hatch in about a week and tadpoles metamorphose into froglets in about eight weeks. Froglets can be found in late July and August (Broderson and Tessler, 2008). Juveniles may disperse from 1,000 to 4,000 feet from natal ponds (AKNHP, 2014b). The population size and trends in Alaska are unknown, but are considered to be stable to slightly declining. Numerous reports from the Kenai Peninsula, Anchorage Bowl, and Talkeetna indicate wood frogs are no longer present at historical breeding sites (AKNHP, 2014b).

VICINITY MAP



X:\AKLNG\Resource Reports\RR03\Figure 3_4_7-1 Wood Frog Range and Collection Records within the Project Area.mxd

LEGEND

- Project Facility
- Existing Facility
- Alaska Place Names
- Wood Frog Collection
- Alaska LNG Rev C2 Route
- Major Highways
- Major Rivers
- Wood Frog Range

0 40 80 160 Miles

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PREPARED BY:	AGDC		
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WOOD FROG RANGE AND COLLECTION RECORDS WITHIN THE PROJECT AREA

FIGURE 3.4.7-1

ALASKA LNG

3.4.8 Terrestrial and Aquatic Invertebrates

Invertebrates are a diverse group of animals that occur in terrestrial, freshwater, and marine habitats. Alaska supports a diversity of terrestrial and aquatic invertebrates that serve important ecosystem functions in food webs and energy networks throughout all of the ecoregions crossed by the Project. In general, most taxa represented within North America occur in Alaska; although, because of harsh climatic conditions and glacial history, invertebrate fauna are generally less diverse.

Alaska has no federal or state-listed terrestrial invertebrates. Common insects include flies, mosquitoes, beetles, moths, butterflies, wasps, and bees. Knowledge of the status of terrestrial invertebrates in Alaska is limited, but two potentially rare groups have been identified: the western bumble bee (*Bombus occidentalis*) and land snails in Arctic and boreal habitats (ADF&G, 2006). In addition, the conservation status of a butterfly, the Eskimo Arctic (*Oeneis alpina*), has been evaluated (McClory and Gotthardt, 2006a).

Common freshwater aquatic invertebrates or aquatic larval stages of terrestrial invertebrates include water fleas, fairy shrimp, midges, black flies, dragonflies, damselflies, mayflies, stoneflies, caddisflies, clams, mussels, and snails. Freshwater aquatic invertebrates provide important nutritional support for freshwater and anadromous fisheries, as well as aquatic and terrestrial food webs, and are important indicators for monitoring water quality. Mayflies, stoneflies, caddisflies or Ephemeroptera, Plecoptera, Trichoptera (EPT) populations are highly sensitive to heavy metals, organic pollutant contamination, and sedimentation and turbidity. This group transfers primary productivity to many vertebrates, including waterbirds and fish. Nonbiting midges and their aquatic or terrestrial larvae are critical to aquatic and terrestrial food webs on Alaska's North Slope (Huryn and Hobbie, 2012).

3.4.8.1 Liquefaction Facility

A benthic survey and benthic macroinvertebrate species bioassessment was performed at the Project MOF area in September, 2015 as part of Project dredging studies. Reports are provided in Resource Report No. 2 Appendix R Analytical Results of Sediment Sampling Near the Marine Terminal in Cook Inlet -Test Pit Attachment 6. The objective of the benthic bioassessment survey was to develop baseline information concerning benthic macroinvertebrate species composition, which is important for evaluating benthic habitat quality. The results show a benthic infaunal community that is generally low in species abundance and diversity. In the analysis of the five benthic samples, there were a total of 37 benthic invertebrate taxonomic identifications and 186 individuals captured by the sampling program. The species were divided into the following groups; Annelida, Crustacea, and Mollusca, for a detailed list of benthic species identified refer to the Benthic Report (Resource Report No. 2, Appendix Q)

A previous 2012 study of the infauna of Cook Inlet found an average abundance of 505 animals per 0.1 square meter grab sample (Fukuyama et al. 2012). The study concluded that there was a strong north-south gradient of increasing diversity. Upper Cook Inlet and industrial areas were found to have much lower numbers of individuals and fewer taxa. The benthic survey bioassessment observation results were similar to Fukuyama et al. (2012). Fukuyama et al. (2012) hypothesized that tidal currents, low salinity, and high turbidity results in a local environment with low total organic carbon and a high proportion of fine sediment. These factors result place a high level of environmental stress on infaunal communities thereby potentially limiting abundance and diversity.

Previous sampling intertidal invertebrate sampling in Middle and Upper Cook Inlet that occurred in August and September 2000 had similar results, finding that the number and scaled biomass of large macrofauna in sediments and on rocks generally decreased with increasing latitude (Lees et al., 2013). Commonly observed invertebrates from Kalifornsky Beach north included the Baltic macoma (*Macoma balthica*) at seven of nine sites, a barnacle (*Semibalanus balanoides*) at five of nine sites, and an isopod (*Saduria entomon*) at four of nine sites (Table 3.4.8-1; Lees et al., 2013). No invertebrates were found on Middle Ground Shoals (Lees et al., 2013). Houghton et al. (2005a) sampled benthic invertebrates using different methods over multiple seasons at Point Woronzof and Point MacKenzie in Upper Cook Inlet and found crustaceans, including a shrimp (*Crangon franciscorus*) and an amphipod *(Lagunogammarus setosus*), were the most abundant (Table 3.4.8-1). Lees et al. (2013) concluded that the distribution and abundance of macroinfauna in Upper Cook Inlet are driven by a complex interrelationship of tidal currents and wave action, turbidity, suspended and deposited nutrients, sediment texture and stability, larval settlement and recruitment success, and predation. Two primary factors are the massive loads of silt transported from river systems and the extreme tidal currents (Lees et al., 2013). Tidal currents influence erosion, ice gouging, sediment texture, and concentrations of organics, resulting in mixing of intertidal sediments within depth of a foot on shoals (Lees et al., 2013). Intertidal infauna from sites in Upper Cook Inlet during August and September 2000 are listed in Table 3.4.8-2.

Subtidal benthic infauna sampling in waters of varying depth near and north of the Forelands in Upper Cook Inlet was completed in August 2008 (Table 3.4.8-3; Cook Inlet Regional Citizens Advisory Council [CIRCAC], 2010). A total of 22 taxa were found at stations in Upper Cook Inlet, with abundance ranging from zero to 111 animals, primarily (93 percent) annelids (Table 3.4.8-3; CIRCAC, 2010). This sampling resulted in collections of previously undescribed species in Upper Cook Inlet, including new polychaetes *Leitoscoloplos* sp. N1 (Station north of West Forelands), *Aphelochaeta* nr. *tigrina* (Station 46), and a new nemertean *Tubulanus* sp. A (Station 79 and 46; CIRCAC, 2010). No nonindigenous species were collected in Upper Cook Inlet. The closest nonindigenous species were collected at the northern end of Kalgin Island: a polychaete (*Microclymene caudata*) from Japan and an anemone (*Halcampa* cf. *duodecimcirrata*) from the north Atlantic Ocean (CIRCAC, 2010).

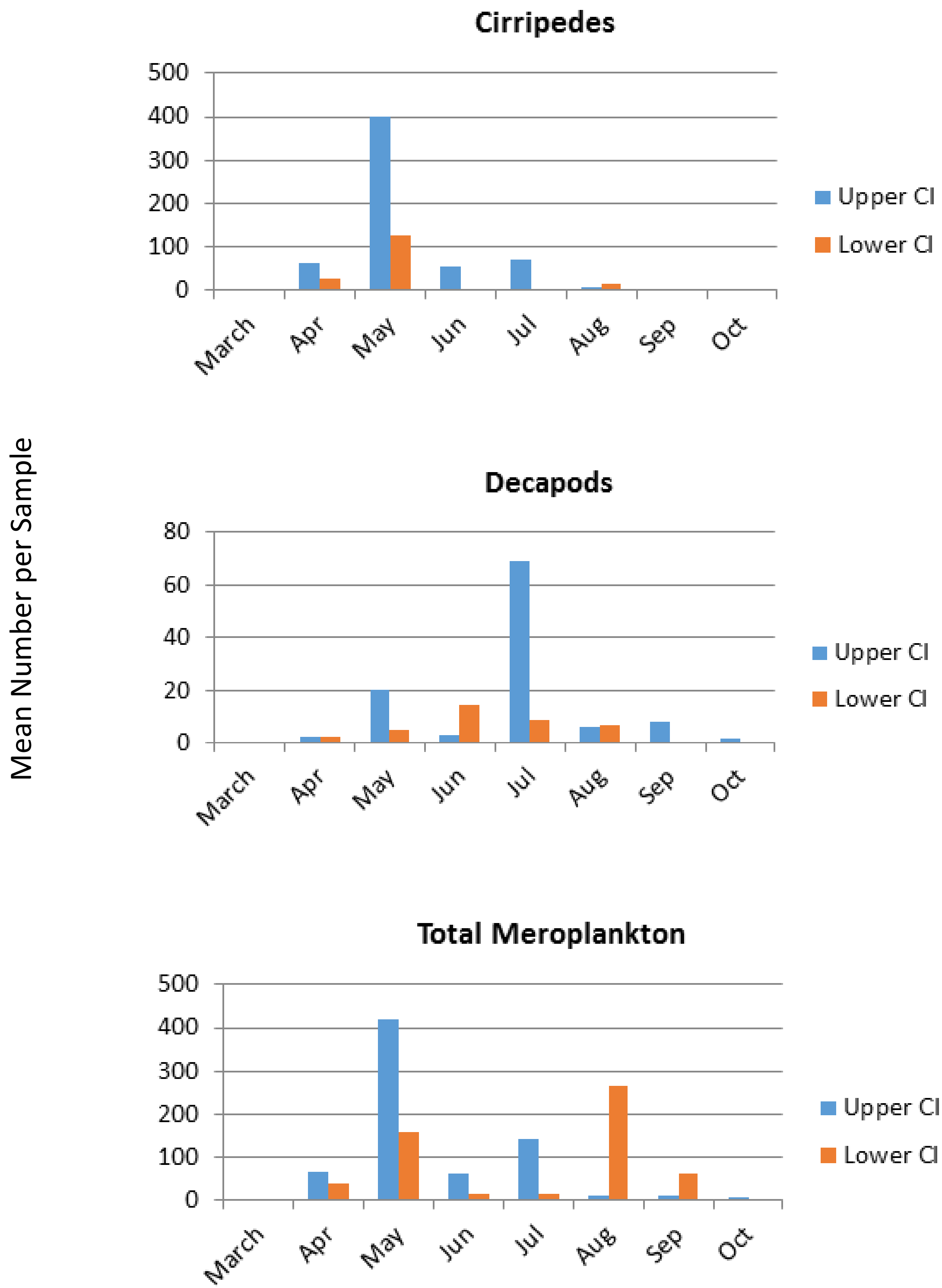
The intertidal and subtidal habitats of Cook Inlet support infaunal and epifaunal invertebrate communities, which are a trophic link between primary producers (i.e., plankton) and higher trophic level organisms. The higher trophic levels they support include commercially import species (e.g., shellfish, crabs, salmon) (BOEM, 2016). A discussion of water depths, tides, and sediments in the Project area is provided in Section 2.3.2.1 of Resource Report No. 2. The area is not noted to have sensitive shoreline habitats (e.g., sheltered tidal flats, sheltered rock shores, or exposed tidal flats) (NOAA, 2002) and the results of NOAA's habitat mapping of the area is provided in Appendix B-1. Within the limits of the MOF, the sediments consist of medium dense sandy silt and sand overlying hard sandy clay. Cobbles and boulders of varying sizes up to 10 feet to 15 feet in diameter are also present (CH2MHill, 2015). Therefore, subtidal epifaunal organisms would consist primarily of crustaceans (e.g., crabs and shrimp) and echinoderms. The presence of epifaunal suspension feeders (e.g., sponges, anemones, mussels) would be more characteristic of rocky habitats. Coral reefs have not been identified in Cook Inlet and identified rocky reefs occur south of the Project area in lower Cook Inlet (BOEM, 2016). Geophysical and geotechnical surveys were conducted by the Applicant in 2015 in Cook Inlet in the MOF Project area and along the submerged Mainline route crossing Cook Inlet; the results of the surveys are included in Resource Report No. 6, Appendix A and Appendix C.

The benthic infauna community in the area is typical of soft sediment habitats. Based on studies conducted in Cook Inlet, sandy, silty, and muddy intertidal substrates are generally dominated by infaunal suspension- and deposit-feeders, particularly polychaete worms, gammarid amphipods, and clams. Deeper sands are generally dominated by clams and echiurid worms (BOEM, 2016). Sampling results in the area of the MOF at the Liquefaction facility indicate a generally low species abundance and diversity of the infauna present at the site. The dominant taxa present were polychaetes (e.g., *Melinna elisabethae*, Spionidae, Terebellidae) and crustaceans (e.g., Cirripedia, *Leptochelia savignyi*). Taxa richness was approximately 10 species per sample and fewer than 40 individuals per sample, averaged over five 0.1 m^2 samples collected using a sediment sampler. There was a high degree of heterogeneity found among samples, indicating differences in community composition over samples a relatively short distance apart. Strong tidal currents, low salinity, and high turbidity result in a local environment with low total organic carbon and a high proportion of fine sediment, placing a high level of stress on the infauna communities; presumably limiting abundance and diversity (CH2M, 2016b).

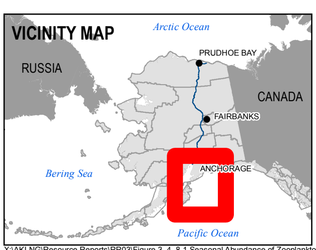
In Cook Inlet, generally the nutrient supply decreases as distance from shore increases, resulting in decreased benthic productivity in relatively deeper subtidal areas. The benthic habitat in deeper waters of Cook Inlet is characterized by unconsolidated sediments on a smooth bottom and strong tidal currents. Benthic infaunal communities in the deeper areas are represented by two major infaunal groups: deposit feeders characterize muddy substrata, and suspension feeders dominate sandy substrata. Infaunal invertebrates within the deep subtidal benthic community primarily consist of mollusks, polychaetes, and bryozoans. These subtidal infaunal organisms are important trophic links for crabs, flatfishes, and other common Cook Inlet organisms (BOEM, 2016).

Juvenile salmon smolt feed on phytoplankton, zooplankton, and ichthyoplankton (e.g., fish eggs, larval fish). The species composition, distribution, abundance, and seasonal variation of plankton species in Cook Inlet are strongly influenced by the physical environment (EPA, 2013). Upper Cook Inlet is comparatively less productive than lower Cook Inlet due to extreme tidal variation and turbidity. Upper Cook Inlet is fed by silt-laden streams, resulting in high levels of suspended sediment (Kinney et al., 1970) that can retard phytoplankton growth (e.g. primary productivity) by reducing light penetration (Feely et al., 1981). Many zooplankton are major consumers of phytoplankton; thus, the factors influencing phytoplankton's primary productivity indirectly affect zooplankton populations. Consequently, zooplankton are also less abundant in Upper Cook Inlet than in lower Cook Inlet, south of the Forelands (Science Applications International Corporation [SAIC], 2002).

Cook Inlet zooplankton data have been collected using the Continuous Plankton Recorder (CPR) transect method. The CPR samples the Alaskan shelf and crosses the slope into the open Gulf of Alaska, providing a record of taxonomically resolved near-surface zooplankton and large phytoplankton abundance over wide spatial scales. Nine CPR data points from Upper and Lower Cook Inlet are located in close proximity to the Project area (Batten and Welch, 2015). These data were recorded in 2004, 2005, and 2006. Small copepods were the most abundant zooplankton recorded with large copepods, euphausiids (krill), chaetognaths (arrow worms), and cirrepedes (larval barnacles) present in lower numbers. Diatoms were abundant at two sampling locations during 2005, but were not reported during 2004 or 2006. Very few phytoplankton were present in the CPR samples. No ichthyoplankton were recorded in Upper Cook Inlet. Seasonal patterns for Cook Inlet indicate that phytoplankton abundance peaks in August and meroplankton abundance peaks in May (cirripedes) and July (decapods – larval crabs and shrimp) in Upper Cook Inlet (Figure 3.4.8-1; Batten and Welch, 2015). Bivalves (larval clams) were not recorded in Cook Inlet CPR data, cyphonautes (larval bryozoans) occurred only in Lower Cook Inlet, and echinoderms (larval sea stars and urchins) occurred primarily in Lower Cook Inlet (Batten and Welch, 2015).



VICINITY MAP



LEGEND

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SEASONAL ABUNDANCE OF ZOOPLANKTON IN COOK INLET

FIGURE 3.4.8-1

ALASKA LNG

X:\AKLNG\Resource Reports\RR03\Figure 3_4_8-1 Seasonal Abundance of Zooplankton in Cook Inlet.mxd

3.4.8.2 Interdependent Project Facilities

3.4.8.2.1 Beaufort Sea

Productivity in the water column of the Beaufort Sea is primarily controlled by temperature, nutrients, light, and the amount of sea ice. Phytoplankton productivity is highest in the summer and plankton abundance generally decreases from inshore to offshore areas, except where there is upwelling. Deposits of flocculated particles from plankton blooms, epontic organisms, and ice algae from ice retreat all contribute to the bottom habitat of the Beaufort Sea, which consist predominantly of silt, clay, and sand (BOEM, 2014). Marine benthic communities in the Beaufort Sea contain numerous species of epifaunal and infaunal invertebrates, as well as microalgae (diatoms), large and small species of macrophytic algae, and bacteria (MMS, 1996).

Disturbance from sea-ice scour is a dominant process affecting the seafloor, including Prudhoe Bay. The ice-impacted nearshore areas are recolonized each summer, mainly by mobile, opportunistic, epifaunal crustaceans (e.g., amphipods, mysids, cumaceans, and isopods), which are fed on primarily by waterfowl and fishes. Farther offshore the ice impacted areas are habitat for opportunistic infauna (e.g., small clams and other invertebrates), which are fed on by seabirds, fishes, and walrus (BOEM, 2014). The juveniles and adults of a number of benthic species in the nearshore and coastal waters of the Beaufort Sea do not live in constant association with bottom sediments. Instead, certain species may opportunistically leave the bottom sediments, usually during the spring, to become grazers or predators on epontic (within- or under-ice) communities that are composed primarily of diatoms and meiofauna. Larvae of some benthic polychaetes and molluscs spend part of their life cycle inside sea ice as members of that epontic community. Juveniles of benthic species may also spend time as members of the zooplankton in the water column and may graze or prey on plankton until reaching their adult stages and retreating to the bottom (Homer, 1979; Homer and Murphy, 1985).

The nearshore environment of the Beaufort Sea ranges from the shoreline to a depth of 5–6 feet, which corresponds to the bottom-fast ice zone. The coastal (sometimes called inshore) environment ranges from about 6 to 65 feet and includes deeper areas inside the barrier islands as well outside of the islands. Offshore areas include those greater than approximately 66 feet and extending out across the continental shelf. The majority of the Beaufort Sea nearshore and coastal environment consists of large expanses of soft-substrate, silty muds, or sands (Alaska LNG, 2014). Marine soft-bottom habitats in nearshore waters of the Beaufort Sea, such as those near West Dock, support benthic communities of microalgae, bacteria, polychaete and oligochaete worms, small mollusks, and amphipods (Broad et al,. 1979). Invertebrate abundance and distribution data for the nearshore Arctic coast indicate that polychaete worms and small mollusks are the predominant infaunal organisms, while isopods, nemerteans, and benthic amphipods are the predominate epifaunal invertebrates (Broad et al., 1978). Offshore in Stefansson Sound, mud and silt substrates are interrupted with sporadic boulders and cobble that support Arctic kelp beds (Barnes and Reimnitz, 1974).

A discussion of water depths, tides, and sediments in the Project area is provided in Section 2.3.2.2.2 of Resource Report No. 2. Borehole data from the West Dock area indicates that it consists of a 0.5 to 6-foot thick layer of sandy and clayey silt at the seafloor, underlain by gravelly to silty sand (Alaska LNG, 2014). Special aquatic sites, including sanctuaries and refuges, mud flats, vegetated shallows, coral reefs, and riffle and pool complexes, also do not exist in the Project area. The only special aquatic site in the region that has been identified is the “Boulder Patch,” which is located approximately 20 miles to the east of West Dock (Dunton and Schonberg, 2000). Within the Boulder Patch area, localized deposits of gravel, cobble, and small boulders (<1 meter in diameter) provide unique habitat for attached algae and epifauna resulting in an enriched community as compared to the soft-bottom substrate present throughout most of the Beaufort Sea (Alaska LNG, 2016). Boulders have not been previously found in the vicinity of West Dock. Therefore, there is no indication of the presence of an enriched "boulder patch" environment that might support a community of brown kelps and other hard-substrate flora and fauna in the Project area (Alaska LNG, 2014).

As noted above, ice physically disturbs bottom sediments and limits the abundance and distribution of infaunal and to a lesser extent, epifaunal organisms, as well as algae. Bottom-fast ice in nearshore waters prohibits over-wintering of most benthic species, resulting in a population dependent upon colonization during ice-free periods by motile species (Alexander et al., 1975; MMS 1990). However, oligochaete worms and midge (chironomid) larvae appear to be able to survive in the bottomfast ice zone (Broad et al., 1979). Because of the nearshore ice process, epifaunal species such as isopods, amphipods, and mysids that are highly mobile and opportunistic characterize nearshore areas. Outside of nearshore waters, in coastal areas less than ~65 feet in depth, both biomass and diversity of the infauna increase with water depth (MMS 1990). Polychaete worm and clam abundance typically increase with depth from the nearshore bottomfast ice zone (Broad et al., 1978). In the shear zone, at ~50- to 70-foot water depths where shorefast ice and the moving pack ice meet, ice gouging can further disturb bottom sediments, limiting infaunal abundance (MMS 1990).

Houghton (2012) presented and summarized past and recent surveys of benthic infauna and epifauna at the West Dock DH 4 construction area, the berthing basin area, and the former APP potential dredge disposal area. Results of infauna sampling were similar to previous programs in the vicinity with generally low abundance of animals and dominance of mobile crustaceans at shallow stations typical of areas affected by bottomfast ice (Table 3.4.8-4). Infaunal density and biomass were greater in a nearby alternative disposal area (see Section 10.6.4.2.2 of Resource Report No. 10) than in the DH 4/berthing basin area primarily due to a greater abundance of larger polychaetes and bivalve mollusks. The polychaete *Ampharete vega* was the most abundant animal at eight of nine sample stations and was the most abundant single species in the infauna. More abundant and diverse infaunal communities were typical in deeper waters beyond the bottomfast ice zone, but where the bottom may occasionally be disturbed by ice keels. Epibenthic invertebrates sampled by trawls in the dredge disposal and reference areas included 25 invertebrate taxa (Table 3.4.8-5), dominated numerically by the mysid shrimp *Mysis littoralis* with biomass dominated by the large isopod *Saduria entomon*. The stations sampled were representative of conditions throughout much of Stefansson Sound outside of the areas with hard bottom known as the Boulder Patch (Houghton, 2012).

Sampling at the former APP potential dredge disposal sites in 2015 included benthic infauna sampling using grab samples or cores sieved to obtain macrofauna and megafauna (Section 9 of Appendix R in Resource Report No. 2). Trawling was completed to characterize epibenthic invertebrate assemblages. In terms of total counts, about 80 percent of the biomass of the infauna collected by grab samples or cores were annelids (worms). Crustaceans and mollusks were the second- and third-most-abundant groups. Of the annelids, the slender tube-dwelling polychaete (*Pygospio elegans*) was most common with *Ampharete vega* also abundant. Among crustaceans, the isopod *Saduria entomon* was by far the most abundant and the Gammarid amphipod *Monoporeia affinis* was second-most abundant. All of the mollusks documented in the study were bivalve clams. The most abundant mollusk was *Cyrtodaria kurriana*. The second-most-common bivalve was *Macoma balthica*. Species present in low numbers includes the hydrozoan *Tubularia indivisa*, the sea grape (*Rhizomolgula globularis*), the priapulid worm (*Priapulus caudatus*), and colonial bryozoans identified as *Alcyonidium spp.* and *Synnotum spp.*

Crustaceans comprised the majority of the trawl catch. *Saduria spp.* were most abundant with benthopelagic mysid shrimp (*Mysidae*, unidentified) and several species of amphipod (*Gammarus setosus*, *Gammaracanthus loricatus*, *Monoporeia affinis*, and *Weyprechtia heuglini*) also common. Less abundant species included the solitary sea grape tunicate (*R. globularis*), various unidentified hydroid medusa, and colonial bryozoans (*Alcyonidium* spp. and *Synnotum* spp.). Mysids, amphipods, copepods, isopods, and euphausiids comprise a major portion of the diets of some fish (MMS, 1990).

Similar results were found in a comparison of sediment samples collected in proximity to West Dock DH 2 in water depths of approximately 5 to 8 feet and farther offshore at depths of approximately 11–13 feet. Annelids and crustaceans were found to be present at all sites. Polychaetes were the dominant infauna, with *A. vega* or *Tharynx* spp. being the dominant species. Trawl sampling performed in conjunction with the Project indicates that mysids and the isopod *Saduria* spp. are the most abundant epibenthic invertebrates documented in the general vicinity (Alaska LNG, 2014).

TABLE 3.4.8-1

Middle and Upper Cook Inlet Intertidal Invertebrate Summary

Group	Taxa[a]	West Side Cook Inlet				East Side Cook Inlet						
		Beluga River SW[b]	Nikolai Creek[b]	West Foreland North[b]	West Foreland South[b]	Point MacKenzie (KA 16)[c]	Point Woronzof (KA 13)[c]	Chick-aloon Bay[b]	Moose Point[b]	Bishop Creek Beach[b]	Boulder Point[b]	Kalifornsky Beach[b]
Annelida: Polychaeta	*Abarenicola pacifica*	S	0	0	0			0	0	0	0	42.4
Annelida: Polychaeta	*Laonnates* sp. (?)	0	A	0	0			A	0	0	0	0
Annelida: Polychaeta	*Neanthes limnicola*					0.1	0.1					
Annelida: Polychaeta	Sabellidae (unknown)	0	0	0	0			0	0	0	0	S
Arthropoda: Amphipoda	*Anisogammarus pugettensis*	0	0	S	0			0	0	0	S	0
Arthropoda: Amphipoda	Gammarid amphipod	0	0	0	C			0	0	0	0	0
Arthropoda: Amphipoda	*Lagunogammarus setosus*					0.4	21.6					
Arthropoda: Amphipoda	*Onisimus* sp.					0	0.9					
Arthropoda: Cirripedia	*Semibalanus balanoides*	0	0	1.4	S			0	S	0	S	C
Arthropoda: Decapoda	*Crangon* sp.	0	0	S	0	9.4	2.2	0	0	0	0	0
Arthropoda: Decapoda	*Crangon franciscorum*					61.6	33.9					
Arthropoda: Decapoda	*Crangon nigricauda*					2.1	1.7					
Arthropoda: Diptera	Chironomid	0	0	0	0			0	S	C?	0	0
Arthropoda: Isopoda	*Saduria entomon* (?)	C	0	S	S?	0.1	1.7	0	S	0	0	0

TABLE 3.4.8-1

Middle and Upper Cook Inlet Intertidal Invertebrate Summary

Group	Taxa[a]	West Side Cook Inlet				East Side Cook Inlet						
		Beluga River SW[b]	**Nikolai Creek[b]**	**West Foreland North[b]**	**West Foreland South[b]**	**Point MacKenzie (KA 16)[c]**	**Point Woronzof (KA 13)[c]**	**Chick-aloon Bay[b]**	**Moose Point[b]**	**Bishop Creek Beach[b]**	**Boulder Point[b]**	**Kalifornsky Beach[b]**
Arthropoda: Mysida	*Mysis litoralis*					<0.1	0.1					
Arthropoda: Mysida	*Neomysis rayii*					7.3	4.1					
Arthropoda: Mysida	*Neomysis mercedis*					0.8	0.1					
Cnidaria: Anthozoa	*Urticina crassicornis*	0	0	0	0			0	0	0	C	S
Cnidaria: Hydrozoa	Campanulariidae (unknown)	0	0	0	S			0	S	0	0	0
Cnidaria: Hydrozoa	Corynidae (unknown)	0	0	0	0			0	0	0	0	C
Echinoderm	Asteroidea (unknown)	0	0	0	0			0	0	0	0	C
Mollusca: Bivalvia	*Macoma balthica*	A	S	S	A	X	0	461.3	0	S	0	2.4
Mollusca: Bivalvia	*Yoldia* sp.	0	0	0	0			0	0	0	0	X
Mollusca: Gastropoda	*Beringius kennicottii*	0	0	S	0			0	0	0	0	0
Mollusca: Gastropoda	*Littorina sitkana*	0	0	S (YOY)	0	0	<0.1	0	S	0	0	0
Mollusca: Gastropoda	Lottiidae (unknown)	0	0	0	0			0	S	0	0	0
Mollusca: Gastropoda	*Nucella lima*	0	0	0	0			0	0	0	0	C
Mollusca: Gastropoda	*Onchidoris bilamellata*	0	0	0	0			0	0	0	0	A

TABLE 3.4.8-1

Middle and Upper Cook Inlet Intertidal Invertebrate Summary

Group	Taxa[a]	West Side Cook Inlet				East Side Cook Inlet						
		Beluga River SW[b]	Nikolai Creek[b]	West Foreland North[b]	West Foreland South[b]	Point MacKenzie (KA 16)[c]	Point Woronzof (KA 13)[c]	Chick-aloon Bay[b]	Moose Point[b]	Bishop Creek Beach[b]	Boulder Point[b]	Kalifornsky Beach[b]
Mollusca: Gastropoda	*Volutharpa ampullacea*	0	0	0	0			0	0	0	0	C

Sources: Lees et al., 2013, Table 3-4 (all sites except Point Woronzof and Point MacKenzie); Houghton et al., 2005a, Table B-1 (Point Woronzof and Point MacKenzie)

[a] Where "?" appears within a taxa there may be a question on identification.

[b] Lees et al., 2013: Quantity based on 2.7 square feet, qualitative based on visual observations.
Qualitative abundance: S = Sparse, C = Common, A = Abundant, X = Observed, YOY = Young of Year

[c] Houghton et al. 2005a: catch per unit effort for beach seine, X = Observed

TABLE 3.4.8-2

Middle and Upper Cook Inlet Intertidal Infauna Summary

		West Side Cook Inlet				East Side Cook Inlet			
Group	**Taxa[a]**	**Beluga River SW**	**Nikolai Creek**	**West Foreland North**	**West Foreland South**	**Chickaloon Bay**	**Moose Point**	**Bishop Creek Beach**	**Kalifornsky Beach**
Annelida: Polychaeta	*Abarenicola pacifica*	0	0	0	0	0	0	0	0.4
Annelida: Polychaeta	*Capitella capitat*	0	0.2	0	0	0	0	0	0
Annelida: Polychaeta	*Dipolydora caulleryi*	0	0.2	0	0	0	0	0	0
Annelida: Polychaeta	*Eteone longa*	0.2	0.2	0	5.2	0.2	0	0	0
Annelida: Polychaeta	*Leitoscopoplos pugettensis*	0	0	0.2	0	0.2	0	0	0
Annelida: Polychaeta	*Nephtys longosetosa*	0	0	0	0	0	0	0	0.2
Annelida: Polychaeta	*Pygospio elegans*	0	0	0	2	0	0	0	0
Annelida: Polychaeta	*Scolelepis squamata*	0	0	0	0	0	0.2	0	0.6
Arthropoda: Amphipoda	*Grandifoxus acanthinus*	0	0	0.2	0	0	0	0	0
Arthropoda: Amphipoda	*Potoporeia femorata*	0	0	0	0	0	0	0.2	0
Arthropoda: Decapoda	*Crangon alaskensis*	0	0	0	0	0	0	0.2	0
Mollusca: Bivalvia	?*Montacuta* sp.	0	0	0	0.2	0	0	0	0
Mollusca: Bivalvia	*Macoma balthica*	2.6	1.4	0	53	86	0	0.6	0.4

[a]Source: Lees et al., 2013, Table 3-7
Average abundance in core samples, abundance = number of individuals in sample

TABLE 3.4.8-3

Upper Cook Inlet Subtidal Benthic Infauna Summary[a]

						Annelids		Arthropods		Mollusks		Other		Total	
Station	**Lat**	**Lon**	**Depth**	**Diversity**	**CI Side**	**Taxa**	**Abund**	**Taxa**	**Abund**	**Taxa**	**Abund**	**Taxa**	**Abund**	**Taxa**	**Abund**
67	60.9862	-151.4521	23.0	0	W	0	0	0	0	0	0	0	0	0	0
79	60.9468	-151.5388	54.5	0	W	0	0	0	0	0	0	0	0	0	0
79a	60.9565	-151.5419	7.2	1.311	W	1	3	2	3	0	0	1	3	4	9
51	60.8336	-151.7260	20.3	1.035	W	6	111	0	0	0	0	0	0	6	111
100	60.8292	-151.7420	3.0	0.693	W	2	2	0	0	0	0	0	0	2	2
7	60.8289	-151.6700	74.5	N/A	W	0	0	0	0	0	0	0	0	0	0
69	60.8243	-151.7248	22.6	1.470	W	6	48	0	0	1	1	0	0	7	49
48	60.8149	-151.7525	5.6	1.099	W	3	3	0	0	0	0	0	0	3	3
32	60.8075	-151.7507	9.5	1.334	W	7	50	0	0	0	0	0	0	7	50
46	60.7015	-151.7787	35.1	0.562	W	1	3	0	0	0	0	1	9	2	12
60	60.7629	-151.2793	19.7	0.637	E	2	3	0	0	0	0	0	0	2	3
16	60.7569	-151.3301	80.6	0	E	0	0	0	0	0	0	0	0	0	0
16a	60.7480	-151.3351	56.8	0	E	1	1	0	0	0	0	0	0	1	1
59	60.7380	-151.3677	62.0	0	E	0	0	0	0	0	0	0	0	0	0
Total							**224**		**3**		**1**		**12**		**240**

[a] Source: CIRCAC, 2010, Tables 2.2-1, 6.3-1, and 6.3-9.

Station – location identifier, Depth – adjusted for tides in feet, CI Side (Cook Inlet Side) – W = west or E = east, Taxa – number of taxa, Abund – abundance as number of individuals per sample

TABLE 3.4.8-4

West Dock Berthing Basin and Former APP Potential Dredge Disposal Area Infauna Summary

Infauna Group	Berthing Area (*n* = 3)		Former APP Potential Dredge Disposal Area					
			Proposed Site (*n* = 5)		Reference (*n* = 4)		Combined (*n* = 9)	
	Density	Biomass	Density	Biomass	Density	Biomass	Density	Biomass
Macroinfauna (retained on 1-millimeter screen)								
Annelida	1,037	3.9	5,296	58.8	4,861	40.9	5,103	50.8
Crustacea	235	6.3	504	38.1	176	6.5	358	24.1
Mollusca	198	0.5	1,704	119.5	1,565	112.9	1,642	116.6
Other Taxa	37	0.1	14.8	0.1	120.4	5.9	62	2.7
All Taxa	1,506.2	10.8	7,518.5	216.5	6,722.2	166.2	7,164.6	194.1
Megainfauna (retained on 6-millimeter screen)								
Annelida	17	0.3	176	8.0	78	3.8	132	6.1
Crustacea	16	15.8	12	11.8	9	3.5	11	8.1
Mollusca	2	1.2	104	37.9	36	18.6	74	29.3
Other Taxa	1	0.0	2.2	0.2	4.6	0.1	3	0.2
All Taxa	36.6	17.4	293.8	57.9	127.3	26.0	219.8	43.8

Source: Houghton, 2012, Table 15 (Note: rows for disposal and reference sites mislabeled in Table 15)
n – sample size
Density – Number of individuals per square meter (10.7 square feet)
Biomass – wet weight, grams per square meter (10.7 square feet)

TABLE 3.4.8-5

Former APP Potential Dredge Disposal Area at West Dock Epibenthic Invertebrate Summary

Group	Taxa	Description	Effort
Annelida: Polychaeta	*Eunoe nodosa*		0.01
Annelida: Polychaeta	Orbiniidae		0.01
Annelida: Polychaeta	Spionidae		0.01
Annelida		*Subtotal*	*0.03*
Arthropoda: Amphipoda	*Acanthostephaeia behringienses*		0.11
Arthropoda: Amphipoda	Amphipoda		1.00
Arthropoda: Amphipoda	*Atylus carinatus*		0.09
Arthropoda: Amphipoda	*Caprella* sp.		0.01
Arthropoda: Amphipoda	*Gammaracanthus loricatus*		0.05
Arthropoda: Amphipoda	*Gammarus wilkitzkii*		0.01
Arthropoda: Copepoda	Calanoida A		0.11
Arthropoda: Copepoda	Calanoida B		0.02
Arthropoda: Euphausiidae	Euphausiidae	Krill	0.01
Arthropoda: Isopoda	*Saduria entomon*		4.20
Arthropoda: Isopoda	*Saduria sabini*		0.01
Arthropoda: Mysida	Mysida		0.01
Arthropoda: Mysida	*Mysis litoralis*		6.18

TABLE 3.4.8-5

Former APP Potential Dredge Disposal Area at West Dock Epibenthic Invertebrate Summary

Group	Taxa	Description	Effort
Arthropoda: Nymphonidae	*Nymphon brevitarse*		0.06
Crustacea		*Subtotal*	*11.87*
Mollusca: Bivalvia	Bivalvia	Clam	0.01
Mollusca		*Subtotal*	*0.01*
Chaetognatha	*Sagitta elegans* [*Parasagitta elegans*]	Arrow worm	0.03
Cnidaria: Anthozoa	Anthozoa	Anemone	0.01
Cnidaria: Hydrozoa	Hydrozoa	Jellyfish	0.01
Cnidaria: Hydrozoa	*Tubularia indivisa*		0.01
Ctenophora	Ctenophora	Comb jellies	0.02
Nemertea	Nemertinea		0.01
Unknown	Egg cases (unknown)		0.34
Other Taxa		*Subtotal*	*0.43*
Total			**12.32**

Source: Houghton, 2012, Table 10
Effort = catch per 1,076 square feet using an otter trawl; column does not total due to rounding – total from Table 10.

3.4.8.2.2 Cook Inlet

Interdependent Project Facilities in Cook Inlet include the Mainline route across Upper Cook Inlet to the Kenai Peninsula. Lees et al. (2013) found the sand beachface and mud flat south of the Beluga River near where the Mainline would enter Cook Inlet was a moderately productive site with the clam Baltic macoma (*Macoma balthica*) abundant, and lugworms (*Abarenicola pacifica*) common in the lower intertidal muddy sediments (Table 3.4.8-1). Tracks on the surface of sediments and young isopods (*Saduria entomon*, using notation from Lees et al., 2013) were common on the sandy lower reaches of the beachface (Table 3.4.8-1; Lees et al., 2013). Infauna at this site also included the polychaete *Eteone longa* (Table 3.4.8-2; Lees et al., 2013). Lees et al. (2013) sampled the shoreline near Boulder Point where the Mainline would exit Upper Cook Inlet and found the site was a mix of sediment sizes from sand to cobbles separated from the beachface by a well-defined intertidal sand bar. Productivity appeared low with sparse amphipods (*Anisogammarus pugettensis*) under boulders and barnacles (*Semibalanus balanoides*) on boulders (Table 3.4.8-1; Lees et al., 2013). Large sea anemones (*Urticina crassicornis*) occurred in protected crevices between large boulders, and were large enough to represent overwintering populations (Table 3.4.8-1; Lees et al., 2013).

Benthic infauna samples in subtidal sediments were dominated by polychaete worms in Upper Cook Inlet, as discussed in Table 3.4.8-3 (CIRCAC, 2010). No nonindigenous marine invertebrates have been documented in Upper Cook Inlet (CIRCAC, 2010).

3.4.9 Sensitive Wildlife Habitat Areas

3.4.9.1 BLM Areas of Critical Environmental Concern (ACECs)

At various locations along the Mainline corridor ACECs have been designated; they are managed by the Arctic and Central Yukon area field offices of the BLM (Figure 3.4.9-1; Table 3.4.9-1). Between the area south of TAPS Pump Station 3 and the Yukon River along the Dalton Highway, the Project area is within the BLM utility corridor. The utility corridor consists of an inner and outer corridor. The majority of the Mainline and its aboveground facilities would be located in the inner corridor.

Various non-energy transportation activities are restricted within the inner corridor, and with few exceptions, the area is primarily devoted to energy transportation (Public Land Order 5150). These exceptions include ACECs, where special management attention is required to protect and prevent irreparable damage to important historic, cultural, or scenic values, fish and wildlife resources, or other natural systems or processes, or to protect life and safety from natural hazards. Generally, development activities and future energy transportation systems are allowed (BLM, 1989).

The Mainline corridor would cross two ACECs: The Toolik Lake RNA and the Galbraith Lake ACEC (Figure 3.4.9-1; Table 3.4.9-1). Other BLM-designated ACECs that would be skirted, north to south, include West Fork Atigun River, Snowden Mountain, Sukakpak Mountain, Nugget Creek, Poss Mountain, and Jim River (Figure 3.4.9-1; Table 3.4.9-1). These ACECs are used by Dall sheep (Craig and Leonard, 2009).

The Toolik Lake RNA will be crossed by the Mainline corridor for about 10.6 miles. The Toolik Lake RNA is an 82,800-acre parcel that is located within the inner utility corridor. This RNA was established to protect a natural lake and tundra biome, habitats crucial to species listed as threatened, endangered, candidate, or sensitive by the USFWS and the State of Alaska. The Area is used extensively for Arctic natural resources research (BLM, 1989a).

The Galbraith Lake ACEC would be crossed by the Mainline corridor for about 11.5 miles. This 56,000-acre ACEC was established to protect historic and cultural resources, Dall sheep lambing areas and mineral licks, and scenic value, geology, and paleontological resources (BLM, 1989a). The Galbraith Lake ACEC encompasses Galbraith Lake, three large drainages that discharge into the lake, the Atigun River valley, and the sides of the valley. Vegetation in this ACEC is predominately dwarf shrub and dwarf shrub-lichen. The foothills east of Galbraith Lake are valuable to sheep early in the spring, both as a lambing area and spring foraging area, particularly for the nursing ewes. The Galbraith Lake ACEC contains four known lambing areas. Sheep use the west- and south-facing slopes on the eastern side of the Atigun River valley near Atigun Gorge during the spring as lambing-nursery areas. Vegetation in this area emerges earlier in the spring, providing an abundant food source. BLM representatives have observed up to 200 sheep on Black Mountain, a site where early vegetation growth is prevalent. As summer progresses, seasonal movements of sheep to higher elevations occur, including movements out of this ACEC. Winter range covers much of the high ridges of this ACEC.

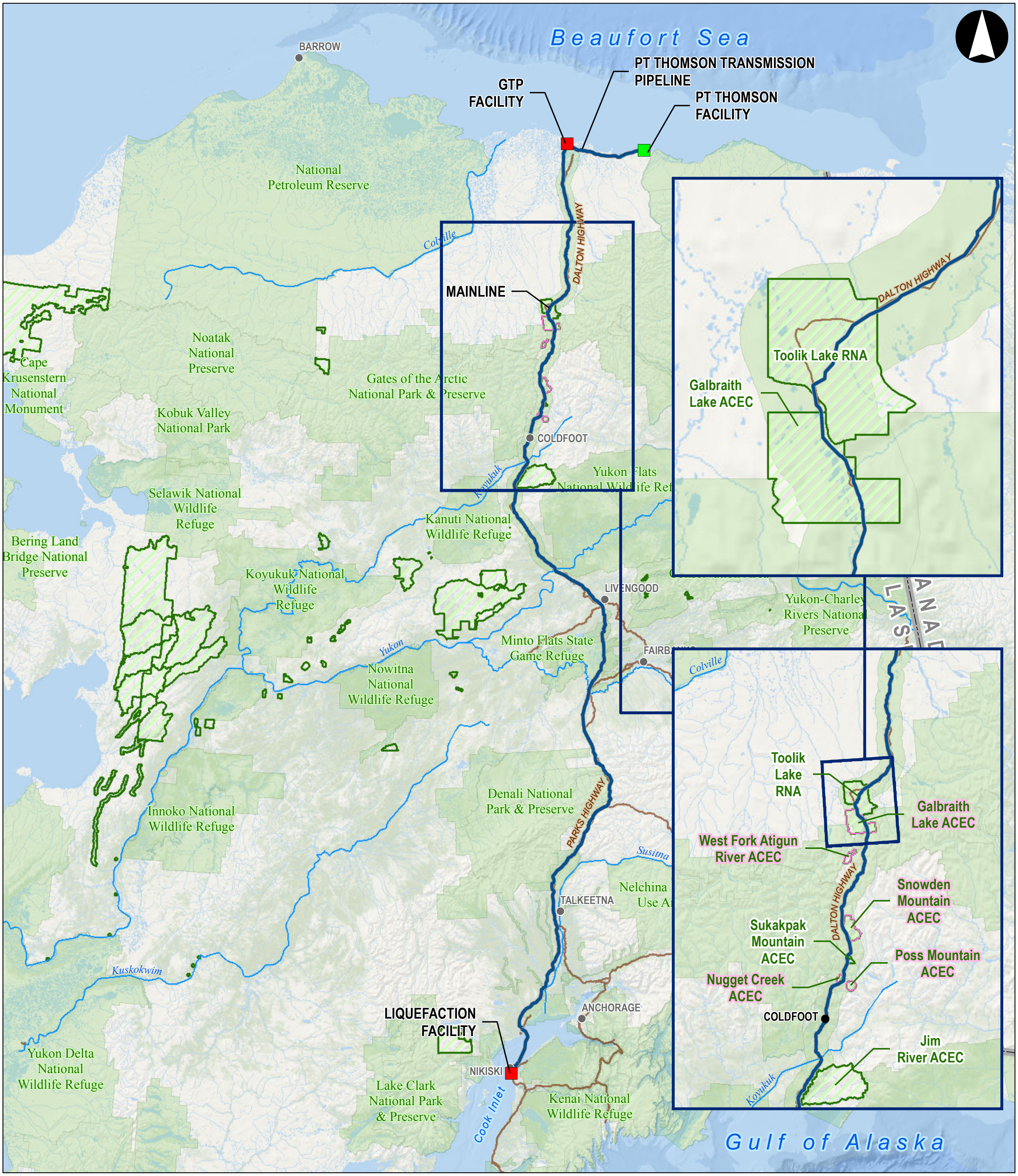
TABLE 3.4.9-1

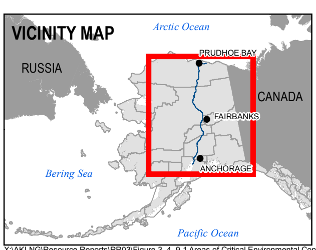
Proximity of Project Components to BLM Areas of Critical Environmental Concern (ACECs)

Sensitive Wildlife Habitats	Closest Facility	Nearest Distance (Miles)	Nearest MP	Start MP	End MP
BLM ACECs (North to South)					
Mainline					
Toolik Lake Research Natural Area – Research	Construction ROW	N/A	127.17	127.17	MP 137.8
Galbraith Lake –Rare Plants, Dall Sheep	Construction ROW	N/A	139.18	139.18	MP 150.7
West Fork Atigun River – Dall Sheep	Construction ROW	2.98	157.40	157.40	N/A
Snowden Mountain – Dall Sheep	ATWS	0.22	199.12	199.12	N/A
Sukakpak Mountain – Scenic	ATWS	0.14	211.86	211.86	N/A
Nugget Creek – Dall Sheep	Access Road	0.48	219.19	219.19	N/A
Poss Mountain – Dall Sheep	Construction ROW	1.43	221.06	221.06	N/A
Jim River – Fishery	Material Site	0.61	281.72	281.72	N/A

Source: BLM – GIS data and descriptions (BLM, 1989a); FLB_ACEC_A_prj.shp; PLC_PREFEED_REVB_3D_POST_P_prj.shp and facility FAC_NEAR_MP_FACILITIES_A_MOD_w_ROW _20150928.shp

N/A = Not Applicable (not crossed)





LEGEND

- Project Facility
- Existing Facility
- Alaska Place Names
- Alaska LNG Rev C2 Route
- Major Highways
- Major Rivers
- ACEC with Identified Lambing Areas
- Areas of Critical Environmental Concern
- State and Federal Conservation Lands

0 35 70 140 Miles

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AREAS OF CRITICAL ENVIRONMENTAL CONCERN

FIGURE 3.4.9-1

ALASKA LNG

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3.4.9.2 National Wildlife Refuges (NWRs), State Game Refuges, and State Critical Habitat Areas (CHAs)

3.4.9.2.1 NWRs and Preserves

3.4.9.2.1.1 Liquefaction Facility

Kenai NWR

The Kenai NWR consists of nearly 2 million acres of diverse habitats and wildlife on the Kenai Peninsula (Figure 3.4.9-2; Table 3.4.9-2). This NWR is the most visited in Alaska. The alpine tundra, wetlands, and boreal forests are home to a variety of species including moose, bears, wolves, trumpeter swans, and salmon. The refuge was initially established to protect the Kenai moose. The refuge exists to protect the variety of wildlife and habitats and to promote scientific research, environmental education, and recreation.

The Liquefaction Facility would be located west of the western boundary of this NWR.

3.4.9.2.1.2 Interdependent Project Facilities

Arctic NWR

The Arctic NWR is the most northern and one of the largest refuges within the NWR system. Including large, contiguous tracts of the Beaufort Coastal Plain Ecoregion, Arctic foothills, and portions of the Brooks Range, the Arctic NWR supports diverse and abundant wildlife populations. This refuge provides important habitat for calving caribou, breeding waterbirds and shorebirds, year-round habitat for Dall sheep, and hunting grounds for wolves and ermine.

The Mainline would pass within 0.2 mile of the Arctic NWR near Galbraith Lake in the Brooks Range (Figure 3.4.9-2; Table 3.4.9-2). No Project components would be located in the Arctic NWR, and no impacts are expected within this refuge.

Kanuti NWR

The Kanuti NWR is located approximately 7.3 miles to the west of the Mainline on the southern slope of the Brooks Range (Figure 3.4.9-2; Table 3.4.9-2). The NWR was primarily established for its rich and diverse waterfowl habitats. Brown and black bear, several wolf packs, moose, wolverine, beavers, American marten, and mink occupy the boreal forests and wetland habitats within the NWR. Caribou from the Western Arctic and Ray Mountain herds occasionally winter here.

No Project components would be located within the Kanuti NWR. However, the Mainline corridor would cross several rivers that are tributaries to streams within the refuge, including the Middle and South forks of the Koyukuk River and Jim River.

Yukon Flats National Wildlife Refuge

The third largest conservation area in the NWR System, the 9 million-acre Yukon Flats NWR (Figure 3.4.9-2; Table 3.4.9-2), contains a vast wetland basin that provides one of the greatest breeding areas for waterfowl in North America. As many as 2 million ducks nest here annually. Game animals such as moose, caribou, and sheep are found in relatively low numbers throughout the refuge, but furbearer resources are abundant, including beaver, fox, lynx, marten, muskrat, otter, weasel, and wolverine.

The Mainline corridor would pass about 0.6 miles west of the Yukon Flats NWR. No Project components would be located in the Refuge.

Denali National Park and Preserve (DNPP)

DNPP is located along the Mainline corridor north of Talkeetna in Interior Alaska (Figure 3.4.9-2; Table 3.4.9-2). The Park was designated nearly a century ago as the world's first national park established for the conservation of wildlife. Denali covers 6 million acres of wild land from low-elevation taiga forests to high alpine tundra and snow-capped mountains of the Alaska Range, including North America's tallest peak. There is a diversity of wildlife that includes 39 species of mammals, 169 species of birds, and 650 species of vascular plants. Caribou from the Denali herd occur within the Park.

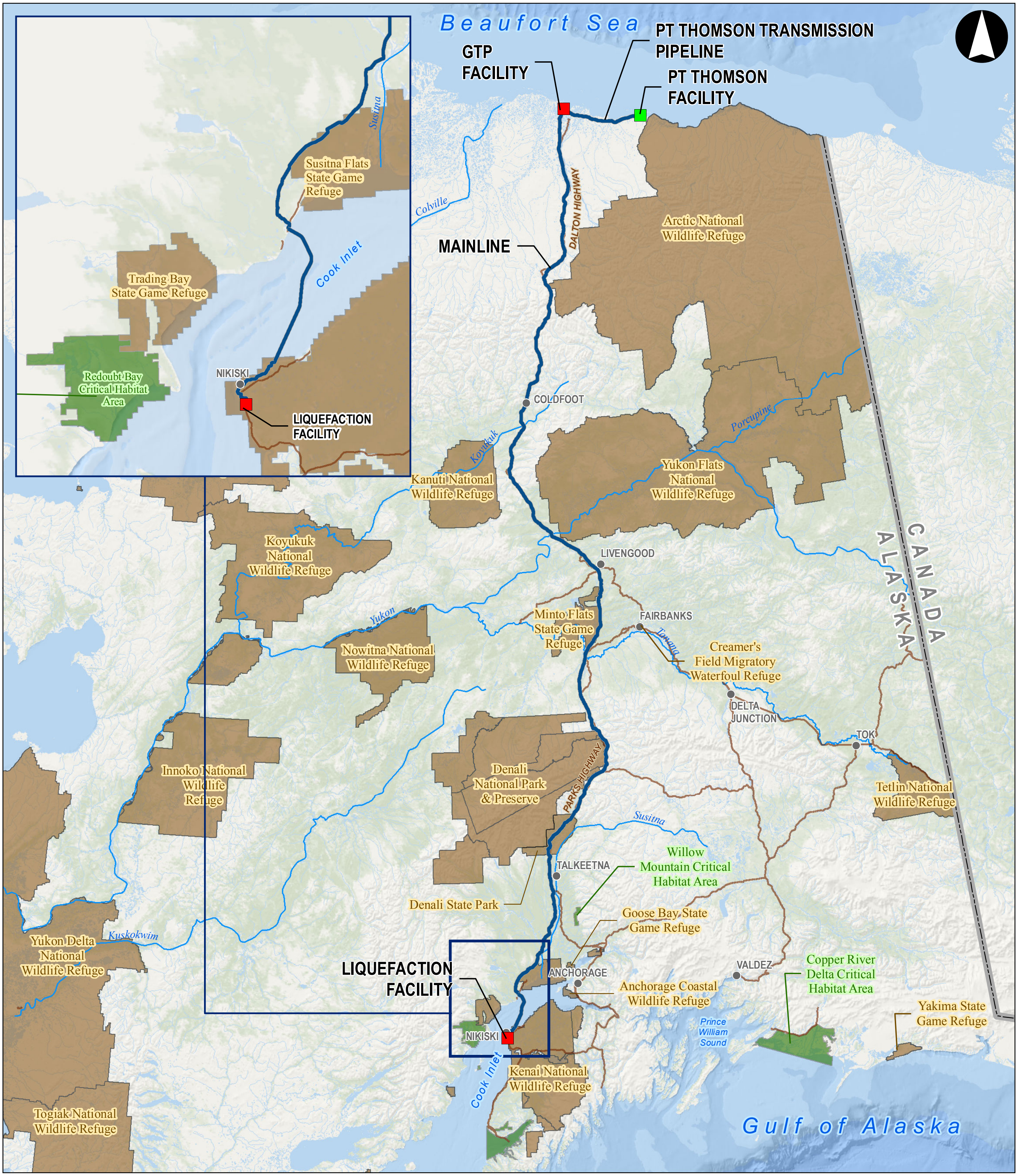
The Mainline would follow the Parks Highway along outside of the eastern border of DNPP.

Kenai NWR

The Kenai NWR has been previously described in Section 3.4.9.2.1.1. The Mainline would be constructed outside of and removed from the northwestern boundary of the Kenai NWR.

TABLE 3.4.9-2
Proximity of Project Components to National Wildlife Refuges and Preserves

Sensitive Wildlife Habitats	Closest Facility	Nearest Distance (Miles)	Nearest MP
Arctic NWR	Construction ROW	0.16	MP 124
Gates of the Arctic National Park and Preserve	Bend ATWS	1.06	MP 188
Kanuti NWR	Material Source	7.31	MP 299
Yukon Flats NWR	Access Road	0.63	MP 365
DNPP	Construction ROW	0.02	MP 536
Kenai NWR	Anchor ATWS; Mainline ROW	2.74	MP 785



X:\AKLNG\Resource Reports\RR03\Figure 3_4_9-2 NWRs, State Game Refuges, and State CHAs for Wildlife.mxd

LEGEND

Red square	Project Facility	Brown line	Major Highways
Green square	Existing Facility	Blue line	Major Rivers
Dot	Alaska Place Names	Brown area	State Refuge Area
Dark blue line	Rev C2 Route	Green area	State Critical Habitat Area

0 25 50 100 Miles

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NWRS, STATE GAME REFUGES, AND STATE CHAS FOR WILDLIFE

FIGURE 3.4.9-2

ALASKA LNG

3.4.9.2.2 Alaska State Game Refuges and Parks

3.4.9.2.2.1 Interdependent Project Facilities

Minto Flats State Game Refuge

The Minto Flats State Game Refuge encompasses 500,000 acres of wetland in Interior Alaska. The Refuge provides excellent habitat for waterfowl, big game, and furbearers. More than 150,000 ducks and one of the largest breeding populations of trumpeter swans in North America nest here annually. The Refuge is also an important spring and fall staging area, particularly for geese and swans.

The Mainline corridor would be located along the eastern border of the Minto Flats State Game Refuge and would cross the southeastern tip of the Refuge for 22.11 miles within the existing ROW of the Parks Highway.

Denali State Park

Denali State Park is located along the Mainline corridor north of Talkeetna in Interior Alaska (Table 3.4.9-3). Denali Sate Park shares its western boundary with DNPP. Denali State Park covers 325,240 acres of wild land from low-elevation taiga forests to high alpine tundra and snow-capped mountains of the Alaska Range. The park is home to a diversity of wildlife with 130 species of birds. Caribou from the Denali herd occur within the park. The Mainline would follow the Parks Highway, crossing through 38 miles of Denali State Park.

Goose Bay State Game Refuge

Goose Bay State Game Refuge consists of wetland habitats on the western side of Upper Cook Inlet. The refuge provides important spring and fall resting and staging areas for waterfowl, geese, and swans during migration. Over 20,000 geese, especially Canada and snow geese, use the refuge each spring. A moose calving concentration area occurs in the shrub habitat along the inland portion of the refuge.

No Project components would be located within Goose Bay State Game Refuge.

Susitna Flats State Game Refuge

The Susitna Flats State Game Refuge, located on the western side of Cook Inlet between the Beluga River and Point MacKenzie, is known for the spring and fall concentration of migrating waterfowl, geese, and shorebirds that occur there. As many as 100,000 waterfowl use the refuge for resting and staging during migration. Tule geese, a subspecies of the greater white-fronted goose, nest in the refuge. Moose, brown and black bears, beavers, mink, otters, muskrats, coyotes, and wolves occur in the refuge. Beluga whales concentrate in an area extending from the Little Susitna River to the Beluga River in late May and June to calve, breed, and feed on the large runs of eulachon fish returning to spawn in the Susitna River.

The Mainline corridor would cross 9.9 miles of this refuge prior to crossing Cook Inlet to reach the Kenai Peninsula.

Anchorage Coastal Wildlife Refuge

The Anchorage Coastal Wildlife Refuge on the eastern side of Cook Inlet consists of extensive tidal flats, marsh communities, and alder-bog forests for 16 miles from Point Woronzof to Potter Creek. Peak numbers of ducks, geese, swans, and shorebirds occur in the refuge during spring and fall migration. Moose and muskrats commonly occur on the refuge; coyotes, least weasels, snowshoe hares, mink, lynx, river otters, and black and brown bear are less frequently seen.

No Project components would be located within this refuge.

Trading Bay State Game Refuge

Trading Bay State Game Refuge is located on the western side of Cook Inlet, south of the proposed route for the Mainline to cross Cook Inlet. The large expanse of low relief wetlands and associated tidal flats that comprise this refuge provide critical spring feeding, summer nesting, and fall staging habitat for thousands of ducks, geese, swans, and cranes. The refuge also provides important wintering habitat for approximately 500 moose. The Noaukta Slough supports high numbers of black and brown bears feeding on returning salmon.

The Mainline would cross Cook Inlet within about 13 miles of the refuge at its closest point. No Project components would be located within this refuge.

3.4.9.2.3 State of Alaska CHAs

3.4.9.2.3.1 Liquefaction Facility

Redoubt Bay CHA

Redoubt Bay CHA is located west of the proposed Liquefaction Facility on the western side of Cook Inlet. It encompasses the low-lying expanse of wetlands and riparian habitats across the Inlet from the Liquefaction Facility. This CHA provides spring and fall feeding and resting habitats for hundreds of thousands of waterfowl, geese, and swans. Several tens of thousands of ducks also nest in this area. Wetlands of the Redoubt Bay CHA provide important moose overwintering habitat and brown bears frequent intertidal drainages on the outer flats when salmon return to spawn.

3.4.9.2.3.2 Interdependent Project Facilities

Willow Mountain CHA

Willow Mountain CHA is located about 13 miles east of the Mainline corridor in the Talkeetna Mountain Range. This area supports some of the largest concentrations of moose in the state. Frequently seen birds include ravens, ptarmigan, raptors, songbirds and dippers. A small number of caribou occur in the higher elevations of this area.

Redoubt Bay CHA

Redoubt Bay CHA, described previously in Section 3.4.9.2.3.1, is located north of the Mainline corridor on the western side of Cook Inlet.

TABLE 3.4.9-3

Proximity of Project Components to State Refuges, Parks, and CHAs

Sensitive Wildlife Habitats	Closest Facility	Nearest Distance (Miles)	Nearest MP	Start MP	End MP
Alaska State Game Refuges and Parks (North to South)					
Minto Flats State Game Refuge	Construction ROW	0	MP 431	MP 430.9	MP 468.61
Creamer's Field Migratory Waterfowl Refuge	DJ Yard	7.53	MP 445	N/A	N/A
Denali State Park	Construction ROW	0	MP 609	MP 609.0	MP 646.9
Goose Bay State Game Refuge	Construction ROW	14.80	MP 710	N/A	N/A
Palmer Hay Flats State Game Refuge	DJ Yard	4.88	MP 710	N/A	N/A
Chugach State Park	DJ Yard	25.59	MP 735	N/A	N/A
Susitna Flats State Game Refuge	Construction ROW	0	MP 737	MP 737.3	MP 752.3
Anchorage Coastal Wildlife Refuge	Material Site	25.59	MP 735	N/A	N/A
Trading Bay State Game Refuge	Construction ROW	13.31	MP 784	N/A	N/A
Tuxedni Refuge	Liquefaction Facility	50.50	MP 807	N/A	N/A
Alaska State Critical Habitat Areas (North to South)					
Willow Mountain Critical Habitat Area	ATWS	13.25	MP 691	N/A	N/A
Redoubt Bay Critical Habitat Area	ATWS	12.09	MP 807	N/A	N/A
Fox River Flats Critical Habitat Area	Construction ROW	58.98	MP 803	N/A	N/A
Clam Gulch Critical Habitat Area	Construction ROW	19.27	MP 807	N/A	N/A
Anchor River & Fitz Creek Critical Habitat Area	Construction ROW	58.30	MP 807	N/A	N/A
Kalgin Island Critical Habitat Area	Construction ROW	26.38	MP 807	N/A	N/A
Kachemak Bay Critical Habitat Area	Liquefaction Facility	59.02	MP 807	N/A	N/A

Source: GIS data GIS data Rev C2; PLC_PREFEED_REVC2_ROUTE_3D_L_20160925
N/A = Not Applicable (not crossed)

3.4.9.2.4 Audubon Important Bird Areas (IBAs)

IBAs that occur near or are crossed by the Project footprint or within marine habitats crossed by LNGCs are described in Section 3.4.6. Project facilities would be constructed within three IBAs: West Dock modifications would be within the Beaufort Sea Nearshore Global IBA (crossed three times); the Mainline would cross through 6.9 miles of the Alaska Range Foothills IBA; and the Mainline would cross through 15 miles of the Susitna Flats IBA (Table 3.4.9-4). Other IBAs range from less than 0.1 mile to more than 100 miles from Project facilities (Table 3.4.9-4).

TABLE 3.4.9-4

Proximity of Project Components to Audubon Important Bird Areas (IBAs)

Sensitive Wildlife Habitats	Closest Facility	Nearest Distance (Miles)	Nearest Mainline MP	Start MP	End MP
Audubon Important Bird Areas (IBAs, North to South)					
Northeast Arctic Coastal Plain	PTTL	22.95	MP 0	N/A	N/A
Beaufort Sea Nearshore Global IBA	GTP Dock Head	N/A	MP 0	N/A	N/A
Alaska Range Foothills IBA	Construction ROW	N/A	MP 530	N/A	N/A
Kahiltna Flats-Petersville Road IBA	Construction ROW	0.08	MP 662	N/A	N/A
Susitna Flats IBA	Pipe Storage Yard 21	0	MP 745	N/A	N/A
Susitna Flats IBA	Construction ROW	0	MP 737	MP 737.3	MP 752.3
Goose Bay IBA	Construction ROW	14.72	MP 710	MP 709.8	N/A
Anchorage Coastal IBA	Construction ROW	25.62	MP 735	MP 734.9	N/A
Swanson Lakes IBA	Construction ROW	2.75	MP 784	N/A	N/A
Tuxedni Bay IBA	Liquefaction Facility	49.58	MP 807	N/A	N/A
Kachemak Bay, South Shore IBA	Liquefaction Facility	65.89	MP 807	N/A	N/A
Lower Cook Inlet Global IBA	Liquefaction Facility	80.66	MP 807	N/A	N/A
Kamishak Bay Global IBA	Liquefaction Facility	103.62	MP 807	N/A	N/A
Barren Islands Colonies IBA	Liquefaction Facility	113.74	MP 807	N/A	N/A

Source: GIS data Rev C2; PLC_PREFEED_REVC2_ROUTE_3D_L _20160925
N/A = Not Applicable (not crossed)

3.4.10 Potential Construction Impacts and Mitigation Measures

The Project, as proposed, would result in approximate 70,000 acres of both temporary and permanent impacts. Impacts and disruptions to wildlife due to construction may result from construction sound from machinery, pile driving, excavation, and blasting; habitat loss, conversion, and fragmentation; blockage of seasonal movements or migrations; disruption during breeding and nesting periods; increased traffic (air, land, and sea); increased human interactions; increased erosion and sedimentation; and spills and leaks of hazardous materials such as oil, lubricants, and solvents. Most construction-related disturbance impacts would be considered temporary, and has been designed to avoid or reduce potential effects on wildlife as practicable. Clearing of vegetation in the Project corridor would take place during the winter when the ground is frozen and precipitation is low, this minimizes soil compaction and prevents damage to root mats of dormant plants. Several plans and procedures have been developed that would further reduce potential impacts to wildlife and wildlife habitat, including, but not limited to:

- *Wildlife Avoidance and Interaction Plan* (includes *North Slope Activities: Polar Bear and Pacific Walrus Avoidance and Interaction Plan*; Appendix J);
- Marine Mammal Protection Act (MMPA) Assessment Report (Appendix F);

- *Draft Marine Mammal Mitigation and Monitoring Plan* (Appendix N);
- Draft *Avian Protection Plan* (Appendix E);
- *Noxious and Invasive Plant and Animal Control Plan* (Appendix K);
- *Project Waste Management Plan* (Appendix J in Resource Report No. 8);
- *Construction Noise Abatement Plan* (Appendix T in Resource Report No. 9);
- *Fire Prevention and Suppression Plan* (Appendix G in Resource Report No. 8);
- Applicant's *Plan* (Appendix D in Resource Report No. 7);
- Applicant's *Procedures* (Appendix N in Resource Report No. 2);
- *Stormwater Pollution Prevention Plan (SWPPP)* (Appendix J in Resource Report No. 2);
- Draft *Spill Prevention, Control, and Countermeasure (SPCC) Plan* (Appendix M in Resource Report No. 2);
- *HDD Inadvertent Release Contingency Plan* (Appendix L in Resource Report No. 2);
- *Fugitive Dust Control Plan* (Appendix J in Resource Report No. 9); and
- *Unanticipated Contamination Discovery Plan* (Appendix I in Resource Report No. 8).

Following construction, many temporary habitat impacts (e.g., those areas no longer required to facility operational tasks) would be reclaimed and allowed to revert to preconstruction conditions. Potential construction impacts to wildlife and mitigation measures discussed by facility in the following sections are summarized in Table 3.4.10-1. Operational or permanent impacts associated with the Project are discussed in Section 3.4.11.

TABLE 3.4.10-1

Construction Impacts and Mitigation for Wildlife Associated with the Project

Activity	Potential Impact	Mitigation[a]
CONSTRUCTION OF FACILITIES, ROADS, AND PIPELINES		
Marine Mammals		
General Construction	Displacement from habitat due to sound from construction, dredging, and pile driving Injury to hearing from pile driving Injury or mortality from exposure to contaminants due to spills	• Follow recommendations in the final MMPA Assessment and eventual permit requirements; • Inspect equipment regularly for leaks; • Maintain spill response and cleanup equipment and materials onsite; follow spill response protocols; • All crews will follow mitigation measures outlined in the Project's Draft *Marine Mammal Mitigation and Monitoring Plan* (Appendix N), which includes procedures that reduce interactions between vessels and marine mammals; and • Construction crews would follow and implement an SPCC Plan to minimize effects of accidental discharges of contaminates to land and water.
Waterbody Crossings	Displacement from habitat, interference with movement Injury or mortality if blasting is needed to clear way for pipeline placement Degradation of critical habitat	• Follow recommendations in the final MMPA Assessment and eventual permit requirements; • Follow Applicant's *Procedures;* • All crews will follow mitigation measures outlined in the Project's Draft *Marine Mammal Mitigation and Monitoring Plan* (Appendix N), which includes procedures that reduce interactions between vessels and marine mammals; • PSOs would be employed to establish and clear safety zones of marine mammals to prevent blast injury; and • Crews would follow BMPs that would reduce impacts to critical habitat.
Sealift barges and tugs and supply vessels	Disturbance and disruption of behaviors from vessel noise Injury or mortality from ship strikes Injury or mortality from fuel spill	• Follow established navigation routes; • Carry spill response equipment and material; and • Employ spill response protocols.
Wildlife – Large and Small Mammals		
General Construction	Habitat loss, alteration, and fragmentation Altered survival, mortality, or reproduction due to spills	• Keep construction activities within the proposed LODs; • Spills would be minimized by following procedures outlined in the *SPCC Plan* developed for this Project; • Follow the Applicant's *Plan*, *Procedures*, and *Winter Construction Plan;* • Where required, and at locations that would be determined in pre-construction consultation with the ADF&G and other agencies depending on the location of the camp and landownership, provide wildlife monitors to educate construction personnel of local wildlife, sensitive areas, and potential threats; • The Applicant will acquire wildlife hazing permits from state and federal agencies for construction activities; and • Training to increase worker awareness of how to avoid problems with wildlife.

TABLE 3.4.10-1

Construction Impacts and Mitigation for Wildlife Associated with the Project

Activity	**Potential Impact**	**Mitigation[a]**
Clearing, Grubbing, and Grading	Reduced survival and reproduction due to decrease in vegetative cover for optimal nesting, feeding, and rearing sites	• Avoid unnecessary vegetation removal; • Follow Applicant's *Plan*, *Procedures*, and *Winter Permafrost Construction Plan;* and • To the extent practicable, limit vegetation removal to the winter.
Blasting	Direct mortality during blasting and indirect mortality due to stress	• Follow *Blasting Plan;* • Clear areas of wildlife prior to blasting as practicable, using hazing techniques under hazing permits acquired from state and federal agencies as needed; and • To the extent practicable, conduct blasting outside sensitive reproduction, nesting, and rearing timeframes.
Trenching and Backfilling	Direct mortality during construction, wildlife entrapment, and indirect mortality due to stress	• Follow Applicant's *Plan*, *Procedures*, and *Winter Construction Plan;* • Avoid unnecessary removal of vegetation; • Keep construction activities within the proposed LOD; • Minimize the length of trench left "open" for long periods of time; • Use construction safety fence in areas of known migration and feeding routes; • Provide trench crossing areas, such as trench breaks; • Provide escape ramps, especially in known areas of migration corridors; • Reduce construction traffic, both motor vehicular and aircraft by utilizing only necessary equipment during these periods; and • Follow Draft *Project Restoration Plan.*
Contractor Yards and Camps	Attraction of wildlife due to trash and food Mortality due to defense of life or property.	• Follow *Waste Management Plan;* • Train workers to have good housekeeping practices; • Store food and scraps in animal-resistant containers as practicable; • Where required, provide wildlife monitors to educate construction personnel on local wildlife, sensitive areas, and potential threats; and • Training to increase worker awareness or how to avoid problems with wildlife.
Access Roads (Temporary)	Vehicular interactions with wildlife	• Follow Applicant's *Plan*, *Procedures*, and *Winter Construction Plan;* • Use existing roads, two-tracts, cart-ways, and the construction ROW travel lanes to the greatest extent possible; • Limit vegetation removal to tree trimming instead of removal; • Where requested by the landowner, restore roads in accordance with landowners or land management agency; • Reduce the number of roads needed to facilitate construction; • Reduce the amount of vehicular traffic by utilizing busses to and from the work site; and • Post speed limit signs, especially in sensitive areas.

TABLE 3.4.10-1

Construction Impacts and Mitigation for Wildlife Associated with the Project

Activity	Potential Impact	Mitigation[a]
Wildlife–Birds		
General Construction	Habitat loss, alteration, and fragmentation	• Follow the guidelines and mitigation measures detailed in the final *Avian Protection Plan* after development with USFWS and ADF&G • Follow Applicant's *Plan*, *Procedures*, and *Winter Permafrost Construction Plan;* • Project ROW would avoid identified important bird habitats to the maximum extent practicable; • Follow Draft *Project Restoration Plan;* and • Follow *Noxious and Invasive Plant and Animal Control Plan.*
Clearing, Grubbing, and Grading Blasting Contractor Yards and Camps	Direct mortality Indirect mortality from disturbance causing reduced survival and/or reproduction	• Follow Applicant's *Plan*, *Procedures*, and *Winter Permafrost Construction Plan;* • Follow the guidelines and mitigation measures detailed in the final *Avian Protection* Plan after development with USFWS and ADF&G • Winter vegetation clearing will be outside migratory bird nesting season; • Adopt vessel, motor vehicle, and aircraft procedures that reduce the potential for collisions with birds; and • Spills would be reduced by following procedures outlined in the *SPCC Plan* developed for this Project.

[a] These measures will be used where practical

3.4.10.1 Liquefaction Facility

Construction of the Liquefaction Facility would encompass 982 acres onshore and about 82 acres offshore (Table 3.4.10-2). In addition, spoil disposal would occur at an offshore site of approximately 1,200 acres. The acreage for the Liquefaction Facility would accommodate the associated infrastructure necessary to build the Facility, as well as the facilities required to maintain safe operations. The Liquefaction Facility would be located in Alaska's GMU 15, which encompasses the west side of the Kenai Peninsula. Construction activities including site preparation (clearing, grading, excavation), sheet and pile driving, dock construction, blasting, dredging and dredge disposal, vehicle traffic, vessel traffic, hydrostatic testing, and accidental spills/leaks would be temporary and could result in both direct and indirect impacts to wildlife.

3.4.10.1.1 Site Preparation and Foundation Construction

3.4.10.1.1.1 Marine Mammals

General construction sounds from vehicles and machinery usually do not reach levels that would be injurious or harassing to marine mammals. Potential effects on water quality that could reach marine mammal habitats would be avoided and reduced through measures in the Project's *SWPPP* and *SPCC Plan*. Onshore site preparation and foundation construction are not expected to affect marine mammals.

3.4.10.1.1.2 Large Mammals

Site preparation for the Liquefaction Facility and associated infrastructure would result in habitat loss and alteration that could result in both temporary and permanent displacement of large mammals that are likely to occur in the area, including moose and black bear. Wolves, caribou from the Kenai Peninsula herds, and brown bear may also occur, but would rarely be encountered (Table 3.4.4-1). Long-term habitat loss or alteration would occur over the entire 980-acre onshore construction footprint.

Habitat loss would result in a reduction in available land for foraging, cover, and prey availability. The Liquefaction Facility would be located in an area that has already experienced both industry and residential development; habitat loss and fragmentation associated with the Project would be additive. Habitats lost would include mixed forests that are likely to support moose in the area (Table 3.4.10-2). Habitat for large mammals is abundant on the Kenai Peninsula, and large tracts of undisturbed habitat occurs just north and east of the proposed Liquefaction Facility in the Kenai NWR.

Animals differ in their sensitivity to sounds by species and by life history stage during exposure. Exposure to loud SPLs can result in temporary or permanent hearing loss in mammals. Because most mammals can move away from sound that would potentially be physically damaging, most effects of noise would result in behavioral responses as summarized in a review from Francis and Barber (2013). Noise-related behavioral responses generally fall into four categories: 1) changes in temporal patterns, 2) alteration in distribution or movements, 3) decrease in foraging with increase in anti-predator behavior, and 4) change in mate attraction and territorial defense. Loud, intermittent, and unpredictable noise is often perceived as a threat, while more moderate, frequent, and predictable noise is more likely to interfere with the animals' abilities to detect important sounds. The effects of behavioral responses across the disturbance-interference spectrum can lead to energetic costs, as well as reduced fitness and reproduction.

Outdoor ambient noise near the proposed Liquefaction Facility location is representative of a rural residential area with neighboring industrial/commercial facility with day-night sound levels ranging from 37 to 56 dBA depending on location and measurement duration. Outdoor ambient noise includes natural sound such as bird songs, and insect noise, as well as aviation and vehicle traffic, barking dogs and other residential noise, noise from power tools, other construction, building pumps, generators, and other mechanical systems (Appendix M in Resource Report No. 9). During construction, equipment would generate day-night sound levels that would reach about 70 A-weighted decibels (dBA) within 0.5 mile and 64 dBA within 1 mile (Appendix O in Resource Report No. 9). These levels would be increased by about 8 dBA within 1 mile and 14 dBA within 0.5 mile including sounds from pile and sheet driving (Appendix O in Resource Report No. 9).

Noise, lighting, and other activities associated with construction of the Liquefaction Facility during sensitive seasons could also temporarily displace large mammals. No moose calving concentration areas occur near the proposed Liquefaction Facility, and it is unlikely that bears den in the area. Construction-related disturbance would be temporary and would likely affect few large mammals.

Direct impacts associated with construction-related activities at the Liquefaction Facility may result in injury and/or mortality to large mammals due to increased workforce, vehicle traffic, construction equipment, open excavations, and logistics pertaining to delivery of materials and supplies via roads, rails, and waterways. The greatest potential for large mammal injury or mortality would be from vehicle collisions, construction equipment encountering newborn moose calves or hibernating bears in dens, and defense of life or property kills of food-conditioned bears attracted to the worksite.

Through development of Project execution plans, procedures, and training, coupled with site features such as security and exclusionary fencing, escape routes, land bridges along open trenches, and overall good housekeeping, any potential direct impacts would be reduced. Potential impacts to large mammals would be avoided or reduced through the measures described in the Project *Wildlife Avoidance and Interaction Plan* in Appendix J of Resource Report No. 3.

3.4.10.1.1.3 Furbearers and Small Mammals

Site preparation for the Liquefaction Facility and associated infrastructure would result in habitat loss and alteration that could result in both temporary and permanent displacement of furbearers and small mammals that are likely to occur in the area (Table 3.4.5-1). It is anticipated that the entire 980-acre onshore construction footprint would be required to facilitate future operations of the facility in a safe manner, therefore long-term habitat loss and alteration would occur.

Indirect impacts associated with long-term habitat alteration may occur from habitat loss and fragmentation. Habitat loss would result in a reduction in available land for foraging, cover, breeding, and prey availability. Habitat fragmentation includes a reduction in total habitat area and division of large continuous habitats into smaller, more isolated remnants. Habitat fragmentation can affect dispersal of small mammals. Removal of vegetation such as trees, shrubs, and grasses that provide legumes, berries, and grains for furbearers and small mammals. Habitats lost would include mixed and deciduous forests and low scrub that are likely to support foxes, squirrels, porcupines, weasels, and rodents (Table 3.4.10-2). Habitat for furbearers and small mammals is abundant on the Kenai Peninsula, and large tracts of undisturbed habitat occur east and north of the Liquefaction Facility in the Kenai NWR.

Noise, lighting, and other activities associated with construction of the Liquefaction Facility during sensitive seasons may also temporarily displace furbearers and small mammals that may breed and/or den near the Liquefaction Facility. Construction-related disturbance would be temporary and would likely affect few furbearers and small mammals.

TABLE 3.4.10-2

Wildlife Habitats (Acres) Affected by Construction and Operation of the Liquefaction Facility

Level I	Level II	Level III	Liquefaction Operations Area		Construction Camp		Marine Terminal		Total	
			Const	**Ops**	**Const**	**Ops**	**Const**	**Ops**	**Const**	**Ops**
Forest	Deciduous Forest	Closed Deciduous Forest	5.64	62.32	3.73	-	-	-	*66.05*	62.32
		Open Deciduous Forest		12.06	-	-	-	-	*12.06*	12.06
	Deciduous Forest Total			5.64	74.38	*0*	*0*	*0*	*78.11*	74.38
	Mixed Forest	Closed Mixed Forest		54.58	-	-	-	-	*55.69*	55.69
		Open Mixed Forest	50.57	332.57	52.43	-	-	-	*384.46*	332.03
		Woodland Mixed Forest	6.32	110.88	6.32	-	-	-	*124.46*	118.14
	Mixed Forest Total		*56.89*	*498.03*	498.03	*0*	*0*	*0*	*564.61*	505.86
Forest Total			**62.53**	**572.41**	**62.48**	**0**	**0**	**0**	**642.72**	**580.24**
Scrub	Low Scrub	Open Low Scrub		68.25	10.9	-	0.71	0.37	*79.86*	68.62
Scrub Total				**68.25**	**10.9**	**0**	**0.71**	**0.37**	***79.86***	**68.62**
Herbaceous	Graminoid Herbaceous	Mesic Graminoid Herbaceous	11.01	4.49	-	-	-	-	*4.49*	4.49
		Wet Graminoid Herbaceous	11.01	6.01	-	-	-	-	*6.01*	6.01
	Forb Herbaceous	Mesic Forb Herbaceous	**11.01**	3.36	-	-	-	-	*3.36*	3.36
	Bryoid Herbaceous	Mosses		2.22	-	-	-	-	*2.22*	2.22
Herbaceous Total					**0**	**0**	**0**	**0**	***16.08***	**16.08**
Barren Unvegetated	None	None	7.77	227.03	7.92	-	-	-	*234.95*	227.03
Barren Total				**227.03**	**7.92**	**0**	**0**	**0**	**234.95**	**227.03**
Water	Pond	Pond		0.27	-	-				
	Saltwater	Saltwater		9.74	-	-	81.51	19.84	*91.25*	29.58
		Dredge Disposal Area	-	-	-	-	1,200	-	1,200	0
Water Total			**10.01**	**10.01**	**0**	**0**	**1,281.51**	**19.84**	**1,291.52**	**29.85**
		Liquefaction Facility Total	**901.61**	**901.61**	**81.30**	**0.00**	**1,282.22**	**20.21**	**2,265.13**	**921.82**

Source: Project Vegetation Mapping.
Const = Construction, Ops = Operations; Construction acreage includes operational areas. See Resource Report No. 1, Table 1.4-1 for definitions of construction and operations affected areas.
[1] Levels are generally consistent with Viereck's Alaska Vegetation Classification System (Viereck et al., 1992). This classification is based on (Level I) dominant growth forms (tree, shrub, herb), (Level II) canopy height, and (Level III) and closure, general soil moisture and salinity, and dominant plants.

Direct impacts associated with construction activities of the Liquefaction Facility may result from injury and/or mortality due to increased workforce, vehicular traffic, movement of construction equipment, open excavations, and logistics pertaining to delivery of materials and supplies via roads, rails, and waterways. The greatest potential for furbearer or small mammal injury or mortality would be from vegetation and land clearing, and vehicle collisions. Vegetation clearing would occur in winter and small mammals in nests or borrows may be injured or killed. Through development of Project execution plans, procedures, and training, coupled with site features such as, security and exclusionary fencing, escape routes, land bridges along open trenches, and overall good housekeeping, any potential direct impacts would be reduced. Potential impacts to furbearers and small mammals would be avoided or reduced through the measures described in the Project *Wildlife Avoidance and Interaction Plan*.

3.4.10.1.1.4 Birds

Site preparation, including excavation, ground improvements, and placement of granular surfaces for the Liquefaction Facility, would result in nesting habitat loss primarily through vegetation clearing that could result in displacement of an estimated 85 birds, primarily passerines, based on breeding bird densities for survey routes near the proposed Liquefaction Facility (Table 3.4.10-3). Because vegetation clearing would occur outside of the nesting season, active nests with young are not expected to be impacted by construction. The Heavy Haul road cut through the bluff may also remove swallow nesting habitat, although this area currently does not appear to support nest burrows. As scheduled, the heavy haul road work would occur before nesting season.

The Liquefaction Facility would be located in an area that has ongoing industrial and residential development. Because the facility would be located in an industrial area, there has been previous onshore and shoreline habitat fragmentation by roads, buildings, and docks; as well as residential development in the surrounding area.

Sound from construction of the Liquefaction Facility during the bird nesting season may create disturbance that could displace nesting birds from habitats in the surrounding area. If birds begin to nest prior to initiation of construction disturbance, active nests with eggs or young may be abandoned. If initiation of construction disturbance occurs early during nesting, displaced birds may re-nest farther away from the disturbance. Nesting habitat for birds is abundant on the Kenai Peninsula, and large tracts of undisturbed habitats occur east and northeast of the Liquefaction Facility in the Kenai NWR. Potential effects from habitat loss to birds would be minor and effects from construction disturbance would be temporary.

TABLE 3.4.10-3

Potential Nesting and Foraging Birds Displacement Impacts Due to Liquefaction Facility Construction

Common Name	Kalifornsky Breeding Bird Survey (BBS) Route[a] (birds/mile)	Estimated Onshore Impacts (birds)	Estimated Offshore Impacts (birds)	Total Impacts (birds)
Impact Area (miles)	-	2.4	4.9	7.3
Canada Goose	0.09	0.2	0.4	0.6
Geese & Swans Total	*0.09*	0.2	0.4	0.6
Red-breasted Merganser	0.04	0.1	0.2	0.3
American Wigeon	0.31	0.7	1.5	2.3
Ducks Total	*0.36*	0.8	1.8	2.6
Waterfowl Total	0.44	1.0	2.2	3.2
Loons & Grebes				
Common Loon	0.01	0.0	0.1	0.1
Pacific Loon	0.01	0.0	0.1	0.1
Red-throated Loon	0.07	0.2	0.4	0.5
Loons & Grebes Total	*0.10*	0.2	0.5	0.7
Raptors				
Northern Harrier	0.01	0.0	N/A	0.0
Northern Goshawk	0.01	0.0	N/A	0.0
Bald Eagle	0.44	1.0	2.2	3.2
Merlin	0.03	0.1	N/A	0.1
Raptors Total	0.50	1.2	2.2	3.4
Rails, Coots, Cranes				
Sandhill Crane	0.21	0.5	N/A	0.5
Shorebirds				
Wilson's Snipe	0.40	0.9	N/A	0.9
Short-billed Dowitcher	0.03	0.1	N/A	0.1
Greater Yellowlegs	0.16	0.4	N/A	0.4
Lesser Yellowlegs	0.04	0.1	N/A	0.1
Shorebirds Total	*0.63*	1.5	N/A	1.5
Seabirds				
Glaucous-winged Gull	0.50	1.2	2.5	3.6
Herring Gull	14.97	35.4	73.3	108.7
Mew Gull	1.35	3.2	6.6	9.8
Bonaparte's Gull	0.03	0.1	0.1	0.2
Arctic Tern	0.53	1.3	2.6	3.8
Aleutian Tern	0.01	0.0	0.1	0.1
Seabirds Total	17.39	41.1	85.2	126.3
Owls				
Short-eared Owl	0.01	0.0	N/A	0.0
Great Horned Owl	0.01	0.0	N/A	0.0
Owls Total	0.03	0.1	N/A	0.1
Passerines				
Belted Kingfisher	0.01	0.0	N/A	0.0
Olive-sided Flycatcher	0.01	0.0	N/A	0.0

TABLE 3.4.10-3

Potential Nesting and Foraging Birds Displacement Impacts Due to Liquefaction Facility Construction

Common Name	Kalifornsky Breeding Bird Survey (BBS) Route[a] (birds/mile)	Estimated Onshore Impacts (birds)	Estimated Offshore Impacts (birds)	Total Impacts (birds)
Western Wood-Pewee	0.03	0.1	N/A	0.1
Alder Flycatcher	1.06	2.5	N/A	2.5
Black-billed Magpie	0.26	0.6	N/A	0.6
Gray Jay	0.40	0.9	N/A	0.9
Common Raven	0.13	0.3	N/A	0.3
Northwestern Crow	0.09	0.2	N/A	0.2
Pine Grosbeak	0.03	0.1	N/A	0.1
White-winged Crossbill	0.11	0.3	N/A	0.3
Common Redpoll	1.42	3.3	N/A	3.3
Pine Siskin	1.19	2.8	N/A	2.8
Savannah Sparrow	0.53	1.3	N/A	1.3
White-crowned Sparrow	0.93	2.2	N/A	2.2
Golden-crowned Sparrow	0.01	0.0	N/A	0.0
Dark-eyed Junco	2.26	5.3	N/A	5.3
Lincoln's Sparrow	1.02	2.4	N/A	2.4
Fox Sparrow	0.27	0.6	N/A	0.6
Tree Swallow	0.06	0.1	N/A	0.1
Violet-green Swallow	0.01	0.0	N/A	0.0
Bank Swallow	0.01	0.0	N/A	0.0
Orange-crowned Warbler	0.79	1.9	N/A	1.9
Yellow Warbler	0.04	0.1	N/A	0.1
Yellow-rumped Warbler	1.65	3.9	N/A	3.9
Wilson's Warbler	0.01	0.0	N/A	0.0
Brown Creeper	0.03	0.1	N/A	0.1
Red-breasted Nuthatch	0.07	0.2	N/A	0.2
Black-capped Chickadee	0.09	0.2	N/A	0.2
Boreal Chickadee	0.53	1.3	N/A	1.3
Ruby-crowned Kinglet	0.80	1.9	N/A	1.9
Swainson's Thrush	0.14	0.3	N/A	0.3
Hermit Thrush	0.23	0.5	N/A	0.5
American Robin	1.76	4.2	N/A	4.2
Varied Thrush	0.54	1.3	N/A	1.3
Passerines Total	16.53	39.1	N/A	39.1
All Birds	35.83	84.7	90.0	174.7

Source: Pardieck et al., 2015;

[a] Linear density (birds/mile) based on average of 2005 to 2014 ground survey data for 03028 Kalifornsky breeding bird survey (BBS) route (Pardieck et al., 2015).

3.4.10.1.1.5 Amphibians

Vegetation clearing, grading, and excavation associated with site preparation for the Liquefaction Facility would result in habitat loss and alteration for wood frogs. Vegetation clearing for the Liquefaction Facility would primarily occur during winter. Mortality to hibernating wood frogs could occur from the operation of heavy equipment during vegetation clearing and placement of granular material. Construction activities would result in removal of primarily forested vegetation over about 642 acres and excavation would alter a 1.45-acre natural pond that occurs on the site. Impacts would be minor due to the wide distribution of wood frogs across Alaska.

Noise from construction of the Liquefaction Facility during the breeding season could interfere with wood frog calling and mate finding. Breeding success is dependent on successful calling that leads to mating. Loud anthropogenic noise has been demonstrated to impair the ability of female wood frogs to locate calling males (Tennessen et al., 2014). Construction noise could also result in a physiological stress response that is energetically costly to frogs. Calling frogs would need to call louder, more frequently, or at novel intervals to compensate for anthropogenic noise (Sun and Narins, 2005; Penna and Zuniga, 2014). These impacts could result in diminished reproductive success or survival of individual wood frogs.

3.4.10.1.1.6 Terrestrial and Aquatic Invertebrates

Vegetation clearing, grading, and granular fill and excavation for site preparation would result in habitat loss and alteration for terrestrial and aquatic invertebrates. Vegetation clearing would occur during winter and would permanently remove vegetative habitat for terrestrial invertebrates, as well as removing areas where ponded water provides habitat for aquatic invertebrates. Impacts would be minor due to the wide distribution of terrestrial and aquatic invertebrates and abundance of unaffected habitats across Alaska.

3.4.10.1.2 Marine Terminal and Temporary MOF Construction

3.4.10.1.2.1 Marine Mammals

Most potential construction-related effects on marine mammals would be due to exposure to potentially harmful SPLs and potential habitat degradation. Underwater SPLs typically generated during in-water construction summarized here are discussed in detail in the *Marine Mammal Protection Act Assessment Report* provided in Appendix F. Current thresholds established for underwater SPLs to prevent Level B harassment or Level A injury to whales are 120 dB_{rms} for disturbance from continuous sounds; 160 dB re 1 µPa rms for disturbance from impulsive sounds; and 180 dB re 1 µPa rms for injury. Thresholds established for underwater SPLs to prevent Level B harassment or Level A injury to seals are 120 dB_{rms} for disturbance from continuous sounds; 160 dB re 1 µPa rms for disturbance from impulsive sounds; and 190 dB re 1 µPa rms for injury. Exposure of marine mammals to SPLs above these threshold values has the potential to cause short-term (temporary threshold shift [TTS]) or long-term (permanent threshold shift [PTS]) hearing loss, masking of vocal communications, or physiological stress that can lead to mortality. Pile driving, anchor handling associated with offshore pipelay, and the use of thrusters when docking large vessels docking would be the primary activities during Marine Terminal and Temporary MOF construction that could result in marine mammals being exposed to underwater sound at levels that exceed NMFS threshold levels. Vessel noise may displace marine mammals during the construction of the MOF. Large ships, such as LNGCs, produce broadband 1.09-yard source levels of about 180 dB re 1 µPa (rms) (Richardson et al., 1995; Blackwell and Greene, 2002). However, because these sound levels are transient (the vessel is moving), NMFS does not consider transiting vessel sound to rise to the level of "take" (S. Guan, NMFS, pers. comm.). Areas that would be ensonified and the marine mammal species that could be exposed are indicated in Table 3.4.10-4. The selection of some construction methods such as pile driving method (e.g. impact hammers or vibratory hammers) and mitigation measures has not been finalized. Development and selection of final mitigation measures would continue through the permitting process. A range is therefore provided in Table 3.4.10-4 for some activities. Further analysis of vessel noise impacts and explanation of how the estimates were calculated can be found in Appendix F under Vessel Noise. A Draft Petition for Incidental Take Regulations for construction of the Applicant's in Cook Inlet, Alaska (AGDC 2017) has been submitted to NMFS. Estimates of potential marine mammal exposures will be refined in the petition with the NMFS based on additional project details and the new NMFS (2016) technical guidance on underwater acoustic thresholds and effects on marine mammals.

TABLE 3.4.10-4

Marine Mammals that May Be Exposed during Construction to Sound Exceeding NMFS Thresholds

Species	**Area Ensonified**		
	Pile Driving [b]	**Offshore Pipelay** [c]	**Vessel Docking** [d,e]
Estimated radius to threshold [a]	2.17 mi	0.57 mi	2.64 mi
Estimated area ensonified [g]	7.42 mi^2	1.01 mi^2	10.95 mi^2
Potential Exposures in Exposed in Cook Inlet			
Cook Inlet Beluga Whale	34-49	99	37
Harbor Porpoise	39-58	35	4
Killer Whale	7-9	6	24
Harbor Seal	1,732-2,566	1,563	1,102
Potential Exposures in Prudhoe Bay			
Ringed Seal	-	-	845
Bearded Seal	-	-	42
Spotted Seal	-	-	84
Bowhead Whale	-	-	8

[a] NMFS thresholds for impulsive sound source (pile driving) is 160 dB, and continuous sound sources (pipelay, dredging, vessel docking) is 120 dB (NMFS, 2016).
[b] Source and model from Blackwell 2005, transmission loss = 222.0 – 17.5 Log (r); exposures would be expected to vary with the type of pile driving equipmtn selected for construction
[c] Source value from Laurinolli et al. 2005, isopleth radius calculated with 20 Log ® model.
[d] Source value from URS 2007 source isopleth radius calculated with 20 Log ® model.
[e] Source and radius from Blackwell and Greene 2003, transmission loss = 17.8 Log (r)
[f] Ensonified area calculated as лr2 * 0.5 for shoreline activities; otherwise лr2

3.4.10.1.2.2 Large Mammals

Impacts to large mammals from in-water work for construction of the Marine Terminal are not anticipated. Construction of the temporary MOF would create noise and disturbance that could displace a few large mammals from the area. Most potential impacts to large mammals would be associated with other construction activities described throughout this section.

3.4.10.1.2.3 Furbearers and Small Mammals

Impacts to furbearers and small mammals from in-water work for construction of the Marine Terminal are not anticipated. However, traffic along the shoreline associated with construction of the temporary MOF and PLF could affect and possibly displace a few small mammals. Most potential impacts would be associated with other construction activities described throughout this section.

3.4.10.1.2.4 Birds

Waterfowl, loons, bald eagles, shorebirds, seabirds, belted kingfishers, swallows, and a few other passerines use the shoreline and nearshore water habitats in the Project vicinity for foraging (Table 3.4.10-3). Shorebirds likely to nest in the area use primarily emergent wetlands or forested habitats for nesting (Table 3.4.10-3). Seabirds, bald eagles, and belted kingfishers use the shoreline as a movement corridor for both seasonal and local movements. Dock construction at the Liquefaction Facility could create perch sites for eagles and gulls. The perches could be used for resting or searching for prey. During construction of the marine infrastructure, perch site use would be expected to be minimal due to noise and activity from equipment and people. During operations, perch use could increase due to reduced noise and activity compared to construction. Impacts to wildlife from the potential increase in perch sites from dock creation would be expected to be minimal due to the numerous existing natural perch sites surrounding the marine facilities. Construction of the Marine Terminal would result in the temporary loss of approximately 82 acres of foraging habitat identified by NOAA (2002) in upper Cook Inlet and may cause some minor alteration of seabird use or movement through the area. This represents a very small portion (0.07 percent) of the available foraging and rafting habitat in the upper Cook Inlet. Waterbirds may be displaced from the marine construction areas, but may return to the area when activity is reduced during equipment maintenance days and between the 12-hour marine construction work shifts.

3.4.10.1.2.5 Amphibians

Impacts to wood frogs from in-water work for construction of the Marine Terminal are not anticipated. Construction of the MOF would create noise and disturbance, but wood frogs are not expected to use Cook Inlet shoreline habitats. Most potential impacts to wood frogs would be associated with site preparation and construction noise described throughout this section.

3.4.10.1.2.6 Terrestrial and Aquatic Invertebrates

Few terrestrial invertebrates would be killed or injured during in-water construction of the temporary MOF and PLF. Insects and moths could be attracted to work lights over the water. Habitat for marine aquatic invertebrates would be disturbed and some benthic marine habitat would be changed from silts/sands to gravel prior to cover by piles. Some direct mortality of aquatic invertebrates would likely occur from in-water construction. Pilings would provide settlement habitat for barnacles and mussels.

The primary disturbance to benthic marine habitat would be dredging of the MOF as described in Sections 3.4.10.1.3 and 3.4.10.1.3.6. Minimal habitat would be lost due to long-term placement of the piles. In addition, benthic community abundance and diversity in the area is low, dominated by polychaetes and crustaceans (see Section 3.4.8.1). Thus, the loss of benthic invertebrate biomass would be negligible. Benthic communities indirectly impacted by placement of the piles (e.g., turbidity, sedimentation) are anticipated to generally re-populate within on- year or less (MMS, 2004; BOEM 2016). It is anticipated that the invertebrate community in the area is adapted to the disturbance such as high turbidity and sediment movement in Cook Inlet.

3.4.10.1.3 Dredging, Dredge Disposal

Dredging and seabed preparation would be completed during April through October at the MOF during the second construction season using a combination of dredging barge (barge-mounted crane, clamshell) and hydraulic dredge for about 206 days over an area of about 50.7 acres. The MOF area would be dredged to -35 feet MLLW. Dredge materials would be discharged in deep water within 5 miles of the Liquefaction Facility. Because of the high natural turbidity in upper Cook Inlet, it is unlikely that dredging and dredge disposal would exceed background water turbidity more than 200 feet from these activities. Maintenance dredging may be required in subsequent years to maintain channel depths depending on the rate of sedimentation. The proposed dredge material disposal sites, including deep water locations, are identified in Section 10.6.4.2.1.3 and Figure 1.5.2-1 in Resource Report No. 1.

3.4.10.1.3.1 Marine Mammals

The Draft *Marine Mammal Mitigation and Monitoring Plan* (Appendix N) would be implemented to reduce and mitigate effects of dredging on marine mammals, because dredging equipment would generate both airborne and underwater sound. Airborne SPLs from dredging (89 dBrms at 33 feet) would be unlikely to exceed levels considered to be harassing to marine mammals. However, underwater SPLs that would likely be generated during dredging would exceed the NMFS threshold level (120 dB) that is considered to be harassing. Initial estimates of the probable sound levels at the source, and transmission and spreading loss with distance, indicate that the 120 dB threshold would be exceeded out as far as 443 feet from the activity (Table 3.4.10-4). Based on what is known of the distribution and density of marine mammals in Cook Inlet, it is expected that only a small number of harbor seals would be exposed to those SPLs. Other marine mammals found in Cook Inlet, such as killer whales, harbor porpoises, and northern sea otters, are not expected to be in the area, but could potentially be exposed to sounds above the 120 dB threshold if they were. Appendix F gives details on noise sources and exposure calculations. Appendix N gives details on mitigation and monitoring to avoid potential exposure to noise above thresholds. The SPLs are not injurious, effects on marine mammals from any exposures to these SPLs would consist of brief behavioral responses such as ephemeral avoidance, displacement, or startle responses. Any such effects would be short-term lasting only as long as the activity, and minor, affecting a very small percentage of the harbor seal population.

Dredging could potentially have indirect effects on marine mammals as well. Dredging for the temporary MOF would also result in direct impacts to about 11.32 acres of benthic marine habitat. Disposal of the dredged material would potentially affect an additional 1,200 acres of benthic habitat in Cook Inlet. These benthic habitats support secondary productivity and/or prey that supports prey for marine mammals. The areas proposed for dredging are not known to be heavily used by marine mammals, have very low levels of secondary production of benthic organisms, represent a very small portion of similar habitat available in Cook Inlet, and would recover in a few years or less. Any such indirect effects on marine mammals would be therefore short-term and minor. Appendix F and Appendix N provide more information on these effects and the mitigation and monitoring measures that would be implemented to avoid potential exposure to noise above thresholds.

3.4.10.1.3.2 Large Mammals

Dredging and offshore dredge disposal for the temporary MOF would have no effect on large mammal habitats. Noise from this activity could displace a few large mammals from the immediate area.

3.4.10.1.3.3 Furbearers and small mammals

Dredging and offshore dredge disposal for the MOF would have little effect on furbearer or small mammal habitats. Active dredging in conjunction with onshore construction at the Liquefaction Facility could block movements of river otters along the shoreline, although few are expected to occur in the area. Noise from this activity could displace a few foxes and coyotes from the immediate area.

3.4.10.1.3.4 Birds

Nearshore benthic habitats support biota that provide forage for fish and invertebrates that in turn provide prey for birds. Construction of the MOF would occur during the open-water period from April through October, with dredging and seabed preparation occurring during the second construction season. Dredging and seabed preparation would increase water turbidity that may reduce foraging efficiency for loons or seabirds that pursue fish or invertebrates underwater. Cook Inlet waters are naturally turbid due to the influx of glacial silt from rivers. It is unlikely that dredging would result in more than minor loss of forage and minor temporary increases in turbidity that could reduce foraging efficiency for loons, bald eagles, and seabirds (Table 3.4.10-3).

3.4.10.1.3.5 Amphibians

Wood frogs would not be affected by nearshore and offshore dredging and dredge disposal.

3.4.10.1.3.6 Terrestrial and aquatic invertebrates

Terrestrial invertebrates could be attracted to work lights on dredges, but, in general, would not be affected by habitat loss from dredging or dredge disposal.

Dredging for the MOF would affect about 50.7 acres of benthic habitat and an additional area offshore from cover by disposal of the dredged material. Ambient turbidity of Cook Inlet ranges from 0.3 to 0.6 g/L, with dredging methods falling into background concentration levels (NOAA Undated). Thus, turbidity caused by dredge/dredge disposal is not anticipated to impact marine invertebrates except where direct mortality by entrainment occurs. Construction of the marine facilities would occur during the open-water period from April through October, with dredging and seabed occurring during the second construction season. Dredging would increase water turbidity that may temporarily reduce habitat suitability for marine aquatic invertebrates. Habitat effects from turbidity would be temporary and of short duration. Dredge disposal would occur within 5 miles of the dredged area within a relatively deep water dispersive area of Cook Inlet, thereby reducing turbidity in the water column during dredging and placement operations. Direct mortality of aquatic invertebrates would occur from entrainment in dredged sediments. Typical subtidal infauna that would be affected by dredging on the east side of upper Cook Inlet was not abundant or diverse with the stations closest to the MOF, including only the annelids (Table 3.4.8-3). The polychaete *Dipolydora* *quadrilobata* is the most abundant species in Cook Inlet (CIRCAC, 2010). Invertebrates would be expected to recolonize suitable habitats after disturbance from dredging.

The recovery period for soft sediment benthic habitat disturbed by construction activities would depend on factors such as water depth, sediment type, and community composition. Although the benthic community would be directly affected, these communities generally re-populate within one year (MMS, 2004; BOEM 2016). Disturbed sediments with a greater proportion of sand to mud may fill in with fine silty material, altering grain size and potentially resulting in a change in the community composition that recolonizes (BOEM, 2016). It is anticipated that the invertebrate community in the area is adapted to the disturbance such as high turbidity and sediment movement in Cook Inlet. This is supported by the high degree of local heterogeneity noted in the infaunal community in the marine facilities Project area and the relatively low number of individuals and taxa present (CH2M, 2016b).

3.4.10.1.4 Pile Driving

Airborne and underwater noise generated during sheet and pile impact and vibratory hammering are discussed in detail in Appendix F.

3.4.10.1.4.1 Marine Mammals

Airborne SPLs from impact (106 to 113 dB_{rms} at 33 feet) and vibratory (92 to 102 dB_{rms} at 33 feet) pile and sheet driving would exceed threshold harassment value for harbor seals (90 dB_{rms}) within a potential range of about 0.62 mile. Because no harbor seal haulouts occur near the MOF, no seal haulouts would be disturbed by airborne sounds from pile driving. Underwater SPLs from pile driving would exceed levels that are considered to be harassing within distances of 0.060 to 2.65 miles depending on the type of material and type of installation (Table 3.4.10-4). Impact and vibratory driving would occur for an estimated 531 days over multiple years and the following species would potentially be exposed to pile-driving sound above the threshold values: harbor porpoises, killer whales, and harbor seals (estimate for harbor seals. Steller sea lions (Nemeth et al., 2007) rarely occur in the Upper Cook Inlet, with few sightings north of Anchor Point (Rugh 2005), and therefore would not be expected to occur near the site of the proposed Liquefaction Facility during pile driving or to be exposed to sounds above the 120 dB threshold (Appendix F). The site is also outside the range of the northern sea otter, so no exposures of sea otters to sound energy generated by pile driving would be expected. Appendix F gives details on noise sources and exposure calculations, and Appendix F gives details on mitigation and monitoring to avoid potential exposure to noise above thresholds. Mitigation would include monitoring the area that would be exposed to noise above the threshold and stopping the activity if a marine mammal entered that area (Appendix F).

3.4.10.1.4.2 Large and Small Mammals

Intermittent loud noises (such as impact pile driving) that can reach levels of 106 to 113 dB_{rms} at 33 feet would likely initially trigger a startle response in nearby animals, potentially followed by movement away from the sound source. More moderate and constant noise from construction would be less likely to cause displacement from the area, but would be more likely to interfere with the exposed animal’s ability to detect important sounds or cues that could increase predation or vehicle collision risks.

3.4.10.1.4.3 Birds

Sheet and pile driving for the MOF and PLF would occur during the open-water season (April through October) over four years. Noise generated during vibratory and impact pile driving could range from 80 to 111 dBA in air depending on the type, conditions, and distance from the source. The intermittent banging from pile driving may be more disturbing to animals than more continuous vibratory driving, which is generally not as loud. Both types of sheet and pile driving would be necessary to construct the Marine Terminal. Waterbirds may return to the marine construction areas during periods between active sheet and pile driving, during equipment maintenance days, and/or between shifts at night.

Initiation of pile driving early in the nesting season may lead to displacement of nesting birds from habitats surrounding the construction area. Initiation of pile driving during the middle of the nesting season may lead to nest abandonment and lost or reduced productivity. Some birds, such as many raptors, owls, and common ravens, however, are likely to initiate nests well before the open-water construction season begins on April 1. Initiation of pile driving in early April could disturb these nesting birds leading to nest abandonment if they nest close to the Project area. Raptor nest surveys did not identify any raptor nests within 2 miles of the proposed Liquefaction Facility, other than the bald eagle nest discussed in Section 3.5. Pile driving during spring and fall could displace migrant birds from coastal stopover or staging habitats. The eastern shore of Cook Inlet is located within a spring concentration and nesting concentration area for waterfowl—ducks and geese (ADF&G, 1985). However, shoreline habitats near the Liquefaction Facility do not appear to be important migration fall stopover or staging habitats for waterfowl, shorebirds, or seabirds (ADF&G, 1985; NOAA, 2002).

Available habitat for resident and migratory birds is abundant nearby, with large tracts of undisturbed habitat occurring east of the Liquefaction Facility in the Kenai NWR.

3.4.10.1.4.4 Amphibians

Available habitat for amphibians is limited (very few small emergent wetlands on site). Noise from pile driving activities in the nearshore areas of Cook Inlet would not impact amphibians found on site.

3.4.10.1.4.5 Terrestrial and Aquatic Invertebrates

The Liquefaction Facility site would contain limited numbers of terrestrial invertebrates because of the current developed state of most of the acreage planned for the facility. Few areas of aquatic habitat (< 6 acres of emergent wetland) are found on the site that will be impacted by land clearing for construction. Noise from offshore pile driving activities would not impact these invertebrates.

3.4.10.1.5 Blasting

No blasting is expected to be conducted at the proposed Liquefaction Facility site.

3.4.10.1.6 Vessel Activity

3.4.10.1.6.1 Marine Mammals

Construction of the Liquefaction Facility would require material and modules to be delivered via HLV, module carriers, and barges. Vessels may collide with marine mammals resulting in injury and death. Whale mortalities from ship strikes are usually caused by blunt force trauma from striking the ship bow, or by lethal wounding from propeller cuts. Neilson et al. (2012) documented 108 ship strikes in Alaska from 1978 to 2011 and found the vast majority involved humpback whales in Southeast Alaska. Vessel speed is the primary factor in the probability of a vessel strike, as well as the probability of the strike being lethal. The number of vessel strikes by vessels traveling at less than 10 knots (11.5 miles per hour) is very low relative to the number of vessels normally traveling at those speeds. Seals and sea lions are far less susceptible to vessel strikes, probably because of their visual awareness both above and below water, and their quick maneuverability. The slow speeds for most HLV traffic associated with construction of the Liquefaction Facility makes the potential for vessel collisions with marine mammals low.

Noise from HLVs maneuvering at the MOF could displace a few marine mammals from the area (Table 3.4.10-4). Underwater noise from HLVs during docking would exceed levels that are considered to be harassing within distances out to 2.64 miles (Table 3.4.10-4). About 190 HLV dockings would occur during construction over multiple years and the estimated potential exposures to noise above threshold values could include: 20 harbor porpoises, three killer whales, and 914 harbor seals (estimate for harbor seals is likely inflated due to bias in density estimates). Appendix F gives details on noise sources and exposure calculations, and Appendix N gives details on mitigation and monitoring to avoid potential exposure to noise above thresholds.

Vessels can impact habitat quality for marine mammals through the introduction of aquatic invasive organisms. Vessels can introduce aquatic invasive organisms from ballast-water discharge, fouled hulls, and equipment placed overboard (e.g., anchors). Construction vessel traffic would arrive from Asia and could potentially transport non-native tunicates, green crab (*Carcinus maenas*), and Chinese mitten crab (*Eriocheir sinensis*) (ADF&G, 2002), which impact food webs and can outcompete native invertebrates, resulting in habitat degradation.

HLVs would plan to ballast loads with cargo rather than water and would use minimal amounts of freshwater for ballast. Use of freshwater ballast would allow for removal of ballast within transporting marine aquatic invasive organisms. All vessels brought into the State of Alaska or federal waters are subject to USCG 33 C.F.R. 151 regulations, which are intended to reduce the transfer of aquatic invasive organisms. Management of ballast water discharge is regulated by federal regulations (33 C.F.R. 151.2025) that prohibit discharge of untreated ballast water into the waters of the United States unless the ballast water has been subject to a mid-ocean ballast water exchange (at least 200 nautical miles offshore). Vessel operators are also required to remove "fouling organisms from hull, piping, and tanks on a regular basis and dispose of any removed substances in accordance with local, state, and federal regulations" (33 C.F.R. 151.2035(a)(6). Adherence to the USCG 33 C.F.R. 151 regulations would reduce the likelihood of Project-related vessel traffic introducing aquatic invasive species.

3.4.10.1.6.2 Large Mammals

HLV activity would not be expected to affect large mammals, or their habitats, although introduction or spread of rats or mice transported with materials by HLV would have the potential to decrease habitat quality for large mammals through spread of disease, displacement of native prey, or spread of invasive plants that would reduce forage quality. Measures would be implemented to prevent the introduction and spread of invasive plants and animals (Appendix K).

3.4.10.1.6.3 Furbearers and Small Mammals

HLV activity would not generally be expected to affect small mammals. Introduction or spread of rats or mice transported to shore with materials from infested vessels would have the potential to decrease habitat quality for small mammals through spread of disease, displacement of native prey, or spread of invasive plants that would reduce forage quality. Measures would be implemented to prevent the introduction and spread of invasive plants and animals (Appendix K).

3.4.10.1.6.4 Birds

Vessel traffic during construction from April through October may be sufficient to displace birds from the immediate area. Waterbirds would continue to move through the area, but may fly or swim farther offshore or inland away from the center of vessel activity near the temporary MOF. However, some tolerant birds, such as gulls, may continue to use shoreline habitats in the area; others may return and use the area when activity is moderated during periods between vessel arrivals and departures.

Introduction or spread of rats or mice transported to shore with materials from infested vessels would have the potential to increase bird mortality through depredation of nests, decrease habitat quality through spread of disease, displacement of native prey, or spread of invasive plants that would reduce habitat quality. Measures would be implemented to prevent the introduction and spread of invasive plants and animals (Appendix K).

3.4.10.1.6.5 Amphibians

Wood frogs are not expected to be affected by vessel activity.

3.4.10.1.6.6 Terrestrial and Aquatic Invertebrates

Vessel traffic would be unlikely to affect terrestrial invertebrates. Entrainment of the pelagic larval stages of aquatic invertebrates could occur. Free-floating larvae would be present in the water column and could become entrained by passing vessels, although effects would be limited to the time when larvae are present in the vessel corridor study area. Larval barnacles are present in Upper Cook Inlet from April through September, with peak abundance in May; decapod abundance peaks in July (Figure 3.4.8-1).

Introduction or spread of aquatic invasive organisms would have the potential to impact native aquatic invertebrates through competition, spread of disease, displacement, and reduced habitat quality. Vessels would plan to ballast loads with cargo rather than water and would use minimal amounts of freshwater for ballast. Use of fresh water ballast would allow for removal of ballast without transporting marine aquatic invasive organisms. Further mitigation measures that would be implemented to prevent the introduction and spread of invasive plants and animals can be found in Appendix K. See discussions of invasive aquatic organisms in sections 3.2.7 and 3.2.8.

3.4.10.1.7 Traffic (Land and Air)

Direct impacts to wildlife from ground and air traffic for construction of the Liquefaction Facility could include injury or mortality from collisions, disruption of seasonal movements, displacement from roadside habitats, and/or reduced productivity from disturbance. Most materials for construction of the Liquefaction Facility would be transported to Alaska by ships. Some break-bulk cargo would be distributed by roads to the Liquefaction Facility from Anchorage, Seward, or possibly Homer. During construction, an estimated 80,000 self-unloading dump transport loads would transport bulk granular material across Highways 1 and 9 and the Kenai Spur Highway, primarily during summer and fall; and 10,270 truckloads would transport camps and camp modules for the LNG Plant and Marine Terminal facility. The subject portion of the Kenai Spur Highway would be vacated at this point in time, as approximately 95 percent of the traffic would be on the Liquefaction Facility footprint. Currently, Anchorage to Kenai full truck loads average 15,386 truckloads/year (range 6,749–36,981 truckloads/year).

3.4.10.1.7.1 Marine Mammals

Traffic on roads would not affect marine mammals. Noise from aircraft overflights has the potential to disturb marine mammals. Most air traffic to support construction of the Liquefaction Facility would be for transport of Project personnel to the Kenai Municipal Airport and Ted Stevens Anchorage International Airport. Commercial aircraft would normally operate at altitudes over 1,500 feet above sea level when in flight, and noise reaching water would be below threshold values. Routine Project-related air traffic to support construction of the Liquefaction Facility would not be expected to affect marine mammals in Cook Inlet, and would be indistinguishable from current air traffic over Cook Inlet.

3.4.10.1.7.2 Large Mammals

Moose are vulnerable to collision with vehicles and the increase in truck traffic would be likely to increase moose-vehicle collision mortality. Currently, collision mortality is considered to be one of the leading causes for decline in the moose population on the western Kenai Peninsula, with an estimated 100 vehicle mortalities per year. Moose-vehicle collisions increase during fall as moose are moving and distracted during rut and daylight decreases, reducing drivers’ ability to detect and avoid collisions. Measures to avoid and reduce potential collision mortality for large mammals would be implemented to the extent practicable (Appendix J), however, the large increase in Project-related traffic is likely to increase moose-collision mortality on the Kenai Peninsula. Bears and caribou are also vulnerable to vehicle collision mortality.

3.4.10.1.7.3 Furbearers and Small Mammals

While less notable than large mammal collision mortality; furbearers and small mammals are also vulnerable to collision mortality and the large increase in Project-related traffic is likely to increase small mammal collision mortality on the Kenai Peninsula. Measures in the *Wildlife Avoidance and Interaction Plan* would be implemented to reduce potential collision mortality to the extent practicable (Appendix J).

3.4.10.1.7.4 Birds

Birds are vulnerable to collision mortality and disturbance from air and vehicle traffic. From 1990–2012, 127,163 bird strikes from civilian aircraft were reported, resulting in mortality of 250 humans and 229 aircraft, 83 percent of bird strikes from aircraft occur at elevations from ground level to 500 feet (FAA 2013). Most air traffic to support construction of the Liquefaction Facility would be for transport of Project personnel to the Kenai Municipal Airport and Ted Stevens Anchorage International Airport. Commercial aircraft would normally operate at altitudes over 1,500 feet above sea level when in flight; noise and potential disturbance would be most probable during landing and takeoff. Increase in air traffic by routine Project-related flights to support construction of the Liquefaction Facility would not be expected to affect many birds, and would be indistinguishable from current air traffic over Cook Inlet.

Birds are vulnerable to vehicle collisions and increased traffic may result in some additional displacement away from roadside habitats. The large increase in Project-related traffic is likely to increase bird collision mortality on the Kenai Peninsula. Measures in the *Wildlife Avoidance and Interaction Plan* would be implemented to reduce potential collision mortality to the extent practicable (Appendix J).

3.4.10.1.7.5 Amphibians

Increased traffic associated with the construction of the Liquefaction Facility has the potential to have lethal and sub-lethal effects on amphibians. Mortality resulting from collision with automobiles on roads could occur throughout the years while frogs are migrating or foraging. Off-road mortality could occur during hibernation. Sub-lethal effects to frogs could include reduced breeding success due to noise disturbance and contamination of breeding pools caused by vehicle exhaust and brake pad dust.

Noise disturbance from air and land traffic is energetically costly to frogs and has been shown to reduce breeding success of wild populations. Breeding success requires successful calling leading up to mating. Traffic noise impairs the ability of female wood frogs to locate calling males, in addition to inducing a physiological stress response (Tennessen et al., 2014). Male frogs may call louder, more frequently, or at novel intervals to compensate for anthropogenic noise from both air and road traffic (Sun and Narins, 2005; Cunnington and Fahring, 2010; Penna and Zuniga, 2014). Traffic noise would occur throughout the year and could negatively affect wood frogs during their active period of April through August.

Copper is a contaminant known to negatively affect amphibians and other aquatic organisms at sub-lethal levels. Vehicle exhaust and brake dust are known sources of copper, which can enter hydrologic systems through runoff (Sansalone and Buchberger, 1997). Wood frog tadpoles exposed to low concentrations of copper exhibited greatly reduced movement frequency and slower than normal growth, increasing their risk of predation (Reeves et al., 2011; Hayden et al., 2015).

3.4.10.1.7.6 Terrestrial and Aquatic Invertebrates

Terrestrial invertebrates are vulnerable to vehicle collisions when in flight or crawling across roadways. Aquatic invertebrates are susceptible to lethal and sublethal effects from environmental contamination. Copper from vehicle exhaust and brake dust may enter hydrologic systems through runoff. Elevated levels of copper in water adversely affect survival, growth, reproduction, feeding, and incidence of morphological deformity (Majumdar and Gupta, 2012; Hayden et al., 2015).

3.4.10.1.8 Human Interaction

During the seven-year construction of the LNG Plant and Marine Terminal, a peak workforce of about 4,400 to 5,000 people would be required. This increase in personnel would increase the potential for interactions with wildlife that can often be detrimental to wildlife and can put workers at risk. Measures to avoid and reduce potential interactions with wildlife are described in the *Wildlife Avoidance and Interaction Plan* (Appendix J). An important measure in avoiding interactions is to contain all food waste to ensure that wildlife do not become habituated to human food (see Appendix J in Resource Report No. 8).

3.4.10.1.9 Hydrostatic Testing

To the maximum extent practicable, integrity testing would be done in a controlled environment at the pre-fabrication yards. Hydrotest water would be obtained from the onsite water wells and only approved additives (e.g., oxygen scavengers, biocides, or preservatives) would be used as necessary to meet specifications. Hydrostatic test water would be filtered and discharged into the sediment basins on site in compliance with applicable permits. The water would then be tested prior to discharge via outfall to Cook Inlet.

3.4.10.1.9.1 Marine Mammals

Hydrostatic testing would not be likely to affect marine mammals due to discharges being into sediment basins and water testing requirements under associated permits.

3.4.10.1.9.2 Wildlife

Hydrostatic testing would have minor impacts to wildlife because discharges would occur in uplands and Cook Inlet, and the water would be extracted from uncontaminated sources. Hydrostatic testing would not likely affect amphibians due to the controlled nature of the action. It would be unlikely that amphibians would come into contact with hydrostatic water.

3.4.10.1.10 Spills

Large and small quantities of hazardous materials, including diesel fuel and gasoline, would be handled, transported, and stored following the rules and procedures described in the *SPCC Plan* (Appendix M in Resource Report No. 2). Each contracting firm, facility, and pipeline spread would prepare their own separate SPCC Plan that follows the outline in *SPCC Plan* (Appendix M in Resource Report No. 2).

3.4.10.1.11 Marine Mammals

Spills and leaks of oil or wastewater arising from Project activities that reach marine waters could result in direct impacts to the health of exposed marine mammals. Individual marine mammals could show acute irritation or damage to their eyes, blowhole or nares, and skin; fouling of baleen, which could reduce feeding efficiency; and respiratory distress from the inhalation of vapors (Geraci and St. Aubin, 1990). Long-term impacts from exposure to contaminants to the endocrine system could impair health and reproduction (Geraci and St. Aubin, 1990). Ingestion of contaminants could cause acute irritation to the digestive tract, including vomiting and aspiration into the lungs, which could result in pneumonia or death (Geraci and St. Aubin, 1990).

Indirect impacts from spills or leaks could occur through the contamination of lower-trophic-level prey, which could reduce the quality and/or quantity of marine-mammal prey. In addition, individuals that consume contaminated prey could experience long-term effects to health (Geraci and St. Aubin, 1990).

3.4.10.1.11.1 Large and Small Mammals

Spills could originate from fuel trucks, improperly maintained equipment, and the improper use and storage of fuels, lubricants, and other hazardous materials. Spills and leaks would most likely be detected and cleaned up, and would be unlikely to injure large or small mammals. Spills that reach vegetation could damage and reduce available habitat. Oil can affect mammals by reducing foraging habitats and would injure or kill mammals that ingested oil through grooming, foraging on coated vegetation, or foraging on contaminated prey. Ingestion of oil could result in lethal and sub-lethal effects. Large and small mammals that come into contact with and get oil in their fur or hair may lose the insulating properties of the fur or hair, which could lead to hypothermia.

3.4.10.1.11.2 Birds

Spills could originate from fuel trucks, improperly maintained equipment, and the improper use and storage of fuels, lubricants, and other hazardous materials. Spills and leaks would most likely be detected and cleaned up, and are unlikely to injure birds. Spills occurring during the winter would be less likely to affect birds because many birds are migratory and would not occur in the region during winter. Contamination of lower-trophic-level organisms could reduce the quality and/or quantity of prey. Potential effects of exposure of birds to spills could include mortality, health effects from ingested contaminants, impaired foraging, and increased energy expenditure for thermal regulation. Oil reduces the insulation and buoyance of feathers; effects could include hypothermia and drowning. Activity associated with cleanup efforts could also disturb and displace individuals or flocks from foraging and staging habitats.

3.4.10.1.11.3 Amphibians

To minimize and prevent spills of fuels and lubricants from heavy machinery a SPCC plan would be developed and applied during construction of the Liquefaction Facility.. Spills of fuels and lubricants could result in exposure of eggs, tadpoles, or adult frogs. Amphibians may absorb toxins from oil through their skin. Exposure to toxins that occurs during egg formation in reptiles and amphibians can lead to reduced productivity and teratogenic effects. Teratogens are any agent that can disturb the development of an embryo or fetus. Also, the Project’s use of fuel and lubricants would comply with current regulatory requirements and personnel would be trained for proper handling, storage, disposal and spill response of potential contaminants.

3.4.10.1.11.4 Terrestrial and Aquatic Invertebrates

In the event of a spill of fuel oil or lubricants from vessels or heavy equipment during construction of the Liquefaction Facility, direct exposure could cause mortality to invertebrates residing in the vicinity of the spill. Many invertebrates are relatively immobile and often indiscriminate filter-feeders, and may not be able to avoid exposure to contaminants. Floating oil and volatile compounds can contaminate plankton, including the larvae of various invertebrates. Effects to invertebrates are magnified since they ingest a large quantity of water relative to their body size. Contamination can produce long-term effects on respiration, mobility, digestion, growth, and reproduction (Earth Gauge, 2011). Sinking oil can affect invertebrates occupying the bottom of waterbodies, contaminating or smothering these organisms. If mobility is reduced, invertebrates can become more vulnerable to predators or more susceptible to currents.

Oil or lubricants that aggregate in shallow areas could trap or incapacitate invertebrates by exposure to dissolved fractions of oil. Many invertebrates cannot metabolize PAHs, which instead accumulate in body tissues (Earth Gauge, 2011). Filter-feeding bivalves (e.g., clams, mussels) easily ingest dispersed oil droplets and oiled particles suspended in the water column. Bivalves do not metabolize hydrocarbons, which remain in the tissues for extended periods. Crabs may be affected for a short time, but they, like most crustaceans, tend to metabolize hydrocarbons and quickly eliminate them as body waste. Some stress-tolerant organisms, including polychaete worms, snails, and mussels, have been found to be more abundant at oiled sites—possibly due to organic enrichment from the oil, or from reduced competition or predation from more sensitive species. To minimize and prevent spills of fuel oil or lubricants from vessels or heavy equipment during construction, an Oil Discharge Prevention and Contingency Plan and SPCC plan would be developed and applied. Also, storage of fuel oil or lubricants would comply with current regulatory requirements and personnel would be trained for proper handling, storage, disposal and spill response of potential contaminants.

3.4.10.1.12 Waste

Measures outlined in the *Wildlife Avoidance and Interaction Plan* (Appendix J) and the *Waste Management Plan* provided in Appendix J in Resource Report No. 8 would be used to prevent wildlife access to food waste. All construction wastes would be stored appropriately within the fenced area of the facility. With this measure and others identified in the *Wildlife Avoidance and Interaction Plan* and the *Waste Management Plan* any impacts on wildlife would be minor and temporary.

Construction waste has the potential to impact wildlife habitats by the construction of landfills or temporary storage areas. Garbage or unsecured food waste can attract wildlife such as bears, coyotes, foxes, and nuisance wildlife such as gulls or rats. Attraction of bears to camps can lead to an increase in human interactions that often lead to destruction of the bear. Attraction and nutritional supplements can increase predation on local wildlife, including amphibians, small mammals, and birds. However, with the measures in the *Waste Management Plan* and *Wildlife Avoidance and Interaction Plan*, it is expected that these potential impacts would be reduced.

3.4.10.1.13 Contamination

Measures outlined in the *SPCC Plan* (Appendix M in Resource Report No. 2) and the *Unanticipated Contamination Discovery Plan* (Appendix I of Resource Report No. 8) would be used to contain and prevent exposure of wildlife to hazardous waste.

Exposure to contamination can be hazardous to wildlife, with the type and severity of the potential hazard related to the properties of the contamination. All waste, including contaminated soils and absorbent materials would be stored and disposed of following state and federal regulations. There are no licensed hazardous waste treatment or disposal facilities in Alaska. All hazardous waste and contaminated soils may be stored in a secure location at the Contractor yard until shipment to a licensed facility. Contractors should provide a site-specific SPCC plan for temporary storage of waste, including measures for containment, waste segregation, and security. Potential impacts to wildlife from waste include spills and contaminated soils. To prevent and mitigate against inadvertent contamination from waste, all waste storage areas should occur in upland areas and be properly contained until disposal. Impacts to wildlife that are directly related to waste and waste disposal are not anticipated.

3.4.10.1.14 Sensitive Wildlife Habitat Areas

The sensitive wildlife habitats closest to the proposed Liquefaction Facility are located about 5 miles away and include the Kenai NWR and the Swanson Lakes IBA within the Kenai NWR. This sensitive wildlife habitat area would not be affected by construction of the Liquefaction Facility.

3.4.10.1.15 Alaska Game Management Areas

The Liquefaction Facility is located within GMU 15A. Construction of the Liquefaction Facility would be unlikely to interfere with game management within this unit due to the commercial and industrial nature of the site, although there would be an increased potential for moose-vehicle collisions and bear-human interactions.

3.4.10.2 Interdependent Project Facilities

3.4.10.2.1 Pipeline

3.4.10.2.1.1 Mainline

The Mainline ROW would contain about 137 acres of aquatic (excluding Cook Inlet) and terrestrial wildlife habitats (Table 3.4.10-5) Undisturbed and protected wildlife habitats are abundant throughout Alaska. The Mainline would be routed to coincide with other transportation or utility corridors across much of its length.

TABLE 3.4.10-5

Wildlife Habitats (Acres) Affected by Construction and Operation of the Mainline – Compressor Stations and Associated Infrastructure

Level I[c]	**Level II[c]**	**Level III[c]**	**Mainline ROW[a]**		**Compressor Stations**	**Associated Infrastructure[b]**			**Mainline Total**	
			Const	**Ops**	**Const**	**Ops**	**Const**	**Ops**	**Const**	**Ops**
Forest	Evergreen Forest	Closed Evergreen	22.15	8.86			20.70	0.73	263.00	64.09
		Open Evergreen	1,759.31	704.32	29.64	29.64	1,632.11	91.87	603.18	125.91
		Woodland Evergreen	556.89	222.39	16.50	16.50	625.70	62.02	719.47	194.90
Evergreen Forest Total			*2,338.35*	*935.57*	*46.14*	*46.14*	*2,278.50*	*154.62*	*1,585.64*	*384.89*
	Deciduous Forest	Closed Deciduous	96.73	38.03			437.61	25.55	752.79	287.96
		Open Deciduous	351.11	137.49	29.32	29.32	326.97	16.02	545.08	209.14
		Woodland Deciduous	172.78	62.96			90.22	1.13	4,598.45	1,264.89
Deciduous Forest Total			*620.62*	*238.48*	*29.32*	*29.32*	*854.81*	*42.71*	*5,896.32*	*1,761.99*
	Mixed Forest	Closed Mixed	345.85	144.87			352.36	88.52	42.85	9.59
		Open Mixed	2,007.79	803.89	31.97	31.97	2,175.54	96.46	1,199.09	300.91
		Woodland Mixed	222.82	90.32			205.07	7.95	3,421.94	825.83
Mixed Forest Total			*2,576.46*	*1,039.07*	*31.97*	*31.97*	*2,732.98*	*192.92*	4,663.88	1,136.33
Forest Total			**5,535.43**	**2,213.12**	**107.44**	**107.44**	**5,866.29**	**390.25**	**12,145.84**	**3,283.21**
Scrub	Dwarf Tree Scrub	Closed Dwarf	10.71	4.44			42.62		53.33	4.44
		Open Dwarf	489.32	204.09	23.56	23.56	317.51	18.42	272.93	65.76
		Woodland Dwarf	164.40	64.96			108.54	0.80	830.5	246.2
Dwarf Tree Scrub Total			*664.43*	*273.49*	*23.56*	*23.56*	*468.66*	*19.22*	*1,156.85*	316.47
	Tall Scrub	Closed Tall	262.13	100.36	3.80	3.80	226.71	2.12	492.92	106.38
		Open Tall	455.58	178.77	0.42	0.42	530.13	66.40	1,001.45	246.18
Tall Scrub Total			*717.71*	*279.13*	*4.22*	*4.22*	*756.84*	*68.52*	*1,494.37*	*352.5*
	Low Scrub	Closed	394.68	160.68			181.24	3.00	575.98	163.68
		Open	2,125.70	881.37	69.55	69.55	1,450.19	49.00	3,743.96	1079.14
Low Scrub Total			*2,524.83*	*1,043.93*	*69.55*	*69.55*	*1,632.41*	*52.00*	*4,319.94*	*1242.82*
	Dwarf Scrub	Dryas	25.26	11.48	0.40	0.40	29.88	0.42	126.28	32.20
		Ericaceous	194.63	82.06			84.11	0.85	341.04	102.97

TABLE 3.4.10-5

Wildlife Habitats (Acres) Affected by Construction and Operation of the Mainline – Compressor Stations and Associated Infrastructure

Level I[c]	Level II[c]	Level III[c]	Mainline ROW[a]		Compressor Stations	Associated Infrastructure[b]			Mainline Total	
			Const	Ops	Const	Ops	Const	Ops	Const	Ops
		Willow	126.14	53.06	8.99	8.99	46.97	0.26	362.56	105.35
		(blank)	211.61	84.42	21.53	21.53	114.44	-	149.61	43.92
	Dwarf Scrub Total		*557.63*	*231.03*	*30.92*	*30.92*	*275.39*	*1.52*	*979.49*	*284.45*
Scrub Total			**4,464.59**	**1,827.58**	**128.25**	**128.25**	**3,133.31**	**141.26**	**7,950.65**	**2,196.29**
Herbaceous	Graminoid Herbaceous	Dry Graminoid	66.64	27.54			45.08	1.73	111.75	29.27
		Mesic Graminoid	1,719.66	678.73	0.33	0.33	675.05	10.89	4,189.97	1,564.27
		Wet Graminoid	443.51	166.87	21.46	21.46	143.19	5.51	1,550.63	529.26
Graminoid Herbaceous Total			**2,229.81**	**873.14**	**21.79**	**21.79**	**863.32**	**18.13**	**5,852.35**	**2122.80**
	Forb Herbaceous	Dry Forb	26.05	11.10			28.50		54.55	11.10
		Mesic Forb	10.38	4.91			58.11	9.07	71.85	17.34
Forb Herbaceous Total			*36.43*	*16.01*			*86.61*	*9.07*	*126.41*	*28.44*
	Bryoid Herbaceous	Lichens	0.31	0.13			0.09		0.39	0.13
Bryoid Herbaceous Total			*0.31*	*0.13*			*0.09*		*0.39*	*0.13*
	Aquatic (nonemergent)	Freshwater Aquatic	0.33	0.14			0.84		0.04	--
Aquatic nonemergent herb. Total			*0.33*	*0.14*			*0.84*		*6.52*	*2.91*
Herbaceous Total			**2,266.89**	**889.42**	**21.79**	**21.79**	**950.86**	**27.21**	**5,985.72**	**2,154.29**
Disturbed	None	None	88.18	28.43	0.01	0.01	1,396.18	90.44	1,829.68	405.57
No Data[d]	**None**	**None**	-	-	-	-	32.27	-	-	-
Disturbed Total	**None**	**None**	88.18	28.43	0.01	0.01	**1,428.45**	**90.44**		**118.88**
Water	Lake/Pond	Lake/Pond	22.30	8.11	0.10	0.10	50.05	0.30	72.45	8.51
	Stream	Stream	115.56	51.60			299.67	0.05	415.23	51.65
	Offshore	Offshore	38,126.57	324.92			1.22		38127.79	324.92

TABLE 3.4.10-5

Wildlife Habitats (Acres) Affected by Construction and Operation of the Mainline – Compressor Stations and Associated Infrastructure

Level I[c]	Level II[c]	Level III[c]	Mainline ROW[a]		Compressor Stations	Associated Infrastructure[b]			Mainline Total	
			Const	Ops	Const	Ops	Const	Ops	Const	Ops
Water Total			**38,352.61**	**413.06**	**0.10**	**0.10**	**1,747.13**	**90.79**	**39,161.79**	**542.84**
		Mainline Total	**50,619.52**	**5,343.18**	**257.58**	**257.58**	**11,729.85**	**649.51**	**67,073.68**	**8,582.20**

Source: Project Vegetation Mapping; Boggs et al., 2012

Const = Construction, Ops = Operations; Construction acreage includes operational areas. See Resource Report No. 1, Table 1.4-1 for definitions of construction and operations affected areas.

[a] Mainline Construction and Operations ROWs included about 50 acres of overlapping MLBV and compressor station footprints.

[b] Associated Infrastructure excludes ice infrastructure and includes all permanent gravel pads and gravel access roads that would be retained during operations. See Resource Report No. 1, Table 1.4-1 for definitions of construction and operations affected areas. Note: Approximately 15 percent of the Mainline construction impact area for material sites was not covered by Project vegetation mapping, the AKNHP mapping was used to fill in missing vegetation mapping.

[c] Levels are generally consistent with Viereck's Alaska Vegetation Classification System (Viereck et al., 1992). This classification is based on (Level I) dominant growth forms (tree, shrub, herb), (Level II) canopy height, and (Level III) and closure, general soil moisture and salinity, and dominant plants.

[d] No data-information not available for land classification in these areas.

TABLE 3.4.10-6

Brown Bear Habitat Crossed by the Project Pipeline ROW

Pipeline	Milepost		Description of Sensitive Season	Length Crossed (mile)	Construction ROW Area (acres)	ROW Construction Season[a]	Pipelay Season[b]
	Start	End					
PTTL	0.0	62.53	General – Year-round	62.47	1,726.53	Winter	W1
Mainline	0.0	56.6	General – Year-round	56.6	994.06	Summer	W1
Mainline	56.6	75.8	General – Year-round	19.2	299.22	Summer	S1.5
Mainline	76.1	114.7	General – Year-round	38.6	604.81	Summer	S1.5
Mainline	114.7	148.4	General – Year-round	33.6	525.04	Winter	W2
Mainline	148.7	166.2	General – Year-round	17.6	273.69	Winter	W2
Mainline	166.2	168.7	General – Year-round	2.4	36.45	Summer	W2
Mainline	168.7	170.2	General – Year-round	1.6	23.81	Summer	S2.5
Mainline	170.2	171.6	General – Year-round	1.4	27.26	Summer	S2.5
Mainline	171.6	177.8	General – Year-round	6.1	100.67	Summer	S2.5
Mainline	177.8	182.1	General – Year-round	4.4	63.94	Winter	W2
Mainline	182.1	186.1	General – Year-round	4.0	69.95	Winter	S2.5
Mainline	186.1	196.4	General – Year-round	10.3	163.39	Winter	S2.5
Mainline	196.4	198.7	General – Year-round	2.3	38.52	Winter	S2.5
Mainline	198.7	208.9	General – Year-round	10.2	157.38	Winter	S2.5
Mainline	208.9	222.0	General – Year-round	13.1	203.35	Winter	W1
Mainline	222.0	227.7	General – Year-round	5.7	103.06	Winter	W1
Mainline	227.7	227.8	General – Year-round	0.1	2.08	Winter	W1
Mainline	227.8	228.1	General – Year-round	0.3	103.06	Winter	W1
Mainline	228.1	228.3	General – Year-round	0.1	2.46	Winter	W1
Mainline	228.3	228.9	General – Year-round	0.6	8.58	Winter	W1
Mainline	228.9	232.7	General – Year-round	3.8	58.01	Winter	W1
Mainline	232.7	232.9	General – Year-round	0.3	4.63	Winter	W1
Mainline	232.9	235.6	General – Year-round	2.7	39.48	Winter	W1
Mainline	235.6	238.0	General – Year-round	2.3	34.50	Winter	W1
Mainline	238.0	239.9	General – Year-round	2.0	29.90	Winter	W1
Mainline	240.2	241.1	General – Year-round	0.8	12.10	Winter	W1
Mainline	241.1	243.2	General – Year-round	2.1	31.58	Winter	W1
Mainline	243.2	251.0	General – Year-round	7.8	121.83	Winter	W1
Mainline	251.0	251.2	General – Year-round	0.2	3.21	Winter	W1
Mainline	251.2	281.4	General – Year-round	30.2	478.11	Summer	S1.5
Mainline	281.4	314.9	General – Year-round	33.5	503.59	Summer	S1.5
Mainline	314.9	326.7	General – Year-round	11.8	178.10	Summer	S1.5
Mainline	326.7	332.5	General – Year-round	5.8	84.90	Summer	S1.5
Mainline	332.8	340.3	General – Year-round	7.5	111.37	Summer	S1.5
Mainline	340.3	347.8	General – Year-round	7.5	116.67	Summer	S1.5
Mainline	347.8	355.8	General – Year-round	8.0	118.78	Summer	W2
Mainline	355.8	376.4	General – Year-round	20.6	315.35	Summer	S2.5
Mainline	376.4	382.3	General – Year-round	5.9	89.22	Winter	W2
Mainline	382.3	400.7	General – Year-round	18.4	308.82	Winter	S2.5

TABLE 3.4.10-6

Brown Bear Habitat Crossed by the Project Pipeline ROW

Pipeline	Milepost		Description of Sensitive Season	Length Crossed (mile)	Construction ROW Area (acres)	ROW Construction Season[a]	Pipelay Season[b]
	Start	End					
Mainline	400.7	408.8	General – Year-round	8.1	153.00	Winter	W0
Mainline	408.8	430.4	General – Year-round	21.5	319.44	Winter	W0
Mainline	430.4	473.3	General – Year-round	42.9	777.98	Winter	W0
Mainline	473.3	473.8	General – Year-round	0.5	7.31	Winter	W1
Mainline	473.8	489.4	General – Year-round	15.6	283.99	Winter	W1
Mainline	489.4	498.6	General – Year-round	9.2	155.97	Winter	W1
Mainline	498.6	520.8	General – Year-round	22.2	324.19	Winter	W1
Mainline	520.8	532.0	General – Year-round	11.1	171.28	Summer	S0.5
Mainline	532.0	532.7	General – Year-round	0.8	12.24	Summer	S0.5
Mainline	532.7	535.0	General – Year-round	2.3	42.63	Summer	S0.5
Mainline	535.0	537.8	General – Year-round	2.8	43.78	Summer	S0.5
Mainline	537.8	538.7	General – Year-round	0.9	13.56	Summer	S0.5
Mainline	538.7	542.9	General – Year-round	4.2	69.52	Winter	S0.5
Mainline	542.9	559.0	General – Year-round	16.2	266.67	Winter	S0.5
Mainline – Brown Bear – General Habitat Total				***557.8***	***9,082.49***		
Mainline	186.1	196.4	Berry - Summer, Fall	10.3	163.39	Winter	S2.5
Mainline	198.7	208.9	Berry - Summer, Fall	10.2	157.38	Winter	S2.5
Mainline	208.9	222.0	Berry - Summer, Fall	13.1	203.35	Winter	W1
Mainline	227.7	227.8	Berry - Summer, Fall	0.1	2.08	Winter	W1
Mainline	228.1	228.3	Berry - Summer, Fall	0.1	2.46	Winter	W1
Mainline	232.7	232.9	Berry - Summer, Fall	0.3	4.63	Winter	W1
Mainline	235.6	238.0	Berry - Summer, Fall	2.3	34.50	Winter	W1
Mainline	243.2	251.0	Berry - Summer, Fall	7.8	121.83	Winter	W1
Mainline – Brown Bear – Berry Habitat Total				***44.2***	***689.62***		
Mainline	186.1	196.4	Spring	10.3	163.39	Winter	S2.5
Mainline	198.7	208.9	Spring	10.2	157.38	Winter	S2.5
Mainline	208.9	222.0	Spring	13.1	203.35	Winter	W1
Mainline	227.7	227.8	Spring	0.1	2.08	Winter	W1
Mainline	228.1	228.3	Spring	0.1	2.46	Winter	W1
Mainline	232.7	232.9	Spring	0.3	4.63	Winter	W1
Mainline	235.6	238.0	Spring	2.3	34.50	Winter	W1
Mainline	243.2	251.0	Spring	7.8	121.83	Winter	W1
Mainline	532.7	535.0	Spring	2.3	42.63	Summer	S0.5
Mainline	535.0	537.8	Spring	2.8	43.78	Summer	S0.5
Mainline – Brown Bear – Spring Habitat Total				***49.3***	***776.03***		

Source: ADF&G, 1985, 1986a, b.

[a]Start of ROW Construction Season = Construction season when ROW clearing and preparation activities begin. This may include the installation of work pads, if applicable. ROW Construction activities will be continuous through the Pipe Lay Season

[b]Pipelay season = Construction season when pipe laying activities take place. Examples are listed below. Additional values are provided in Resource Report No. 1, Table 1.5.2.3 - Typical Construction Progression for the Mainline

TABLE 3.4.10-6

Brown Bear Habitat Crossed by the Project Pipeline ROW

Pipeline	Milepost		Description of Sensitive Season	Length Crossed (mile)	Construction ROW Area (acres)	ROW Construction Season[a]	Pipelay Season[b]
	Start	End					

W0 = "winter zero" – the first winter of pipe lay
W1 = "winter one" – the second winter of pipe lay
W2 = "winter two" – the third winter of pipe lay
S0.5 = "summer zero point five" – the summer between W0 and W1
S1.5 = "summer one point five" – the summer between W1 and W2
S2.5 = "summer two point five" – the summer after W2

Site Preparation

Marine Mammals

Site preparation would not be required for the nearshore and offshore portions of the Mainline ROW.

Large and Small Mammals

Site preparation of the Mainline ROW would result in habitat loss and alteration, which would result in both temporary and potential permanent habitat impacts that may result in both direct and indirect impacts to large mammals (Table 3.4.10-5). It is anticipated that the construction ROW would require 12,500 acres onshore to facilitate construction in a safe manner.

Placement of fill into wetlands would result in the loss and/or conversion of important wetland functions such as hydrologic functions (storage of floodwater and shoreline protection), biogeochemical functions (water quality), and habitat suitability for aquatic and terrestrial flora and fauna. For unavoidable impacts to wetlands (losses), some form of mitigation would be required. The Project Wetland Mitigation Plan (Resource Report 2, Appendix P) provides an outline of mitigation options.

Noise, lighting, and other activities associated with construction of the Mainline during sensitive seasons could temporarily displace mammals that may breed, reproduce, forage, winter, or den near the Mainline ROW. Disturbance during winter, when animals may be energetically stressed by forage or prey availability/quality, can be particularly stressful to large mammals. Habitat for large and small mammals is abundant throughout the Mainline ROW, and large tracts of undisturbed habitat occur along the route. Clearing and grading during winter could potentially run over or uncover denning bears or hibernating ground squirrels. Some small mammals are likely to be injured and killed during ROW preparation. Animals may become habituated to human presence over time, increasing likelihood of human-wildlife interactions. Increased human-wildlife interactions are likely to negatively impact wildlife by dispatching of nuisance animals, disrupting migrations, and altered behavior.

Sensitive brown bear habitats that would be crossed by the Mainline ROW construction and pipelay season are presented for the Arctic and Interior regions, based on ADF&G habitat atlases, in Table 3.4.10-6. Brown bear habitats were not included in the Southcentral region atlas, although the region contains brown bears and the Mainline ROW would cross brown bear habitat. Most spring sensitive habitats would have construction activities in summer or winter (Table 3.4.10-6). Most summer and fall berry areas would have construction activities in summer (Table 3.4.10-6).

Sensitive caribou habitats that would be crossed by the Mainline ROW construction and pipelay season are presented for the Arctic, Interior, and Southcentral regions, based on ADF&G habitat atlases, in Table 3.4.10-7. The Mainline would cross the calving range for the Central Arctic Caribou Herd between milepost 23.8 and milepost 36.8 (Table 3.4.10-7) (Arthur and Del Vecchio, 2009). Sensitive winter range would have construction activities in both summer and winter (Table 3.4.10-7).

TABLE 3.4.10-7

Caribou Habitat Crossed by the Project Pipeline ROWs

Pipeline	**Milepost**		**Description of Sensitive Season**	**Length Crossed (mile)**	**Construction ROW Area (acres)**	**ROW Construction Season[a]**	**Pipelay Season[b]**
	MP Start	**MP End**					
PTTL	0.0	45.0	Winter	45.0	1,185.77	Winter	W1
PTTL	45.0	45.4	Winter	0.4	28.87	Winter	W1
PTTL	45.4	45.9	Winter	0.5	18.61	Winter	W1
PTTL	45.9	61.5	Winter	15.6	461.29	Winter	W1
PTTL	61.5	62.2	Winter	0.7	27.03	Winter	W1
PTTL-Caribou-Winter Habitat				***62.5***	***1,726.53***		
Mainline	0.0	31.0	Winter	31.0	543.92	Summer	W1
Mainline	31.0	56.6	Winter	25.7	450.14	Summer	W1
Mainline	56.6	75.8	Winter	19.2	299.22	Summer/Winter	S1.5
Mainline	76.1	114.7	Winter	38.6	604.81	Summer/Winter	W2
Mainline	114.7	148.4	Winter	33.6	525.04	Winter	W2
Mainline	148.7	152.3	Winter	3.6	55.13	Winter	W2
Mainline	159.8	160.3	Winter	0.5	8.86	Winter	W2
Mainline	169.4	170.2	Winter	0.8	12.23	Summer/Winter	W2
Mainline	170.2	171.6	Winter	1.4	27.26	Summer	S2.5
Mainline	171.6	171.9	Winter	0.3	4.73	Summer	S2.5
Mainline	179.3	182.1	Winter	2.9	42.01	Winter	W2
Mainline	182.1	208.9	Winter	26.7	429.24	Winter	S2.5
Mainline	208.9	228.9	Winter	20.0	319.53	Winter	W1
Mainline	228.9	239.9	Winter	11.1	166.52	Winter	W1
Mainline	240.2	241.1	Winter	0.8	12.10	Winter	W1
Mainline	241.1	251.2	Winter	10.1	156.63	Winter	W1
Mainline	251.2	281.4	Winter	30.2	478.11	Summer	S1.5
Mainline	281.4	309.2	Winter	27.7	416.79	Summer	S1.5
Mainline	493.2	498.6	Winter	5.4	91.32	Winter	W1
Mainline	498.6	520.8	Winter	22.2	324.19	Winter	W1
Mainline	520.8	526.1	Winter	5.3	79.20	Summer	S0.5
Mainline – Caribou – Winter Habitat				***317.2***	***5,047.63***		
PTTL	0.00	45.03	Insect-Relief – Summer	45.03	1,184.93	Winter	W1
PTTL	45.39	45.92	Insect-Relief – Summer	0.53	18.61	Winter	W1
PTTL – Caribou – Insect-Relief Habitat				***45.56***	***1,203.53***		

Source: ADF&G, 1985, 1986a, b; CAH Caribou Calving - Arthur and Del Vecchio, 2009.

[a]Start of ROW Construction Season = Construction season when ROW clearing and preparation activities begin. This may include the installation of work pads, if applicable. ROW Construction activities will be continuous through the Pipe Lay Season

TABLE 3.4.10-7

Caribou Habitat Crossed by the Project Pipeline ROWs

Pipeline	Milepost		Description of Sensitive Season	Length Crossed (mile)	Construction ROW Area (acres)	ROW Construction Season[a]	Pipelay Season[b]
	MP Start	MP End					

[b]Pipelay season = Construction season when pipe laying activities take place. Examples are listed below. Additional values are provided in Resource Report No. 1, Table 1.5.2.3 - Typical Construction Progression for the Mainline

W0 = "winter zero" – the first winter of pipe lay

W1 = "winter one" – the second winter of pipe lay

W2 = "winter two" – the third winter of pipe lay

S0.5 = "summer zero point five" – the summer between W0 and W1

S1.5 = "summer one point five" – the summer between W1 and W2

S2.5 = "summer two point five" – the summer after W2

Sensitive Dall sheep habitats that would be crossed by the Mainline ROW construction and pipelay season are presented for the Arctic, Interior, and Southcentral regions, based on ADF&G habitat atlases, in Table 3.4.10-8. The Mainline would approach a sensitive mineral lick site near milepost 197 during summer (Table 3.4.10-8). Sensitive winter range between mileposts 148.1 and 162.7 would have construction activities in summer (Table 3.4.10-8).

TABLE 3.4.10-8

Dall Sheep Habitat Crossed by the Project Pipeline ROWs

Pipeline	Milepost		Description of Sensitive Season	Length Crossed (mile)	Construction ROW Area (acres)	ROW Construction Season[a]	Pipelay Season[b]
	MP Start	MP End					
Mainline	148.1	148.2	General – Year-round	0.1	0.94	Winter	W2
Mainline	148.7	162.7	General – Year-round	14.0	217.82	Winter	W2
Mainline	162.7	166.2	General – Year-round	3.5	55.86	Winter	W2
Mainline	166.2	168.7	General – Year-round	2.4	36.45	Winter	W2
Mainline	168.7	170.2	General – Year-round	1.6	23.81	Summer	S2.5
Mainline	170.2	177.8	General – Year-round	7.5	127.93	Summer/Winter	S2.5/W2
Mainline	177.8	182.1	General – Year-round	4.4	63.94	Winter	W2
Mainline	182.1	200.1	General – Year-round	18.0	296.18	Winter	S2.5
Mainline	227.8	228.7	General – Year-round	0.9	14.06	Winter	W1
Mainline	231.1	234.7	General – Year-round	3.6	51.17	Winter	W1
Mainline	238.2	239.3	General – Year-round	1.1	15.98	Winter	W1
Mainline – Dall Sheep – General Habitat				***57.2***	***904.17***		
Mainline	148.1	162.7	Winter	14.1	218.8	Winter	W2

Source: ADF&G, 1985, 1986a, b.

[a]Start of ROW Construction Season = Construction season when ROW clearing and preparation activities begin. This may include the installation of work pads, if applicable. ROW Construction activities will be continuous through the Pipe Lay Season

[b]Pipelay season = Construction season when pipe laying activities take place. Examples are listed below. Additional values are provided in Resource Report No. 1, Table 1.5.2.3 - Typical Construction Progression for the Mainline

TABLE 3.4.10-8

Dall Sheep Habitat Crossed by the Project Pipeline ROWs

Pipeline	Milepost		Description of Sensitive Season	Length Crossed (mile)	Construction ROW Area (acres)	ROW Construction Season[a]	Pipelay Season[b]
	MP Start	MP End					
W0 = "winter zero" – the first winter of pipe lay							
W1 = "winter one" – the second winter of pipe lay							
W2 = "winter two" – the third winter of pipe lay							
S0.5 = "summer zero point five" – the summer between W0 and W1							
S1.5 = "summer one point five" – the summer between W1 and W2							
S2.5 = "summer two point five" – the summer after W2							

Sensitive moose habitats that would be crossed by the Mainline ROW construction and pipelay season are presented for the Arctic, Interior, and Southcentral regions, based on ADF&G habitat atlases, in Table 3.4.10-9. The Mainline ROW would cross 98 miles of spring calving habitat, 121 miles of fall rutting habitat, and 244 miles of winter habitat (Table 3.4.10-9).

TABLE 3.4.10-9

Moose Habitat Crossed by the Project Pipeline ROWs

Pipeline	Milepost		Description of Sensitive Season	Length Crossed (mile)	Construction ROW Area (acres)	ROW Construction Season[a]	Pipelay Season[b]
	MP Start	MP End					
MOOSE							
PTTL	0.0	61.5	General – Year-round	61.5	1694.54	Winter	W1
PTTL	61.5	62.2	General – Year-round	0.7	27.03	Winter	W1
PTTL	62.3	62.5	General – Year-round	0.3	4.95	Winter	W1
PTTL-Moose-General Habitat				**62.5**	**1726.53**		
Mainline	428.2	430.4	Calving – Spring	2.2	37.84	Winter	W0
Mainline	430.4	439.8	Calving – Spring	9.4	170.52	Winter	W0
Mainline	446.9	467.8	Calving – Spring	20.9	384.01	Winter	W0
Mainline	472.7	473.3	Calving – Spring	0.6	9.07	Winter	W0
Mainline	473.3	473.8	Calving – Spring	0.5	7.31	Winter	W1
Mainline	473.8	477.0	Calving – Spring	3.2	58.33	Winter	W1
Mainline	518.0	520.8	Calving – Spring	2.8	41.97	Winter	W1
Mainline	520.8	532.0	Calving – Spring	11.1	171.28	Summer	S0.5
Mainline	532.0	535.0	Calving – Spring	3.1	54.88	Summer	S0.5
Mainline	535.0	538.7	Calving – Spring	3.7	57.34	Summer	S0.5
Mainline	538.7	542.9	Calving – Spring	4.2	69.52	Winter	S0.5
Mainline	542.9	556.7	Calving – Spring	13.8	214.62	Winter	S0.5
Mainline	721.2	727.3	Calving – Spring	6.1	105.01	Winter	W1
Mainline	730.6	736.5	Calving – Spring	5.9	106.68	Winter	W1
Mainline	736.5	738.5	Calving – Spring	2.0	34.78	Winter	W1
Mainline	738.5	739.9	Calving – Spring	1.4	24.37	Winter	W1
Mainline	739.9	742.3	Calving – Spring	2.4	43.09	Winter	W1
Mainline	742.3	745.9	Calving – Spring	3.6	63.24	Winter	W1
Mainline	745.9	747.1	Calving – Spring	1.1	19.94	Winter/Summer	W1/S1.5
Mainline – Moose – Calving Habitat				***98.0***	***1,673.80***		
Mainline	428.2	430.4	Rutting – Fall	2.2	37.84	Winter	W0
Mainline	430.4	439.8	Rutting – Fall	9.4	170.52	Winter	W0
Mainline	446.9	467.8	Rutting – Fall	20.9	384.01	Winter	W0

TABLE 3.4.10-9

Moose Habitat Crossed by the Project Pipeline ROWs

Pipeline	Milepost		Description of Sensitive Season	Length Crossed (mile)	Construction ROW Area (acres)	ROW Construction Season[a]	Pipelay Season[b]
	MP Start	MP End					
Mainline	472.7	473.3	Rutting – Fall	0.6	9.07	Winter	W0/W1
Mainline	473.3	473.8	Rutting – Fall	0.5	7.31	Winter	W1
Mainline	473.8	477.0	Rutting – Fall	3.2	58.33	Winter	W1
Mainline	510.4	518.0	Rutting – Fall	7.6	109.36	Winter	W1
Mainline	518.0	520.8	Rutting – Fall	2.8	41.97	Winter	W1
Mainline	520.8	532.0	Rutting – Fall	11.1	171.28	Summer	S0.5
Mainline	532.0	535.0	Rutting – Fall	3.1	54.88	Summer	S0.5
Mainline	535.0	538.7	Rutting – Fall	3.7	57.34	Summer	S0.5
Mainline	538.7	542.9	Rutting – Fall	4.2	69.52	Winter	S0.5
Mainline	542.9	556.7	Rutting – Fall	13.8	214.62	Winter	S0.5
Mainline	604.8	607.4	Rutting – Fall	2.5	44.03	Winter	S1.5
Mainline	607.4	635.5	Rutting – Fall	28.1	431.67	Winter	S1.5/S0.5
Mainline	728.0	730.5	Rutting – Fall	2.6	46.30	Winter	W1
Mainline	736.5	738.5	Rutting – Fall	2.0	34.78	Winter	W1
Mainline	739.9	742.3	Rutting – Fall	2.4	43.09	Winter	W1
Mainline – Moose – Rutting Habitat				***120.7***	***1985.92***		
Mainline	64.4	75.8	Winter	11.4	169.20	Summer	S1.5
Mainline	76.1	82.2	Winter	6.1	89.29	Summer	S1.5
Mainline	82.7	83.4	Winter	0.8	11.27	Summer	S1.5
Mainline	88.7	89.1	Winter	0.4	6.68	Summer	S1.5
Mainline	93.1	95.8	Winter	2.7	43.81	Summer	S1.5
Mainline	107.4	107.8	Winter	0.4	6.58	Summer	S1.5
Mainline	108.5	114.7	Winter	6.2	92.53	Summer	S1.5
Mainline	114.7	115.0	Winter	0.3	4.19	Winter	W2
Mainline	297.1	301.3	Winter	4.2	64.05	Summer	S1.5
Mainline	354.7	355.8	Winter	1.2	17.60	Summer	W2/S2.5
Mainline	355.8	359.7	Winter	3.9	59.61	Summer	S2.5
Mainline	360.6	376.4	Winter	15.9	242.75	Summer	S2.5
Mainline	376.4	382.3	Winter	5.9	89.22	Winter	W2
Mainline	382.3	384.5	Winter	2.2	34.93	Winter	S2.5
Mainline	391.2	394.3	Winter	3.1	56.48	Winter	S2.5
Mainline	428.2	430.4	Winter	2.2	37.84	Winter	W0
Mainline	430.4	439.8	Winter	9.4	170.52	Winter	W0
Mainline	439.8	446.9	Winter	7.2	135.48	Winter	W0
Mainline	446.9	467.8	Winter	20.9	384.01	Winter	W0
Mainline	472.7	473.3	Winter	0.6	9.07	Winter	W0/W1
Mainline	473.3	473.8	Winter	0.5	7.31	Winter	W1
Mainline	473.8	477.0	Winter	3.2	58.33	Winter	W1
Mainline	510.4	518.0	Winter	7.6	109.36	Winter	W1
Mainline	518.0	520.8	Winter	2.8	41.97	Winter	W1
Mainline	520.8	532.0	Winter	11.1	171.28	Summer	S0.5
Mainline	532.0	535.0	Winter	3.1	54.88	Summer	S0.5
Mainline	535.0	538.7	Winter	3.7	57.34	Summer	S0.5
Mainline	538.7	542.9	Winter	4.2	69.52	Winter	S0.5
Mainline	542.9	556.7	Winter	13.8	214.62	Winter	S0.5
Mainline	589.5	599.0	Winter	9.6	166.58	Winter	S1.5
Mainline	604.8	607.4	Winter	2.5	44.03	Winter	S1.5
Mainline	607.4	635.5	Winter	28.1	431.67	Winter	S0.5
Mainline	665.3	665.9	Winter	0.5	7.62	Winter	S0.5/W0
Mainline	665.9	678.0	Winter	12.1	170.99	Winter	W0
Mainline	681.8	685.7	Winter	3.9	47.32	Winter	W0
Mainline	686.8	686.9	Winter	0.1	1.17	Winter	W0

TABLE 3.4.10-9

Moose Habitat Crossed by the Project Pipeline ROWs

Pipeline	Milepost		Description of Sensitive Season	Length Crossed (mile)	Construction ROW Area (acres)	ROW Construction Season[a]	Pipelay Season[b]
	MP Start	MP End					
Mainline	689.3	692.9	Winter	3.6	57.46	Winter	W0
Mainline	703.9	705.2	Winter	1.2	20.26	Winter	W0/W1
Mainline	705.2	706.8	Winter	1.7	28.31	Winter	W1
Mainline	707.5	707.9	Winter	0.4	5.76	Winter	W1
Mainline	718.2	721.2	Winter	3.0	50.61	Winter	W1
Mainline	721.2	727.3	Winter	6.1	105.01	Winter	W1
Mainline	730.6	736.5	Winter	5.9	106.68	Winter	W1
Mainline	736.5	738.5	Winter	2.0	34.78	Winter	W1
Mainline	738.5	739.9	Winter	1.4	24.37	Winter	W1
Mainline	739.9	742.3	Winter	2.4	43.09	Winter	W1
Mainline	742.3	745.9	Winter	3.6	63.24	Winter	W1
Mainline	745.9	747.1	Winter	1.1	19.94	Winter	W1/S1.5
Mainline – Moose – Winter Habitat				***244.2***	***3,938.60***		

Source: ADF&G, 1985, 1986a, b.

[a]Start of ROW Construction Season = Construction season when ROW clearing and preparation activities begin. This may include the installation of work pads, if applicable. ROW Construction activities will be continuous through the Pipe Lay Season

[b]Pipelay season = Construction season when pipe laying activities take place. Examples are listed below. Additional values are provided in Resource Report No. 1, Table 1.5.2.3 - Typical Construction Progression for the Mainline

W0 = “winter zero” – the first winter of pipe lay

W1 = “winter one” – the second winter of pipe lay

W2 = “winter two” – the third winter of pipe lay

S0.5 = “summer zero point five” – the summer between W0 and W1

S1.5 = “summer one point five” – the summer between W1 and W2

S2.5 = “summer two point five” – the summer after W2

Sensitive muskoxen habitats include calving and wintering areas. Muskoxen use Sagavanirktok River riparian areas along the Dalton Highway that would be crossed by the Mainline ROW (Table 3.4.10-10). Muskoxen form winter groups by the end of October to early November and remain in the same general area through April to mid-May. They calve from mid-April through the end of June, and begin splitting into groups with calves, bull groups, and mixed-sex, non-calf groups beginning in June. Muskoxen are vulnerable to vehicle collisions and some muskoxen are killed by vehicles on the Dalton Highway (Lenart, 2011b).

TABLE 3.4.10-10

Muskoxen General Seasonal Concentration Areas Crossed by the Project Pipeline ROWs

Pipeline	Milepost		Sensitive Season	Length Crossed (mile)	ROW Construction Acreage	ROW Construction Season[a]	Pipelay Season[b]
	Start	End					
PTTL– Muskoxen – Calving Distribution							
PTTL	39.59	54.70	Fall Winter	15.11	469.82	Winter	W1
PTTL	46.09	56.14	Spring Calving	10.05	290.45	Winter	W1
Mainline – Muskoxen – Fall/Winter Aggregations							
1-A	21.39	24.77	Fall Winter	10.31	181.13	Winter	W1
1-A	24.77	35.08	Fall Winter	5.36	94.16	Winter	W1
1-A	24.77	35.08	Fall Winter	0.78	13.79	Winter	W1
1-A	35.08	39.72	Fall Winter	3.44	60.53	Winter	W1
1-A	39.72	44.15	Fall Winter	2.9	43.57	Summer	S1.5
1-A	39.72	44.15	Fall Winter	0.85	12.47	Summer	S1.5
1-A	44.15	49.5	Fall Winter	1.04	15.11	Summer	S1.5
1-A	44.15	49.5	Fall Winter	-	0.65	Summer	S1.5
1-A	44.15	49.5	Fall Winter	5.83	84.94	Summer	S1.5
1-A	49.5	50.29	Fall Winter	5.88	86.65	Summer	S1.5
1-A	49.5	50.29	Fall Winter	1.56	23.37	Winter	W2
Mainline – Muskoxen – Calving Distribution							
1-A	50.29	53.73	Spring Calving	4.43	77.92	Winter	W1
1-B	61.43	63.68	Spring Calving	5.36	94.16	Winter	W1
1-B	63.68	71.03	Spring Calving	2.24	37.8	Summer	S1.5
1-B	63.68	71.03	Spring Calving	7.35	108.58	Summer	S1.5
1-B	71.03	73.93	Spring Calving	2.9	43.57	Summer	S1.5
1-B	71.03	73.93	Spring Calving	1.21	20.87	Summer	S1.5
1-B	71.03	73.93	Spring Calving	5.88	86.65	Summer	S1.5
1-B	73.93	74.78	Spring Calving	1.56	23.37	Winter	W2
1-B	73.93	74.78	Spring Calving	0.12	1.61	Winter	W2
Mainline – Muskoxen – Summer Distribution							
1-B	74.78	75.82	Summer	3.38	59.38	Winter	W1
1-B	75.97	-	Summer	10.31	181.13	Winter	W1
1-B	76.12	81.95	Summer	4.64	80.58	Winter	W1
1-B	106.1	107.64	Summer	4.43	77.92	Winter	W1
1-B	107.64	108.86	Summer	5.36	94.16	Winter	W1
1-B	107.64	108.86	Summer	0.78	13.79	Winter	W1
1-B	108.86	114.74	Summer	7.35	108.58	Summer	S1.5
1-B	108.86	114.74	Summer	2.9	43.57	Summer	S1.5
1-B	108.86	114.74	Summer	0.85	12.47	Summer	S1.5
1-C-1	114.74	116.3	Summer	1.54	26.66	Summer	S1.5
1-C-1	114.74	116.3	Summer	1.21	20.87	Summer	S1.5
1-C-1	114.74	116.3	Summer	5.88	86.65	Summer	S1.5
1-C-1	116.3	116.42	Summer	1.56	23.37	Winter	W2
1-C-1	116.3	116.42	Summer	0.12	1.61	Winter	W2

TABLE 3.4.10-10

Muskoxen General Seasonal Concentration Areas Crossed by the Project Pipeline ROWs

Pipeline	Milepost		Sensitive Season	Length Crossed (mile)	ROW Construction Acreage	ROW Construction Season[a]	Pipelay Season[b]
	Start	End					

Source: Lenart, 2015; ADF&G unpublished data (general 2014 distribution points buffered by 5 miles, aggregated by season)

[a]Start of ROW Construction Season = Construction season when ROW clearing and preparation activities begin. This may include the installation of work pads, if applicable. ROW Construction activities will be continuous through the Pipe Lay Season

[b]Pipelay season = Construction season when pipe laying activities take place. Examples are listed below. Additional values are provided in Resource Report No. 1, Table 1.5.2.3 - Typical Construction Progression for the Mainline

W0 = “winter zero” – the first winter of pipe lay

W1 = “winter one” – the second winter of pipe lay

W2 = “winter two” – the third winter of pipe lay

S0.5 = “summer zero point five” – the summer between W0 and W1

S1.5 = “summer one point five” – the summer between W1 and W2S2.5 = “summer two point five” – the summer after W2

Wolves occur throughout the Mainline corridor. Den sites, rendezvous locations, and gathering points likely occur throughout the corridor and could be affected by Project-related construction disturbance or destruction. Maps of wolf pack ranges, den sites, or denning areas are not available from ADF&G for analysis. The numbers of packs and wolf densities by GMU are listed in Table 3.4.4-2.

Birds

Construction of the pipeline including land clearing in the ROW; placement of granular fill for roads and storage yard; and installation of associated pipeline facilities and structures would result in habitat loss for breeding birds. Placement of fill into wetlands would result in the loss and/or conversion of important wetland functions such as hydrologic functions (storage of floodwater and shoreline protection), biogeochemical functions (water quality), and habitat suitability for aquatic and terrestrial flora and fauna. For unavoidable impacts to wetlands (losses), some form of mitigation would be required. The Project Wetland Mitigation Plan (Resource Report 2, Appendix P) provides an outline of mitigation options. Areal density (sightings/square mile) and linear density (birds/mile) of birds based on breeding bird surveys by bird group within ecoregions crossed by the Mainline are presented in Table 3.4.10-11. Based on these densities and the estimated impact areas for the Mainline summarized in Table 3.4.10-12, the estimated number of breeding birds that could potentially be displaced due to Mainline construction is summarized in Table 3.4.10-13. The groups with the greatest numeric effects are those groups that are most abundant, which is generally passerines, with the exception of the Beaufort Coastal Plain Ecoregion, where shorebirds were more abundant (Table 3.4.10-13). Because vegetation clearing would occur outside of the nesting season, active nests with young are not expected to be impacted by construction.

TABLE 3.4.10-11

Bird Density by Ecoregion for Aerial or Ground-based Surveys in the Project Area

Bird Groups	Ecoregions								
	BCP[a]	BF[b]	BR[b]	KRV[b]	RM[b]	TKL[b]	YTU[b]	AR[b]	CIB[b]
Geese and Swans	5.08	0.98	0.01	0	0.00	0	0.03	0.05	0.06
Ducks	4.14	0.31	0.07	0.08	0.02	0	0.19	0.11	0.15
Waterfowl	9.22	1.29	0.08	0.08	0.02	0	0.23	0.16	0.21
Grouse and Ptarmigan	14.01	0.07	0.01	0.01	0.00	0	0	0.20	0
Loons and Grebes	0.85	0.06	0.02	0.02	0.01	0	0	0.00	0.15
Raptors	N/A [c]	0.02	0.04	0.02	0.02	0.02	0.02	0.08	0.19
Sandhill Crane	N/A [c]	0	0	0	0.01	0	0.02	0.00	0.14
Shorebirds	195.73	0.58	0.17	0.21	0.08	0.05	0.06	0.49	0.88
Seabirds	1.06	0.37	0.03	0.01	0.00	0.31	0.16	0.39	4.46
Owls	N/A [c]	0.02	0.02	0.02	0.01	0.05	0.01	0.01	0.01
Passerines	71.41	14.50	9.25	11.02	11.30	15.97	8.75	24.46	19.55
All Birds	**292.28**	**16.90**	**9.61**	**11.40**	**11.46**	**16.41**	**9.24**	**25.81**	**25.60**

Source: Bart et al., 2012; Pardieck et al., 2015

Ecoregion Abbreviations: BCP = Beaufort Coastal Plain, BF = Brooks Foothills, BR = Brooks Range, KRV = Kobuk Ridges and Valleys, RM = Ray Mountains, TKL = Tanana-Kuskokwim Lowlands, YTU = Yukon-Tanana Uplands, AR = Alaska Range, CIB = Cook Inlet Basin

[a] Relative density (sightings/square mile) based on ground surveys (shorebirds and passerines, Table 4.12) or aerial surveys (waterfowl, seabirds; Table 4.11; Bart et al., 2012).

[b] Linear density (birds/mile) based on average of 2005 to 2014 ground survey data for 16 breeding bird survey routes (Pardieck et al., 2015).

[C] N/A is not applicable for the cited source (Bart et al., 2012), which focused on shorebirds and did not include regional densities for sandhill cranes, raptors or owls, although these species are known to breed there (Table 3.4.6-1).

TABLE 3.4.10-12

Estimated Mainline Areal and Linear Impacts for Calculation of Potential Breeding Bird Displacement by Ecoregion

Mainline Facility[a]	**Ecoregions**								
	BCP	**BF**	**BR**	**KRV**	**RM**	**TKL**	**YTU**	**AR**	**CIB**
Access Roads	0.43	16.92	14.75	0.71	74.49	29.19	12.19	29.30	57.02
Camps	0.11	0.66	1.21	0	1.31	0.28	0.28	1.13	1.49
Pipe Storage Yard	0.07	1.52	1.59	0.27	3.71	0.53	0.27	1.34	3.03
Staging Areas	0	0	0	0	0	0	0	0	0.53
Compressor Stations	0	0.30	0.48	0	0.48	0.15	0.15	0.70	1.06
Material Sites	2.28	7.80	7.77	0	13.85	7.84	1.01	9.12	19.03
Mainline Valves	0.00	0.06	0.11	0	0.19	0.06	0.02	0.09	0.19
Railroad Spur	0	0	0	0	0	2.00	0.87	3.78	1.00
Facility Subtotal	*2.89*	*27.26*	*25.92*	*0.98*	*94.03*	*40.05*	*14.79*	*45.46*	*83.35*
Mainline ROW	1.75	81.50	108.60	5.20	173.30	73.90	12.20	99.50	158.90
Mainline Total	**4.64**	**108.76**	**134.52**	**6.18**	**267.33**	**113.95**	**26.99**	**144.96**	**242.25**

Ecoregion Abbreviations: BCP = Beaufort Coastal Plain, BF = Brooks Foothills, BR = Brooks Range, KRV = Kobuk Ridges and Valleys, RM = Ray Mountains, TKL = Tanana-Kuskokwim Lowlands, YTU = Yukon-Tanana Uplands, AR = Alaska Range, CIB = Cook Inlet Basin

[a] Areal impact area in square miles based on footprints for facilities in BCP. Linear impact areas based widths for facilities, lengths for access roads and Mainline ROW for use with linear densities for breeding birds to assess potential breeding habitat loss impacts

TABLE 3.4.10-13

Estimated Potential Breeding Bird Displacement Due to Mainline Construction by Ecoregion

Bird Groups	**Ecoregions**								
	BCP[a]	**BF**[b]	**BR**[b]	**KRV**[b]	**RM**[b]	**TKL**[b]	**YTU**[b]	**AR**[b]	**CIB**[b]
Geese & Swans	24	107	1	0	1	0	1	7	14
Ducks	19	33	10	1	6	0	5	17	37
Waterfowl	43	140	11	1	6	0	6	24	50
Grouse and Ptarmigan	65	8	1	0	1	0	0	29	0
Loons and Grebes	4	6	2	0	2	0	0	0	37
Raptors	N/A	2	5	0	7	2	0	12	47
Sandhill Crane	N/A	0	0	0	3	0	0	0	34
Shorebirds	909	63	23	1	20	6	2	71	213
Seabirds	5	40	4	0	1	36	4	57	1,081
Owls	N/A	2	2	0	3	6	0	2	3
Passerines	331	1,577	1,244	68	3,020	1,820	236	3,546	4,736
All Birds	1,357	1,838	1,293	70	3,063	1,870	249	3,741	6,200

Source: Bart et al., 2012; Pardieck et al., 2015.

Ecoregion Abbreviations: BCP = Beaufort Coastal Plain, BF = Brooks Foothills, BR = Brooks Range, KRV = Kobuk Ridges and Valleys, RM = Ray Mountains, TKL = Tanana-Kuskokwim Lowlands, YTU = Yukon-Tanana Uplands, AR = Alaska Range, CIB = Cook Inlet Basin

[a] Relative density (sightings/square mile) based on ground surveys (shorebirds and passerines, Table 4.12) or aerial surveys (waterfowl, seabirds; Table 4.11; Bart et al., 2012).

[b] Linear density (birds/mile) based on average of 2005 to 2014 ground survey data for 16 breeding bird survey routes (Pardieck et al., 2015).

Sensitive waterfowl habitats that would be crossed by the Mainline ROW construction and pipelay season are presented for the Arctic, Interior, and Southcentral regions, based on ADF&G habitat atlases, in Table 3.4.10-14. The Mainline ROW would cross about 315 miles of waterfowl habitats, including nesting concentration areas and migration staging areas (Table 3.4.10-14).

TABLE 3.4.10-14

Waterfowl Habitat Crossed by the Project Pipeline ROW

Pipeline	**Milepost**		**Description of Sensitive Season**	**Length Crossed (mile)**	**Construction ROW Area (acres)**	**ROW Construction Season[b]**	**Pipelay Season[c]**
	Start	**End**					
PTTL DUCKS[a]							
PTTL	0.00	23.18	General – Spring to Fall	23.18	625.50	Winter	W1
PTTL	42.98	51.98	General – Spring to Fall	9.00	320.64	Winter	W1
PTTL	23.18	42.98	General – Spring to Fall/ Nesting	19.81	476.77	Winter	W1
PTTL	51.98	62.24	General – Spring to Fall/ Nesting	10.26	298.76	Winter	W1
PTTL	62.26	62.53	General – Spring to Fall/ Nesting	0.27	4.95	Winter	W1
PTTL Ducks –Nesting Habitat				***30.34***	***1726.62***		
PTTL GEESE[a]							
PTTL	0.00	28.82	General	28.82	760.13	Winter	W1
PTTL	28.82	62.24	General – Spring to Fall /Nesting	33.42	961.54	Winter	W1
PTTL	62.26	62.53	General – Spring to Fall /Nesting	0.27	4.95	Winter	W1
PTTL Geese–Nesting Habitat				***33.69***	***966.49***		
DUCKS[a] Nesting Habitat Arctic Region							
Mainline	0.00	28.62	General – Spring to Fall /Nesting	28.61	502.09	Winter	W1
Mainline	29.17	31.13	General – Spring to Fall / Nesting	1.96	33.57	Winter	W1
Mainline	46.62	56.63	General – Spring to Fall Nesting	10.01	175.58	Winter	W1
Mainline	56.63	60.72	General – Spring to Fall /Nesting	4.09	69.68	Summer	S1.5
Ducks –Nesting Habitat Arctic Region				***44.67***	***780.92***		
DUCKS[a] General Habitat Arctic Region							
Mainline	0.00	28.62	General – Spring to Fall	28.61	502.09	Winter	W1
Mainline	29.17	31.13	General – Spring to Fall	1.96	33.57	Winter	W1
Mainline	28.62	29.17	General – Spring to Fall	0.55	11.03	Winter	W1
Mainline	31.13	46.62	General – Spring to Fall	15.49	271.78	Winter	W1
Mainline	46.62	56.63	General – Spring to Fall	10.01	175.58	Winter	W1
Mainline	56.63	60.72	General – Spring to Fall	4.09	69.68	Summer	S1.5
Mainline	60.72	62.24	General – Spring to Fall	1.52	25.71	Summer	S1.5
Ducks –General Habitat Arctic Region				***62.24***	***1,089.45***		
GEESE[a] Nesting Habitat Arctic Region							
Mainline	0.00	19.86	General – Spring to Fall /Nesting	19.86	348.79	Winter	W1
Mainline	46.05	54.05	General – Spring to Fall /Nesting	8.00	140.24	Winter	W1
Geese –Nesting Habitat Arctic Region				***27.86***	***489.03***		
GEESE[a] General Habitat Arctic Region							
Mainline	0.00	19.86	General – Spring to Fall	19.86	348.79	Winter	W1

TABLE 3.4.10-14

Waterfowl Habitat Crossed by the Project Pipeline ROW

Pipeline	Milepost		Description of Sensitive Season	Length Crossed (mile)	Construction ROW Area (acres)	ROW Construction Season[b]	Pipelay Season[c]
	Start	End					
Mainline	19.86	46.05	General – Spring to Fall	26.19	459.56	Winter	W1
Mainline	46.05	54.05	General – Spring to Fall	8.00	140.24	Winter	W1
Mainline	54.05	56.63	General – Spring to Fall	2.58	45.47	Winter	W1
Mainline	56.63	61.47	General – Spring to Fall	4.84	82.26	Summer	S1.5
Mainline	73.49	75.82	General – Spring to Fall	2.33	34.38	Summer	S1.5
Mainline	75.97	-	General – Spring to Fall	-	0.65	Summer	S1.5
Mainline	76.12	81.11	General – Spring to Fall	4.99	72.71	Summer	S1.5
Mainline	81.11	81.41	General – Spring to Fall	0.29	4.42	Summer	S1.5
Mainline	83.06	102.78	General – Spring to Fall	19.72	312.08	Summer	S1.5
Mainline	106.29	109.34	General – Spring to Fall	3.05	52.72	Summer	S1.5
Geese –General Habitat				***91.85***	***1,553.27***		
DUCKS and GEESE[a] Interior.Region							
Mainline	250.75	251.22	General – Spring to Fall	0.47	7.17	Winter	W1
Mainline	251.22	256.49	General – Spring to Fall	5.26	77.52	Summer	S1.5
Mainline	353.01	355.85	General – Spring to Fall	2.83	41.66	Summer	W2
Mainline	355.85	356.74	General – Spring to Fall	0.89	12.88	Summer	S2.5
Mainline	380.06	382.33	General – Spring to Fall	2.27	34.00	Winter	W2
Mainline	382.33	382.49	General – Spring to Fall	0.16	2.59	Winter	S2.5
Mainline	401.16	404.35	General – Spring to Fall	3.19	59.68	Winter	W0
Mainline	429.09	430.38	General – Spring to Fall	1.29	22.36	Winter	W0
Mainline	430.38	436.02	General – Spring to Fall	5.64	102.44	Winter	W0
Mainline	438.80	448.95	General – Spring to Fall	10.15	190.70	Winter	W0
Mainline	449.63	449.83	General – Spring to Fall	0.20	4.27	Winter	W0
Mainline	450.76	457.21	General – Spring to Fall	6.45	119.67	Winter	W0
Mainline	460.99	473.28	General – Spring to Fall	12.29	211.48	Winter	W0
Mainline	473.28	473.78	General – Spring to Fall	0.50	7.31	Winter	W1
Mainline	473.78	489.38	General – Spring to Fall	15.60	283.99	Winter	W1
Mainline	489.38	493.94	General – Spring to Fall	4.56	77.06	Winter	W1
Mainline	504.33	507.50	General – Spring to Fall	3.17	46.52	Winter	W1
Mainline	513.70	516.35	General – Spring to Fall	2.65	38.95	Winter	W1
Mainline	543.57	544.39	General – Spring to Fall	0.82	12.23	Winter	S0.5
Mainline	545.84	546.65	General – Spring to Fall	0.82	11.56	Winter	S0.5
Mainline	559.30	562.29	General – Spring to Fall	2.99	47.09	Winter	S0.5
Mainline	565.49	566.80	General – Spring to Fall	1.31	20.35	Winter	S0.5
Ducks and Geese –General Habitat Interior Region				***83.53***	***1,431.47***		
DUCKS and GEESE[a] Southcentral Region							
Mainline	566.80	592.18	General – Spring to Fall	25.38	387.34	Winter	S1.5
Mainline	592.42	-	General – Spring to Fall	-	0.00	Winter	S1.5
Mainline	592.50	600.34	General – Spring to Fall	7.84	138.73	Winter	S1.5
Mainline	606.27	607.36	General – Spring to Fall	1.09	18.53	Winter	S1.5

TABLE 3.4.10-14

Waterfowl Habitat Crossed by the Project Pipeline ROW

Pipeline	Milepost		Description of Sensitive Season	Length Crossed (mile)	Construction ROW Area (acres)	ROW Construction Season[b]	Pipelay Season[c]
	Start	End					
Mainline	607.36	658.63	General – Spring to Fall	51.27	799.23	Winter	S0.5
Mainline	661.51	663.02	General – Spring to Fall	1.51	22.91	Winter	S0.5
Mainline	665.05	665.28	General – Spring to Fall	0.23	3.59	Winter	S0.5
Mainline	666.37	705.16	General – Spring to Fall	38.79	570.09	Winter	W0
Mainline	705.16	720.91	General – Spring to Fall	15.75	269.51	Winter	W1
Mainline	726.59	729.05	General – Spring to Fall	2.46	42.54	Winter	W1
Mainline	734.63	735.41	General – Spring to Fall	0.78	13.82	Winter	W1
Mainline	738.87	739.98	General – Spring to Fall	1.11	18.72	Winter	W1
Mainline	743.33	744.04	General – Spring to Fall	0.71	11.42	Winter	W1
Mainline	760.90	762.54	General – Spring to Fall	1.63	23.89	Winter	S1.5
Mainline	762.54	763.97	General – Spring to Fall	1.43	21.68	Winter	S1.5
Mainline	763.97	765.98	General – Spring to Fall	2.01	29.50	Winter	S1.5
Mainline	766.00	766.04	General – Spring to Fall	0.04	0.42	Winter	S1.5
Mainline	436.02	438.80	General – Spring to Fall	2.78	51.09	Winter	S1.5
Mainline	457.21	460.99	General – Spring to Fall	3.78	68.86	Winter	S1.5
Mainline	793.27	806.51	General – Spring to Fall	13.25	207.20	Winter	S1.5
Ducks and Geese –General Habitat SouthCentral Region				***171.86***	***2,699.09***		

Source: ADF&G, 1985, 1986a, b.

[a] Separate habitat areas for ducks and geese are identified for the Arctic Region, Interior, and Southcentral Regions.

[b]Start of ROW Construction Season = Construction season when ROW clearing and preparation activities begin. This may include the installation of work pads, if applicable. ROW Construction activities will be continuous through the Pipe Lay Season

[c]Pipelay season = Construction season when pipe laying activities take place. Examples are listed below. Additional values are provided in Resource Report No. 1, Table 1.5.2.3 - Typical Construction Progression for the Mainline

W0 = "winter zero" – the first winter of pipe lay

W1 = "winter one" – the second winter of pipe lay

W2 = "winter two" – the third winter of pipe lay

S0.5 = "summer zero point five" – the summer between W0 and W1

S1.5 = "summer one point five" – the summer between W1 and W2

S2.5 = "summer two point five" – the summer after W2

Sensitive trumpeter swan habitats that would be crossed by the Mainline ROW construction and pipelay season are presented for the Southcentral region, based on ADF&G habitat atlases, in Table 3.4.10-15. The Mainline ROW would cross about 100 miles of general trumpeter swan habitat and 68 miles of nesting habitat (Table 3.4.10-15). Trumpeter swans also use the Interior region extensively and would be found within waterfowl habitats south of the Brooks Range, as listed in Table 3.4.10-15. Portions of the Mainline would be constructed during winter and would lessen impacts to nesting swan habitat. Impacts to trumpeter swan nesting habitat along the Mainline ROW would be considered minor due to the vast extent of nesting grounds available for swans, and temporary in duration because the pipeline will be buried and vegetation (excluding tall shrubs and trees) will be regrown.

TABLE 3.4.10-15

Trumpeter Swan Habitat Crossed by the Project Pipeline ROWs

Pipeline	Milepost		Description of Sensitive Season	Length Crossed (mile)	Construction ROW Area (acres)	ROW Construction Season[b]	Pipelay Season[c]
	Start	End					
TRUMPETER SWANS – Southcentral Region[a]							
Mainline	560.2	561.2	General – Spring to Fall	1.0	15.27	Winter	S0.5
Mainline	565.8	566.8	General – Spring to Fall	1.0	14.95	Winter	S0.5/S1.5
Mainline	566.8	579.0	General – Spring to Fall	12.2	180.51	Winter	S1.5
Mainline	580.0	586.0	General – Spring to Fall	5.9	89.37	Winter	S1.5
Mainline	605.4	607.4	General – Spring to Fall	1.9	33.70	Winter	S1.5
Mainline	607.4	665.9	General – Spring to Fall	58.5	907.93	Winter	S0.5
Mainline	665.9	676.2	General – Spring to Fall	10.4	149.56	Winter	W0
Mainline	764.6	766.0	General – Spring to Fall	1.3	19.52	Winter	S1.5
Mainline	766.0	766.0	General – Spring to Fall	0.0	0.42	Winter	S1.5
Mainline	796.9	806.5	General – Spring to Fall	9.6	149.18	Winter	S1.5
Mainline – Trumpeter Swans – General Habitat				***102.0***	***1,560.40***		
Mainline	676.2	705.2	Nesting – Spring, Summer	28.9	428.06	Winter	W0
Mainline	705.2	730.1	Dispersed Nesting – Spring, Summer	24.9	428.85	Winter	W1
Mainline	756.4	759.7	Dispersed Nesting – Spring, Summer	3.3	49.09	Winter	S1.5
Mainline	759.7	763.9	Dispersed Nesting – Spring, Summer	4.2	62.59	Winter	S1.5
Mainline	763.9	764.6	Dispersed Nesting – Spring, Summer	0.7	10.94	Winter	S1.5
Mainline	793.3	796.9	Dispersed Nesting – Spring, Summer	3.6	58.02	Winter	S1.5
Mainline – Trumpeter Swans – Nesting Habitat				**65.6**	**1,037.55**		

Amphibians

The wood frog uses a wide variety of habitats. Adverse effects to wood frogs would most likely occur during initial clearing and grading to prepare the construction ROW for installation of the pipeline and associated aboveground structures (e.g., compressor stations, heater station, meter stations, pig launching/receiving stations, etc.). Heavy equipment operation during vegetation clearing and placement of granular material could result in mortalities to hibernating wood frogs. Placement of fill into wetlands would result in the loss and/or conversion of important wetland functions such as hydrologic functions (storage of floodwater and shoreline protection), biogeochemical functions (water quality), and habitat suitability for aquatic and terrestrial flora and fauna. For unavoidable impacts to wetlands (losses), some form of mitigation would be required. The Project Wetland Mitigation Plan (Resource Report No. 2, Appendix P) provides an outline of mitigation options. Once the workspace has been prepared for pipeline installation and trench excavation is complete, suitable habitat would no longer be present. Potential direct effects to wood frogs would be unlikely to occur during pipe stringing, bending, welding, installation, and backfilling as the area would no longer provide habitat for frogs. Although the area would not provide suitable frog habitat during construction, some frogs could enter the work area and become disoriented by or trapped within construction areas. Construction activities would result in disturbance to about 7.6 acres of aquatic herbaceous wetlands and ponds south of the Brooks Range that could be suitable breeding habitat for wood frogs. Pond habitats at two of these locations near milepost 475 and milepost 798 are within 1 mile of documented wood frog occurrences (AKHNP, 2014a). Noise generated from construction during the breeding season may create disturbances that could interfere with calling and mate finding of wood frogs. Noise impacts to amphibians are discussed in Section 3.4.10.1.

Terrestrial and Aquatic Invertebrates

Vegetation clearing and grading for preparation of the Mainline ROW would result in habitat loss and alteration for terrestrial and aquatic invertebrates. Placement of fill into wetlands would result in the loss and/or conversion of important wetland functions such as hydrologic functions (storage of floodwater and shoreline protection), biogeochemical functions (water quality), and habitat suitability for aquatic and terrestrial flora and fauna. For unavoidable impacts to wetlands (losses), some form of mitigation would be required. The Project Wetland Mitigation Plan (Resource Report No. 2, Appendix P) provides an outline of mitigation options. After the pipeline is installed vegetation would be expected to re-establish. Areas where granular fill is used as a workpad would result in long-term change in habitats for invertebrates. Areas that do not require clearing and grading, and where frost packing and ice are used as a workpad, would have minimal effects on terrestrial and aquatic invertebrates. While habitat for terrestrial insects would be affected temporarily, some areas where pooling water might provide habitat for aquatic invertebrates would be permanently filled in. Estimated acreages of the vegetated areas within the Mainline construction ROW are listed in Table 3.4.10-5. Aquatic habitats are outlined in Resource Report No. 2.

A number of construction activities would affect the different life-stages of the Yukon floater (*Anodonta beringiana*), which lives in slow-moving streams, ponds, or lakes with a sand or gravel substrate. There are 168 fish-bearing stream crossings that would be trenched for construction of the Mainline throughout the Yukon floater range between milepost 177 and milepost 806 (Appendix H). Adults and juveniles could be affected by clearing, grading, blasting, and trenching activities through injury or mortality, increased turbidity and sedimentation, reducing hard substrate area for attachment, and inhibition of filter-feeding. The glochidia (larvae) are free-swimming for a brief period before they attach to the gills of fish hosts during spring and summer for dispersal, nourishment, and protection while they metamorphose into juvenile mussels. Water withdrawal during spring and summer prior to larvae attaching to a fish hose could remove larval stages from the water column from the following rivers:

- Milepost 211.1 – Middle Fork Koyukuk River;
- Milepost 356.5 – Yukon River;
- Milepost 473.0 – Tanana River;
- Milepost 641.8 – Chulitna River; and
- Milepost 704.7 – Deshka River.

Trenching (Onshore and Offshore)

Trenching would occur within the Mainline ROW and would disturb habitats within the construction ROW.

Marine Mammals

Trenching would be used to install the portions of the offshore pipeline from the shoreline to a depth that would protect the pipeline from ice and other potential erosion impacts. The pipeline at depth would be concrete coated and placed on the bottom of the Inlet. Potential effects on marine mammals could include displacement of harbor seals while foraging, and potential disturbance from loud airborne and underwater sounds generated by trenching equipment, the pipelay barge, and from tugs when thrusters are used to pull anchors (Table 3.4.10-3). Marine mammals that would be expected to be exposed to pipelay SPLs above the 120 dB threshold without mitigation include harbor porpoises, killer whales, and harbor seals (threatened and endangered species are addressed in Section 3.5.3). Appendix F gives details on sound sources and exposure calculations, and Appendix N gives details on mitigation and monitoring to avoid potential exposure to noise above thresholds.

Large and Small Mammals

Onshore trenching would affect large mammals primarily through displacement and blockage of seasonal movements. If necessary, specific procedures would be developed with appropriate agencies to allow for wildlife movement and protection during construction. Occasionally large and small mammals can enter or fall into the trench and become trapped. Pipeline construction would be sequenced to limit the amount and duration of open-trench sections to reduce this occurrence. Some small mammals could be injured or killed during pipeline trenching if burrows are destroyed or they are run over by construction equipment. Construction activities during trenching would have the potential to disrupt seasonal movements of large mammals depending on the location and timing. Important wildlife habitats and pipeline construction seasons are discussed in Section 3.4.10.2.1.1 under site preparation.

Birds

Because vegetation clearing would occur in winter, few if any bird nests would be expected to occur within the Mainline ROW and none are likely to be damaged by pipeline trenching. Trenching during summer in some locations may attract birds that forage on invertebrates exposed during trenching. This could make these birds more susceptible to collisions with construction equipment, but most birds would be able to avoid equipment during trenching. Young waterfowl and flightless birds could be blocked from movement across the trench, and could fall into and become trapped in the trench. Pipeline construction would be sequenced to limit the amount and duration of open trench sections to reduce this potential occurrence. Important water habitats and pipeline construction seasons are discussed previously, under site preparation.

Amphibians

Wood frogs could suffer mortalities due to the operation of heavy equipment during onshore trenching. Trenches would also create a physical barrier to frog movement. Some frogs may fall into the trench, become trapped, and die. Wood frogs are common within their range in Alaska and overall impacts to wood frogs would be minor and short term. Trenching for the pipeline in intertidal to subtidal areas of Cook Inlet would have no effect on wood frogs.

Terrestrial and Aquatic Invertebrates

Onshore and offshore trenching activities would temporarily disturb the terrestrial and aquatic invertebrates. Onshore pipeline trenching would result in streambed disturbance and increased turbidity as discussed in sections 3.2.7 and 3.2.8 that would affect larval stages of aquatic invertebrates, including mayflies/stoneflies/caddisflies that are important for sustaining aquatic and terrestrial food webs. Where the pipeline crosses intertidal habitat on the east side of Cook Inlet, the benthic fauna was composed primarily of the Baltic macoma and lugworms, and isopods (Lees et al., 2013). Where the pipeline crosses intertidal habitat on the west side of Cook Inlet, the benthic fauna was composed of amphipods under boulders and barnacles on the boulders (Lees et al., 2013). Once pipeline installation would be complete, vegetation would re-establish and terrestrial and aquatic invertebrate communities would recolonize. Disturbance from onshore and offshore trenching could allow for the colonization of reed canarygrass.

Special Construction Techniques

Buried trenchless crossings use pipeline construction methods that avoid surface water impacts by drilling under the waterbody and pulling the pipe through the drill bore rather than digging a trench. Construction of buried trenchless river crossings for the Mainline would include the Yukon River, Tanana River, Chulitna River, and Deshka River.

Marine Mammals

No marine mammals would use habitats at these river crossings.

Large and Small Mammals

Installation of buried trenchless crossings requires some additional vegetation clearing that would affect terrestrial mammals. Because riparian vegetation would remain intact, riparian habitat for furbearers would not be fragmented and movement corridors for large and small mammals would experience less potential for fragmentation.

Birds

Installation of buried trenchless crossings requires some additional vegetation clearing that would affect birds. Because riparian vegetation would remain intact, riparian habitats for birds would not be fragmented and movement corridors would experience less potential for fragmentation.

Amphibians

Installation of buried trenchless crossings requires some additional vegetation clearing that could affect wood frogs. Because riparian vegetation would remain intact, riparian habitats and floodplain wetlands for wood frogs would not be fragmented and movement corridors would experience less potential for fragmentation.

Terrestrial and Aquatic Invertebrates

Installation of buried trenchless crossings requires some additional vegetation clearing that could affect invertebrates. Impacts would be short-term and limited to small, localized, and temporary vegetation disturbance in non-aquatic areas. Benthic habitats at these crossings would remain intact and turbidity would not be increased.

Blasting

Blasting would be required for some trench construction and would also likely be required for excavation of material sites. It may also be required at aboveground facility sites. Blasting requirements with pipeline construction season for the Mainline are summarized in Table 3.4.10-16.

TABLE 3.4.10-16

Potential Blasting Locations During Construction of the Mainline

Start MP	End MP	Length of Blasted Ditch (miles)	Length of Blasted Ditch (%)	Length of Backhoe or Blasted Ditch (miles)	Backhoe or Blasted Ditch (%)	ROW Construction Season[a]	Pipelay Season[b]
0.0	63.9	0.0	0.0%	0.0	0.0%	Winter/Summer	W1/S1.5
63.9	145.4	27.2	73.8%	0.3	0.8%	Summer/ Winter	S1.5/W2
145.4	182.3	61.0	74.9%	0.0	0.0%	Winter/Summer	W2
182.3	262.7	53.1	66.1%	0.2	0.2%	Winter/Summer	S2.5
262.7	421.9	86.5	54.3%	2.1	1.3%	Summer/Winter	S1.5/W0/W2
421.9	424.2	1.0	40.9%	1.2	53.2%	Winter	W0
424.2	448.3	4.7	19.6%	2.9	11.9%	Winter	W0
448.3	487.1	0.4	1.0%	1.3	3.3%	Winter	W0/W1
487.1	501.9	0.0	0.0%	12.0	81.0%	Winter	W1
501.9	564.8	14.6	23.2%	25.1	39.9%	Winter/Summer	W1/S0.5
564.8	575.4	1.3	11.9%	8.5	79.8%	Winter/Summer	S0.5
575.4	755.4	4.8	2.7%	131.8	73.2%	Winter/Summer	S1.5
755.4	806.6	0.0	0.0%	17.7	34.6%	Winter	S1.5

Source: WorleyParsons, 2015.

[a]Start of ROW Construction Season = Construction season when ROW clearing and preparation activities begin. This may include the installation of work pads, if applicable. ROW Construction activities will be continuous through the Pipe Lay Season

[b]Pipelay season = Construction season when pipe laying activities take place. Examples are listed below. Additional values are provided in Resource Report No. 1, Table 1.5.2.3 - Typical Construction Progression for the Mainline

W0 = “winter zero” – the first winter of pipe lay

W1 = “winter one” – the second winter of pipe lay

W2 = “winter two” – the third winter of pipe lay

S0.5 = “summer zero point five” – the summer between W0 and W1

S1.5 = “summer one point five” – the summer between W1 and W2

S2.5 = “summer two point five” – the summer after W2

Marine Mammals

No blasting is planned within or near Cook Inlet (Table 3.4.10-16), therefore no impacts to marine mammals would be expected. Blasting is not planned offshore. Onshore blasting is a potential activity, but undetermined at this time. Blasting is not planned for construction of the Liquefaction Facility. Any blasting would comply with the *Blasting Plan* and mitigation would be developed in consultation with the applicable state and federal wildlife management agencies.

Large and Small Mammals

Small mammals within the blast zone could be injured or killed through concussion or flyrock. Noise and vibrations associated with basting to support construction during potentially sensitive periods, including breeding, overwintering, and hibernation, could temporarily displace large mammals. Bears awakening mid-winter during hibernation could result in reduced survival or reproduction if newborn cubs are abandoned. Vibrations from blasting could also collapse dens or burrows. Winter active animals could be displaced from winter habitats and the flight reaction and distraction from blasting could increase their vulnerability to predation. Blasting is expected to be a temporary activity and impacts due to displacement and distraction would be short term. Site-specific blasting procedures would be developed to avoid and reduce potential impacts.

Birds

Birds within the blast zone could be injured or killed through concussion or flyrock. Blasting could disturb breeding birds. Although blasting would likely occur over a short time period, disturbance during breeding could lead to lost or reduced productivity. Blasting near a raptor nest could lead to nest abandonment. Active raptor nests within 0.5 mile of blast locations could be disturbed, and some may be disturbed at greater than 0.5 mile away from nest sites. The Applicant would follow the National Bald Eagle Management Guidelines of no blasting within 0.5 mile of an active bald eagle nest. This would be a conservative distance to apply for other animals, as eagles are protected under the BGEPA, and MBTA and are in a sensitive state when stationary and nesting. In most other situations, animals (birds or wildlife) could be in the range of hearing the blasting but are moving through the area and not invested in a specific location like a nesting bird. Site-specific blasting procedures would be developed to avoid and reduce potential impacts. Based on the 2015 raptor survey nests, non-eagle raptors within 0.5 mile include: one peregrine falcon nest near milepost 95, which would be constructed in winter when birds are not present, and five unknown cliff nests (four inactive and one active) between mileposts 185 and 250 that would be constructed in summer.

Amphibians

Amphibians within the blast zone could be injured or killed through concussion or flyrock. Blasting could disturb breeding frogs. Although blasting would likely occur over a short time period, disturbance during breeding could lead to lost or reduced productivity. Breeding success is dependent on successful calling leading up to mating. The effects of loud anthropogenic noise on amphibians are discussed in Section 3.4.10.1.1.5. Blasting conducted during winter would reduce potential impacts to frogs as it would occur during hibernation when the frogs are partially protected under leaf litter and soil. Potential impacts to amphibians in close proximity to blasting are expected to be temporary and minor.

Terrestrial and aquatic invertebrates

The degree to which noise from activities such as blasting affects invertebrates remains uncertain. Current science suggests that both terrestrial and aquatic invertebrates may exhibit behavioral or biochemical reactions to noise pollution (Morley et al., 2014). In addition to the effects of noise, blasting would result in the direct mortality of invertebrates in close proximity to blasting sites. The only commercially harvested invertebrates in Upper Cook Inlet are razor clams. The commercial harvests of razor clams occur south of

Nikiski, and the nearest clam bed is at Coho Beach in Kasilof, with another significant clam bed located on the west side of Cook Inlet, away from the Project vicinity. Blasting is not anticipated to have an impact on commercial harvests due to their proximity to the footprint. Potential impacts to invertebrate communities from blasting are expected to be temporary and minor.

Traffic (Land and Air)

Pipeline and construction materials would be moved overland by rail and truck. The increase in traffic would be substantial for some remote areas and within some developed areas of Alaska. There would be a considerable increase in collision mortality risk for most wildlife across the Project area. The most notable wildlife rail or truck collisions would include moose, black bears, brown bears, and caribou. Snow conditions may affect the severity of rail and vehicle collision mortality for moose. There would also be an increase in air traffic. Birds can collide with planes in the air and both birds and mammals can collide with planes during landing or takeoff. Low-level overflights of nesting colonies can also be disruptive to waterfowl especially to colonial-nesting waterfowl and seabirds. Disturbance from noise and visual stimuli, including along existing roads, can lead to an increase in displacement of local animals. The increase in traffic would be temporary and would be greatest during construction; potential direct and indirect effects on wildlife could reach moderate levels during the construction phase.

Marine Mammals

Marine mammals are not expected to be affected by increases in land and air traffic.

Wildlife

Large mammals are vulnerable to collision with vehicles and the increase in vehicle traffic would be likely to increase wildlife-vehicle collision mortality. ADOT&PF has correlated traffic volumes and moose collisions at a rate of 0.8 collision per mile per year as traffic volumes increased (ADOT&PF, 2015). Increased traffic speed as well as increased traffic volume were attributed to moose-vehicle collisions in the Kenai Peninsula (Del Frater and Spraker, 1991). Winters with especially deep snow tend to increase vehicle collisions along high-speed roads (Del Frater and Spraker, 1991). The increase in train activity expected during Project construction could increase wildlife mortality; in particular moose. Mortality numbers from train collisions are collected by ADF&G and heavy winter snow fall drives moose to the railroad for ease of access. During low snow years, moose mortality from train collisions is substantially reduced. Small mammals and birds, including ravens, eagles, owls and geese are also killed by vehicle collisions, although these mortalities often go unnoticed. Maintenance to improve visibility, such as clearing tall vegetation, could reduce animal-vehicle collisions on roads. Overall consequences to wildlife are related to population status, which is variable along the length of the Project. Measures to avoid and reduce potential collision mortality for wildlife would be implemented to the extent practicable (Appendix J); however, the large increase in Project-related traffic is likely to increase wildlife-collision mortality throughout the Project area. Wildlife mortalities would be more significant in areas with smaller populations because a greater percentage of the population would be impacted.

Amphibians

Increased traffic associated with the construction of the Mainline has the potential to have lethal and sublethal effects on wood frogs. The operation of cars, trucks, or heavy machinery could result in wood frog mortalities while hibernating, migrating, or foraging. Sublethal effects to frogs include reduced breeding success due to noise disturbance and contamination of breeding pools caused by vehicle exhaust and brake pad dust. The potential effects of noise disturbance and contamination from vehicle use on wood frogs are discussed in Section 3.4.10.1 (Liquefaction Facility). Heavy traffic along the Mainline would be a temporary and short-term source of contamination and noise.

Terrestrial and Aquatic Invertebrates

Aquatic invertebrates are susceptible to lethal and sub-lethal effects from environmental contamination. Copper from vehicle exhaust and brake dust may enter hydrologic systems through runoff. Elevated levels of copper in water adversely affect survival, growth, reproduction, feeding, and incidence of morphological deformity (Majumdar and Gupta, 2012; Hayden et al., 2015). Heavy traffic at construction sites would be short-term and minor source of contamination and noise.

Vessel Traffic

Pipeline and materials would be transported to various ports in Alaska. The increase in vessel traffic would result in an increase in disturbance, noise, potential fuel spills, and potential introduction and spread of aquatic invasive organisms. Typical impacts and mitigation measures for wildlife are discussed in Section 3.4.10.1.6 for the Liquefaction Facility and in Appendix F (MMPA Assessment).

Potential effects on marine mammals from vessel traffic at the Mainline MOF could include displacement of harbor seals and potential disturbance from underwater sounds generated during tug and barge docking when thrusters are used to position the barges at the dock. Initial assessment indicates that tug and barge docking could expose harbor porpoises, killer whale, and harbor seals to SPLs above the 120 dB threshold without mitigation. Northern sea otters are not likely to occur near the Mainline MOF in Upper Cook Inlet. Steller sea lions are rarely observed on the west side of Upper Cook Inlet and are not expected to be exposed to sounds from tug and barge docking at the Mainline MOF.

Human Interaction

Human presence and camps along the construction ROW would likely lead to some displacement of wildlife from the area. Workers who would travel the ROW on foot would be likely to encounter wildlife and surprised or protective large mammals could attack workers. Wildlife could be attracted to construction camps and food smells. Access to waste could create food-conditioned animals that could become persistent and dangerous. Measures in the Project's *Wildlife Avoidance and Interaction Plan* and environmental training would cover appropriate measures to reduce interactions between humans and wildlife. Sensitive wildlife habitats and seasons located within 1 mile of construction camps, based on ADF&G habitat atlases, are listed in Table 3.4.10-17 and Table 3.4.10-18. Note that habitat data are not available in Southcentral atlases for brown bears or in Interior atlases for trumpeter swans (ADF&G, 1985, 1986a, b).

TABLE 3.4.10-17

Terrestrial Mammal Habitats within 1 Mile of Pipeline Construction Camps

		Brown Bear			Caribou				Dall Sheep		Moose				Muskoxen		
MP	**Camp**	**General**	**Berry**	**Spring**	**General**	**Calving**	**Winter**	**Insect**	**General**	**Winter**	**General**	**Calving**	**Rutting**	**Winter**	**Spring/ Caving**	**Summer**	**Fall/Winter**
MAINLINE																	
0.6	Prudhoe Bay	2,625	-	-	2,625	-	2,625	-	-	-	2,625	-	-	-	-	-	-
43.6	Franklin Bluffs	2,658	-	-	2,658	-	2,658	-	-	-	2,658	-	-	-	2,658	2,658	767
75.9	Sagwon CS	2,203	-	-	2,203	-	2,203	-	-	-	376	-	-	1,827	-	6	2,203
85.8	Happy Valley	2,663	-	-	2,663	-	2,663	-	-	-	724	-	-	1,939	-	-	-
142.5	Galbraith Lake	2,658	-	-	2,658	-	2,658	-	-	-	2,658	-	-	-	-	-	-
148.4	Galbraith Lake CS	2,203	-	-	2,203	-	2,203	-	1,047	1,047	1,589	-	-	-	-	-	-
205.9	Dietrich	2,651	2,615	2,615	-	-	2,651	-	396	-	2,651	-	-	-	-	-	-
240.0	Coldfoot CS	2,203	623	623	-	-	2,203	-	327	-	2,203	-	-	-	-	-	-
241.1	Coldfoot	2,652	565	565	-	-	2,652	-	199	-	2,652	-	-	-	-	-	-
278.9	Prospect	2,658	-	-	-	-	2,658	-	-	-	2,658	-	-	-	-	-	-
305.7	Old Man	2,657	-	-	-	-	2,657	-	-	-	2,657	-	-	-	-	-	-
332.6	Ray River CS	2,203	-	-	-	-	-	-	-	-	2,203	-	-	-	-	-	-
353.7	Five Mile	2,658	-	-	-	-	-	-	-	-	2,486	-	-	172	-	-	-
401.0	Livengood Camp	2,658	-	-	-	-	-	-	-	-	2,658	-	-	-	-	-	-
421.5	Minto CS	2,203	-	-	-	-	-	-	-	-	2,203	-	-	-	-	-	-

TABLE 3.4.10-17

Terrestrial Mammal Habitats within 1 Mile of Pipeline Construction Camps

MP	Camp	Brown Bear			Caribou				Dall Sheep		Moose				Muskoxen		
		General	Berry	Spring	General	Calving	Winter	Insect	General	Winter	General	Calving	Rutting	Winter	Spring/ Caving	Summer	Fall/Winter
456.1	Dunbar	2,635	-	-	-	-	-	-	-	-	-	2,607	2,635	2,635	-	-	-
498.6	Rex	2,651	-	-	-	-	2,651	-	-	-	2,651	-	-	-	-	-	-
517.5	Healy CS	2,203	-	-	-	-	2,203	-	-	-	473	562	1,730	1,730	-	-	-
528.9	Healy Camp	2,645	-	-	2,275	-	370	-	-	-	-	2,645	2,645	2,645	-	-	-
567.5	Cantwell Camp	-	-	-	-	-	-	-	-	-	2,697	-	-	-	-	-	-
597.3	Honolulu Creek CS	-	-	-	-	-	-	-	-	-	531	-	-	1,672	-	-	-
606.6	Hurricane Camp	-	-	-	-	-	-	-	-	-	-	-	2,658	2,658	-	-	-
647.8	Chulitna Camp	-	-	-	-	-	-	-	-	-	2,658	-	-	-	-	-	-
675.1	Rabideux Creek CS	-	-	-	-	-	-	-	-	-	163	-	-	2,040	-	-	-
693.7	Susitna Camp	-	-	-	-	-	-	-	-	-	1,519	-	-	1,139	-	-	-
744.9	Sleeping Lady Camp	-	-	-	-	-	-	-	-	-	-	2,669	-	2,669	-	-	-
749.0	Theodore Rive HS	-	-	-	-	-	-	-	-	-	2,173	-	-	-	-	-	-
765.8	Beluga Mar	-	-	-	-	-	-	-	-	-	1,355	-	-	-	-	-	-

TABLE 3.4.10-17

Terrestrial Mammal Habitats within 1 Mile of Pipeline Construction Camps

MP	Camp	Brown Bear			Caribou				Dall Sheep		Moose				Muskoxen		
		General	Berry	Spring	General	Calving	Winter	Insect	General	Winter	General	Calving	Rutting	Winter	Spring/ Caving	Summer	Fall/Winter
803.5	Kenai Camp	-	-	-	-	-	-	-	-	-	1,622	-	-	-	-	-	-
Mainline Total		47,686	3,803	3,803	17,285	-	-	-	-	1,047	48,841	8,483	9,668	21,126	2,658	2,664	2,970
PTTL																	
18.9	Badami	2,710	-	-	2,710	2,710	2,710	2,710	-	-	2,710	-	-	-	-	-	-
49.2	Sag Delta	2,592	-	-	2,592	-	2,592	-	-	-	2,592	-	-	-	2,592	-	2,384
53.7	PTTL Prudhoe Bay	2,677	-	-	2,677	-	2,677	-	-	-	2,677	-	-	-	2,677	-	2,675
PTTL Total		7,980	-	-	7,980	2,710	7,980	2,710	-	-	7,980	-	-	-	5,270	-	5,058

Source: ADF&G, 1985, 1986a, b; Lenart, 2015: ADF&G unpublished data.

TABLE 3.4.10-18

Waterfowl Habitats within 1 Mile of Pipeline Construction Camps

MP	Camp	Trumpeter Swans			Waterfowl - Geese		
		General	Spring/ Fall	Nesting	General	Nesting	Spring
	MAINLINE						
1	Prudhoe Bay / Contractor yard	-	-	-	2,658	2,658	-
44	Franklin Bluffs / Contractor Yard	-	-	-	2,658	290	-
76	Sagwon CS / Contractor Yard	-	-	-	1,634	-	-
86	Happy Valley / Contractor Yard	-	-	-	2,351	-	-
142	Galbraith Lake	-	-	-	-	-	-
148	Galbraith Lake CS	-	-	-	-	-	-
206	Dietrich / Contractor Yard	-	-	-	-	-	-
240	Coldfoot CS / Contractor Yard	-	-	-	-	-	-
241	Coldfoot / Contractor Yard	-	-	-	-	-	-
279	Prospect / Contractor yard	-	-	-	-	-	-
	Old Man / Contractor Yard306	-	-	-	-	-	-
333	Ray River CS / Contractor Yard	-	-	-	-	-	-
354	Five Mile / Contractor Yard	-	-	-	1,282	-	-
401	Livengood Camp / Contractor Yard	-	-	-	772	-	-
421	Minto CS / Contractor Yard	-	-	-	-	-	-
456	Dunbar / Contractory yard	-	-	-	2,005	-	-
499	Rex / Contractor Yard	-	-	-	67	-	-
518	Healy CS / Contractor Yard	-	-	-	288	-	-
529	Healy / Contractor Yard	-	-	-	1,359	-	-
568	Cantwell / Contractor Yard	2,609	-	-	1,844	-	-
597	Honolulu Creek CS / Contractor Yard	-	-	-	1,345	-	-
607	Hurricane / Contractor Yard	2,638	-	-	2,084	-	-
648	Chulitna / Contractor Yard	2,658	-	-	2,658	-	-
675	Rabideux Creek CS / Contractor Yard	2,112	-	91	2,203	-	-
694	Susitna / Contractor	-	-	2,658	2,658	-	-
745	Sleeping Lady / Contractor Yard	-	-	1,087	1,090	-	-
749	Theodore River HS / Contractor Yard	-	-	17	80	-	-
766	Beluga Marine / Contractor Yard	1,278	-	95	2,187	-	-
804	Kenai / Contractor Yard	1,607	-	-	1,043	1,608	1,608
Mainline Total		**12,901**	**-**	**3,948**	**32,265**	**4,555**	**3,242**
19	BADAMI	**-**	**-**	**-**	2,710	-	**-**
49	Sag Delta Camp	**-**	**-**	**-**	2,592	2,592	**-**
54	PTTL Prudhoe Bay	**-**	**-**	**-**	2,677	2,677	**-**
PTTL Total		**-**	**-**	**-**	**7,980**	**5,270**	**-**

Source: ADF&G, 1985, 1986a, b.
Note that limitations to data reduced species covered in some tables.

Hydrostatic Testing

Measures in the Applicant's *Plan* and *Procedures*, as described in prior sections, would be implemented to avoid and reduce potential impacts wildlife habitats. Measures in the *Wildlife Avoidance and Interaction Plan* would be implemented to reduce potential impacts to wildlife. Potential impacts of hydrostatic testing of the Mainline would primarily be to fish and aquatic invertebrates. These potential impacts are discussed in Section 3.2.7. Few additional effects on marine mammals or terrestrial wildlife would be expected other than limited disturbance in the areas of water withdrawal and discharge. Hydrostatic testing could affect wildlife habitat primarily through erosion, sedimentation, and the introduction or spread of aquatic invasive organisms. The Applicant would utilize surface-water and groundwater resources under ADNR water use permits and would follow the stipulations of those permits. The stipulations of the permit guide whether water can be taken from a surface waterbody and how much water may be extracted to minimize impacts to fish and wildlife and to allow recharge to occur. Acute, and often temporary, surface and ground water use will sometimes occur during the nesting season, as is standard practice for industry construction and operation.

Spills

Potential effects of spills on wildlife are described in previous sections within 3.4.10.1.10. Construction of the Mainline would involve transport and staging of large quantities of fuel. Potential spills and leaks of fuels and hazardous materials would be reduced and any impacts mitigated through implementation of procedures in the *SPCC Plan*. Should a spill or leak occur, procedures and materials would be available to contain and clean up the spill.

Waste

Construction waste has a potential to increase the total area of habitat affected by Mainline construction. The *Waste Management Plan* would reduce the additional habitat areas affected by minimizing waste and planning for transport and appropriate disposal. Waste management activities would be performed in accordance with the waste management hierarchy. In order of preference, the aim would be avoidance, minimization, reuse, recycle, recover, and lastly disposal.

Potential impacts to wildlife from hazardous waste are discussed in previous Section 3.2.7.1.8. Garbage and unsecured food waste could lead to attraction of wildlife, such as food-conditioned bears or foxes, and could also attract nuisance wildlife, such as gulls or rats. Access to human garbage can also inflate populations of predators, such as ravens and fox, which can have a significant impact on reproductive success of nesting birds, and consequently on bird populations. The most significant issue with potential attraction of food-conditioned bears is that it could lead to the need for defensive actions that are often detrimental to the bear. Good camp design, waste management, and measures in the *Wildlife Avoidance and Interaction Plan* would be implemented to avoid and reduce potential attraction of wildlife to construction sites.

Contamination

Potential effects of contamination on wildlife are discussed in sections 3.4.10.1.5 and 3.4.10.1.2. Potential contaminated sites that could be disturbed along the ROW are discussed in Resource Report No. 8.

Sensitive Wildlife Habitat Areas

The sensitive wildlife habitats crossed by the Mainline are listed in Section 3.4.9 and include three BLM ACECs (Table 3.4.9-1), DNPP (Table 3.4.9-2), one state park and two state game refuges (Table 3.4.9-3), and three IBAs (Table 3.4.9-4). These sensitive wildlife habitat areas could be affected by disturbance during construction of the Mainline. Construction-related disturbance would be temporary.

Compressor locations that are located within sensitive wildlife habitat areas as defined in Section 3.4.9 include the BLM Galbraith Lake ACEC – Galbraith Lake Compressor Station near milepost 147.

Alaska Game Management Areas

The Project crosses through eight of the 26 GMUs, including portions of 12 Subunits. Construction of the Mainline would be unlikely to interfere with game management within these units, although there would be an increased potential for moose and muskoxen vehicle collisions and bear-human interactions. Most construction would occur during winter or summer and could avoid potential conflicts with fall hunting seasons (Tables 3.4.3-1, 3.4.3-2, and 3.4.3-3), although some hydrostatic testing of pipelines would likely occur during fall. Winter construction within the DHMC would avoid potential conflicts with bow hunting seasons, which open in July (Table 3.4.3-1).

3.4.10.2.1.2 PBTL and PTTL

The PBTL and PTTL ROWs contain about 1,737 acres of aquatic and terrestrial wildlife habitats (Table 3.4.10-19). Undisturbed and protected wildlife habitats are abundant throughout Alaska. PTTL would be collocated with other pipeline corridors for much of its length. Both pipelines would be above ground on VSMs, constructed in winter from ice workpads, and would cross primarily herbaceous and scrub tundra vegetation (Table 3.4.10-20). Potential impacts to wildlife habitats could include delayed restricted access to denning habitat, phenology from late snowmelt, alteration of vegetation communities, alteration of soil moisture regime, thermokarst, contamination from spills, damage to tussocks and dwarf shrubs, and compaction of microtopography. Work at PBTL would use the same camp and laydown yards as the work at GTP (on the GTP pad) and would not result in additional impact or wildlife disturbance. PBTL construction is scheduled for a single year; PTTL construction for two years. The Applicant would develop a Wildlife Avoidance and Interaction Plan that would discuss measures used to avoid and minimize impacts to wildlife.

TABLE 3.4.10-19

Wildlife Habitats (Acres) Affected by Construction and Operation of the PBTL and PTTL

Level I [a]	Level II [a]	Level III [a]	PBTL ROW		PTTL ROW		PTTL Associated Facilities		PTTL Total	
			Const	**Ops**	**Const**	**Ops**	**Const**	**Ops**	**Const**	**Ops**
Scrub	Low Scrub	Open Low	-	-	4.54	1.71	0.41	-	4.95	1.71
	Dwarf Scrub	Dryas Dwarf	-	-	13.65	4.72	12.76	0.13	26.41	4.85
		Willow Dwarf	-	-	4.03	0.82	0.08	-	4.11	0.82
		Ericaceous	-	-	0.19	0.09	2.01	0.17	2.19	0.25
	Dwarf Scrub Total		-	-	*17.86*	*5.63*	*39.96*	*0.30*	*57.82*	*5.92*
Scrub Total			**-**	**-**	**22.40**	**7.34**	**40.36**	**0.30**	**62.77**	**7.63**
Herbaceous	Graminoid Herbaceous	Mesic Graminoid	4.42	4.42	874.66	320.95	197.28	0.85	1,071.94	321.80
		Wet Graminoid	1.07	1.07	617.18	221.73	50.99	0.26	668.16	221.99
		Freshwater aquatic	-	-	3.04	0.48	-	-	3.04	0.48
Graminoid Herbaceous Total			*5.49*	*5.49*	*1,491.83*	*542.68*	*248.31*	*1.11*	*1,740.14*	*543.79*
Herbaceous Total			5.49	5.49	1,494.87	543.16	248.31	1.11	1,743.18	544.27
Barren - unvegetated	None	None	0.17	0.17	8.43	4.03	27.12	0.01	35.55	4.03
Barren Total			0.17	0.17	8.43	4.03	27.12	0.01	35.55	4.03
Water	Lake	Lake	-	-	38.63	8.53	4.96		43.59	8.53
	Pond	Pond	1.65	1.65	80.96	21.30	9.67	-	90.63	21.3
	Stream	Stream	-	-	76.57	26.24	10.88	-	87.44	26.24
Water Total			1.82	1.82	209.34	63.12	61.15	0.05	270.49	63.17
		Totals	**7.31**	**7.31**	**1,726.62**	**613.62**	**349.82**	**1.46**	**2,076.44**	**615.07**

TABLE 3.4.10-19

Wildlife Habitats (Acres) Affected by Construction and Operation of the PBTL and PTTL

Level I [a]	Level II [a]	Level III [a]	PBTL ROW		PTTL ROW		PTTL Associated Facilities		PTTL Total	
			Const	Ops	Const	Ops	Const	Ops	Const	Ops

Source: Project Vegetation Mapping; basis of classification explained in Section 3.3.2; Boggs et al., 2012.

Const = Construction, Ops = Operations; Construction acreage includes operational areas. See Resource Report No. 1, Table 1.4-1 for definitions of construction and operations affected areas. PTTL totals include 18.83 acres for East Pad.

Note: PTTL ROW Operations includes both the ROW and Aboveground Infrastructure within the ROW; Associated Infrastructure = Camps, Helipad, Pipe Storage Yard (gravel); remaining associated infrastructure assumed to be constructed from ice.

Note: Approximately 45 percent of the PBTL was not covered by Project vegetation mapping, the AKNHP mapping was used to fill in missing vegetation mapping.

[a] Levels are generally consistent with Viereck's Alaska Vegetation Classification System (Viereck et al., 1992). This classification is based on (Level I) dominant growth forms (tree, shrub, herb), (Level II) canopy height, and (Level III) and closure, general soil moisture and salinity, and dominant plants.

Site Preparation

Site preparation for the PBTL and PTTL would primarily include construction of ice roads and ice workpads. No vegetation clearing would be required for construction of this aboveground pipeline. The PTTL would be collocated with existing Point Thomson and Badami pipelines along much of its length.

Marine Mammals

No marine mammals would be affected by site preparation for the PBTL or the PTTL.

Large and Small Mammals

Site preparation, including construction of ice workpads, could disturb and displace a few caribou or muskoxen that may occur in the region in winter. Caribou, muskoxen, and foxes would be vulnerable to vehicle collision mortality. Site preparation could result in disturbance of brown bear den sites. Ice road construction over fox dens or arctic ground squirrel burrows could result in destruction of dens or burrows and would kill ground squirrels in hibernation. Small mammals active under the snow would experience habitat loss and potential blockage of movements. Small mammals that emerge above the snow cover to cross ice roads or workpads would be vulnerable to vehicle collisions and increased predation risk from foxes and weasels.

Birds

Few birds are present in the Beaufort Coastal Plain Ecoregion during winter when these pipelines would be constructed. A few ptarmigan could be disturbed and displaced or killed by vehicle collisions.

Amphibians

Wood frogs do not occur in the Beaufort Coastal Plain Ecoregion where these pipelines would be constructed.

Terrestrial and Aquatic Invertebrates

These pipelines would cross tundra wetlands and streams where invertebrates remain in larval stages. The potential effect of ice road construction on larval terrestrial invertebrates such as cranefly larvae and spiders in tundra soils and vegetation has not been studied, but most would not be expected to survive compaction should it occur. The trenched stream crossings for the PTTL would destroy some aquatic invertebrates over the small area of the trench, and invertebrates could be affected by increased turbidity and sedimentation the following spring and summer after construction. Potential effects would most likely be minor and limited to the localized disturbance.

Blasting

No blasting is planned for construction of the PBTL or the PTTL. Some blasting may be required at material sites or at PTTL river crossings. To reduce impacts, blasting plans would comply with ADF&G's Alaska Blasting Standard for the Proper Protection of Fish.

Traffic (Land and Air)

Marine Mammals

Air traffic would use airports in Deadhorse and at Point Thomson, which are over 7 and 2 miles from the Beaufort Sea coast, respectively. As a result,, air traffic is not expected to affect marine mammals.

Wildlife

Caribou and brown bears could be disturbed by air traffic associated with construction of the PTTL. Helicopter and other planes can create disturbance through noise and visual cues that can startle and distract mammals. Low-level overflights of nesting colonies can also be disruptive to waterfowl especially to colonial-nesting waterfowl and seabirds. Vehicles on ice roads can collide with caribou, muskoxen, or foxes. Air traffic during summer would avoid low altitude overflights, and measures in the *Wildlife Avoidance and Interaction Plan* would be followed to avoid sensitive habitats such as caribou calving areas, or snow goose and brant nesting colonies during sensitive seasons (see Appendix J).

Vessel Traffic

Some vessel traffic to Badami would be used to transport equipment and supplies for construction of the PTTL. Vessel traffic would be primarily coastal barges that would travel inside of the barrier islands. Potential interactions with vessel traffic could disturb ringed seals, a few spotted seals or beluga whales transiting the area, although few beluga whales would be expected to occur inside of the barrier islands and there are no documented spotted seal haulouts near the Badami Dock.

Human Interaction

Human presence and camps associated with construction of the PTTL would likely lead to some displacement of wildlife from the area. Workers traveling the ROW in summer during surveying or other studies could encounter brown bears or caribou. Wildlife can be attracted to construction camps and food smells. Access to waste can create food-conditioned animals that can become persistent and dangerous. Measures in the Project's *Wildlife Avoidance and Interaction Plan* and environmental training would cover appropriate measures to reduce interactions between humans and wildlife. With implementation of these mitigation measures, any effects from human interaction on wildlife would be minor behavioral disturbances and temporary, generally lasting only minutes longer than the interaction.

Hydrostatic Testing

Potential impacts of hydrostatic testing of the PBTL and PTTL would primarily be to fish and aquatic invertebrates and is discussed in Section 3.2.7. Few additional effects on marine mammals or terrestrial wildlife would be expected other than limited disturbance in the areas of water withdrawal and discharge. Hydrostatic testing can affect wildlife habitat primarily through erosion, sedimentation, and the introduction or spread of aquatic invasive organisms. Measures in the Applicant's *Plan* and *Procedures* would be implemented to avoid and reduce potential impacts to wildlife or wildlife habitats.

Spills

Potential spills and leaks of fuels and hazardous materials would be reduced and mitigated through implementation of procedures in the *SPCC Plan*. Should a spill or leak occur, procedures and materials would be available to contain and clean up the spill. With these measures in place any effects would be minor and short-term. Potential effects of spills on wildlife are described in Section 3.2.7.1.8. Construction of the PTTL would involve transport and staging of fuel at Badami.

Waste and Contamination

The Project's *Waste Management Plan* would reduce the additional habitat areas affected by minimizing waste and planning for transport and appropriate disposal. Waste management activities would be performed in accordance with the waste management hierarchy. In order of preference, the aim would be avoidance, minimization, reuse, recycle, recover, and lastly disposal. Construction waste has a potential to increase the total area of habitat affected by construction

Good camp design, waste management, and measures in the *Wildlife Avoidance and Interaction Plan* would be implemented to avoid and reduce potential attraction of wildlife to construction sites. Potential impacts to wildlife from hazardous waste are discussed in Section 3.4.10.1.5. Garbage and unsecured food waste could lead to attraction of wildlife such as food-conditioned bears or foxes, and can also attract nuisance wildlife such as gulls or ravens. Access to human garbage can also inflate populations of predators, such as ravens and fox, which can have a significant impact on reproductive success of nesting birds, and consequently on bird populations. The most significant issue with potential attraction of food-conditioned bears is that this could lead to the need for defensive actions that could be detrimental to the bear. No areas of contamination are anticipated to be encountered during construction of the PBTL or the PTTL..

Sensitive Wildlife Habitat Areas

The PTTL crosses three sections of the Beaufort Sea Nearshore IBA, which is discussed in detail in Sections 3.4.6 and 3.4.9. Potential impacts would include increased disturbances to local wildlife from construction related aircraft overflights and mortality due to collisions with vehicle and aircraft during monitoring, maintenance, and inspections.

Alaska Game Management Areas

The PBTL and PTTL would be constructed within GMU 26B. Use of the area surrounding these pipelines is controlled through restricted access and hunting is not allowed. Construction of these pipelines is unlikely to change game management within these units. Although there would be potential for indirect impacts to subsistence hunting caused by animal displacement due to noise from construction, this impact would be negligible based on the total area available for subsistence hunting in this area.

3.4.10.2.1.3 Pipeline Associated Infrastructure

The Mainline Associated Infrastructure contains about 10,836 acres of primarily terrestrial habitats (99 percent) as well as additional aquatic habitats (<1 percent; Table 3.4.10-5). The Mainline would be routed to coincide with other transportation or utility corridors across much of its length. The PTTL Associated

Infrastructure contains about 15 acres of aquatic and terrestrial wildlife habitats (Table 3.4.10-20). Undisturbed and protected wildlife habitats are abundant throughout Alaska. PTTL would be routed to coincide with other pipeline corridors across much of its length.

Site Preparation

Marine Mammals

Pipeline, fuel, and materials for the Mainline would be delivered to the west side of Cook Inlet by barge. Existing barge landing facilities on the west side of Cook Inlet are insufficient to support offload of the size and quantities of materials required for the pipeline. A Mainline MOF would be constructed that would include dredging and filling marine habitats. Sounds and disturbances associated with these construction activities could result in disturbance to a few marine mammals, as described for MOF and PLF construction at the Liquefaction Facility. SPLs associated with these activities are listed in Appendix F.

No seal haulouts would be disturbed by airborne sounds from pile driving. Underwater SPLs from pile driving would exceed levels that are considered to be harassing within distances of 0.097 to 2.65 miles depending on type of material and type of installation. Impact and vibratory driving would occur for an estimated 45 days and could expose harbor porpoises, killer whales, and harbor seals. Northern sea otters would not be expected to occur near the Mainline MOF. Steller sea lions may rarely occur in the Mainline MOF area but could potentially be exposed to sounds above the 160 dB or 120 dB thresholds.

Appendix F gives details on noise sources and exposure calculations, and Appendix N gives details on mitigation and monitoring to avoid exposure to noise above thresholds. Mitigation would include trained and qualified Protected Species Observers (PSOs) to monitor the area for the presence of protected wildlife; defining exclusion and disturbance zones; implementing ramp-up, ramp-down, and shut down procedures; and reporting observations of protected wildlife with applicable wildlife management agencies.

Large and Small Mammals

Site preparation for Pipeline Associated Infrastructure would be similar to ROW preparation and is described earlier in this report.

Birds

Potential habitat loss or alteration impacts to birds from construction of Pipeline Associated Infrastructure are included with the potential ROW impacts in Table 3.4.10-13. Potential disturbance to sensitive trumpeter swan and waterfowl habitats are discussed under the Human Interaction for Construction Camps section.

Amphibians

Some additional wood frog impacts could occur for construction of Pipeline Associated Infrastructure. An estimated 49 acres of aquatic bed wetlands or ponds would potentially be affected by Pipeline Associated Infrastructure. Of these potential impact areas, 22 acres of aquatic bed wetlands or ponds for four material sites are within 1 mile of documented wood frog occurrences and could contain habitats suitable for wood frogs (AKNHP, 2014a):

- Material Site 35-2-5005-1 near milepost 668 contains 5 acres of aquatic bed wetlands and ponds;
- Material Site 35-2-5006-1 near milepost 668 contains about 3 acres of aquatic bed wetlands and ponds;
- Material Site 35-2-5007-1 near milepost 667 contains about 9 acres of ponds; and
- Material Site 35-3-5002-1 near milepost 663 contains about 5 acres of ponds.

Terrestrial and Aquatic Invertebrates

Habitats for terrestrial and aquatic invertebrates that would be affected by Pipeline Associated Infrastructure are listed in table 3.4.10-5. Freshwater aquatic invertebrates would be affected within about 49 acres of lake, pond, and stream habitats for the Mainline and within about 5 acres of lake, pond, and stream habitats for the PTTL. Marine aquatic invertebrates would be impacted by the Mainline MOF facility construction, which would include dredge and dredge material disposal and placement of fill within intertidal habitats. Marine aquatic invertebrates likely to occur within habitats near the Mainline MOF would include Baltic macoma, lugworms, and isopods (Lees et al., 2013).

Traffic (Land and Air)

See the previous discussions in Section 3.4.10.2.1.1 under pipelines.

Human Interaction

See the previous discussions in Section 3.4.10.2.1.1 under pipelines.

Spills

See the previous discussions in Section 3.4.10.2.1.1 under pipelines.

Waste

See the previous discussions in Section 3.4.10.2.1.1 under pipelines.

Contamination

See the previous discussions in Section 3.4.10.2.1 under pipelines.

Sensitive Wildlife Habitat Areas

Material sites and airstrips that would be located within sensitive wildlife habitat area, as defined in Section 3.4.9, are listed in Table 3.4.10-20. Access roads that would be located within sensitive wildlife habitat areas are listed in Table 3.4.10-21. Construction activities would be planned in consultation with the resource managers from each Sensitive Wildlife Habitat Area with the intent to mitigate impacts. Mitigation would be determined during the permitting stage of Project.

TABLE 3.4.10-20

Project Material Sites and Airstrips Located within Sensitive Wildlife Habitat Areas

Sensitive Wildlife Habitats	Associated Facility	Nearest Mainline MP
BLM ACECs (North to South)		
Toolik Lake Research Natural Area – Research	Alternate 65-9-059-2	MP 130
	Alternate Site 38 Extra	MP 137
Galbraith Lake – Rare Plants, Dall Sheep	Galbraith Airstrip	MP 143
	65-9-056-2	MP 149
Alaska State Game Refuges and Parks (North to South)		
Galbraith Lake ACEC	Glabraith Lake	
Minto Flats State Game Refuge	2015-LF10	MP 465
	2015-LF6	MP 439
Denali State Park	35-3-009-1	MP 640
	35-3-010-1	MP 638
	35-3-053-1	MP 636
	35-3-013-014-2	MP 634
	35-3-016-1	MP 630
	35-1-020-1	MP 625
	35-3-024-1	MP 619
	35-3-027-1	MP 618
	35-3-029-1	MP 618
	35-3-032-1	MP 616
	35-3-034-1	MP 614
	35-3-035-1	MP 612
Susitna Flats State Game Refuge	2015-12	MP 740
	2015-13	MP 751
Audubon Important Bird Areas (IBAs, North to South)		
Alaska Range Foothills IBA	37-2-010-2	MP 530
Susitna Flats IBA	2015-12	MP 740
	2015-13	MP 750

Source: BLM – GIS data and descriptions (BLM, 1989a); FLB_ACEC_A_prj.shp; PREFEED_REVC2_ROUTE_3D_L; AKLNG_Project_AKLNG_INF_AIRPORTS_P

TABLE 3.4.10-21

Project Access Roads Located within Sensitive Wildlife Habitat Areas

Sensitive Wildlife Habitats	Associated Facility	Nearest Mainline MP
BLM ACECs (North to South)		
Toolik Lake Research Natural Area	AR-N-127.83	127.8
	PSY-N-129.55	129.5
	AR-MS-MLBV-PSY-E-129.55	129.5
	AR-MS-MLBV-PSY-E-129.55	130.1
	AR-XG-HT-N-136.32	136.3
	AR-XG-HT-I-136.35	136.4
	AR-XG-N-136.48	136.5
	AR-XG-N-136.55	136.5
Galbraith Lake	AR-MS-HT-CAMP-PSY-E-141.24	141.2
	AR-MS-HT-CAMP-PSY-E-141.24	141.5
	AR-N-142.84	142.8
	AR-XG-HT-N-143.82	143.8
	AR-XG-N-143.89	143.9
	AR-GA-E-144.98	145.0
	AR-GA-HT-N-145.36	145.4
	AR-N-147.03	147.1
	AR-MLBV-CS-N-148.51	148.5
	MS-E-148.76	148.7
	MS-E-148.76	148.8
	AR-GA-N-148.81	148.8
	WD-E-149	149.0
	WD-E-149	149.0
Alaska State Game Refuges and Parks (North to South)		
Minto Flats State Game Refuge	AR-MS-N-439.62	439.5
	AR-MLBV-CAMP-HT-PSY-N-455.68	455.8
	AR-MS-E-464.37	464.1
	AR-MS-N-464.37	464.5
	AR-MLBV-N-466.91	466.9
Denali State Park	AR-XG-N-609.21	609.1
	AR-HT-N-612.19	612.1
	ALT-MS-612.19	612.1
	AR-XG-N-612.59	612.4
	AR-XG-N-612.75	612.5
	AR-GA-N-614.3	614.2
	AR-GA-N-615.26	615.2
	AR-MLBV-N-616.31	616.2
	AR-N-617.22	617.1
	ALT-MS-617.61	617.5
	AR-E-618.45	618.2
	AR-N-618.45	618.2
	MS-PSY-E-618.65	618.5

TABLE 3.4.10-21

Project Access Roads Located within Sensitive Wildlife Habitat Areas

Sensitive Wildlife Habitats	Associated Facility	Nearest Mainline MP
	ALT-MS-619.52	619.4
	AR-N-619.52	619.4
	AR-N-622.47	622.3
	AR-XG-N-625.16	625.1
	AR-XG-N-625.33	625.2
	ALT-MS-625.33	625.2
	AR-N-628.33	628.2
	AR-HT-N-630.04	629.9
	AR-XG-N-630.24	630.1
	AR-N-630.43	630.2
	AR-N-630.43	630.3
	ALT-MS-630.74	630.6
	AR-XG-MLBV-N-631.7	631.6
	AR-XG-N-631.84	631.7
	AR-MS-N-633.85	633.5
	AR-GA-N-634.55	634.7
	ALT-MS-636.47	636.3
	AR-N-636.47	636.3
	MS-N-637.78	637.6
	AR-N-637.78	637.6
	AR-XG-N-640.47	640.3
	AR-XG-N-640.65	640.5
	AR-GA-N-640.91	640.8
	AR-GA-HT-N-641.1	640.9
Susitna Flats State Game Refuge	MS-N-739.99	739.8
	AR-HT-CAMP-PSY-N-745.04	744.6
	AR-HT-CAMP-PSY-N-745.04	744.8
	AR-HT-CAMP-PSY-N-745.04	744.9
	AR-HT-CAMP-PSY-N-745.04	744.9
	AR-CAMP-PSY-I-745.04	745.9
	AR-MLBV-CS-E-749.39	749.1
	AR-MLBV-CS-E-749.39	749.2
	AR-I-749.39	749.2
	MS-E-750.95	749.3
	MS-N-750.95	750.8
Kenai National Moose Range	AR-N-793.44	793.3
	AR-CAMP-PSY-N-804.06	803.4
Audubon Important Bird Areas (IBAs, North to South)		
Alaska Range Foothills IBA	AR-N-529.2	529.2
	ALT-MS-529.82	529.8
	AR-GA-N-530.97	531.0
	AR-GA-N-531.78	531.7

TABLE 3.4.10-21

Project Access Roads Located within Sensitive Wildlife Habitat Areas

Sensitive Wildlife Habitats	Associated Facility	Nearest Mainline MP
Susitna Flats IBA	MS-N-739.99	739.8
	AR-HT-CAMP-PSY-N-745.04	744.6
	AR-HT-CAMP-PSY-N-745.04	744.8
	AR-HT-CAMP-PSY-N-745.04	744.9
	AR-HT-CAMP-PSY-N-745.04	744.9
	AR-CAMP-PSY-I-745.04	745.9
	AR-MLBV-CS-E-749.39	749.1
	AR-I-749.39	749.2
	AR-MLBV-CS-E-749.39	749.2
	MS-E-750.95	749.2

Source: BLM – GIS data and descriptions (BLM, 1989a); FLB_ACEC_A_prj.shp; PLC_PREFEED_REVB_3D_POST_P_prj.shp and facility FAC_NEAR_MP_FACILITIES_A_MOD_w_ROW_20150928.shp
N/A = Not Applicable (not crossed)

Alaska Game Management Areas

Alaska GMUs potentially affected by construction of the Mainline, PBTL, and PTTL, including associated infrastructure, are discussed in Section 3.4.10.2.1 under Pipelines.

3.4.10.2.2 GTP

3.4.10.2.2.1 GTP Facility

Construction of the GTP would be initiated during winter with the excavation, transportation, placement, and compaction of granular material being conducted throughout the summer. The GTP Facility would be constructed near the CGF in the Prudhoe Bay Unit (PBU). The GTP Pad and the Operations Center would be connected by a granular road and would cover about 284 acres (and about 28 acres of roads). The Mainline, PBTL, and PTTL would tie in to the GTP.

The GTP would cover about 263 acres of vegetated wildlife habitat, which consists of herbaceous (100 percent) habitats (Table 3.4.10-22).

TABLE 3.4.10-22]

Wildlife Habitats (Acres) Affected by Construction and Operation of the GTP and Associated Infrastructure

Level I [a]	Level II [a]	Level III [a]	Gas Treatment Plant		Associated Infrastructure		Total	
			Const	Ops	Const	Ops	Const	Ops
Herbaceous	Graminoid Herbaceous	Mesic Graminoid	206.27	206.27	359.19	337.16	565.46	543.43
		Wet Graminoid	56.35	56.35	108.38	49.38	164.73	105.73
		Freshwater aquatic	0.07	0.07			0.07	0.07
Herbaceous Total			**81.77**	**81.77**	**121.93**	**55.98**	**203.7**	**137.75**
Barren - unvegetated	None	None	-	-	48.40	47.83	48.40	47.83
Barren Total			**0**	**0**	**48.40**	**47.83**	**48.40**	**47.83**
Water	Lake	Lake	5.65	5.65	6.99	6.67	12.64	12.32
	Pond	Pond	0.12	0.12	3.42	3.00	3.54	3.12
	Estuary	Estuary	-	-	113.24	15.72	113.24	15.72
	Stream	Stream	-	-	0.62	0.62	0.62	0.62
Water Total			**5.77**	**5.77**	**379.27**	**26.01**	**385.04**	**31.78**
Unknown		Pioneer Camp	-	-	30	-	30	0
		GTP Total	**284.46**	**284.46**	**895.86**	**426.49**	**1,180.32**	**710.95**

Source: Project Vegetation Mapping; Boggs et al., 2012; basis of classification explained in Section 3.3.2.

Const = Construction, Ops = Operations; Construction acreage includes operational areas. See Resource Report No. 1, Table 1.4-1 for definitions of construction and operations affected areas.

Note: Approximately 3.3 percent of the GTP was not covered by Project vegetation mapping, the AKNHP mapping was used to fill in missing vegetation mapping.

[a] Levels are generally consistent with Viereck's Alaska Vegetation Classification System (Viereck et al., 1992). This classification is based on (Level I) dominant growth forms (tree, shrub, herb), (Level II) canopy height, and (Level III) and closure, general soil moisture and salinity, and dominant plants.

Site Preparation and Foundation Construction

Marine Mammals

Onshore site preparation for the GTP would have no effect on non-ESA-listed marine mammals.

Large and Small Mammals

Site preparation may displace a few large mammals from the construction area. Caribou could be present year-round, but would most likely occur in the construction area during the insect season in July. Muskoxen could also occur year-round, but would most likely occur in the construction area during summer. Brown bears could be present during their active periods (approximately April to September). A few Arctic ground squirrels and small mammals could be injured or killed during construction through vehicle collisions or burial during hibernation. Fox dens, should they occur within the construction area, could be disturbed.

Birds

Construction of the GTP and associated infrastructure would be initiated during winter; as such, no bird nests would be anticipated to be destroyed during construction. Habitats that would be lost from construction are listed in Table 3.4.10-22. A discussion and estimated density of birds is found in Appendix E. Breeding habitat for birds is not known to be limiting in the Beaufort Coastal Plain Ecoregion and the siting of the GTP within an existing industrial area would reduce potential habitat impacts to breeding birds.

Amphibians

Wood frogs do not occur in the Beaufort Coastal Plain Ecoregion and none would be affected by construction of the GTP.

Terrestrial and Aquatic Invertebrates

Benthic invertebrates and their habitats would be lost and altered by construction of the GTP within lakes and ponds (as identified in Table 3.4.10-22). The impact would be minor and permanent.

Blasting

No blasting is anticipated for construction of the GTP; however, blasting may be required for construction of the reservoir and material site. Site-specific blasting procedures would be developed to avoid and reduce potential impacts when blasting is necessary. For the GTP, impacts could be mitigated by using winter construction (a period when much of the wildlife has migrated to other areas); conducting den surveys to locate brown bear dens (and polar bear dens as indicated in Section 3.5.3); suspending blasting if protected wildlife is within a predefined distance from the blast zone, modifying the size of the explosives, and coordinating with Prudhoe Bay facility operators regarding any observations of wildlife near the area. Large and small mammals and birds within the blast zone could be injured or killed through concussion or flyrock. Noise and vibrations associated with blasting to support construction during potentially sensitive periods, including breeding, overwintering, and hibernation, could temporarily displace large mammals. Bears awakening mid-winter, during hibernation, could result in reduced survival or reproduction if newborn cubs are abandoned. Vibrations from blasting could also collapse dens or burrows. Winter active animals could be displaced from important winter habitats and the flight reaction and distraction from blasting could increase their vulnerability to predation.

Traffic (Land and Air)

Air traffic for transport of construction personnel would use the Deadhorse Airport and is not expected to create undue disturbance to wildlife beyond normal operations. Construction-related traffic on the West Dock road and between the camps and the GTP would increase the disturbance on these roads, which would likely increase collision mortality, disturbance, and potential displacement of large and small mammals and birds. On-ice traffic to support dredging could increase collision mortality risks for red and Arctic foxes.

Human Interaction

Human presence and camps associated with construction of the GTP would likely lead to some displacement of wildlife from the area. Workers could encounter brown bears or caribou. Wildlife such as brown bears, red and Arctic foxes, ravens, and gulls, can be attracted to construction camps and food smells. Access to waste can create food-conditioned animals such as brown bears that can become persistent and dangerous. Measures in the Project's *Wildlife Avoidance and Interaction Plan* and environmental training would cover appropriate measures to reduce interactions between humans and wildlife.

Hydrostatic Testing

Measures in the Applicant's *Plan* and *Procedures* would be implemented to avoid and reduce potential impacts to wildlife or wildlife habitats during hydrostatic testing. Potential impacts of hydrostatic testing of transfer pipelines for the GTP would primarily be to fish and aquatic invertebrates and is discussed in Section 3.2.7. Few additional effects on marine mammals or terrestrial wildlife would be expected other than limited disturbance in the areas of water withdrawal and discharge. Hydrostatic testing can affect wildlife habitat primarily through erosion, sedimentation, and the introduction or spread of aquatic invasive organisms.

Spills

Potential effects of spills on wildlife are described in Section 3.4.10.1.10. Construction of the GTP would involve transport and staging of fuel. Potential spills and leaks of fuels and hazardous materials would be mitigated through implementation of procedures in the *SPCC Plan*. Should a spill or leak occur, procedures and materials would be available to contain and clean up the spill.

Waste and Contamination

Construction waste has a potential to increase the total area of habitat affected by construction. The Project's *Waste Management Plan* would reduce the additional habitat areas affected by minimizing waste and planning for transport and appropriate disposal. Waste management activities would be performed in accordance with the waste management hierarchy. In order of preference, the aim would be avoidance, minimization, reuse, recycle, recover, and lastly disposal.

Good camp design, waste management, and measures in the *Wildlife Avoidance and Interaction Plan* would be implemented to avoid and reduce potential attraction of wildlife to construction sites. Potential impacts to wildlife from hazardous waste are discussed in Section 3.4.10.1.5. Garbage and unsecured food waste could lead to attraction of wildlife, such as food-conditioned bears or foxes, and could also attract nuisance wildlife, such as gulls or ravens. Access to human garbage can also inflate populations of predators, such as ravens and fox, which can have a significant impact on reproductive success of nesting birds, and consequently on bird populations. The most significant issue with potential attraction of food conditioned bears. If escalated beyond hazing by bear behavior to defensive actions, it can be detrimental to the bear No areas of contamination are anticipated to be encountered during construction of the GTP.

Sensitive Wildlife Habitat Areas

The GTP and associated infrastructure would be located within the Prudhoe Bay Oilfield. Sensitive wildlife habitats within this region include the Beaufort Sea Nearshore Global IBA. The GTP facilities would be located over a mile from the IBA. The West Dock modifications would be located within the IBA, but represent a small addition to existing infrastructure. If the dock head were to be used during operations, the associated vessel traffic would result in some temporary disturbance/displacement of birds on the water within the IBA. However, any such effects would be minor and short-term given the infrequency of vessel trips, frequent vessel and heavy equipment activity by other West Dock users, and the temporary nature of such disturbances. There would be no effect on the habitat.

Alaska Game Management Areas

The GTP and associated infrastructure would be located within the PBU, where access is restricted and hunting is generally closed. Construction would be unlikely to interfere with game management within this unit, although there may be an increased potential for vehicle collisions and human interactions with brown bears, caribou, and muskoxen. Such impacts could be mitigated through measures that are already in place within the PBU including speed limits, effective waste management, a non-interference policy with wildlife, requisite driver training programs, and enforcement.

3.4.10.2.2.2 GTP Associated Infrastructure

The GTP Associated Infrastructure would cover about 330 acres of wildlife habitat (Table 3.4.10-22), primarily within dwarf scrub habitats with minor amounts of herbaceous habitats.

Pad and Dock and Construction

Construction of GTP Associated Infrastructure would include excavation of a material site and water reservoir and construction of West Dock at DH 4 that would potentially result in loss and alteration of wildlife habitats as listed in Table 3.4.10-22. Most ground disturbance would be initiated during winter to avoid potential loss of bird nests, but construction activities would continue through summer; noise and activity could disturb and displace wildlife from the area.

Construction of GTP Associated Infrastructure would cover tundra, shoreline, and aquatic habitats, including about 31 acres of benthic marine substrates for the construction of DH 4 (Table 3.4.10-22). Invertebrates would be buried and habitats would be lost or altered. Potential impacts would be reduced by expanding existing infrastructure to support construction of the GTP, which have a smaller footprint than new causeways and entirely docks. Widening of the West Dock road for movement of modules to the

GTP would cover about 0.39 acre of tidal marsh and mud flats, and could affect Arctic tidal marshes or plant associations of conservation concern (section 3.3.7.2.2.2). This in turn could impact nesting bird habitats that utilize tidal marshes for foraging and nesting, the impact would be minor and permanent due to the small area (Figure 3.3.7-1).

Terrestrial and Aquatic Invertebrates

Construction of DH 4 and widening of the West Dock road and causeway would encompass approximately 77 acres of marine habitats. Benthic invertebrates would be destroyed and the habitat lost permanently. These impacts would be permanent but minor given the area of impact in relation to available habitat. No special or sensitive benthic habitats such as hardbottom are found near West Dock or would be impacted. Hard-bottom habitat, consisting of cobbles and boulders, contains a more diverse and densely populated invertebrate community due to the presence of large algae (particularly kelp). The nearest known hard-bottom communities are located in what is known as the Boulder Patch, located approximately more than 20 miles to the east (Figure 3.3.7-1).

The abundance and diversity of benthic invertebrates are thought to be low in the impact areas. In the winter, sea ice freezes to the bottom of the water column in shallow portions of Prudhoe Bay creating bottomfast ice. Bottomfast ice can extend to 10 feet below the surface of the water and generally prohibits overwintering of most benthic species, resulting in a population that is dependent on recolonizing the area during ice-free periods (MMS 1990). Water depths in the areas that would be impacted by DH 4 construction and road widening are less than 10 feet. These impacts would all occur in areas with water depths of less than 10 feet.

Benthic invertebrate communities were sampled in 2015 at four sites in nearshore waters of Prudhoe Bay: South Prudhoe Bay, West Prudhoe Bay, Gull Island, and west of West Dock(Resource Report No. 2, Appendix R).. The observed densities of benthic macrofaunal and megafauna at these sites are indicated in Figure 3.4.10-1 and 3.4.10-2. The overall mean density for both macro and megafauna over the four sites was 1,892 organisms per 10.8 square feet. Mean density of macrofauna at Gull Island at 3,710 organisms per 10.8 square feet was more than twice that of West Prudhoe Bay and South Prudhoe Bay, and five times greater than west of West Dock (Figure 3.4.10-1). Megafauna at Gull Island at 109 organisms per 10.8 square feet was about 30 percent higher than South Prudhoe Bay, twice that of West Prudhoe Bay, and three times that of west of West Dock (Figure 3.4.10-2). For both macrofauna and megafauna, annelids are by far the most abundant taxon throughout sites, followed by crustaceans, mollusks, and miscellaneous taxa. The annelids are dominated by tube-dwelling sessile polychaetes. The crustaceans and mollusks are composed of amphipods, isopods, and bivalves, respectively. The miscellaneous taxa are composed of priapulids, ascidians, and hydrozoa; the priapulids are free-living, the ascidians and hydrozoa.

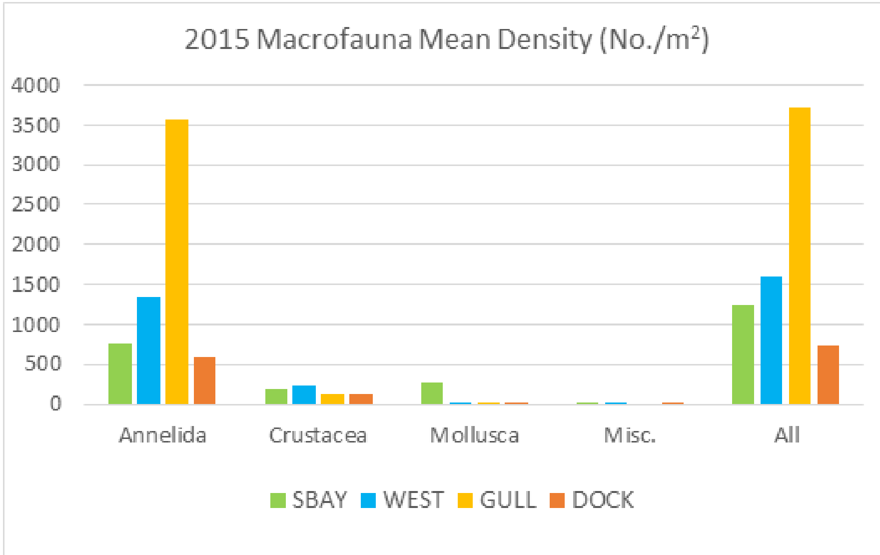


Figure 3.4.10-1 Macro Invertebrate Density at Potential Prudhoe Bay Dredge Disposal Sites

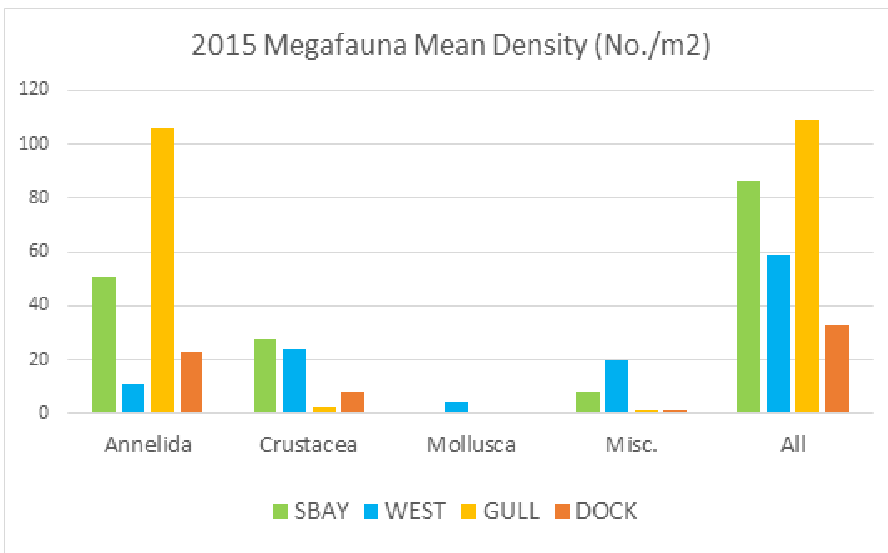
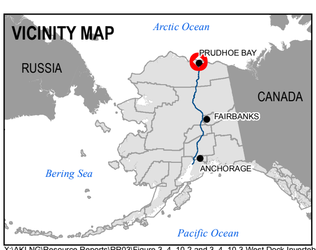


Figure 3.4.10-2 Mega-Invertebrate Density at Potential Prudhoe Bay Dredge Disposal Sites

VICINITY MAP



LEGEND

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DATE:	2017-03-21	SHEET:	1 of 1

WEST DOCK INVERTEBRATES AT DISPOSAL SITES

FIGURE 3.4.10-1 AND 3.4.10-2

ALASKA LNG

X:\AKLNG\Resource Reports\RR03\Figure 3_4_10-2 and 3_4_10-3 West Dock Invertebrates at Disposal Sites.mxd

Pile Driving

DH 4 construction would require installation of piles, most of which would be placed using an impact hammer in winter, and four dolphins required for affixing the temporary barge bridge across the causeway. Ringed seals are the only marine mammals expected to be present in the vicinity during winter. Although not found in the area where pile-driving would occur due to the ice being grounded, the area ensonified to levels that could result in behavioral disturbance would likely extend to areas that might be used by the seals. Marine mammal monitoring plans would be implemented to ensure they are not exposed to injurious levels of sound. Large mammals could potentially occur in the region during winter that could be disturbed and displaced from the activity. Such large mammals could include caribou and muskoxen. Most birds that use habitats in the Beaufort Coastal Plain Ecoregion are migratory and would not be present during winter. As such, winter pile driving would have little potential effect on birds. SPLs from pile driving may cause injury or death to aquatic invertebrates near the activity, as discussed in Section 3.2.7.1.3.

Vessel Activity

Marine Mammals

HLV traffic for delivery of the modules for the GTP would require sealifts during four summer seasons.

Potential effects on marine mammals from vessel traffic at West Dock could include displacement of spotted seals ringed seals and bearded seals, and potential disturbance to beluga whales from loud underwater sounds generated during tug and barge docking, when thrusters are used to position the barges at the dock. (See Appendix F). Exposure of marine mammals to tug and barge docking SPLs above the 120 dB threshold without mitigation includes: beluga whales, spotted seals, ringed seals, and bearded seals. No spotted seal haulouts are located near West Dock. Potential for vessel disturbance and collisions with seals and whales have been discussed in previously in Section 3.4.10.1.6.1.

Wildlife

Sounds and activity associated with delivery of the modules could displace a few caribou from coastal insect-relief habitats in the vicinity of West Dock. A few waterfowl and seabirds could be disturbed and displaced by vessel activity.

Vessel operations would include the potential for introduction or spread of aquatic invasive organisms that would have the potential to degrade coastal marine habitats for seaducks and seabirds. HLVs would anchor in Stefansson Sound inside of Reindeer Island to await offload. Ship hulls, ballast, and equipment lowered into the water may serve to transport invasive aquatic organisms that can degrade coastal marine habitats by displacing or transmit diseases to native aquatic organisms. Ballast management for HLVs would be compliant with regulations. Use of freshwater ballast would allow for removal of ballast without transporting marine aquatic invasive organisms. All vessels brought into the State of Alaska or federal waters are subject to USCG 33 C.F.R. 151 regulations, which are intended to reduce the transfer of aquatic invasive organisms. Currently, no aquatic invasive organisms have become established at Prudhoe Bay and little is known about the environmental tolerance of species that could be released (McGee et al., 2006).

Traffic (Land and Air)

Air traffic for transport of construction personnel would use the Deadhorse Airport and is not expected to create undue disturbance to wildlife beyond normal operations. Construction-related traffic on the West Dock road and between the camps and the GTP may increase the disturbance on these roads, and may moderately increase collision mortality, and potential displacement of large and small mammals and birds. Potential traffic impacts along the roads would be offset with mitigation. Existing wildlife protection measures are in place within the PBU to reduce potential vehicle-animal collisions, such as vehicle speed limits, requisite driver training programs, a non-interference policy with wildlife, waste management, and prohibiting the use of cell phones while driving. On-ice traffic to support dredging could increase collision mortality risks for red or Arctic foxes, although similar mitigation measures would reduce this risk.

Human Interaction

Human presence and camps associated with construction of the GTP would likely lead to some displacement of wildlife from the area. Workers could encounter brown bears or caribou. Wildlife could be attracted to construction camps. Food smells and access to waste could create food-conditioned animals that could become persistent and dangerous. Measures in the Project's *Wildlife Avoidance and Interaction Plan* and environmental training would cover appropriate measures to reduce interactions between humans and wildlife.

Spills

Potential effects of spills on wildlife are described in Section 3.4.10.1.10. Construction of the GTP would involve transport and staging of fuel. Potential spills and leaks of fuels and hazardous materials would be mitigated through implementation of procedures in the *SPCC Plan*. Should a spill or leak occur, procedures and materials would be available to contain and clean up the spill.

Waste and Contamination

The Project's *Waste Management Plan* would reduce the additional habitat areas affected by minimizing waste and planning for transport and appropriate disposal. Waste management activities would be performed in accordance with the waste management hierarchy. In order of preference, the aim would be avoidance, minimization, reuse, recycle, recover, and lastly disposal. Construction waste has a potential to increase the total area of habitat affected by construction. Potential impacts to wildlife from hazardous waste are discussed in Section 3.4.19.2.1.3. Garbage and unsecured food waste could lead to attraction of wildlife, such as food-conditioned bears or foxes, and can also attract nuisance wildlife, such as gulls or ravens. Access to human garbage can also inflate populations of predators, such as ravens and fox, which can have a significant impact on reproductive success of nesting birds, and consequently on bird populations. If the human interaction is escalated from hazing by bear behavior to defensive actions, it can be detrimental to the bear. Good camp design, waste management, and measures in the *Wildlife Avoidance and Interaction Plan* would be implemented to avoid and reduce potential attraction of wildlife to construction sites. No areas of contamination are anticipated to be encountered during construction of the GTP.

Sensitive Wildlife Habitat Areas

The GTP and associated infrastructure would be located within the existing Prudhoe Bay Oilfield. Sensitive wildlife habitats within this region include the Beaufort Sea Nearshore Global IBA.

Alaska Game Management Areas

The GTP associated infrastructure would be located within the Prudhoe Bay Unit (which is within GMU 26B), where access is restricted and hunting is generally closed. Construction would be unlikely to interfere with game management within this unit, although there may be an increased potential for vehicle collisions and human interactions with brown bears, caribou, and muskoxen. Such impacts could be mitigated through measures that are already in place within the PBU including speed limits, effective waste management, a non-interference policy with wildlife, requisite driver training programs, and enforcement.

3.4.11 Potential Operational Impacts and Mitigation Measures

Potential operational impacts to wildlife and mitigation measures discussed by facility in the following sections are summarized in Table 3.4.11-1. Potential operation impacts that include continuing habitat loss initiated during construction are discussed under construction impacts. Potential for noise disturbance from operations of facilities, including the Liquefaction Facility, Mainline compressor and heater stations, and the GTP, are discussed subsequently.

TABLE 3.4.11-1

Potential Operation Impacts and Mitigation to Wildlife Associated with the Project

Activity	Potential Impact	Mitigation
ROUTINE OPERATIONAL ACTIVITIES		
Marine Mammals		
Pipeline Maintenance and Inspections	Disturbance of animals in vicinity	• None expected in marine waters.
Vessel Traffic	Noise, vessel movement, potential spills, and introduction of non-native nuisance species	• Comply with ballast water regulations; and • Implement *Spill Response Plan* and train onsite spill response personnel.
Stormwater Discharge from the GTP and LNG Facilities	Water quality and thermal impacts LNGCs	• Adhere to permit conditions for onshore stormwater discharge.
Wildlife – Large and Small Mammals		
Pipeline Maintenance and Inspections	Increased mortality due to increased hunting/poaching, decrease in reproduction due to stress, impedance of reproduction and migration corridors, vehicular interactions and life and property defense	• ROW patrolling by the operator, no trespassing signs, and the installation of gates, chains, or large boulders at pubic road and trail crossings; • Elevated sections of the pipeline would be at least 7 feet above grade; • Reduce operational traffic, both motor vehicular and aircraft; • Training to increase worker awareness on how to avoid problems with wildlife; and • Minimize human and wildlife interactions.

TABLE 3.4.11-1

Potential Operation Impacts and Mitigation to Wildlife Associated with the Project

Activity	Potential Impact	Mitigation
Access Roads (Permanent)	Vehicular interactions and life and property defense	• Reduce the number of permanent roads needed to facilitate operation and maintenance; • Reduce the amount of vehicular traffic by utilizing busses to and from the work site; • Post speed limit signs, especially in sensitive areas; and • Training to increase worker awareness or how to avoid problems with wildlife.
Vehicular Traffic	Potential spills, and introduction of non-native nuisance species	• Reduce the number of vehicle trips for maintenance; • Implement *Spill Response Plan* and train onsite spill response personnel; and • Training to increase worker awareness or how to avoid problems with wildlife.
Wildlife – Birds		
Facility Operation	Noise; Mortality from collisions with buildings, vessels, vehicles, or aircraft; increased hunting and/or predation; or spills	• Lighting on facilities would adhere to USFWS (2013b, 2016) lighting guidelines; • Follow the final *Avian Protection Plan* after development with USFWS and ADF&G; • Follow the *Wildlife Avoidance and Interaction Plan* (includes North Slope Activities: Polar Bear and Pacific Walrus Avoidance and Interaction Plan; Appendix J); • Follow Project *Waste Management Plan;* • Public access to new waterfowl hunting areas when the ROW deviates from existing ROWs (e.g., between the Parks Highway and Cook Inlet) would be reduced by blocking entry areas; and • Spills would be reduced by following procedures outlined in the *SPCC Plan* developed for this Project. • Leave vegetative buffer in place along the eastern and southern boundaries of the site to reduce noise levels
Vehicle/Vessel Traffic ROW Maintenance	Indirect mortality from disturbance due to routine maintenance activities	• Follow Applicant's *Plan* and *Procedures;* • Project-associated traffic (vessel, aircraft) would avoid important bird habitats during sensitive time periods to the maximum extent practicable; • Vessel traffic would avoid marine IBAs and state critical habitat areas to the maximum extent practicable; and • Routine maintenance activities would be conducted outside sensitive bird timing windows (nesting, migration) whenever possible.
ROW Maintenance	Habitat alteration	• Periodic clearing of vegetation along the ROW would occur outside of the migratory bird nesting period; and • Follow Draft *Project Restoration Plan.*

3.4.11.1 Liquefaction Facility

3.4.11.1.1 Facility Operations

Wildlife habitats that would be affected during operation of the Liquefaction Facility are listed in Table 3.4.10-2. The Liquefaction Facility operations would generate noise, as would the flare system when gas is dumped to the flare for safety. Outdoor ambient noise near the Facility location is representative of a residential area with neighboring industrial/commercial facility with day-night sound levels ranging from 37 to 56 dBA, depending on location and measurement duration. Outdoor ambient noise includes natural sound such as bird songs, and insect noise, as well as aviation and vehicle traffic, barking dogs and other residential noise, noise from power tools, other construction, building pumps, generators, and other mechanical systems (Appendix M in Resource Report No. 9). During operations with recommended noise abatement included in the facility design, the LNG Plant would generate day-night sound levels that would reach about 58 dBA within 0.5 mile and 52 dBA within 1 mile (Appendix O in Resource Report No. 9). These levels would be near the high ambient level recorded near the site. Wildlife responses to noise are described under Construction.

Flare systems would include ground-based wet and dry flares located within a 14-acre enclosure surrounded by radiation shield fencing and a 200-foot-tall low pressure flare located on the bluff near the Marine Terminal. The pilot light for the low-pressure flare would be visible during normal operation, with flaring occurring during upset conditions. The wet and dry ground flare pilot would be visible during normal operations, but would be shielded by the radiation fencing. Stormwater ponds would be built to manage stormwater runoff. Stormwater ponds that receive pollutants would have a skimming pipe and/or skimmer sump to collect any hydrocarbon contamination where stormwater does not already pass through collection systems with oil removal facilities.

Facility lighting would consist of normal and essential lighting panels and lighting fixtures to provide lighting for working areas and for security requirements. Street and area floodlights would be controlled by photocells potentially with manual override. Outdoor general lighting would be high pressure sodium or light-emitting diode lights mounted on poles approximately 100 feet high and directed toward facilities, similar to typical street lighting. Walkway and platform lights would be high pressure sodium or LED stanchion or wall mounts. Pendant mount fixtures may also be used. Lighting design would direct lighting only in places where it is necessary, and would be designed and shielded, where applicable, to reduce light trespass, unwanted projection, and upward directed light. Area lighting would be located on the PLF, as well as on the mooring dolphins and the breasting dolphins. Load indicator lights would be required for the mooring system.

A self-supporting approximately 150-foot-tall communication tower equipped with mandatory aviation obstruction lighting would also be located at the Liquefaction Facility. Building heights would range from 80 to 200 feet.

3.4.11.1.1.1 Marine Mammals

Routine operation of the LNG Plant and the associated noise would not affect marine mammals. Increased levels in ambient noise associated with use of the Marine Terminal may result in some deflection of marine mammal movements along the shoreline (see Resource Report No. 9, Operations Noise Levels Impacts).

3.4.11.1.1.2 Large and Small Mammals

Routine operation of the Liquefaction Facility with associated noise and artificial lighting could displace a few large and small mammals from the vicinity of the LNG Plant (USFWS 2009c). The site of the proposed Liquefaction Facility is located within an already industrialized area, with residential development to the east. Most animals that are sensitive to industrial activity have already been displaced from the area by the existing development and associated activities. Large mammals that occur near the proposed site are likely restricted to those that adapt and become habituated to such development and activity. These include moose and black bear. Other large mammals found in this portion of the Kenai Peninsula such as caribou and wolf likely use the area of the Liquefaction Facility very infrequently if at all. Some moose and black bear would likely be displaced in the immediate vicinity of the facility, but any such effect would be minor as it would be restricted to a small area and would affect a very few individuals given the density that these animals are found at in the region. Small mammals would likely not be displaced by operations. Furbearers such as lynx and river otter may be displaced by facility operations, but any such effects would be minor, as the use of the area by these mammals is probably already very low so few individuals would be affected. Any such effects would be minor but long-term (ARCADIS, 2013).

The pilot light of the low pressure marine flare would be visible during normal operations; however, flaring would only occur during upset conditions. In addition, the pilot light for the main plant flare would be shielded by the radiation fencing, resulting in a low light level/glow being emitted. In general, lighting design shall reduce light trespass by directing light only in places where needed. Final location, number of lights, and shielding installation would be determined as engineering progresses through detail design. The intent is to mitigate the unwanted projection and upward throw of light (Resource Report No. 1).

3.4.11.1.1.3 Birds

Increased noise at the LNG Plant may lead to displacement of nesting birds from the surrounding area. Noise levels at the facility may reach levels that would interfere with bird communication, but would be within industrial standards. As summarized in DOT (2004) the threshold for hearing in birds is higher than for humans at all frequencies and the distance at which communication between the signaler and receiver can be detected depends on the source intensity, amount of masking (i.e., background noise levels), and the rate of attenuation. Masking from noise in the spectral region of the signal is the most effective with signals needing to be 18–20 dB greater at the best frequencies to be detected. Based on the DOT (2004) review of studies, sound production from several bird species has been measured with peaks of approximately 90–95 dB and are generally greater for larger birds. In an open area, the rate of attenuation is about 5 dB/m for a bird 10 meters above ground, with sounds produced lower to the ground attenuating more quickly. Details of the Liquefaction Facility noise impact and mitigation analysis are provided in Appendix P of Resource Report No. 9. Sound levels generated above an Ldn of 60– 65 dB(A) are not anticipated outside of the general Liquefaction Facility and berthing area. Any potential impacts to bird communication would not be anticipated to occur off-site. In addition, because the Liquefaction Facility area has a previous industrial component, some common birds may be habituated to the background noise levels.

The stormwater ponds may attract waterbirds, especially ducks and gulls, which may find the ponds attractive for loafing. Collocation of stormwater ponds with the ground-flare system could lead to unintentional mortality to birds if they are using the pond when the flare becomes active in an upset situation. Some stormwater ponds may receive pollutants from onsite drainage and birds using these ponds could be exposed to small amounts of oils that can damage the thermal insulation and buoyancy of their feathers, leading to hypothermia and potential mortality. Because habitats in this area support concentrations of ducks, geese, and swans, attraction of waterbirds to onsite ponds would be likely and may increase the risk of exposure to contaminants or mortality from collisions with infrastructure, vehicles, or other industrial activities at the Liquefaction Facility.

Birds, especially during migration and periods of low visibility, may be attracted by facility lighting or the low pressure flare pilot and could collide with the flare, communication tower, power lines, the Marine Terminal, or other buildings or modules. Power lines create both a collision and a potential electrocution hazard. Electrical power for the Liquefaction Facility would be generated onsite. With removal of trees, any power poles could become attractive as perches or nest sites for raptors, gulls, and passerines such as ravens, magpies, rock pigeons, and jays; however, most or all powerlines are expected to be underground. Design of substations, transformers, and power distribution lines and poles would incorporate avian safe design to reduce the potential for electrocution hazards and would be sited to avoid placement near waterbird habitats where potential collision mortality could be increased (see Appendix E).

Pilings and in-water structures would create settlement habitat for marine algae and invertebrates, and perching habitat for raptors, seabirds, and passerines. These structures may in turn increase the local densities of fish and invertebrate prey that could attract waterbirds. Anti-perching designs would be considered to reduce attraction of seabirds to Marine Terminal facilities.

3.4.11.1.1.4 Amphibians

Noise from the facility would have the potential to interfere with wood frog calling as discussed under Construction.

3.4.11.1.1.5 Terrestrial and Aquatic Invertebrates

Pilings and in-water structures would create settlement habitat for marine algae and invertebrates. These structures may in turn increase the local densities of fish and invertebrate prey that could attract waterbirds.

3.4.11.1.2 Vessel Operations

3.4.11.1.2.1 Marine Mammals

LNGCs and support vessels operating at the Marine Terminal could affect marine mammals and their habitats through collisions, sound, or introduction and spread of aquatic invasive organisms. Cooling water may result in small-scale changes in aquatic habitat, as discussed in Section 3.2.8.

3.4.11.1.2.2 Disturbance Effects

Noise generated by vessels includes propeller cavitation, engines, and depth sounders. Of these sources, SPLs associated with LNGC docking at the PLF could exceed threshold values for injury or harassment of marine mammals. Sound pressure source levels from LNGCs can be over 190 dB re 1 μPa (rms) with operation of bow thrusters during the short docking period. This potential exposure level is near the 180 dB re 1 μPa (rms) threshold level determined by NMFS as likely to cause permanent hearing threshold shifts. The onset of thruster noise is generally sudden and can cause a startle reaction in nearby marine mammals. The area potentially affected by this level of noise, however, would be limited to within about 16 to 23 feet from the source for about 20 minutes. Appendix F contains the potential numbers of marine mammals impacted by operational noise. Northern sea otters and Steller sea lions rarely occur in the Marine Terminal area but if they are present could potentially be exposed to sounds above the 120 dB threshold.

Anthropogenic noise may also indirectly affect the survival and reproductive success of Cook Inlet marine mammals by having negative effects on their prey (NMFS, 2015b).

3.4.11.1.2.3 Vessel Collisions

Vessels may collide with marine mammals, resulting in injury and death. Whale mortalities from ship strikes are usually caused by blunt force trauma from striking the ship bow, or by lethal wounding from propeller cuts. Neilson et al. (2012) documented 108 ship strikes in Alaska from 1978 to 2011 and found the vast majority involved humpback whales in Southeast Alaska. Vessel speed is the primary factor in the probability of a vessel strike, as well as the probability of the strike being lethal. NOAA Fisheries (2014) reviewed available data (e.g., Jensen and Silber 2003; Laist et al., 2001) on all large whale strikes worldwide from 1975–2002 and some additional strikes since 2002.

A whale strike risk analysis of the proposed operations at the Marine Terminal will be conducted and submitted in Attachment A of Appendix C-BA of Resource Report No. 3.

3.4.11.1.2.4 Large and Small Mammals

Vessel traffic is not expected to affect large or small mammals. Vessels can carry and release rats and mice that can degrade habitats, spread disease, and be detrimental to native wildlife.

3.4.11.1.2.5 Birds

Seabirds, shorebirds, ducks, and geese foraging near or moving through the Marine Terminal area may be displaced by vessel traffic. The anticipated levels of LNGC traffic, ranging from one every other day to one per day, depending on the size of LNGC, are not expected to create more than localized temporary displacement of birds as the ships arrive and depart from the Marine Terminal. Shoreline habitats near the Marine Terminal do not appear to be important migration fall stopover or staging habitats for waterfowl, shorebirds, or seabirds (ADF&G, 1985; NOAA, 2002). Vessel activity at the Marine Terminal is anticipated to result in minor, temporary, local disturbance and displacement of waterbirds.

Vessel transit through Cook Inlet, including transfer of the pilot from Homer and Nikiski by boat at the anticipated rate of one every other day to one per day, is also not expected to result in more than minor temporary local disturbance and displacement of waterbirds. Vessels traffic routes are located offshore far from coastal bird habitats and vessels maintain relatively low speeds in Cook Inlet. Vessel wakes would be minor in comparison to the naturally turbid waters caused by extreme shifts in tides in Cook Inlet, therefor vessel wakes are not anticipated to have an impact on coastal bird habitat. Additionally there are no IBAs or other documented sensitive coastal bird habitats, such as a salt marshes, in the area of Liquefaction Facility that would be impacted by wakes..

3.4.11.1.2.6 Amphibians

Vessel operations are not anticipated to affect wood frogs, as wood frogs are terrestrial and there are no vessel operations planned for freshwater.

3.4.11.1.2.7 Terrestrial and Aquatic Invertebrates

Vessel operations would have little to no effect on terrestrial invertebrates. LNGCs would use Cook Inlet water to cool engines while they are berthed at the Marine Terminal. Cooling water intake and discharge would typically occur for about 21 hours while the LNGC is docked. Uptake rates would be at a low velocity, although larval invertebrates would not be able to avoid the intake. No chemicals would be added to cooling water. Cooling water could potentially introduce thermal pollution, but with the level of water exchange in Cook Inlet any temperature differential would likely be very short-term and limited in extent. Marine aquatic invertebrates could be entrapped and entrained during the pelagic larval stage by vessel cooling water use from Cook Inlet as described in Section 3.2.8. During this stage, free-floating larvae would be present in the water column and could enter the cooling water system or be entrained on seawater intake screens or by passing vessels. Effects would be limited to the time period when larvae are present in Upper Cook Inlet (see Figure 3.4.8-1). The reproductive strategy of most marine invertebrates involves broadcasting very large numbers of eggs, larvae, and adults, which undergo extremely high natural mortality rates each year or generation. The mortality rate of entrained and/or impinged organisms is high, but the effects of entrainment and impingement on the populations would be minor and short term because of the reproductive strategy and short generation time of these types of organisms.

3.4.11.1.3 Traffic (Land and Air)

Ground and air traffic during operations would be much less than during construction. Marine mammals would not be affected by ground and air traffic associated with operation of the Liquefaction Facility due to already-present air traffic flying to Kenai Municipal Airport and minimum altitude requirements for aircraft an altitude of 1,000 feet above the highest obstacle within a horizontal radius of 2,000 feet of the aircraft (14 C.F.R. 91.119). Safe marine mammal viewing altitudes that avoids harassment of animals is a minimum of 1,500 feet (NOAA 2001). A few large and small mammals, birds, wood frogs, and terrestrial invertebrates would be vulnerable to collision injury or mortality, although the potential effects would likely be indistinguishable from other regional traffic sources.

3.4.11.1.4 Human Interaction

Operation of the Liquefaction Facility would not be expected to increase human interactions with wildlife. Measures in Appendix J would be implemented to avoid and reduce adverse effects from human-wildlife interactions.

3.4.11.1.5 Spills

The most likely source of exposure to an oil spill during operations would be from a grounded LNGC with a subsequent release of fuel. While vessel groundings do occur within Cook Inlet, they are rare. Vessel grounding that results in a fuel spill or transmission of aquatic invasive organisms could result in long-term damage to Cook Inlet habitats.

There has never been a major incident involving a large LNG spill or fire on water. Although unlikely, a spill of LNG could still be hazardous to aquatic organisms. A spill of LNG could occur from a tank rupture or valve failure, during LNGC loading, during LNGC grounding, or due to another accident at an adjacent facility. LNG is not water soluble and would vaporize rapidly upon contact as the liquid heats up and becomes a gas. Methane is lighter than air and would quickly dissipate. Because LNG would not mix with water, no water contamination would occur. Over a 60-year history and 40,000 voyages, there has never been an LNG spill from a ship from either grounding or collision (CEE 2006). Significant releases from onshore facilities have been exceedingly rare, but have happened (CEE 2006). The use double-hull LNGC would further reduce the likelihood of a vessel breach.

3.4.11.1.5.1 Marine Mammals

The greatest threat to marine mammals near an LNG spill would be from changes in water temperature. The extremely cold LNG would rapidly cool the upper water layers nearest the spill as it begins to vaporize. Aquatic organisms, including whales, seals, and their prey, could be exposed to freezing temperatures that could cause injury or mortality. Alternatively, vaporized LNG could ignite, resulting in a fire and localized heating of the surface water. Neither heating nor cooling would likely cause the overall water column to change temperature and effects would be limited to the surface layer. Marine mammals would likely respond to spills by moving away from undesirable temperatures, but plankton would be unable to avoid negative impacts.

3.4.11.1.5.2 Wildlife

Fuels and oils are toxic to birds and their invertebrate prey. Spills that reach concentrations of flightless molting ducks could affect a large proportion of their populations (USFWS, 2015a). The most likely source of exposure to an oil spill would be from a grounded vessel with a subsequent release of fuel. While vessel groundings do occur, they are rare. Amphibians are highly sensitive to environmental contamination. Spills of fuels and lubricants could result in exposure of eggs, tadpoles, or adult frogs. Amphibians may absorb toxins from oil through their skin. Exposure to toxins that occurs during egg formation in amphibians can lead to reduced productivity and teratogenic effects. Many invertebrates are relatively immobile and often indiscriminate filter-feeders, and may not be able to avoid exposure to contaminants. Floating oil and volatile compounds can contaminate plankton, including the larvae of various invertebrates. Sinking oil can affect invertebrates occupying the bottom of waterbodies contaminating or smothering these species. Some stress-tolerant organisms, including polychaeta worms, snails, and mussels, have been found to be more abundant at oiled sites—possibly due to the species benefiting from organic enrichment from the oil, or from reduced competition or predation from more sensitive species.

Although unlikely, a release of LNG could be harmful to wildlife. Threats to wildlife near an LNG spill could include freeze burns from rapid temperature changes, injury from fire, and asphyxiation caused by reduced oxygen concentrations through displacement with methane. In the case of a release with no fire, wildlife would likely respond by moving away from the areas of cold liquid prior to receiving freeze burns. If a fire were to occur with the release of LNG, wildlife in the immediate vicinity of the fire could be injured or killed, particularly if floating on the surface. Less-mobile animals such as small mammals and wood frogs would be unlikely to avoid impacts from released liquids. Released LNG would quickly vaporize, forming a cold, heavier-than-air vapor cloud and mammals or birds flying over the area at the time of release could experience asphyxiation from the lack of oxygen until the vapor cloud warms and is dispersed by prevailing winds. Although LNG is nontoxic, LNG vapors at high concentrations can displace oxygen, resulting in oxygen levels that are too low for safe exposure (Resource Report 11, LNG Hazards). Regulations (49 C.F.R. Part 193.2059) require the facility to be designed so that any released vapor cloud remain within the facility property. The property would be maintained as an industrial facility with little or no wildlife habitat. Therefore, any effects on wildlife would be minor and short term as few organisms would be affected, with no effects on regional populations.

3.4.11.1.6 Waste

Measures outlined in the *Wildlife Avoidance and Interaction Plan* (Appendix J) and the *Waste Management Plan* (Appendix J in Resource Report No. 8) would be used to prevent wildlife access to food waste. Garbage or unsecured food waste can attract wildlife such as bears, coyotes, foxes, and nuisance wildlife, such as gulls or rats. Attraction and nutritional supplements can increase predation on local wildlife, including amphibians, small mammals, and birds.

3.4.11.1.7 Sensitive Wildlife Habitat Areas

The sensitive wildlife habitats closest to the proposed Liquefaction Facility are located about 5 miles away and include the Kenai NWR and the Swanson Lakes IBA within the Kenai NWR. This sensitive wildlife habitat area would not be affected by operation of the Liquefaction Facility.

3.4.11.1.8 Alaska Game Management Areas

The Liquefaction Facility would be located within GMU 15A. Operation of the Liquefaction Facility would be unlikely to interfere with game management within this unit, although there would be an increased potential for introduction and spread of noxious and invasive plants and animals that could degrade wildlife habitats within the GMU.

3.4.11.2 Interdependent Project Facilities

3.4.11.2.1 Pipeline

3.4.11.2.1.1 Mainline

Marine Mammals

Operation of the marine sections of the Mainline through Upper Cook Inlet would have limited effects to marine mammals. Pipeline surveillance overflights for routine pipeline inspections (estimated at 26 flights per year), monitoring, and maintenance, could result in disturbance of marine mammals such as belugas, harbor seals, and harbor porpoises. Overflights would be conducted at a minimum altitude of 1,500 feet above sea level when crossing Cook Inlet. At that altitude received sound levels at the water surface would be below the NMFS threshold value of 120 dB (Richardson et al. 1995) for continuous sound sources and would result in a minor disturbance of marine mammals. Cetacean reactions to overflights would consist of brief behavioral responses such as sudden diving or turning away from sound or visual source or no response (Richardson et al. 1995). Long-term aerial studies of beluga whales in Cook Inlet show no change in swim direction or reaction during overflights (Rugh et al., 2000). Pinnipeds would most likely be affected by low flying aircraft if they were hauled out on land or ice and would react by diving into water, however there are no known haul outs within several miles of the Mainline. Any effects on marine mammals would be minor, consisting of brief behavioral responses and affecting few individuals, and short term, lasting only minutes after the aircraft has passed.

Vessel activity during maintenance of marine sections of the Mainline would have minor short-term effects on marine mammals due to noise-generating in-water work and the low risk of entanglement with equipment or anchors. There would be minor impacts to habitat and other marine species from placement of equipment or movement of pipeline on ocean floor causing short-term increases in turbidity. Behavioral responses of marine mammals would include diving or turning away from vessel and equipment.

Wildlife

Operation of the Mainline could affect large mammals primarily through noise from aboveground facilities and disturbance during monitoring, inspections, vegetation maintenance, and repair and revegetation activities associated with control of erosion. Most large mammals in Alaska are already exposed to human disturbance from hunting and other human activities. The areas of wildlife habitats potentially affected within the ROW during operation of the Mainline are listed in Table 3.4.10-5. Potential vegetation clearing impacts would be similar to those discussed under Mainline construction, but would occur over a much smaller area, potentially within sensitive habitats, and at intervals of no less than four years.

Traffic (Land and Air)

Potential injury or mortality and disturbance impacts associated with ground or air traffic would be much less than during construction. Potential disturbance would be reduced and, for ground traffic, would be associated with aboveground facilities discussed subsequently.

Sensitive Wildlife Habitat Areas

The sensitive wildlife habitats crossed by the Mainline are listed in Section 3.4.9 and include three BLM ACECs (Table 3.4.9-1), one state park and two state game refuges (Table 3.4.9-3), and three IBAs (Table 3.4.9-4). It is also located within approximately 0.2 mile of DNPP (Table 3.4.9-2). Wildlife in these areas would be affected by disturbances during operation and maintenance of the Mainline. Impacts to wildlife would be minor, short term, and limited to the ROW areas. Potential impacts would include increased mortality due to collisions with vehicle and aircraft during monitoring, maintenance, and inspections and increased hunting pressure from humans and predators due to new access roads and the cleared ROW.

Alaska Game Management Areas

The Project crosses through eight of 26 GMUs, including portions of 12 Subunits. Operation of the Mainline would be unlikely to interfere with game or game management within these units, although there would be an increased potential for moose and muskoxen vehicle collisions and bear-human interactions.

3.4.11.2.1.2 PBTL and PTTL

Operation of the PBTL and PTTL are unlikely to affect wildlife. These pipelines would be installed above ground. PTTL would be collocated with existing pipelines for most of its length. PBTL is less than 1 mile long. Potential effects on wildlife would therefore be greatly reduced. Habitats that would be affected during operations are listed in Table 3.4.10-20. Potential disturbance during pipeline monitoring could occur from aircraft overflights, as discussed previously, under Construction in sections 3.4.10.2.1.1 and 3.4.10.2.1.2. Because landings and take-off would create the most disturbance, and these would occur at aboveground facilities (helipads at block valves), potential disturbance to sensitive wildlife habitat areas are discussed subsequently.

Sensitive Wildlife Habitat Areas

The PTTL crosses three sections of the Beaufort Sea Nearshore IBA, which is discussed in detail in Sections 3.4.6 and 3.4. 9. Potential operational impacts would include increased disturbances to local wildlife from operations related aircraft overflights and mortality due to collisions with vehicle and aircraft during monitoring, maintenance, and inspections.

Alaska Game Management Areas

The PBTL and PTTL would be operated within GMU 26B. Operation of these pipelines would be unlikely to interfere with game management within these units, though there would be an increased potential for caribou and muskoxen disturbance and bear-human interactions during pipeline inspections and maintenance activities.

3.4.11.2.1.3 Pipeline Aboveground Facilities

Wildlife habitat impacts from Mainline and PTTL aboveground facilities during operations are listed in Tables 3.4.10-5 and 3.4.10-20. Sounds generated by equipment at Mainline compressor and heater stations would generally be continuous and could affect wildlife primarily though interference with hearing important survival or reproductive cues, which could result in reduced survival and productivity of wildlife in the vicinity of these stations. There are no compressor or heater stations associated with PBTL or the PTTL. Initial modeling results indicates that during operations, the stations would only result in a minor increase in sound levels (see Resource Report No. 9). Investigations regarding the level of ensonification at the compressor stations is ongoing.

Marine Mammals

Sounds from compressor or heater stations would not affect marine mammals. The closest the compressor or heater station to marine waters would be the Theodore River Heater Station, which is approximately 8 miles, too far for sound to affect marine mammals.

Large Mammals

Sounds from equipment during operations could affect large mammal habitats that occur within 1 mile of compressor and heater stations by raising ambient sound levels, which degrades the quality of the habitat (Table 3.4.11-2).

TABLE 3.4.11-2

Wildlife Habitats within 1 mile of Pipeline Compressor and Heater Stations (acres)

MP	Camp	Brown Bear			Caribou				Dall Sheep		Moose				Muskoxen		
		General	Berry	Spring	General	Calving	Winter	Insect	General	Winter	General	Calving	Rutting	Winter	Spring/ Caving	Summer	Fall/Winter
MAINLINE																	
76.0	Sagwon CS	2,627	-	-	2,627	-	2,627	-	-	-	549	-	-	2,079	8	18	2,627
148.5	Galbraith Lake CS	2,627	-	-	2,627	-	2,627	-	1,291	1,291	1,822	-	-	-	-	-	-
240.1	Coldfoot CS	2,627	775	775	-	-	2,627	-	425	-	2,627	-	-	-	-	-	-
332.6	Ray River CCS	2,627	-	-	-	-	-	-	-	-	2,627	-	-	-	-	-	-
421.6	Minto CS	2,627	-	-	-	-	-	-	-	-	2,627	-	-	-	-	-	-
517.6	Healy CS	2,627	-	-	-	-	2,627	-	-	-	598	783	2,029	2,029	-	-	-
597.4	Honolulu Creek CS	-	-	-	-	-	-	-	-	-	693	-	-	1,830	-	-	-
675.2	Rabideux Creek CS	-	-	-	-	-	-	-	-	-	208	-	-	2,420	-	-	-
749.1	Theodore River Heater Station	-	-	-	-	-	-	-	-	-	2,523	-	-	-	-	-	-
	Mainline Total Acres	**15,764**	**775**	**775**	**5,255**	**-**	**10,510**	**-**	**1,716**	**1,291**	**14,275**	**783**	**2,029**	**8,358**	**8**	**18**	**2,627**

Source: ADF&G, 1985, 1986a, b; Lenart, 2015: ADF&G unpublished data.

Birds

Sounds from equipment could affect sensitive waterfowl habitats that occur within 1 mile of compressor and heaters stations by raising ambient sound levels which degrade the quality of the habitat (Table 3.4.11-3).

TABLE 3.4.11-3

Waterfowl Habitats within 1 mile of Pipeline Compressor and Heater Stations (acres)

MP	Camp	Trumpeter Swans – General	Trumpeter Swans – Spring/ Fall	Trumpeter Swans – Nesting	Waterfowl – Ducks and Geese – General	Waterfowl – Ducks and Geese – Nesting	Waterfowl – Ducks and Geese – Spring
MAINLINE							
76.0	Sagwon Compressor Station	-	-	-	1,896	-	1,896
148.0	Galbraith Lake Compressor Station	-	-	-	-	-	-
240.0	Coldfoot Compressor Station	-	-	-	-	-	-
332.7	Ray River Compressor Station	-	-	-	-	-	-
421.6	Minto Compressor Station	-	-	-	-	-	-
517.6	Healy Compressor Station	-	-	-	343	-	-
597.2	Honolulu Creek Compressor Station	-	-	-	1,575	-	-
675.1	Rabideux Creek Compressor Station	2,386	-	241	2,627	-	-
749.0	Theodore River Heater Station	-	-	39	193	-	-
	Mainline Total Acres	**2,386**	**-**	**280**	**6,634**	**-**	**1,896**

Source: ADF&G, 1985, 1986a, b.

Amphibians

Potential wood frog habitats within 1 mile of compressor and heater stations and documented wood frog occurrences within the range of the stations are listed in Table 3.4.11-4. Periodic vegetation clearing would be required around compressor and heater stations to prevent potential fires from spreading to surrounding habitats. Potential vegetation clearing impacts on wood frogs would have similar impacts as described for construction, but would be on a much smaller scale. Noise from the compressor and heater stations could interfere with wood frog calling. There are no records of wood frogs within 1 mile of the compressor or heater stations (AKNHP, 2014a).

TABLE 3.4.11-4

Wood Frog Habitats within 1 Mile of Pipeline Compressor and Heater Stations (acres)

MP	Camp	Wetlands			Wood Frog Records
		Aquatic Bed	Pond	Total	
MAINLINE					
76.0	Sagwon Compressor Station		0.00	0.00	-
148.0	Galbraith Lake Compressor Station		36.52	36.52	-
240.0	Coldfoot Compressor Station		0.00	0.00	-
332.7	Ray River Compressor Station		0.00	0.00	-
421.6	Minto Compressor Station		0.00	0.00	-
517.6	Healy Compressor Station`		2.49	2.49	-
597.2	Honolulu Creek Compressor Station	2.32	5.65	5.65	-
675.1	Rabideux Creek Compressor Station		33.25	33.25	-
749.0	Theodore River Heater Station		0.00	0.00	-
	Mainline Total Acres		**77.91**	**77.91**	-

Source: AKNHP, 2014a; USFWS, 2015c.

Terrestrial and Aquatic Invertebrates

Operations of the Pipeline Aboveground Facilities would have minimal impact on terrestrial and aquatic invertebrates as there would be little traffic during operations. Water and wastewater would be primarily from groundwater sources. Wastewater would be treated and meet applicable standards prior to discharge. Periodic vegetation clearing would be required around compressor and heater stations to prevent potential fires from spreading to surrounding habitats. Potential vegetation clearing impacts on invertebrates would have similar impacts as described for construction, but would be on a much smaller scale.

Traffic (Land and Air)

Traffic associated with movement of personnel to compressor or heater stations would primarily be by ground. Pipeline and MLBV inspections would likely be accessed by helicopter. Helicopter landing and departure from helipads at the MLBVs and the helipads at compressor or heater stations could cause short-term disturbance and distraction to wildlife. No marine mammals would be disturbed by air traffic for pipeline inspections.

Marine Mammals

Aircraft completing pipeline monitoring would go up to a minimum altitude of at least 1,500 feet above sea level when crossing Cook Inlet, except for landing and takeoffs. At altitudes of 1,500 feet or more, aircraft overflights generally result in received sound levels at the water surface that are below the NMFS threshold value of 120 dB for continuous sound sources (Richardson et al. 1995). Overflights at these altitudes would result in little if any disturbance of marine mammals due to either acoustical or visual cues. The Applicant does not anticipate using helicopters for movement of crew or operations over open marine waters. Any resulting disturbance effects would be minor and short term consisting only of brief behavioral responses such as diving.

Large Mammals

Helicopter landing and takeoff could cause short-term disturbance and distraction to large mammals. Distraction during sensitive periods could lead to increased predation risk or displacement from sensitive habitats. Sensitive habitats located within 1 mile of compressor or heater stations have been discussed previously (Section 3.4.11.2.1.3). Sensitive habitats within 1 mile of MLBVs and PTTL block valves are listed in Table 3.4.11-5.

TABLE 3.4.11-5

Wildlife Habitats within 1 Mile of Mainline Block Valves (acres)

MP	MLBVs	Brown Bear			Caribou				Dall Sheep		Moose				Muskoxen		
		General	Berry	Spring	General	Calving	Winter	Insect	General	Winter	General	Calving	Rutting	Winter	Spring/ Caving	Summer	Fall/ Winter
MAINLINE																	
36.7	MLBV 2	2,143	-	-	2,143	-	2,143	-	-	-	2,143	-	-	-	-	2,143	-
112.0	MLBV 4	2,143	-	-	2,143	-	2,143	-	-	-	511	-	-	1,632	2,143	2,143	2,143
194.1	MLBV 6	2,143	1,636	1,636	-	-	2,143	-	2,143	-	2,143	-	-	-	-	-	-
286.1	MLBV 8	2,143	-	-	-	-	2,143	-	-	-	2,143	-	-	-	-	-	-
377.9	MLBV 10	2,143	-	-	-	-	-	-	-	-	-	-	-	2,143	-	-	-
444.9	MLBV 12	2,047	-	-	-	-	-	-	-	-	-	112	112	2,047	-	-	-
467.1	MLBV 13	2,143	-	-	-	-	-	-	-	-	449	1,695	1,695	1,695	-	-	-
493.0	MLBV 14	2,047	-	-	-	-	729	-	-	-	2,047	-	-	-	-	-	-
534.8	MLBV 16	2,047	-	2,007	2,047	-	-	-	116	-	-	2,047	2,047	2,047	-	-	-
538.8	MLBV 17	2,047	-	259	2,047	-	-	-	-	-	-	2,047	2,047	2,047	-	-	-
546.5	MLBV 18	2,143	-	-	2,143	-	-	-	-	-	-	2,143	2,143	2,143	-	-	-
572.2	MLBV 19	-	-	-	-	-	-	-	-	-	1,996	-	50	-	-	-	-
625.8	MLBV 21	-	-	-	-	-	-	-	-	-	-	-	2,047	2,047	-	-	-
648.2	MLBV 22	-	-	-	-	-	-	-	-	-	2,143	-	-	-	-	-	-
703.7	MLBV 24	-	-	-	-	-	-	-	-	-	1,344	-	-	799	-	-	-
725.9	MLBV 25	-	-	-	-	-	-	-	-	-	-	2,025	-	2,047	-	-	-
766.0	MLBV 27	-	-	-	-	-	-	-	-	-	1,328	-	-	-	-	-	-
793.3	MLBV 28	-	-	-	-	-	-	-	-	-	1,324	-	-	-	-	-	-
799.9	MLBV 29	-	-	-	-	-	-	-	-	-	1,270	-	-	-	-	-	-
Mainline Total Acres		**23,191**	**1,636**	**3,902**	**10,524**	**-**	**9,302**	**-**	**2,259**	**-**	**18,842**	**10,069**	**10,141**	**18,647**	**2,143**	**4,286**	**2,143**
PTTL																	
18.9	MLBV	2,047	-	-	2,047	-	2,047	2,047	-	-	2,047	-	-	-	-	-	-
35.0	MLBV	2,047	-	-	2,047	-	2,047	2,047	-	-	2,047	-	-	-	-	-	-
51.7	MLBV	2,047	-	-	2,047	-	2,047	-	-	-	2,047	-	-	-	2,047	-	2,047

TABLE 3.4.11-5

Wildlife Habitats within 1 Mile of Mainline Block Valves (acres)

MP	MLBVs	Brown Bear			Caribou				Dall Sheep		Moose				Muskoxen		
		General	Berry	Spring	General	Calving	Winter	Insect	General	Winter	General	Calving	Rutting	Winter	Spring/ Caving	Summer	Fall/ Winter
PTTL Total Acres		**6,141**	**-**	**-**	**6,141**	**6,141**	**6,141**	**4,094**	**-**	**-**	**6,141**	**-**	**-**	**-**	**2,047**	**-**	**2,047**

Source: ADF&G, 1985, 1986a, b; Lenart, 2015: ADF&G unpublished data.

Birds

Sensitive waterfowl habitats within 1 mile of MLBVs are listed in Table 3.4.11-6.

TABLE 3.4.11-6

Waterfowl Habitats within 1 Mile of Mainline Block Valves (acres)

MP	MLBVs	Trumpeter Swan		Waterfowl – Ducks and Geese		
		General	Nesting	General	Nesting	Spring
MAINLINE						
36.7	MLBV 2	-	-	2,143	177	-
112.0	MLBV 4	-	-	893	-	-
286.1	MLBV 8	-	-	-	--	--
444.9	MLBV 12	-	-	--	1	1
467.1	MLBV 13	-	-	--	-	-
534.8	MLBV 16	-	-	--	--	--
538.8	MLBV 17	-	-	-	--	--
546.5	MLBV 18	-	-	-	-	-
572.2	MLBV 19	1,943	-	-	--	--
625.8	MLBV 21	2,047	-	-	-	-
648.2	MLBV 22	2,143	-	-	-	-
703.7	MLBV 24	-	2,143	2,143	-	-
725.9	MLBV 25	-	2,047	362	-	-
766.0	MLBV 27	1,315	29	2,047	-	-
793.3	MLBV 28	-	1,322	725	1,322	1,322
799.9	MLBV 29	1,261	-	785	1,262	1,262
	Mainline Total Acres	**8,010**	**5,541**	**21,167**	**2,761**	**2,584**
PTTL						
18.9	MLBV MP18.9	-	-	-	2,047	-
35.0	MLBV MP35	-	-	-	2,047	2,047
51.7	MLBV MP51.7	-	-	-	2,047	2,047
	PTTL Total Acres	**-**	**-**	**-**	**6,141**	**4,094**

Source: ADF&G, 1985, 1986a, b; Lenart, 2015: ADF&G unpublished data.

Amphibians, Terrestrial and Aquatic Invertebrates

Traffic associated with operation and maintenance of these facilities would be at a much lower level than during construction and would not be expected to affect wood frogs or terrestrial or aquatic invertebrates.

Human Interaction

Potential for human-wildlife interactions during operations would be greatest for manned stations. Most stations would be remotely operated; therefore, this potential would be reduced. Interactions with wildlife, as described in previous sections, could occur during pipeline monitoring and maintenance activities and would be avoided and reduced through measures described in Appendix J.

Spills

Potential fuel and hazardous material spill impacts to wildlife are discussed in Section 3.4.10.1.10. The impacts of hydrocarbons are caused by either the physical nature of the oil (physical contamination and smothering) or by its chemical components (toxic effects and bioaccumulation). To reduce the potential for accidental releases of hazardous materials, a Project-specific *SPCC Plan* (Appendix M of Resource Report No. 2) for the construction phase has been prepared.

Spills or leaks of natural gas from natural gas pipelines aboveground facilities would not be expected to affect wildlife. The worst outcome of a pipeline failure would be a major rupture that results in a fire or explosion and may lead to injury or death of wildlife in the vicinity. However, methane, the primary component of natural gas, has an ignition temperature of about 1,000 ºF and is flammable at concentrations between 5–15 percent in air. Unconfined mixtures of methane in air are not generally explosive while confined releases can be. See Resource Report No. 11 for further details on hazards of natural gas leaks and Historical Incident Data from the U.S. Department of Transportation for information regarding natural gas incidents.

Waste

Potential for waste disposal habitat and wildlife impacts are discussed in Section 3.4.10.1.11. Remote operations of most pipeline-related facilities would reduce the potential for waste generation at Pipeline Aboveground Facilities. Waste management procedures are described in Appendix J in Resource Report No. 8.

Sensitive Wildlife Habitat Areas

See prior discussions under Construction of Pipeline Aboveground Facilities.

Alaska Game Management Areas

The Project would cross through eight of the 26 GMUs, including portions of 12 Subunits. The operations footprint represents an extremely small portion of any of the traversed GMUs. Operation of the Mainline would be unlikely to interfere with game management within these units, which consist largely of harvest regulation and enforcement, check stations, self-reporting of harvests, aerial game surveys, and sometimes tagging/collaring of game animals. Existence of the buried Mainline and primary operations activities such as vegetation management, pipeline surveillance, operation and maintenance of the pipeline, and compressor and meter stations would be unlikely to conflict with any known game management activities.

3.4.11.2.2 GTP and Associated Infrastructure

Wildlife habitats that would be affected during operation of the GTP are listed in Table 3.4.10-22. Operation of the GTP would result in equipment sounds and vehicle traffic. The GTP would be located near the CGF, which also generates sound during operations. West Dock would not be used during operation of the GTP.

Marine Mammals

Non-ESA marine mammals would not be affected by operation of the GTP. The distance of the GTP to marine waters would significantly reduce the potential for any impacts to marine mammals caused by anthropogenic disturbances. There are no spotted seal haulouts near the GTP and operation would not require vessel traffic.

Wildlife

Large mammal habitats near the GTP include caribou insect-relief habitat (ADF&G, 1986a), where caribou gather annually due to lower levels of biting insects in the area. Impacts to caribou seeking refuge from insects and other wildlife include being displaced from the GTP vicinity in the Prudhoe Bay Oilfield due to sound and activity. Measures in Appendix J would be implemented to avoid and reduce potential impacts to wildlife.

Birds

During poor weather and visibility conditions, low-flying birds could collide with GTP modules, buildings, and communication towers. The Waste Heat Recovery Units and Stacks would be about 240 feet tall, and would likely be the tallest structures at the GTP. The potential for bird collisions with the GTP may be reduced because of its inland location as eiders typically migrate over water along shorelines (Day et al., 2005). Facility modules would range from about 25 to 180 feet high. These structures would be visible to birds under normal conditions. Communication towers or overhead power lines have an increased collision risk because of their reduced visibility. The communication tower at the GTP would be about 150 feet tall. Power would be provided onsite at the GTP and no overhead power lines would be used. Most collisions would be expected during periods of poor visibility, such as fog or low clouds, during fall migration. Outdoor lighting can attract birds to facilities, especially during periods of low visibility, potentially increasing collision risk. Communications towers designed without guy wires would reduce their collision risk to birds. Lighting directed only where needed and use of downward shielded light fixtures would reduce potential attraction of birds to the facility during periods of impaired visibility.

Facilities, communication towers, and elevated pipelines provide nesting and vantage perches for raptors, common ravens, and glaucous gulls that are not otherwise available across the Beaufort Coastal Plain Ecoregion (USFWS, 2003). Facilities can also provide artificial den sites, thermal refuges, and access to human food for Arctic and red foxes (Burgess et al., 2014). Effective waste management at facilities would reduce the attraction of foxes, bears, ravens, and gulls to facilities. Bird deterrence structures (bird spikes, etc.) would be implemented to limit raven nesting on facilities. Predators attracted to the GTP could increase predation risk for nesting birds.

Waterfowl habitats near the GTP include duck and goose nesting concentrations (ADF&G, 1986a). Operation of the facility would generate noise above ambient levels. Studies of responses of waterbirds to noise generated at the nearby Gas Handling Expansion Phase 1 (GHX-1) facility found the turbines generated low frequency (31.5 Hz and 63 Hz) sounds and increased industrial sounds in the area by about 2.7 dBA, depending on winds. The CGF, east of the GTP, contributed to the ambient noise levels in this region that were on the order of 52 dBA prior to operation of the GHX-1 (Anderson et al., 1992). The additional sound generated by the GTP would contribute to further increase industrial noise in the area and could result in additional displacement of birds in the vicinity of the GTP.

Snow management during operations would create snow piles on the edges of the pads, where it would not disturb nesting birds on the tundra. The area north of the GTP pad provides basin habitat that may be suitable for eider nesting. Snow piled in the lake basin could reduce the quality of this habitat for spectacled eiders, although spectacled eiders are not expected to nest close to granular pads.

The flare stacks for the GTP would be located on a granular pad that would extend into a basin wetland complex that has been used by nesting waterbirds. Waterbirds using this basin complex could be at an increased risk for collision with the flare stacks. The height of the flare would generally preclude an incineration hazard for nesting birds. The bright light emitted during flare events may attract migrating eiders, and could present a collision and incineration hazard for migrating eiders; although, most eiders would be expected to migrate offshore and at mean altitudes well below the flare height (Day et al., 2015). The flare stacks would be equipped with aviation obstruction lighting.

Terrestrial and Aquatic Invertebrates

Operation of the GTP and associated infrastructure could affect aquatic invertebrates through snow management and annual water withdrawal to refill the GTP reservoir from the Putuligayuk River, as discussed in Section 3.2.8.

Traffic (Land and Air)

Vehicle traffic for movement of personnel and transport of materials and supplies during operations would be reduced substantially from construction traffic levels. Some potential disturbance would continue to occur that may reduce habitat suitability near the GTP. Wildlife injuries or mortalities could occur due to vehicle collisions with birds, small mammals such as ground squirrels and red and Arctic foxes, and large mammals such as caribou or brown bears. The probability of such collisions would be very low. The traffic would be within a developed oil field. Roads are generally higher than the surrounding lands and tundra vegetation is short providing high visibility. PBU traffic and wildlife interactions rules would further reduce the chance of wildlife-vehicle collisions. Speed limits are low (<35 miles per hour) and wildlife is given the ROW. If wildlife is observed vehicles must stop and remain stopped until wildlife exits the roadway. Given these mitigation measures, vehicle-animal collisions would be rare events, if they occurred at all, and would affect few individual animals with no measurable effect on regional populations. Any such effects would be minor and short term.

Human Interaction

Activity would be reduced from construction and fewer interactions would be expected with wildlife during operations. Measures in Appendix J would be implemented to avoid and reduce potential impacts to wildlife.

Spills

Potential effects of spills on wildlife are discussed in Section 3.4.10.1.10.

Waste

Waste during operations would be reduced from construction. Potential effects of waste are discussed in Section 3.4.10.1.11. Measures in Appendix J of Resource Report No. 8 would be implemented to avoid and reduce potential impacts to wildlife.

Sensitive Wildlife Habitat Areas

The GTP and associated infrastructure would be located within the Prudhoe Bay Oilfield. Sensitive wildlife habitats within this region include the Beaufort Sea Nearshore Global IBA.

Alaska Game Management Areas

The GTP and associated infrastructure would be located within GMU 26B. Operation of the GTP would be unlikely to interfere with game or game management within this unit; although, there would be an increased potential for vehicle collisions and human interactions with brown bears, caribou, and muskoxen. This area is generally closed to hunting.

3.5 THREATENED, ENDANGERED, AND SPECIAL-STATUS SPECIES

3.5.1 Federally Listed Threatened and Endangered Species

Section 3 of the ESA establishes two categories of protected species: endangered species and threatened species. An endangered species is any species that is in danger of extinction throughout all or a significant portion of its range. A threatened species is any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. A candidate species is any species that is undergoing a status review that has been announced in a Federal Register, but has not yet been finally listed. A proposed species is a species that was found to warrant listing as either threatened or endangered and was officially proposed as such in a Federal Register notice after the completion of a status review and consideration of other protective conservation measures. Critical habitat for threatened and endangered species is a specific geographic area(s) that contains features essential for the conservation of a threatened or endangered species and that may require special management and protection. Listed species are under the jurisdiction and management of either the USFWS or NMFS according to a memorandum of understanding between the two Services. In general, NMFS manages marine species and USFWS manages freshwater and terrestrial species; however, in Alaska, NMFS manages the listed fish, sea turtles, pinnipeds (seals and sea lions except walrus), and cetaceans (whales and porpoises), and USFWS manages birds, land mammals, northern sea otter, Pacific walrus, and polar bear.

FERC is expected to be the lead agency for consultation with NMFS and USFWS on the potential effects of the Project on ESA-listed species. Other federal agencies with authority over the Project are expected to act as cooperating agencies in this consultation and to be covered by any eventual biological opinion issued by NMFS and USFWS.

The ESA and its implementing regulations obligate federal agencies to consult with NMFS and/or USFWS to ensure that actions they authorize, fund or carry out that "may affect" ESA-listed species or designated critical habitat are not likely to jeopardize the continued existence of such species or result in the destruction or adverse modification of critical habitat. Consultation is initiated by the federal action agency when it determines that an action it is considering may affect a threatened or endangered species or its designated critical habitat. Consultation may be either informal or formal. Informal consultation is less structured and results in a letter of concurrence if the result of consultation is a no-effect determination. If it is determined that the action is likely to adversely affect listed species or critical habitat, formal consultation must be undertaken, which the action agency initiates by preparing and submitting a biological assessment. After formal consultation, NMFS and/or USFWS prepare a biological opinion which analyzes the anticipated effects of the proposed action. If NMFS and/or USFWS determine that the federal action is consistent with the requirements of the ESA, it will also issue an incidental take statement which specifies the impact of any incidental take and includes reasonable and prudent measures and terms and conditions to reduce the impact of such incidental take.

Section 7(a)(4) of the ESA requires federal agencies to confer with NMFS and/or USFWS on any action which is likely to jeopardize the continued existence of a species proposed for listing or result in the destruction or adverse modification of critical habitat that is proposed for designation. The results of a conference are presented by NMFS and/or USFWS in a conference opinion, which may be adopted as a biological opinion when/if a final listing rule or critical habitat designation rule is implemented.

Thirty federally listed species, Distinct Population Segments (DPSs), or Evolutionarily Significant Units (ESUs), one candidate for listing, and two previously listed species were identified by the Services as potentially occurring in the action area (NMFS, 2015e; USFWS, 2014a). Candidate species are taxa for which NMFS or USFWS has sufficient information on biological vulnerability and threat(s) to support issuance of a proposal to list, but issuance of a proposed rule is currently precluded by higher priority listing actions (61 FR 7596-7613). The listing decisions for the ringed seal and bearded seal have been vacated (see footnotes to Table 3.5.1-1); therefore, these species are discussed under non-ESA-listed species sections. The Pacific walrus as a candidate species, is also discussed with the other non-ESA-listed species. Table 3.5.1-1 summarizes the remaining species, their ranges, and seasonal occurrence. The Project *BA*, included as Appendix C, addresses 31 federally listed species, DPSs, and ESUs that potentially occur in the action area (NMFS, 2015e; USFWS, 2014a). Activities associated with the Project could potentially affect 12 listed marine mammals (bowhead whale, blue whale, fin whale, gray whale, humpback whale, North Pacific right whale, sei whale, sperm whale, Cook Inlet beluga whale, Steller sea lion, northern sea otter, and polar bear), and two listed seaducks (spectacled eider and Steller's eider). Wood bison have been classified as experimental, nonessential populations in Alaska and are managed under special rules that are less restrictive with respect to "takings."

TABLE 3.5.1-1

Federally Listed Threatened and Endangered Species Potentially Occurring in the Project Area

Common Name	Scientific Name	Project Component	Seasonal Presence in Project Area	Range in Alaska and Habitat	Status	Critical Habitat Proposed or Designated
MARINE MAMMALS – NMFS [1,2]						
Beluga Whale, Cook Inlet	*Delphinapterus leucas*	Marine Terminal, Mainline	Year-round, spring to fall in upper inlet	Cook Inlet; associated with salmon runs, river deltas	Endangered	Designated
Blue Whale	*Balaenoptera musculus*	Sealifts to Prudhoe Bay; LNG Terminal	July–October	Gulf of Alaska, Bering Sea; pelagic	Endangered	None
Bowhead Whale	*Balaena mysticetus*	GTP	May–October	Chukchi and Beaufort Seas; shelf waters	Endangered	None
Fin Whale	*Balaenoptera physalus*	Sealifts to Prudhoe Bay; LNG Terminal	July–October	Gulf of Alaska, Bering and Chukchi seas; pelagic	Endangered	None
Gray whale, Western North Pacific DPS	*Eschrichtius robustus*	Sealifts to Prudhoe Bay; LNG Terminal	July–October	Gulf of Alaska, Bering, Chukchi, and Beaufort seas; coastal shelf waters	Threatened	None
Humpback Whale, Western Pacific and Mexico DPS	*Megaptera novaeangliae*	Sealifts to Prudhoe Bay; LNG Terminal	July–October	Gulf of Alaska, Bering Sea; pelagic and coastal	Proposed Threatened	None
North Pacific Right Whale	*Eubalaena japonica*	Sealifts to Prudhoe Bay; LNG Terminal	July–October	Gulf of Alaska, Bering Sea; pelagic	Endangered	Designated
Ringed Seal, Arctic subspecies	*Pusa (Phoca) hispida*	GTP, Sealifts to Prudhoe Bay	Year-round, mostly winter and spring	Bering, Chukchi and Beaufort seas; shelf waters, ice–associated	None [1]	Proposed
Bearded Seal, Beringia DPS	*Erignathus barbatus*	GTP, Sealifts to Prudhoe Bay	May–October (some year-round)	Bering, Chukchi and Beaufort seas; shelf waters, ice–associated	None [2]	None
Sei Whale	*Balaenoptera borealis*	LNG Terminal	July–October	Gulf of Alaska; pelagic	Endangered	None
Sperm Whale	*Physeter macrocephalus*	LNG Terminal	July–October	Gulf of Alaska, Bering Sea; pelagic	Endangered	None
Steller Sea Lion, Western DPS	*Eumetopias jubatus*	Marine Terminal	Year-round; summer in Bering Sea	Gulf of Alaska, Cook Inlet, Bering Sea; coastal	Endangered	Designated
MARINE MAMMALS – USFWS						
Northern Sea Otter, Southwest Alaska DPS	*Enhydra lutris kenyoni*	Marine Terminal	Year-round	Gulf of Alaska, Cook Inlet; coastal	Threatened	Designated

TABLE 3.5.1-1

Federally Listed Threatened and Endangered Species Potentially Occurring in the Project Area

Common Name	Scientific Name	Project Component	Seasonal Presence in Project Area	Range in Alaska and Habitat	Status	Critical Habitat Proposed or Designated
Pacific Walrus	*Odobenus rosmarus divergens*	GTP	July–October	Bering, Chukchi, and Beaufort seas; shelf and coastal, ice–associated	Candidate	None
Polar Bear	*Ursus maritimus*	Mainline, GTP, PBTL, PTTL	Year-round, mostly winter and spring	Beaufort Sea, Beaufort Coastal Plain Ecoregion; land, nearshore, sea ice	Threatened	Designated
Terrestrial Mammals – USFWS						
Wood Bison	*Bison athabascae*	Mainline	Year-round	Minto Flats, Yukon Flats	Threatened - NEP	None
Birds – USFWS						
Eskimo Curlew	*Numenius borealis*	Mainline	May–October	Considered extirpated	Endangered	None
Short-tailed Albatross	*Phoebastria albatrus*	Sealifts to Prudhoe; LNG Terminal	July–October	Gulf of Alaska, Bering Sea; pelagic	Endangered	None
Steller's Eider, Alaska-breeding population	*Polysticta stelleri*	Marine Terminal, Mainline, GTP, PBTL, PTTL	May–October September–April	Beaufort Coastal Plain Ecoregion, coastal Chukchi and Beaufort Sea waters nesting and migration, coastal Cook Inlet waters in winter	Threatened	Designated
Spectacled Eider	*Somateria fischeri*	Mainline, GTP, PBTL, PTTL	May–October	Beaufort Coastal Plain Ecoregion, coastal Chukchi and Beaufort Sea waters nesting and migration	Threatened	Designated
Fish – NMFS						
Chinook Salmon ESUs	*Onchorhynchus tshawytscha*					
	Lower Columbia River Spring [3]	LNG Terminal - vessel traffic	Year-round	Gulf of Alaska; coastal and pelagic	Threatened	Designated
	Upper Columbia River Spring [3]	LNG Terminal - vessel traffic	Year-round	Gulf of Alaska; coastal and pelagic	Endangered	Designated
	Puget Sound [3]	LNG Terminal - vessel traffic	Year-round	Gulf of Alaska; coastal and pelagic	Threatened	Designated
	Snake River Fall*	LNG Terminal - vessel traffic	Year-round	Gulf of Alaska; coastal and pelagic	Threatened	Designated
	Snake River Spring/Fall [3]	LNG Terminal - vessel traffic	Year-round	Gulf of Alaska; coastal and pelagic	Threatened	Designated
	Upper Willamette River[3]	LNG Terminal - vessel traffic	Year-round	Gulf of Alaska; coastal and pelagic	Threatened	Designated

TABLE 3.5.1-1

Federally Listed Threatened and Endangered Species Potentially Occurring in the Project Area

Common Name	Scientific Name	Project Component	Seasonal Presence in Project Area	Range in Alaska and Habitat	Status	Critical Habitat Proposed or Designated
Steelhead Trout DPSs	*Oncorhynchus mykiss*					
	Lower Columbia River [3]	LNG Terminal - vessel traffic	Year-round	Gulf of Alaska; coastal and pelagic	Threatened	Designated
	Middle Columbia River [3]	LNG Terminal - vessel traffic	Year-round	Gulf of Alaska; coastal and pelagic	Threatened	Designated
	Upper Columbia River [3]	LNG Terminal - vessel traffic	Year-round	Gulf of Alaska; coastal and pelagic	Endangered	Designated
	Puget Sound [3]	LNG Terminal - vessel traffic	Year-round	Gulf of Alaska; coastal and pelagic	Threatened	Designated
	Snake River Basin [3]	LNG Terminal - vessel traffic	Year-round	Gulf of Alaska; coastal and pelagic	Threatened	Designated
	Upper Willamette River [3]	LNG Terminal - vessel traffic	Year-round	Gulf of Alaska; coastal and pelagic	Threatened	Designated

Sources: NMFS, 2015e; USFWS, 2014a

[1] Ringed seal not included. On March 11, 2016, the U.S. District Court for the District of Alaska issued a memorandum decision in a lawsuit challenging the listing of ringed seals under the ESA (Alaska Oil and Gas Association v. National Marine Fisheries Service et al., Case No. 4:14-cv-00029-RRB; North Slope Borough v. Pritzker et al., Case No. 4:15-cv-0000w-RRB; and State of Alaska v. National Marine Fisheries Service et al., Case No. 4:15-cv-00005-RRB). The consolidated decision vacated NMFS's listing of the Arctic ringed seal as a threatened species.

[2] Bearded seal not included. On March 11, 2016, the U.S. District Court for the District of Alaska issued a memorandum decision in a lawsuit challenging the listing of ringed seals under the ESA (Alaska Oil and Gas Association v. National Marine Fisheries Service et al., Case No. 4:14-cv-00029-RRB; North Slope Borough v. Pritzker et al., Case No. 4:15-cv-0000w-RRB; and State of Alaska v. National Marine Fisheries Service et al., Case No. 4:15-cv-00005-RRB). The consolidated decision vacated NMFS's listing of the Arctic ringed seal as a threatened species.

[3] These fish/stocks (ESUs/DPSs) spawn on the West Coast outside of Alaska, but may occur in Lower Cook Inlet, Gulf of Alaska, Aleutian Island, Bering Sea waters during the marine phase of their life cycle.

3.5.1.1 Liquefaction Facility

ESA-listed marine mammals, birds, and fish that occur in Cook Inlet near the Liquefaction Facility and Marine Terminal include: Cook Inlet beluga whales, Steller sea lion, and northern sea otter (Table 3.5.1-1). These listed animals are described in the following sections, with additional information on occurrence in in the vicinity of Project facilities provided at the end of each description. In addition, marine vessel traffic associated with the Liquefaction Facility would occur within areas of the Gulf of Alaska potentially used by blue whales, fin whales, gray whales, humpback whales, north Pacific right whales, sei whales, sperm whales, short-tailed albatross, Steller's eider, and stocks of listed Pacific salmon and steelhead. These listed animals are described in the following sections, with additional information on occurrence in association with proposed Project facilities provided at the end of each description.

3.5.1.1.1 Blue Whale

Blue whales (*Balaenoptera musculus*) have a mottled gray color pattern, which appears light blue in water, a smaller dorsal fin and a broad, flat rostrum (NMFS, 2015a). North Pacific blue whales are approximately 90 feet long; females are slightly larger than males (NMFS, 2015a). They are sexually mature at 5 to 15 years of age, and breed and give birth primarily in winter (NMFS, 2015a). Females have a single calf every 2 to 3 years in southern regions off Mexico, Central America, and California; calves are nursed for 6 to 7 months (NMFS, 2015a; ADF&G, 2015a). Blue whales are baleen whales and filter feed on euphausiids (e.g., krill) (NMFS, 2015a). The Gulf of Alaska, along the Aleutian Islands, and the Bering Sea are used as summer feeding grounds (ADF&G, 2015a). Blue whales may travel alone or in pairs in pelagic waters, but may occur near the ice edge while migrating (ADF&G, 2015a). They may live for 80 years (ADF&G, 2015a).

Blue whales were listed as endangered in 1970 under the Endangered Species Conservation Act (predecessor act to the ESA of 1973) primarily due to overexploitation in commercial fisheries (35 FR 8491). Its listing covers the species throughout its entire range; however, NMFS has identified two stocks of blue whales within the North Pacific Ocean. The Eastern North Pacific Stock includes animals found in the eastern North Pacific from the northern Gulf of Alaska to the eastern tropical Pacific. The Western stock appears to feed in summer southwest of Kamchatka, south of the Aleutians, and in the Gulf of Alaska (Stafford, 2003; Watkins et al., 2000). In winter, the Western stock migrates to lower latitudes in the western Pacific and, less frequently, to the central Pacific, including Hawaii (Stafford et al., 2001). The best estimate of blue whale abundance for the Eastern Pacific stock is taken from the Chao model results of Calambokidis (2013) for the period 2008 to 2011, at 1,647 (coefficient of variation [CV]=0.07) whales. The International Whaling Commission (IWC) (2007) reports a North Pacific Basin population estimate at approximately 2,500 whales. Critical habitat has not been designated for blue whales.

Although blue whales are found in coastal waters, they are thought to generally occur more offshore than other whales. In Alaska, Moore et al. (2002a) found an association between whale distribution and the Emperor Seamounts, the steep continental slope off Kamchatka Peninsula, and the Aleutian Island chain (Appendix G).

3.5.1.1.2 Cook Inlet Beluga Whale

Beluga whale (*Delphinapterus leucas*) adults are white, toothed, and have a large melon (e.g., bulbous structure on their forehead) (ADF&G, 2015a). They have a ridge down their back rather than a dorsal fin, are approximately 11 to 15 feet long, and can weigh 1,000 to 3,300 pounds; females are smaller than males (ADF&G, 2015a). Females are sexually mature at 8 to 10 years of age (males mature slightly later), and give birth to a single calf every 3 years (ADF&G, 2015a). Mating occurs in the spring and calves are born 14 months later, in summer (ADF&G, 2015a). Calves are approximately 5 feet long at birth, weigh 90 to 130 pounds, and nurse for 2 years (ADF&G, 2015a). Beluga whales are opportunistic feeders, consuming fish (e.g., salmon, cod and sculpin), crustaceans (e.g., shrimp and crab), mollusks (e.g., octopus, snails, and clams), and annelids (polychaetes) (ADF&G, 2015a; Bryan, et. al.). They can be found in open ocean, continental shelf and coastal areas of Cook Inlet, Bristol Bay, eastern Bering Sea, eastern Chukchi Sea, and Beaufort Sea (ADF&G, 2015a). Their lifespan is 30 years (ADF&G, 2015a).

Cook Inlet beluga whales are one of five stocks of beluga whales identified in Alaska. The Cook Inlet DPS was listed as endangered in October 2008 (73 FR 62919) due to population declines caused by subsistence overharvest during the mid-1990s. A conservation plan was developed pursuant to the MMPA that describes life history and habitat requirements, and identified threats that included subsistence harvest, pollution, predation, disease, contamination, fisheries interactions, vessel traffic, small stock size, restricted summer range, and habitat alteration (NMFS, 2008). The Cook Inlet beluga whale is a subsistence resource for Alaska Natives, however, due to population declines, harvests are significantly restricted (ADF&G, 2015a).

In April 2011, NMFS designated critical habitat for Cook Inlet beluga whales (76 FR 20180) in two specific areas of Cook Inlet:

- Area 1. All marine waters of Cook Inlet north of a line from the mouth of Threemile Creek (61°08.5′ N., 151°04.4′ W.) connecting to Point Possession (61°02.1′ N., 150°24.3′ W.), including waters of the Susitna River south of 61°20.0′ N., the Little Susitna River south of 61°18.0′ N., and the Chickaloon River north of 60°53.0′ N.

- Area 2. All marine waters of Cook Inlet south of a line from the mouth of Threemile Creek (61°08.5′ N., 151°04.4′ W.) to Point Possession (61°02.1′ N., 150°24.3′ W.) and north of 60°15.0 ′N., including waters within 2 nautical miles seaward of mean high water (MHW) along the western shoreline of Cook Inlet between 60°15.0′ N. and the mouth of the Douglas River (59°04.0′ N., 153°46.0′ W.); all waters of Kachemak Bay east of 151°40.0′ W.; and waters of the Kenai River below the Warren Ames bridge at Kenai, Alaska (Appendix G).

The physical or biological features (used interchangeably with primary constituent elements or PCEs) of the critical habitat includes prey resources and access to prey, good water quality, and an acoustic environment that will not result in abandonment of habitat. The waters of Joint Base Elmendorf-Richardson and the Port of Anchorage were excluded from the designation under the provision of Section 4(b)(2) of the ESA. A draft recovery plan has been prepared by the Cook Inlet Beluga Recovery Team. NMFS issued a draft recovery plan for public review and comment in May 2015.

During the open-water months in Upper Cook Inlet (north of the forelands), beluga whales are typically concentrated near river mouths (Rugh et al., 2010). The winter distribution of this stock is not well known; however, evidence exists that some whales may inhabit Upper Cook Inlet year-round (Hansen and Hubbard, 1999; Rugh et al. 2004; Hobbs et al., 2005). Satellite tags from 10 whales tagged from 2000 through 2002 transmitted through the fall, and of those, three tags deployed on adult males transmitted through April and late May. None of the tagged beluga moved south of Chinitna Bay on the western side of Cook Inlet. A review of all marine mammal surveys conducted in the Gulf of Alaska from 1936 to 2000 discovered only 31 beluga sightings among 23,000 marine mammal sightings, indicating that very few belugas occur in the Gulf of Alaska outside of Cook Inlet (Laidre et al., 2000 cited in Allen and Angliss, 2014).

Beluga whales may be affected by noise from construction activities and interaction with vessels during construction and operation of the facilities. Likely effects include disturbance and temporary displacement for localized areas due to noise and presence of construction equipment. Most of these activities will take place south and west of the Forelands where whales are less abundant, particularly in the spring and summer months when they are foraging in the upper Inlet in estuaries and river mouths in and near Knik Arm. Reports of vessel strikes involving beluga whales are rare; most small cetaceans are adept at avoiding vessels, particularly large commercial vessels that tend to proceed at steady speeds on predictable courses.

3.5.1.1.3 Fin Whale

Fin whales (*Balaenoptera physalus*) are the second-largest species of whale and are fast swimmers (NMFS, 2015a). They are black or dark brownish-gray with a white ventral surface, have a V-shaped head and a tall, “falcate” (e.g., hooked) dorsal fin (NMFS, 2015a). Fin whales are 75 feet long in the Northern hemisphere (females are slightly longer than males) and weigh more than 80,000 pounds (NMFS, 2015a). Males are sexually mature at 6 to 10 years of age, and females at 7 to 12 years (NMFS, 2015a). Females give birth to one calf every two to three years in tropical and subtropical areas during midwinter (NMFS, 2015a; ADF&G, 2015a). Calves are about 18 feet long and weigh 4,000 to 6,000 pounds (NMFS, 2015a). Fin whales form social groups of two to seven individuals and feed in large groups with other whales and dolphins (NMFS, 2015a). They are baleen whales foraging on krill, squid, and small schooling fish, but they fast during winter migrations (NMFS, 2015a). The Gulf of Alaska, along the Aleutian Islands, the Bering Sea, and the Chukchi Sea are used as summer feeding grounds (ADF&G, 2015a). They often travel in groups, pairs, or alone in pelagic and deep coastal waters, and may live for 100 years (ADF&G, 2015a).

Fin whales were listed as endangered in 1970 under the Endangered Species Conservation Act (predecessor act to the ESA of 1973) primarily due to overexploitation in commercial fisheries (35 FR 8491). Its listing covers the entire species throughout its entire range; however, three stocks of fin whales are recognized within U.S. Pacific and Western Arctic waters: the Hawaii stock, the California/Washington/Oregon stock, and the Northeast Pacific stock (Allen and Angliss 2014). Individuals found in Alaska waters belong to the Northeast Pacific stock, which ranges from the Washington/Canada border to the Bering Sea (Allen and Angliss, 2014). Critical habitat has not been designated for fin whales. The most recent abundance estimate of the Northeast Pacific stock is from surveys conducted in the Bering Sea and near the Kenai Peninsula (Moore et al., 2002b; Zerbini et al., 2006). When combined, these surveys provide a provisional minimal estimate for the stock of 5,600 fin whales.

Fin whales typically range in U.S. waters from the North Pacific south to Hawaii, entering into the Bering Sea during ice-free summer months (Appendix G; Allen and Angliss, 2014). Most information about the distribution of fin whales in Alaska comes from acoustic surveys, which indicate that nearly all individuals in the Bering Sea congregate along the shelf-break in the central and eastern Bering Sea (Moore et al., 2000, 2002b). Fin whale calls, detected in the southeast Bering Sea from April 2006 through April 2007, showed peaks fin whale calls from September through November, February, and March (Stafford et al., 2010). No fin whales have been recorded in the Beaufort Sea, although a few individuals have been sighted and detected acoustically in the Chukchi Sea during the open-water months of summer and fall (Brueggeman et al., 2009; Ireland et al., 2009; Delarue et al., 2013). Recent records of fin whales in the Chukchi Sea may coincide with rising sea-surface temperatures and/or may indicate a range expansion similar to that observed for humpback whales (Hashagen et al., 2009).

3.5.1.1.4 Gray Whale – Western North Pacific DPS

Gray whales (*Eschrichtius robustus*) are slate gray in color with gray and white patches, have a dorsal hump instead of a dorsal fin and short, gray, paddle-shaped flippers (ADF&G, 2015a). They often travel in groups of two to three in coastal shallow waters over the continental shelf (ADF&G, 2015a). Adult males are 45 to 46 feet long and weigh 30 to 40 tons; females are slightly larger (ADF&G, 2015a). Gray whales are sexually mature at 5 to 11 years (e.g., when they reach 36-39 feet in length) (ADF&G, 2015a). Females give birth in and near lagoons in Baja, California in January or February to a single calf every 2 or more years (ADF&G, 2015a). Calves are 15 feet long and weigh 1,100 to 1,500 pounds at birth; they nurse for 7 to 8 months (ADF&G, 2015a). From late February to May, gray whales migrate north through coastal waters of the Gulf of Alaska, Aleutian Islands, and Bering Sea to summer feeding grounds in the Bering, Chukchi, and Beaufort seas (ADF&G, 2015a). They are baleen whales, feeding primarily by dredging through the mud and filtering out bottom-dwelling crustaceans (e.g., amphipods) (ADF&G, 2015a). Gray whales may live for 78 to 80 years (ADF&G, 2015a).

Gray whales were listed as endangered in 1970 under the Endangered Species Conservation Act (predecessor act to the ESA of 1973) primarily due to overexploitation in commercial fisheries (35 FR 8491). The original listing covered the entire species throughout its entire range. In 1994, the Eastern North Pacific (ENP) gray whale population, which feeds in the Chukchi, Beaufort and northwestern Bering seas during summer and fall, was determined to have recovered and was removed from the endangered species list (59 FR 31094; Allen and Angliss 2014; Weller et al. 2013). The current ENP gray whale population is estimated to be 26,000 (ADF&G, 2015a). The Western North Pacific (WNP) stock remained listed as an endangered species. The distribution and migration pattern of the WNP gray whale is poorly known. In summer, WNP gray whales are found in feeding areas off the coasts of Sakhalin Island and the Kamchatka Peninsula, although some whales observed off Sakhalin have been sighted off Bering Island in the western Bering Sea (Appendix G; Weller et al., 2013). Recent evidence exists from photo-identification, genetic, and telemetry studies of spatial and temporal overlap between the WNP and ENP gray whales (Weller et al., 2013). These studies show that some WNP gray whales that feed off Sakhalin Island during summer/fall migrate to the West Coast of North America during the winter/spring with ENP gray whales (Weller et al., 2013). Despite the apparent migration of few WNP gray whales to waters off of Vancouver Island, Canada and San Ignacio Lagoon, Mexico, they are unlikely to be present in Gulf of Alaska waters.

3.5.1.1.5 Humpback Whale ‑ Western North Pacific DPS

Humpback whales (*Megaptera novaeangliae*) are predominately black with shades of white on the throat, belly, flippers, and flukes (ADF&G, 2015a). Their most distinguishing features are their extremely long flippers (25 to 30 percent of the animal's length), along with their dorsal fin and ventral pleats, which run from the lower jaw to the belly (ADF&G, 2015a). They often congregate in groups of two to 12 in pelagic and coastal shallow waters (ADF&G, 2015a). Adult females are 49 feet long and weigh about 35 tons; males are slightly smaller (ADF&G, 2015a). Females and males are sexually mature at 5 and 7 years of age, respectively (ADF&G, 2015a). Breeding and calving take place in tropical waters (e.g., Hawaii and Mexico) during the winter months, and females give birth to a single calf every 1 to 3 years (ADF&G, 2015a). Calves are 10 to 15 feet long, weigh 1.5, tons and nurse for 6 to 10 months (ADF&G, 2015a). Humpback whales are baleen whales, feeding primarily on euphausiids (e.g., krill) and small schooling fish; however, they tend to fast during winter and while migrating (ADF&G, 2015a). Humpback whale summer feeding grounds extend from Washington State, Gulf of Alaska, to the Chukchi Sea (ADF&G, 2015a). They may live for 50 years (ADF&G, 2015a).

Humpback whales were listed as endangered in 1970 under the Endangered Species Conservation Act (predecessor act to the ESA of 1973) primarily due to overexploitation in commercial fisheries (35 FR 8491). Its listing covers the entire species throughout its entire range; however, three stocks are recognized in the North Pacific: the California/Oregon/Washington stock that winters in coastal Central America and Mexico, then migrates to areas ranging from the coast of California to southern British Columbia in summer/fall (Carretta et al., 2014); the Central North Pacific stock that winters in the Hawaiian Islands, then migrates to northern British Columbia, Southeast Alaska, and Prince William Sound west to Kodiak; and the Western North Pacific stock that winters near Japan, then likely migrates to waters west of the Kodiak Archipelago (the Bering Sea and Aleutian Islands) in the summer/fall (Allen and Angliss, 2014). Some mixing occurs between these stocks. Sightings of humpback whales in the Beaufort Sea are assumed to represent vagrants from the central North Pacific stock (Allen and Angliss, 2014) or the western North Pacific stock (Hashagen et al., 2009). Critical habitat has not been designated for humpback whales.

Between 2004 and 2006, a multinational coordinated study called Structure of Populations, Levels of Abundance and Status of Humpbacks (SPLASH) examined humpback whale population structure and abundance in the North Pacific. The most current estimate of abundance for the entire North Pacific basin, resulting from the SPLASH project is 18,302 individuals (Calambokidis et al., 2008). This amount is significantly larger than any previous estimates for the basin and is greater than some of the published estimates of pre-whaling abundances (Rice, 1978). Barlow et al. (2011) used the SPLASH data to generate an estimate of humpback whale abundance in the North Pacific by correcting for some of the known biases, such as those caused by not sampling calves and by births and deaths between sampling periods. This estimate (21,808 CV=0.04) is higher than previous estimates, but may still be an underestimate of actual humpback whale abundance due to biases that could not be corrected with available data (Flemming and Jackson, 2011).

The minimal population estimate for the central North Pacific stock is 5,833 whales (CV = 0.3); and for the western Pacific stock is 732 whales (assumed CV of 0.30) (Allen and Angliss, 2014).

Humpback whales use portions of Cook Inlet. Humpback use of Cook Inlet has been observed to be largely confined to Lower Cook Inlet. They have been regularly seen near Kachemak Bay during the summer months (Rugh et al., 2005a). There are anecdotal observations of humpback whales as far north as Anchor Point, with recent summer observations extending to Cape Starichkof (Owl Ridge, 2014). Although there is considerable distributional overlap in the humpback whale stocks that use Alaskan waters, the whales seasonally found in Lower Cook Inlet are probably of the Central North Pacific stock (Barlow, et al. 2011; Angliss and Allen, 2014).

3.5.1.1.6 North Pacific Right Whale

North Pacific (NP) right whales (*Eubalaena japonica*) are large, slow-swimming whales that are mostly black with white patches and lack a dorsal fin (ADF&G, 2015a). They are rare and sometimes confused with bowhead whales; however, NP right whales' heads have wart-like callosities, while bowheads have smooth skin (ADF&G, 2015a). Their heads are also approximately 25 percent of their body length (ADF&G, 2015a). NP right whales often congregate in groups of 2 to 12 in pelagic and coastal shallow waters (ADF&G, 2015a). Females can grow up to 55 feet in length and weigh 220,000 pounds, while males are smaller (ADF&G, 2015a). Females give birth starting at 9 to 10 years of age. Calves are born at lower latitudes during winter (ADF&G, 2015a). Calves are 13 to 15 feet long, weigh 1 ton, and nurse for 1 year (ADF&G, 2015a). NP right whales are baleen whales, feeding primarily on zooplankton (e.g., krill and copepods) by skimming through schools with their mouths open; they generally forage in the spring and fall (ADF&G, 2015a). Their summer range includes the southern Bering Sea and Gulf of Alaska (ADF&G, 2015a). They may live for 50 years (ADF&G, 2015a).

Right whales were listed worldwide as endangered in 1970 under the Endangered Species Conservation Act (predecessor act to the ESA of 1973) primarily due to overexploitation in commercial fisheries (35 FR 8491). In 2008, the North Pacific right whale was recognized as a separate species Eubalaena japonica and relisted as an endangered species in 2008 (73 FR 12024). Right whales are large, slow-swimming whales that tend to congregate in coastal areas. Right whales have been observed during surveys most summers since 1996 in a portion of the southeastern Bering Sea (Goddard and Rugh, 1998). Analysis of acoustic data indicates that right whales remain in the southeastern Bering Sea from May through December, with peak call detection in September (Munger and Hildebrand, 2004; Stafford and Mellinger, 2009). Recorders deployed from 2007 to 2012 indicate the presence of right whales in the southeastern Bering Sea almost year-round, with a peak in August and a sharp decline in detections in early January (Allen and Angliss, 2014). The minimum estimate of abundance of North Pacific right whales is 25.7, based on the photo-identification estimate of 31 whales (CV=0.226; Wade et al., 2011). The genetic-identification catalogue has a total of 23 individuals identified from 1997 to 2011 (Allen and Angliss, 2014). Critical habitat for northern right whales has been designated in the southeastern Bering Sea and in the Gulf of Alaska south of Kodiak Island (Appendix G; 71 FR 38277, 6 July 2006). Principal habitat requirements for right whales are dense concentrations of prey (Clapham et al., 2006).

3.5.1.1.7 Sei Whale

Sei whales (*Balaenoptera borealis*) are dark bluish-gray to black with a pale underside and erect "falcate" (e.g., hooked) dorsal fin (NMFS, 2015a). They are distinguished from Bryde's whales by the single ridge on the animal's rostrum (e.g., snout) (NMFS, 2015a). Sei whales average 40 to 60 feet in length (females may be slightly longer than males), weigh up to 100,000 pounds and occur alone or in groups of two to five in pelagic waters (NMFS, 2015a; ADF&G, 2015a). They reach sexual maturity at 6 to 12 years and may live for 50 to 70 years (NMFS, 2015a). Mating and birthing occur at lower latitudes during winter (NMFS, 2015a). Females breed every 2 to 3 years, giving birth to a single calf that is approximately 15 feet long and 1,500 pounds (NMFS, 2015a). Sei whales are baleen whales that feed on zooplankton (e.g., copepods and krill), small schooling fish, and squid by gulping and skimming (ADF&G, 2015a). Their summer feeding grounds include the Gulf of Alaska (ADF&G, 2015a).

Sei whales were listed as endangered in 1970 under the Endangered Species Conservation Act (predecessor act to the ESA of 1973) primarily due to overexploitation (35 FR 8491). It is listed globally as a single species. They do not appear to be associated with coastal features in temperate regions of the world (Appendix G). Kanda et al. (2014) investigated the stock structure of North Pacific sei whales based analysis of one microsatellite loci and concluded that North Pacific waters are occupied by a single stock of sei whales. Hakamada et al. (2013) estimated the abundance of sei whales in the central North Pacific (north of 40° North latitude, south of Aleutian Islands, between 170° East and 170° West longitude) was 9,286 (CV=0.35). Abundance estimates range between 8,528 and 9,188 in sensitivity analyses. NMFS has determined that data are insufficient to determine population structure, but conservatively does not assume panmixia across the entire North Pacific and has divided sei whales into three discrete areas: Hawaiian waters; California, Oregon and Washington waters; and Alaskan waters (Carretta et al., 2014). No reliable abundance estimates are available at this scale (Carretta et al., 2014). There is currently no designated critical habitat for sei whales.

3.5.1.1.8 Sperm Whale

Sperm whales (*Physeter macrocephalus*) are the largest of the toothed whales (e.g., odontocetes) and are mostly dark gray (NMFS, 2015a). Their head, which has a single blowhole on the left side, is 25 to 35 percent of their total body length (NMFS, 2015a). They are 36 to 52 feet in length and can weigh 15 to 45 tons; males are considerably larger than females (NMFS, 2015a). They occur in social groups of 10 to 80 females with young, small male bachelor groups or single mature males in deep pelagic waters (ADF&G, 2015a). Sperm whale females reach sexual maturity at 9 years (males mature later), and produce a single calf at 5 year intervals (NMFS, 2015a). Calves are born at lower latitudes during winter and are 13 feet long (NMFS, 2015a). Sperm whales specialize in feeding on large squid, but will also feed on sharks, skates, and other fish (ADF&G, 2015a). Some sperm whales migrate to higher latitudes in summer, with some males occurring as far north as the Bering Sea (ADF&G, 2015a). The sperm whale lifespan is unknown (ADF&G, 2015a).

Sperm whales were listed as endangered in 1970 under the Endangered Species Conservation Act (predecessor act to the ESA of 1973) primarily due to overexploitation in commercial fisheries (35 FR 8491). Its listing covers the entire species throughout its entire range; however, three stocks of sperm whales are currently recognized in US waters: Alaska North Pacific stock; the California, Washington, and Oregon stock; and the Hawaii stock (Allen and Angliss, 2014). New information from Mizroch and Rice (2012) based on marking and whaling data, however, indicate no apparent divisions between stocks within the North Pacific, suggesting that this structure should be reviewed and updated. Summer surveys conducted between 2001 and 2010 by the NMFS National Marine Mammal Laboratory have found sperm whales most frequently in the coastal waters around the central and western Aleutian Islands (Appendix G; Allen and Angliss, 2014). Acoustic surveys have detected sperm whales year-round in the Gulf of Alaska, although they appear to be more common in summer than in winter (Mellinger et al., 2004). This seasonal detection pattern is consistent with the hypothesis that sperm whales migrate to higher latitudes in summer and migrate to lower latitudes in winter (Whitehead and Arnbom, 1987). No estimate for numbers of sperm whales in Alaska waters is available, nor is a reliable estimate of abundance for the North Pacific stock (Allen and Angliss, 2014). Critical habitat has not been designated for sperm whales.

3.5.1.1.9 Steller Sea Lion – Western DPS

The Steller sea lion (*Eumetopias jubatus*) is the largest member of the family Otariidae (e.g., eared seals) (ADF&G, 2015a). They have external ear flaps, use long forearms resembling flippers for propulsion, and are capable of quadrupedal locomotion on land via rotatable hind flippers (ADF&G, 2015a). Adult females tend to be buff colored on the back, with an average length of 8.6 feet and weight of 579 pounds (ADF&G, 2015a). Adult males are darker on the front of the neck and chest, with an average length of 10.6 feet and weight of 1,245 pounds (ADF&G, 2015a). Steller sea lions are sexually mature at 3 to 7 years, but males are 9 to 13 years old before they hold territories on breeding rookeries (ADF&G, 2015a). Females exhibit rookery site fidelity, are capable of pupping annually, and breed in June, giving birth the following June to a single pup 3.3 feet long and weighing 35 to 50 pounds (ADF&G, 2015a; NMFS, 2008b; NMFS, 2015a). Steller sea lions are generalists, feeding on seasonally available fish and cephalopods (ADF&G, 2015a). They do not migrate, but move their haulouts to follow prey concentrations (ADF&G, 2015a). They inhabit the Aleutian chain, the central Bering Sea, the Gulf of Alaska, and southeastern Alaska (ADF&G, 2015a). Males may live 20 years, while females may live 30 years (ADF&G, 2015a).

The Steller sea lion was listed throughout its range as a threatened species in 1990 because of significant population declines of 63 percent since 1985, and 82 percent since 1960 (55 FR 49204). The minimum abundance estimate for the western U.S. stock of Steller sea lion, including Russian populations, is 45,916 animals, based on pup and other count data collected between 2008 and 2011 (DeMaster, 2011). This is down from a 1950s population estimated for Alaska alone at 140,000 (Merrick et al., 1987). Potential reasons for the declines that have been identified include marine habitat regime change that lowered the carrying capacity of the environment; competition for prey with other predators and commercial fisheries; and predation by sharks and killer whales. Steller sea lions are a subsistence resource with harvests of 150-300 annually by Natives in Alaska and Canada (ADF&G, 2015a).

In 1997, NMFS reclassified Steller sea lions as two DPSs under the ESA, based on genetic studies and phylogeographic analyses from across the sea lion's range (62 FR 24345). The western DPS includes those animals found west of Cape Suckling, Alaska (144°W) through Prince William Sound and Cook Inlet, along the Alaska Peninsula, through the Aleutian Islands and Bering Sea, to the Kuril Islands, Sea of Okhotsk, and to the northern coast of Japan. The western DPS was listed as endangered and the eastern DPS was listed as threatened (ADF&G 2015a). A recovery plan was developed in 2008 (NMFS, 2008b). In November 2014, NMFS determined that the eastern DPS was recovered and it was delisted (78 FR 66140). In 1993, critical habitat was designated for the Steller sea lion that includes a 20 nautical mile buffer around all major haulouts and rookeries, as well as associated terrestrial, air, and aquatic zones (58 FR 45269, Appendix G). Portions of the southern reaches of the Lower Cook Inlet are designated as critical habitat, including those near the mouth of the Inlet.

A few individual Steller sea lions may rarely venture into Upper Cook Inlet. Steller sea lions use habitats along vessel corridors. Vessels entering Cook Inlet would pass near rookery sites at Sugarloaf and Marmot Island, as well as several haulout sites in the in the Barren Islands located between the Stevens and Kennedy entrances to the Inlet (Appendix G). LNGCs calling at Nikiski would pass near these same areas. Tugs towing construction barges to West Dock would likely transit near rookery and haulout sites on the Shumagin Islands, Atkins Island, and Ugamak Island, and transit through the eastern portion of the Bogoslof foraging area in the Bering Sea.

3.5.1.1.10 Northern Sea Otter, Southwest Alaska DPS

The northern sea otter (*Enhydra lutris*) is the largest member of the weasel family and has a brown, black, or silver coat and webbed feet for swimming (ADF&G, 2015a). Adult sea otters are 5 feet long and weigh 50 to 100 pounds; females are smaller than males (ADF&G, 2015a). Females are sexually mature at 2 to 5 years of age, and males at 4 to 6 years (ADF&G, 2015a). Females give birth each year, usually in the late spring in Alaska, to a single pup weighing 3 to 5 pounds (ADF&G, 2015a). Sea otters feed on fish and invertebrates, including clams, octopus, crabs, and sea urchins, which they find in shallow coastal waters (ADF&G 2015a). Their lifespan is 15 to 20 years (ADF&G, 2015a).

The Alaska subspecies of the northern sea otter (*E. lutris kenyoni*) ranges from southeast Alaska through the Aleutian Islands. Within this range, three stocks have been identified based on morphological and some genetic differences between the Southwestern and Southcentral Alaska stocks, and physical barriers to movement across the upper and the lower portions of Cook Inlet (Appendix G; 70 FR 46366). The southwest DPS, which includes sea otters along the Alaska Peninsula and Bristol Bay coasts, and the Aleutian, Barren, Kodiak, and Pribilof islands, was listed as a threatened in August 2005 (70 FR 46366) due to substantial observed population declines. The cause of the overall decline is not known with certainty, but the weight of evidence points to increased predation, most likely by killer whales (USFWS, 2013). Other threats include infectious disease, biotoxins, contaminants, oil spills, food limitations, bycatch in commercial fisheries, subsistence harvest, loss of habitat, and illegal take, although most of these are considered of low to moderate importance for recovery (USFWS, 2013).

In October 2009, the USFWS designated critical habitat for the southwestern Alaska DPS of the northern sea otter. The designated critical habitat encompasses 5,855 square miles of shallow coastal waters from Attu Island in the Aleutians to Redoubt Point in Cook Inlet (74 FR 51988). The essential elements of critical habitat include shallow, rocky areas less than 6.6 feet deep; nearshore waters that provide protection or escape from marine predators within 328.1 feet from the mean high tide line; kelp forests that provide protection from marine predators in waters less than 65.6 feet deep; and prey resources within these areas in sufficient quantity and quality to support sea otters' energetic requirements. Critical habitat is divided into five habitat units, which correspond to the five management units for the DPS (Appendix G; 74 FR 51988).

The southwest DPS is distributed throughout most of its former range, but at low densities in most areas. Designated critical habitat in Unit 5 Kodiak, Kamishak, and Alaska Peninsula would coincide with potential construction and shipping traffic for the proposed pipeline and Liquefaction Facility in Cook Inlet (Appendix G). Sea otters occur throughout the Project area from Redoubt Point in Cook Inlet along the southwestern shore, through Kamishak Bay, around the Kodak Island group, including the Barren Islands in the entrance to Cook Inlet, and west along the Alaska Peninsula to Unimak Pass. Typically they are found in shallow, rocky reef waters, were adequate forage exists, and kelp forests provide cover. Southwest DPS sea otters would occur within the regions transited by vessel traffic into and out of Cook Inlet carrying materials for pipeline and Liquefaction Facility construction and LNG carrier traffic during operation. The Liquefaction Facility would be constructed outside of the designated shoreline critical habitat in Unit 5.

3.5.1.1.11 Short-tailed Albatross

The short-tailed albatross (*Phoebastria albatrus*) was listed in 1970 as an endangered foreign species (35 FR 8495) under the Endangered Species Conservation Act (predecessor to the ESA of 1973). In 2000, USFWS modified the listing to extend protection throughout its range including those portions in areas under the jurisdiction of the US (65 FR 46643). Critical habitat has not been designated for the short-tailed albatross. The short-tailed albatross is the largest seabird in the North Pacific. They nest on two remote islands in the western Pacific, although they spend most of their life at sea. The areas that are most heavily used by short-tailed albatross include regions of upwelling and high productivity along the northern edge of the Gulf of Alaska, along the Aleutian Islands, and along the Bering Sea continental shelf break from the Alaska Peninsula out toward St. Matthew Island (Suryan et al. 2007a; Tickell 2000; USFWS 2009a). Short-tailed albatross adults spent less than 20 percent of their time over waters exceeding 9.843 feet deep; with adults and subadults frequently within waters shallower than 3,281 feet deep for more than 70 and 80 percent of the time, respectively (Suryan et al. 2007b). Known threats identified for the short-tailed albatross include volcanic activity, landslides and typhoons on their nesting islands; ingestion of plastics; mortality from longline, gillnet and troll fisheries, and oil and gas development within their breeding and at-sea habitats. Although Project-related barge and LNGC traffic would occur within the nonbreeding range of the short-tailed albatross through the Aleutian Islands, vessel traffic has not been identified as a potential threat to these birds and the proposed Project would have no effect on the short-tailed albatross.

3.5.1.1.12 Steller's Eider – Alaska-breeding Population

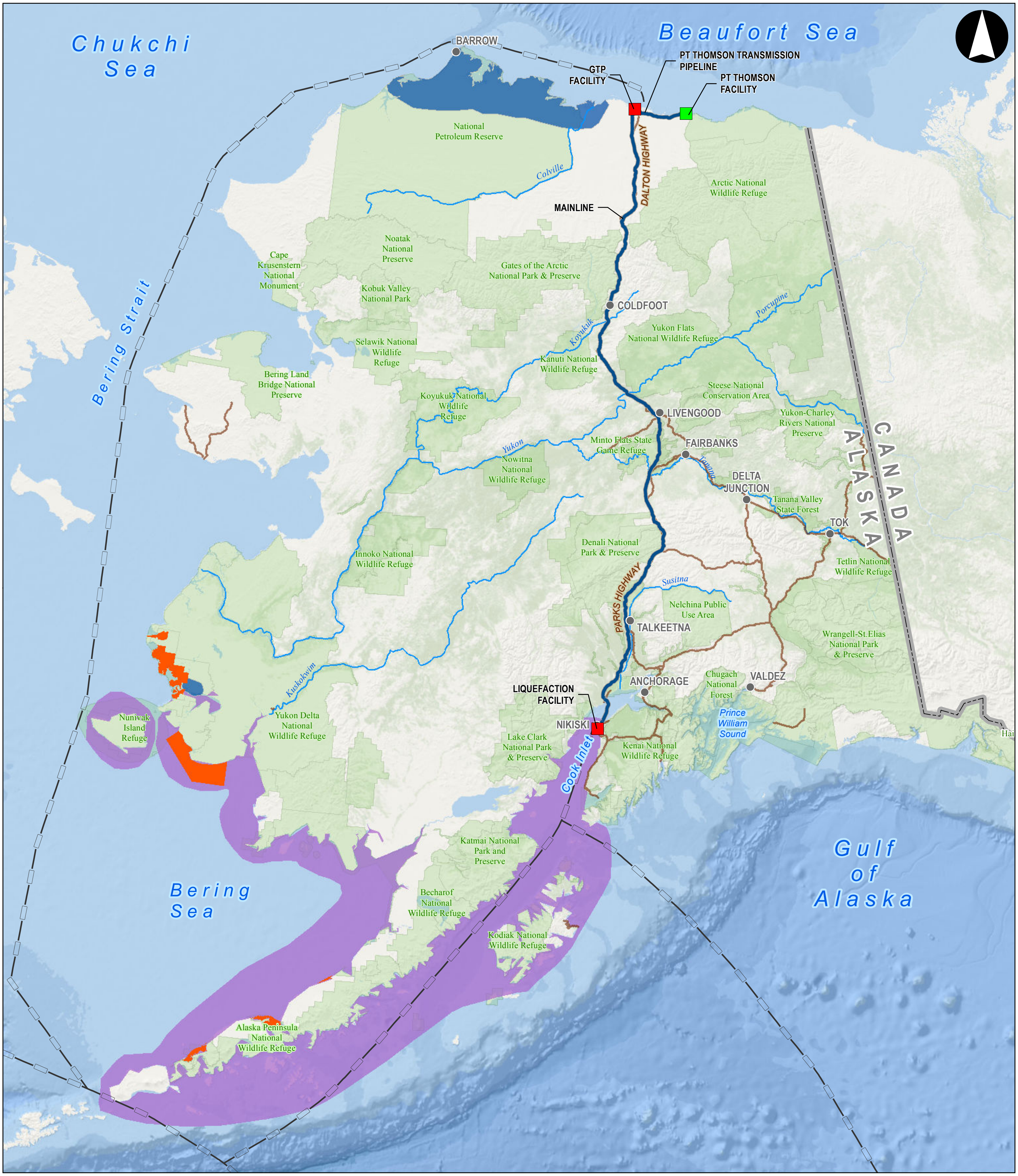
The Alaska-breeding population of Steller's eiders (*Polysticta stelleri*) was listed as threatened under the ESA in 1997 because of a substantial decrease in nesting range and the increased vulnerability of the remaining breeding population to extirpation (62 FR 31748). The USFWS designated critical habitat for Steller's eiders in 2001 that includes breeding habitat on the Yukon Kuskokwim Delta, molting habitat in marine waters of Kuskokwim Shoals in northern Kuskokwim Bay, Seal Islands, Nelson Lagoon, and Izembek Lagoon on the northern side of the Alaska Peninsula (Figure 3.5.1-1 66 FR 8850). Alaska-breeding Steller's eiders are one of three breeding populations of Steller's eiders; the other two populations breed in Arctic Russia. Threats identified for the Alaska-breeding population include shooting, ingestion of lead shot, disturbance and loss of breeding habitat, and predation in terrestrial habitats; bottom trawl fishing in critical habitat; and mining and offshore oil and gas development in molting, wintering, or staging areas (USFWS, 2009b).

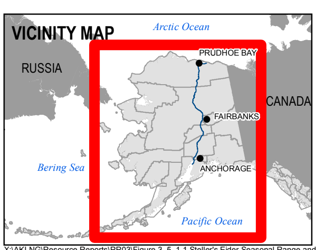
Most Steller's eider populations winter in marine waters off Alaska and migrate in spring along the Bristol Bay coast of the Alaska Peninsula across Bristol Bay toward Cape Pierce, continuing northward along the Bering Sea coast (Larned, 2012). During migration, eiders linger to feed at the mouths of lagoons and other productive habitats (Larned, 2012). Most Steller's eiders then cross the Bering Strait to breeding grounds in Russia, with a smaller number continuing north to the Beaufort Coastal Plain Ecoregion to breed (Larned, 2012). In May and June, the North Slope breeding population migrates to coastal areas of the Beaufort Coastal Plain Ecoregion along the Eastern Chukchi and Western Beaufort Seas, where Steller's eiders nest on tundra habitats. More recently, nesting in the Beaufort Coastal Plain Ecoregion has been limited to the vicinity of Barrow (Quakenbush et al., 2002). Although the historic nesting range of this population overlaps with the Project footprint and Steller's eiders have been observed at Prudhoe Bay during the breeding season, nesting Steller's eiders have not been documented at Prudhoe Bay (Quakenbush et al., 2002).

Interannual disparity is wide in the number of breeding pairs returning and the number of offspring produced (Obritschkewitsch and Ritchie, 2008); eiders may not breed when lemming numbers are low due to increased predation (Quakenbush and Suydam, 1999). Quakenbush et al. (2004) found that most Steller's eiders nesting near Barrow use edges of low-centered polygons near ponds with emergent vegetation, particularly those with sedges and pendant grass (*Arctophila fulva*). Eggs hatch from early July to early August, following an incubation period of approximately 24 days (Quakenbush et al., 2004). Broods are raised in nearby freshwater, often within 0.5 miles of their nest sites. Ducklings fledge 32 to 37 days after hatching, and once fledged, depart with the females to marine waters.

Following nesting in high Arctic Russia and Alaska, most Steller's eiders migrate to southwest Alaska, including Lower Cook Inlet. Steller's eiders occasionally occur across the nearshore marine waters of the Beaufort Sea to the Canadian border (Quakenbush et al., 2002). On the Alaska Peninsula, nonbreeding subadults begin arriving in mid-July and peak in early August (Fredrickson, 2001). Nonbreeding and post-breeding birds use the nearshore zone of the northeastern Chukchi Sea and large lakes around Barrow for molting and summering, and a few occasionally occur as far east as the U.S.-Canada border (Quakenbush et al., 2002). Molting patterns are similar to those of spectacled eiders. Females molt after the nesting season and males return to molting areas in nearshore marine waters after breeding in late June or July (Fredrickson, 2001). Adults begin arriving in mid-August and peak in mid-September in lagoons off the Alaska Peninsula (Fredrickson, 2001). Very few Steller's eiders occur in Upper Cook Inlet near the proposed Marine Terminal on the eastern shore of Cook Inlet near Nikiski. Steller's eiders winter in Lower Cook Inlet, arriving as early as mid-July and remaining through late-April, with highest numbers occurring in January or February (Figure 3.5.1-2 Larned, 2006).

Steller's eiders were observed 25 percent of the time in eastern Cook Inlet between the nearshore area of Anchor Point to 15 miles north of Ninilchik (Larned, 2006), south of the Marine Terminal. In western Cook Inlet, Steller's eiders were most abundant in the extensive shoals from Douglas Bay to Bruin Bay, a shoal 7 miles southeast of Bruin Bay, and the mouth of Iniskin Bay (Figure 3.5.1-4). Larned (2006) observed the use of substantial numbers of molting Steller's eiders in the Douglas Shoals area of Kamishak Bay during August and September. LNGCs and construction barge traffic to and from the Marine Terminal would follow recommended guidelines and procedures for operating in Cook Inlet (U.S. Coast Pilot 9, and guidelines and directives of the Captain of the Port); Steller's eiders generally use habitats close to shore.





LEGEND

- Project Facility
- Existing Facility
- Alaska LNG Rev C2 Route
- Major Highways
- Marine Transporation Route
- Major Rivers
- Critical Habitat
- Current Breeding Range
- Molting and Winter Range
- State and Federal Conservation Lands

0 50 100 200 Miles

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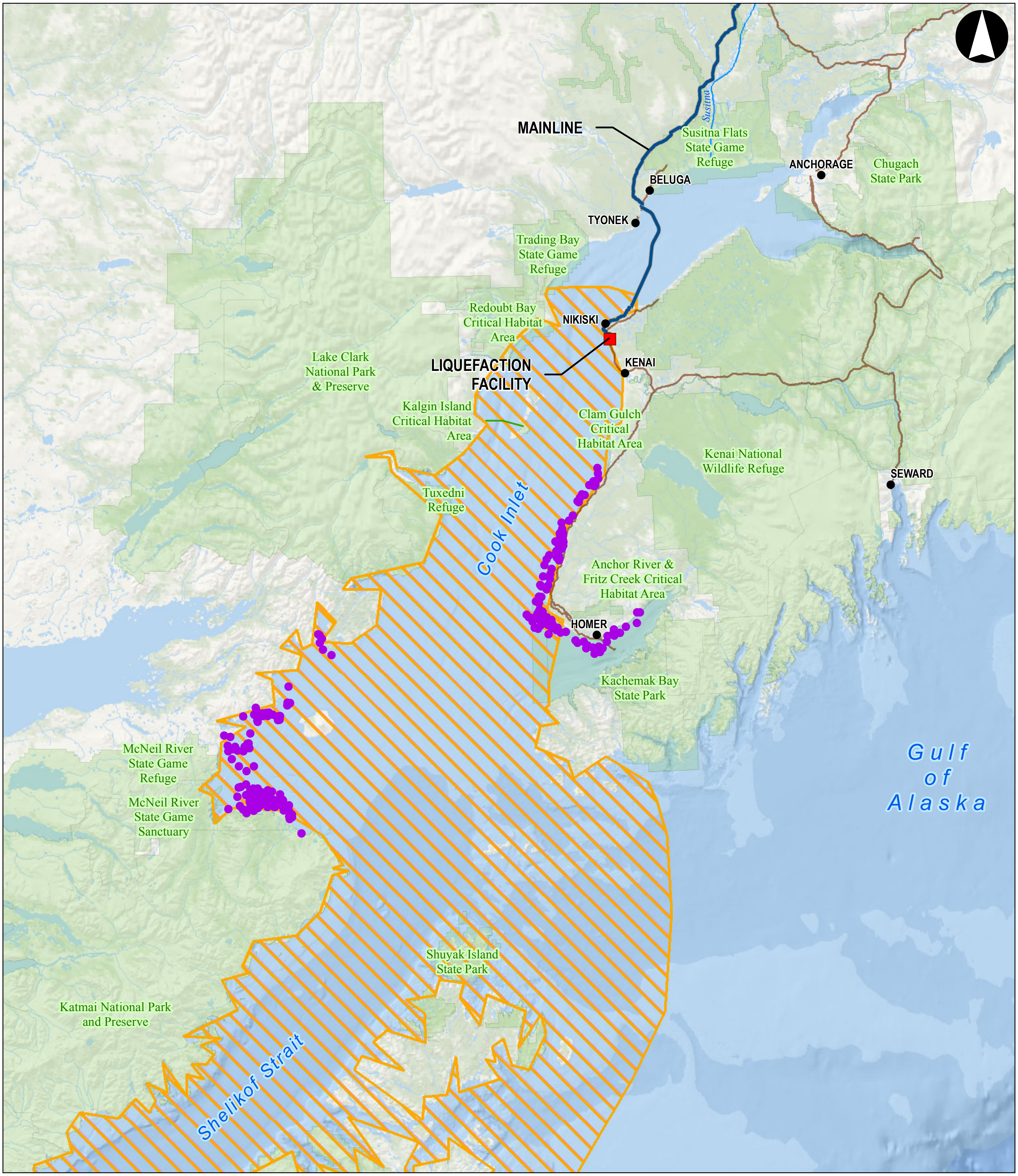
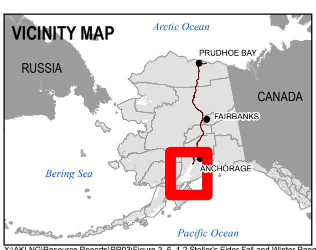
STELLER'S EIDER SEASONAL RANGE AND CRITICAL HABITAT

FIGURE 3.5.1-1

ALASKA LNG

X:\AKLNG\Resource Reports\RR03\Figure 3_5_1-1 Steller's Eider Seasonal Range and Critical Habitat.mxd





LEGEND

- Project Facility
- Existing Facility
- Alaska Place Names
- Steller's Eider Observations
- Alaska LNG Rev C2 Route
- Major Highways
- Major Rivers
- Steller's Eider Molting and Winter Range
- State and Federal Conservation Lands

0 10 20 40 Miles

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STELLER'S EIDER FALL AND WINTER RANGE IN COOK INLET

FIGURE 3.5.1-2

X:\AKLNG\Resource Reports\RR03\Figure 3_5_1-2 Steller's Eider Fall and Winter Range in Cook Inlet.mxd

3.5.1.1.13 Chinook Salmon ESUs and Steelhead Trout DPSs

The majority of Pacific salmon and steelhead trout populations are healthy and meet management objectives. Twelve Chinook (king) salmon populations or ESUs and steelhead trout populations or DPSs that are listed as threatened or endangered are known or suspected to occur in Alaskan waters (Table 3.5.1-1). These listed populations spawn in Washington, Oregon, or Idaho and migrate to forage in North Pacific waters. Although differentiating marine distribution patterns for specific salmon and steelhead stocks is challenging, it is apparent that salmon and steelhead stocks share feeding grounds and are found at a variety of depths and distances from shore. Salmon and steelhead migrations are influenced by dominant ocean currents and are associated with prey concentrations, which in turn are driven by seasonal plankton production and cold water upwelling (Bracis, 2010).

Pacific salmon ESUs and steelhead DPSs recognized by NMFS as potentially occurring along LNGC routes through the Gulf of Alaska and Aleutian Islands are:

- One endangered and five threatened Chinook salmon ESUs; and
- One endangered and five threatened steelhead trout DPSs (NMFS, 2015a).

These Chinook salmon and steelhead trout populations have experienced declines in recent decades as a result of multiple impacts, including: freshwater habitat reduction, modification, degradation, and elimination; estuarine rearing habitat reduction, modification, degradation, and elimination; juvenile and adult mortality from hydroelectric and flood control structures; overfishing and bycatch; detrimental effects from invasive aquatic animals and plants; interactions, genetic, and disease impacts from hatchery practices; and changing hydrologic cycles and marine water productivity. Activities associated with the Project would not affect the factors that led to the listing of these Chinook salmon and steelhead trout ESUs. No critical habitat is designated in Alaska waters for ESA-listed Chinook salmon ESUs or steelhead trout DPSs.

3.5.1.2 Interdependent Project Facilities

ESA-listed marine mammals, terrestrial mammals, and birds that would only occur near Interdependent Project Facilities or along marine vessel routes through the Bering, Chukchi, and Beaufort seas to Prudhoe Bay, include the following: bowhead whale, polar bear, wood bison, and spectacled eiders (Table 3.5.1-1). Steller's eiders nest on the coastal plain and would potentially migrate through the Prudhoe Bay area, but they also overwinter in Lower Cook Inlet. Most of the marine mammals described for the Liquefaction Facility could also occur along the marine transportation routes to Prudhoe Bay (Table 3.5.1-1).

3.5.1.2.1 Bowhead Whale

Bowhead whales (*Balaena mysticetus*) have a dark body, distinctive white chin, two blow holes and no dorsal fin (NMFS, 2015a; ADF&G, 2015a). Adults weigh 75 to 100 tons and are 45 to 60 feet long; their bow-shaped skull accounts for roughly a third of their length (NMFS, 2015a). Bowhead whales reach sexual maturity at approximately 35 to 40 feet long, and they likely mate in the Bering Sea during late winter and spring (NMFS, 2015a; ADF&G, 2015a). Females typically have 1 calf every 3 to 4 years, giving birth between April and early June (NMFS, 2015a; ADF&G, 2015a). Calves are 13 to 14 feet long, weigh 1 ton, and are gray (NMFS, 2015a; ADF&G, 2015a). Bowhead whales use baleen plates to consume zooplankton (e.g., crustaceans), other invertebrates, and fish (NMFS, 2015a). Their life expectancy is unknown, but they may live over 100 years (NMFS, 2015a). They are circumpolar, occupying the Arctic Ocean and surrounding seas, spending winters associated with the southern limit pack ice and moving north in the spring (NMFS, 2015a). Bowhead whales are listed as ESA endangered and MMPA depleted throughout their range (NMFS, 2015a). Bowhead whales in Alaskan waters belong to the Western Arctic stock (also called the Bering–Chukchi–Beaufort Sea stock) (Allen and Angliss, 2014). The Western Arctic stock is the largest population, estimated to be 6,400 to 9,200 whales (NMFS, 2015a; ADF&G, 2015a). Critical habitat has not been designated for bowhead whales.

Bowhead whales overwinter in the central and western Bering Sea (Rugh et al., 2003). As sea-ice begins to retreat in April, bowhead whales begin migrating north to the Chukchi and Beaufort seas (Appendix G). Most bowhead whales continue to migrate eastward into the Beaufort Sea from April through mid-June and remain at summer foraging grounds until late August or early September before migrating westward again toward the Bering Sea (Rugh et al., 2003; Hannay et al., 2013).

Bowhead whales are common in the Beaufort Sea on a seasonal basis with an overall density estimate of six bowhead whales per 1,000 square miles during open-water season surveys in 2007 (Ireland et al., 2009). Bowhead whales could be disturbed by noise associated with construction activities at West Dock. These effects are likely to be transitory and minor in nature, as the migration routes are offshore of the construction site and noise is likely to be muffled by the coastal islands.

3.5.1.2.2 Polar Bear

Polar bears (*Ursus maritimus*) have water-repellant white or yellowish coats, and large feet for swimming and walking on thin ice (ADF&G, 2015a). They also have smaller ears, narrower heads, and longer necks than other bears (ADF&G, 2015a). On average, males are 8 to 10 feet long and weigh 600 to 1,200 pounds; females weigh 400 to 700 pounds (ADF&G, 2015a). Females and males become sexually mature at 3 to 6 and 4 to 5 years of age, respectively. Polar bears breed during March through May (ADF&G, 2015a). Females typically reproduce every three years, creating dens in October and November in preparation for the cubs, birth in December or January (ADF&G, 2015a). Females may give birth to one to three cubs, but twins are most common. Cubs weigh 1 to 2 pounds at birth, but weigh approximately 20 to 25 pounds when they emerge from natal dens by late March or early April (ADF&G, 2015a). Cubs remain with their mother for about 2.5 years; otherwise, polar bears are solitary animals (ADF&G, 2015a). They primarily feed on ringed seals, but they will also consume bearded seals, walruses, and beluga whales (ADF&G, 2015a). The life expectancy of a polar bear is 25 years (ADF&G, 2015a). Polar bears are circumpolar and typically remain with the northern hemisphere pack ice as it seasonally advances and recedes (ADF&G, 2015a). However, some polar bears come on land to rest along the coast until the pack ice returns in the late fall (ADF&G, 2015a). Population size is difficult to estimate due to habitat, movement, and funding (USFWS, 2015a). The two Alaskan stocks, Southern Beaufort Sea and Chukchi/Bering Seas, are currently listed as ESA threatened and MMPA depleted (USFWS, 2015a; USFWS, 2015b).

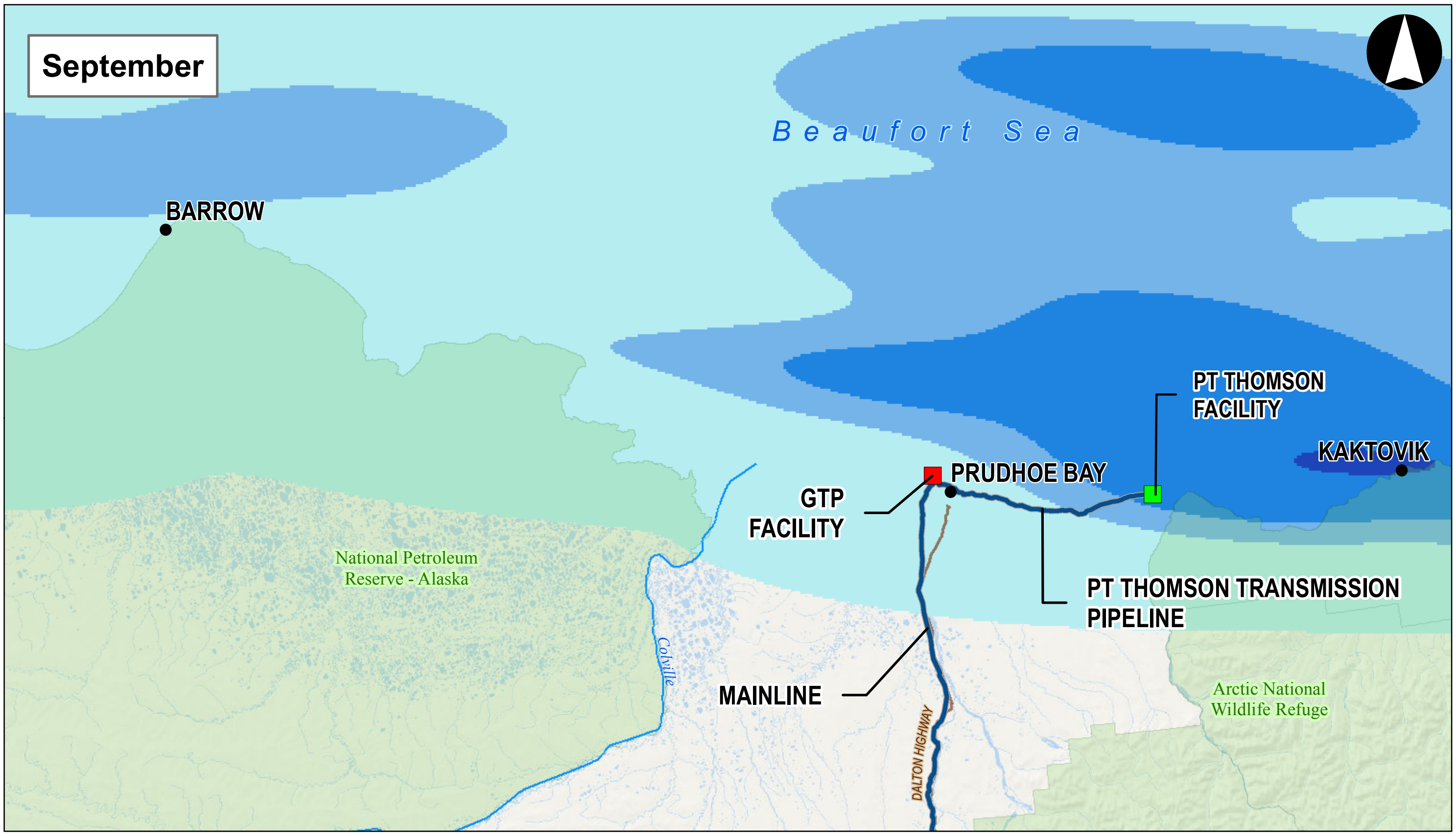
Polar bears were listed by the USFWS as a threatened species throughout their range in May 2008 (73 FR 28212) because the USFWS found that their principal habitat, sea ice, is declining. USFWS found that the decline is expected to continue for the foreseeable future and this loss threatens the polar bear throughout all of its range. Polar bears are also protected under the MMPA. In December 2010, the USFWS designated more than 187,000 square miles of polar bear critical habitat consisting of offshore sea ice, terrestrial denning habitat, and barrier islands (75 FR 76086). Parties challenged the critical habitat designation, and the district court vacated the designation in its entirety (Alaska Oil & Gas Assn v. Salazar, 916 F. Supp.2d 974 [D. Alaska 2013]). However, in February 2016, the Ninth Circuit reversed the district court's decision and remanded the case to the court for entry in favor of USFWS (Alaska Oil & Gas Assn v. Jewel, No. 13-35619 [9th Cir. 2016]). The critical habitat designation has been reinstated. Part of the Project area is presumed to be within polar bear critical habitat.

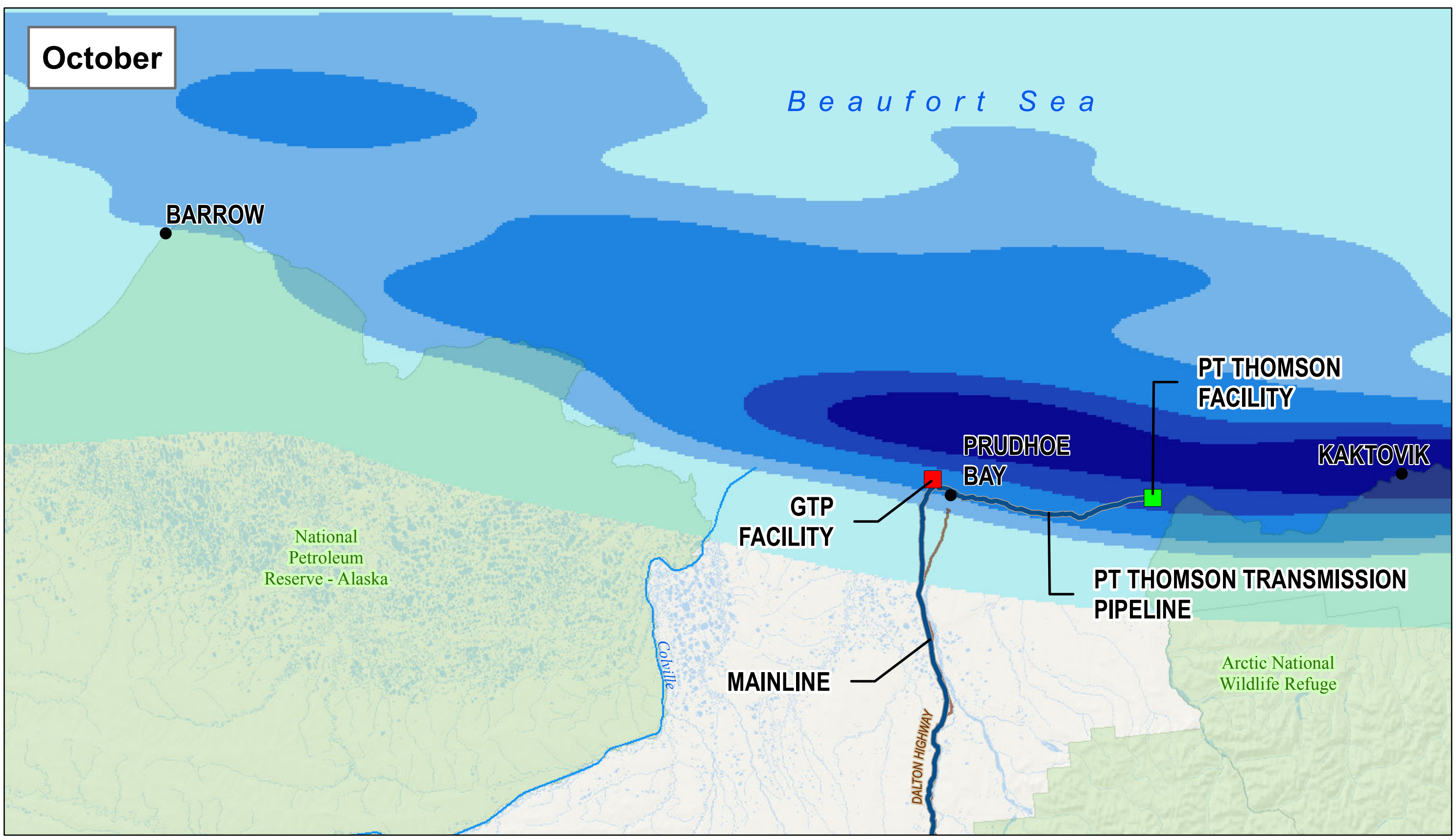
Polar bear distribution and movements are tied to seasonal sea ice dynamics, such that their range is limited to areas covered in sea ice for much of the year (Stirling et al., 1999). Habitat use changes seasonally with the formation, advance, movement, retreat, and melt of sea ice (Schliebe et al., 2008). During winter and spring, nondenning polar bears tend to concentrate in areas of ice with pressure ridges, at floe edges, and on drifting seasonal ice at least 8 inches thick (Schliebe et al., 2006). They use mostly shallow water areas on active ice with shear zones and leads (Durner et al., 2004). Mating usually occurs from March to late May or early June, when both sexes are active on the sea ice. During the pupping season of ringed seals in the spring, polar bears move into the landfast ice zone to hunt. In late summer and early autumn, they move to multiyear ice as the pack ice retreats (Durner et al., 2004; Ferguson et al., 2000). Pack ice is the primary summer habitat for Alaskan polar bears. Landfast ice is sea ice that is attached to the shore and usually reforms annually. However, landfast ice can also contain some floes of multi-year pack ice. Landfast ice has two constituent parts: bottomfast ice, which is frozen from the water surface to the seafloor and extends from the shoreline out to a depth of approximately 6.6 feet; and floating ice, which extends from the edge of the bottomfast ice out to water depths of 66–98 feet. Pack ice is located seaward of the grounded ice and consists of:

- First-year ice, ice that has survived one or more melt seasons;
- Multi-year floes and ridges; and
- Ice islands, icebergs that have calved from distant ice shelves.

Shear ice or the shear ice zone is found where interactions occur between the landfast ice and pack ice. Wind-driven ice movements between the landfast and pack ice result in rubble fields and ridges in the grounded ice.

Polar bears in the southern Beaufort Sea gather to feed at the butchering sites of harvested bowhead whales (e.g., Barter Island [Kaktovik], Cross Island, Barrow). Polar bear densities across the Alaskan central Beaufort Sea coast tend to be highest near Kaktovik in September and between Oliktok Point and the western border of the Arctic National Wildlife Refuge in October (Figure 3.5.1-3).





LEGEND

- Project Facility
- Existing Facility
- Alaska Place Names
- Alaska LNG Rev C2 Route
- Major Highways
- Major Rivers
- State and Federal Conservation Lands

Relative Density of Female Polar Bears (animals per km²)

- 0.00001 - 0.005
- 0.005 - 0.010
- 0.011 - 0.025
- 0.026 - 0.040
- 0.041 - 0.065

0 15 30 60 Miles

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RELATIVE FEMALE POLAR BEAR DENSITY DURING SEPTEMBER AND OCTOBER

FIGURE 3.5.1-3

ALASKA LNG

X:\AKLNG\Resource Reports\RR03\Figure 3_5_1-3 Relative Female Polar Bear Density During September and October.mxd

Adult male and nonpregnant female polar bears remain active all year, using temporary dens as shelter during severe weather. Most pregnant female polar bears of the southern Beaufort Sea stock construct and enter dens in mid-November, where they hibernate and give birth (Amstrup, 2000). Dens are excavated in compacted snow drifts on the pack ice or on coastal banks (barrier islands and mainland bluffs), river or stream banks, and other areas with at least 4 feet of vertical topographic relief that accumulate snow drifts (Durner et al., 2001, 2003, 2006). Dens are found most frequently near the edges of stable sea ice on the shoreward side of barrier islands, onshore in drifts along the coastline, and, to a lesser extent, along river or stream banks (Durner et al., 2003). Female polar bears do not necessarily return to the same den, but females tend to den on the same type of substrate (pack ice or land) from year to year and may return to the same general area (Amstrup and Gardner, 1994; Schliebe et al., 2006; Fischbach et al., 2007). Cubs remain with the females for about 2.5 years before weaning (DeMaster and Stirling, 1981; Amstrup et al., 2000). The presence and age of cubs affects female polar bear distribution and movements, as does the availability of ice suitable for hunting (Amstrup et al., 2000).

An analysis of den locations used by collared polar bears between 1985 and 2005 has documented shifts in den distributions from pack ice to land primarily in response to reduction in sea ice extent and delay in freeze-up in northern Alaska (Fischbach et al., 2007). The proportion of dens located on drifting pack ice decreased from 62 percent (1985-1994) to 37 percent (1998-2004), with proportionately fewer dens on pack ice in the western Beaufort Sea (Fischbach et al., 2007). Terrestrial areas with the appropriate configuration for accumulating snow drifts large enough for polar bear dens have been mapped across much of the Beaufort Coastal Plain Ecoregion portion of the Project area (Durner et al., 2001, 2003, 2006). The Project area with documented polar bear den sites in the vicinity of the Project footprint from 1910 through 2010 are shown in Figure 3.5.1-4.

Polar bears are more likely to move through the Beaufort Coastal Plain Ecoregion portion of the Project area in fall and winter, when bears are present along the entire Beaufort Sea coast from Demarcation Point to Point Barrow, although polar bears can occur within this area year-round. The PTTL would be constructed in a region that has supported previous polar bear den sites. The GTP would be surrounded by areas with ridges and bluffs that could provide den habitat. Gestating and subsequently post-parturient females can be present in dens (although not obvious) from late November through early April (Amstrup, 2000).

POLAR BEAR DEN SITES AND POTENTIAL DENNING HABITAT IN THE PROJECT AREA

FIGURE 3.5.1-4

ALASKA LNG

LEGEND

- Project Facility
- Existing Facility
- Alaska Place Names
- Polar Bear Maternal Den Sites 1910-2010
- Alaska LNG Rev C2 Route
- Potential Denning Habitat
- Major Highways

0 1.5 3 6 Miles

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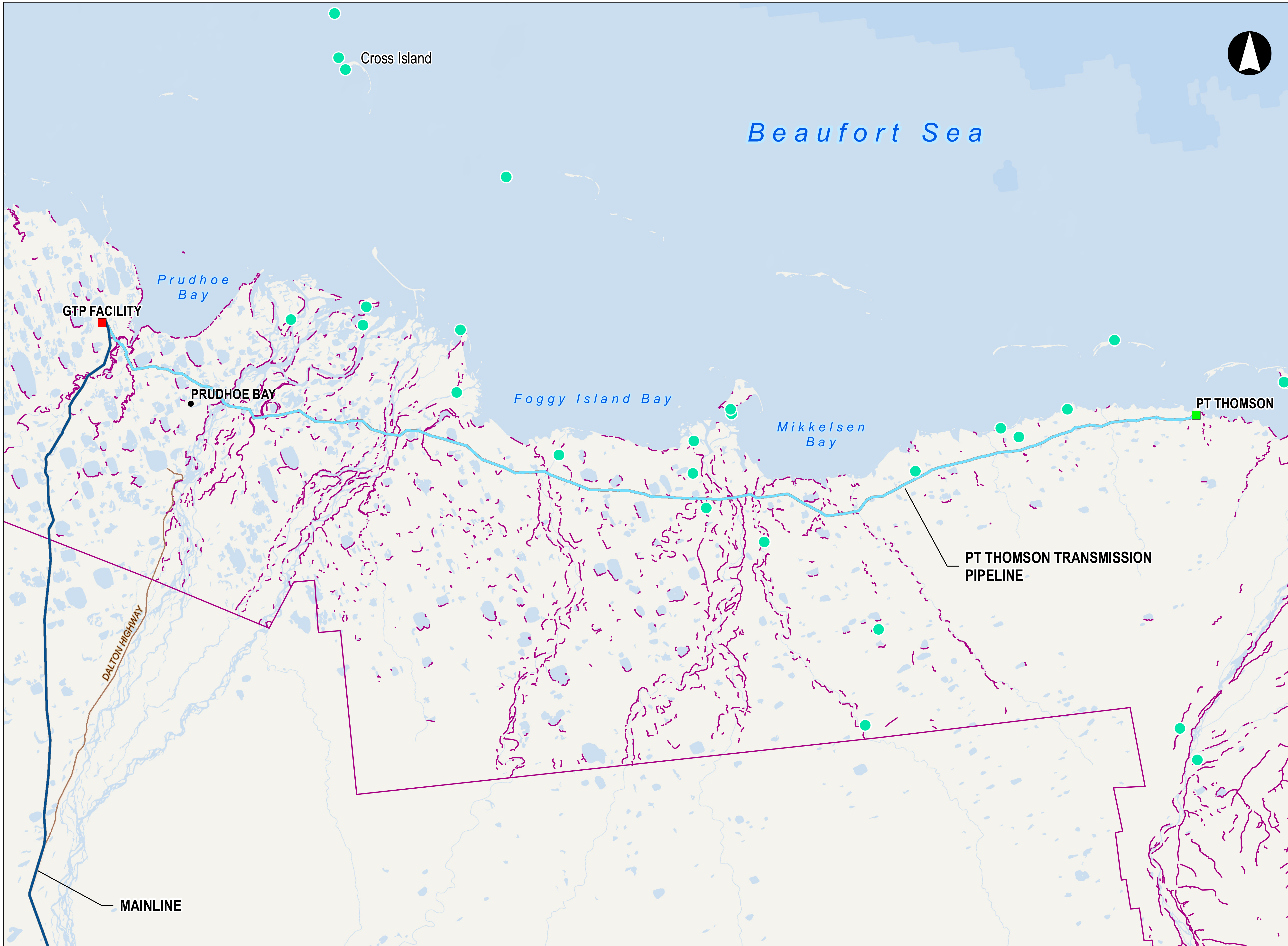
VICINITY MAP



X:\AKLNG\Resource Reports\RR03\Figure 3_5_1-4 Polar Bear Den Sites and Potential Denning Habitat in The Project Area.mxd

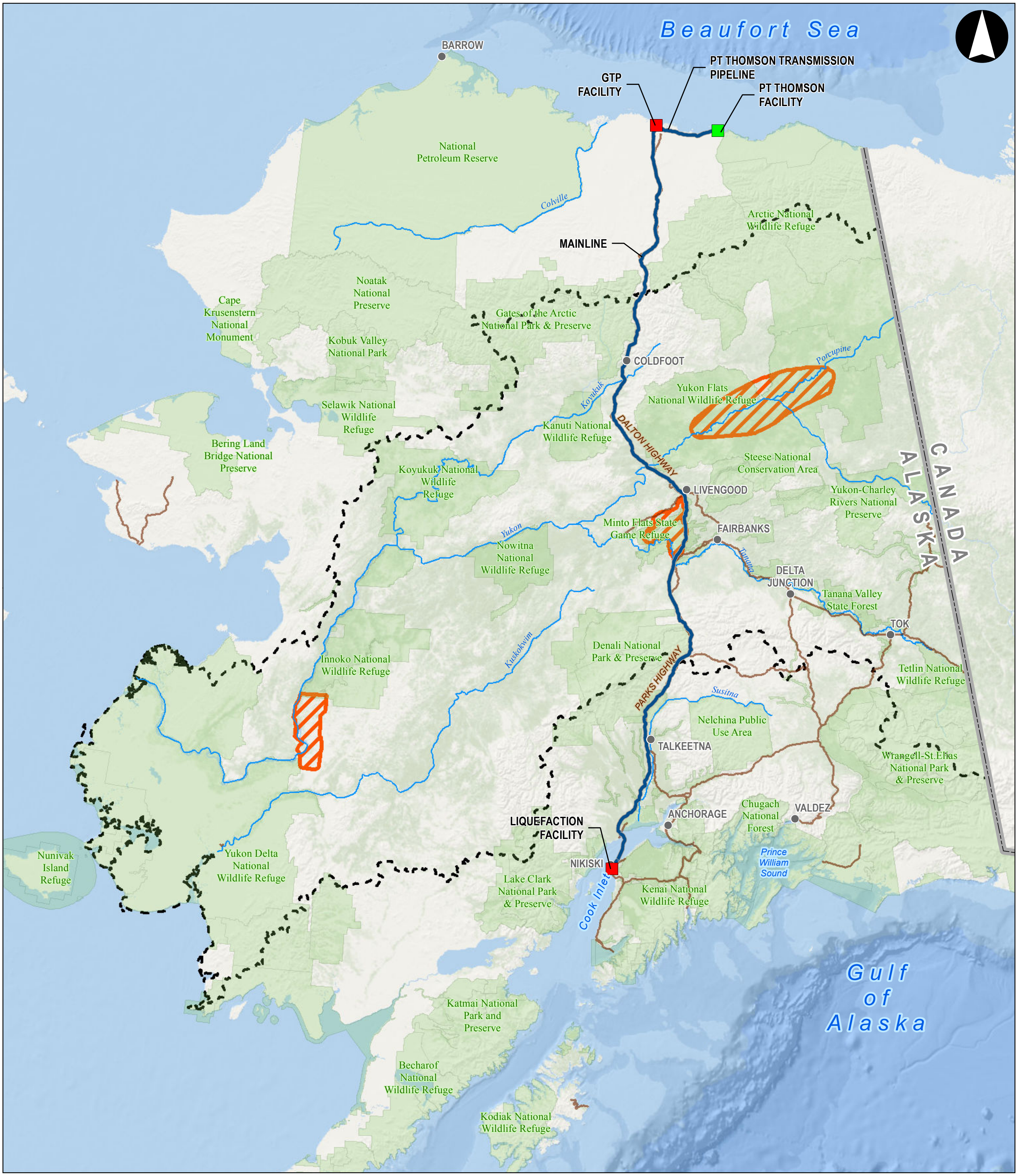
3.5.1.2.3 Wood Bison

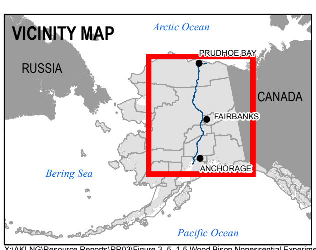
Wood bison (*Bison athabascae*) are one of the two subspecies of North American bison; they are larger, have a more pronounced hump, a forelock, and reduced chaps and beard compared to the plains bison (*Bison bison*), which have been reintroduced in Alaska beginning with establishment of the Delta Herd in 1928 (ADF&G, 2013a; Bruning, 2012). The ADF&G released about 100 wood buffalo near Shageluk in the lower Innoko River area in 2016 and plans to reintroduce wood bison into one or more areas including Yukon Flats, Minto Flats, and Yukon River area from the captive breeding herd at the Alaska Wildlife Conservation Center at Portage, Alaska (Figure 3.5.1-5; ADF&G, 2013a). In May 2014, USFWS issued a final rule designating reintroduced wood bison as a nonessential experimental population (79 FR 26175). Within the Nonessential Experimental Population (NEP) area and outside of national parks or wildlife refuges, reintroduced wood bison are considered a proposed species under ESA 10(j); within the national parks or wildlife refuge system, they are protected as a threatened species. The Mainline corridor would cross through the defined NEP area and near the proposed Minto Flats reintroduction site (Figure 3.5.1-5). Project construction and operation may coincide with wood bison reintroductions and a conference (Minto Flats: 86 percent state-owned Minto Flats State Game Refuge; 14 percent privately owned) or consultation (Yukon Flats: 63 percent federally owned Yukon Flats National Wildlife Refuge; 32 percent privately owned; 4 percent state owned) with USFWS would be required (ADF&G, 2013a). The wood bison NEP establishment rule allows for incidental take that may occur from oil and gas development and pipelines within the NEP area (79 FR 26175).

3.5.1.2.4 Spectacled Eider

Spectacled eiders (*Somateria fischeri*) were listed as threatened throughout their range under the ESA in May 1993 as a result of severely declining populations in western Alaska, and possible declining populations in northern Alaska and eastern Russia (58 FR 27474). The USFWS established a recovery plan for spectacled eiders in 1996 (USFWS, 1996). In 2010, a review of the species was completed that evaluated potential threats to recovery (USFWS, 2010c). Ongoing threats on the breeding ground are thought to include lead contamination, illegal harvest, and predation (USFWS, 2010c). Spectacled eiders spend a majority of their life cycle in marine habitats, but little information on current threats is available; future threats identified include climate change and offshore oil spills (USFWS, 2010c). Critical habitat was designated in 2001 for nesting on the Yukon-Kuskokwim Delta; for molting in Norton Sound and Ledyard Bay; and for wintering south of St. Lawrence Island (Figure 3.5.1-7; 66 FR 9146).

As illustrated in Figure 3.5.1-7, spectacled eiders nest on tundra habitats in Alaska's Beaufort Coastal Plain Ecoregion and in western Alaska, molt in coastal areas of the Chukchi and Bering seas, and while they do make use of polynyas in the Bering Sea during winter, they primarily exploit cracks and temporary leads in sea ice that is often otherwise continuous. These holes and leads are often kept open by the birds themselves as the drifting ice slowly transports wintering flocks of eiders across sections of seafloor that are densely populated with their preferred prey species: nuculana clams (Cooper et. al., 2003; Douglas and Peterson, 2004). The Beaufort Coastal Plain Ecoregion breeding population departs from wintering areas in the Bering Sea following spring leads and openings in the Bering and Chukchi seas, arriving in the Beaufort Coastal Plain Ecoregion from late May to early June (Petersen et al., 2000). Telemetry data indicate that spring migrant spectacled eiders remain within 31 miles from shore with first arrival on June 10 (Sexson et al., 2011).





LEGEND

- Project Facility
- Existing Facility
- Alaska Place Names
- Alaska LNG Rev C2 Route
- Major Highways
- Major Rivers
- State and Federal Conservation Lands
- Wood Bison Nonessential Experimental Population Area
- Wood Bison Proposed Reintroduction Sites

0 50 100 200 Miles

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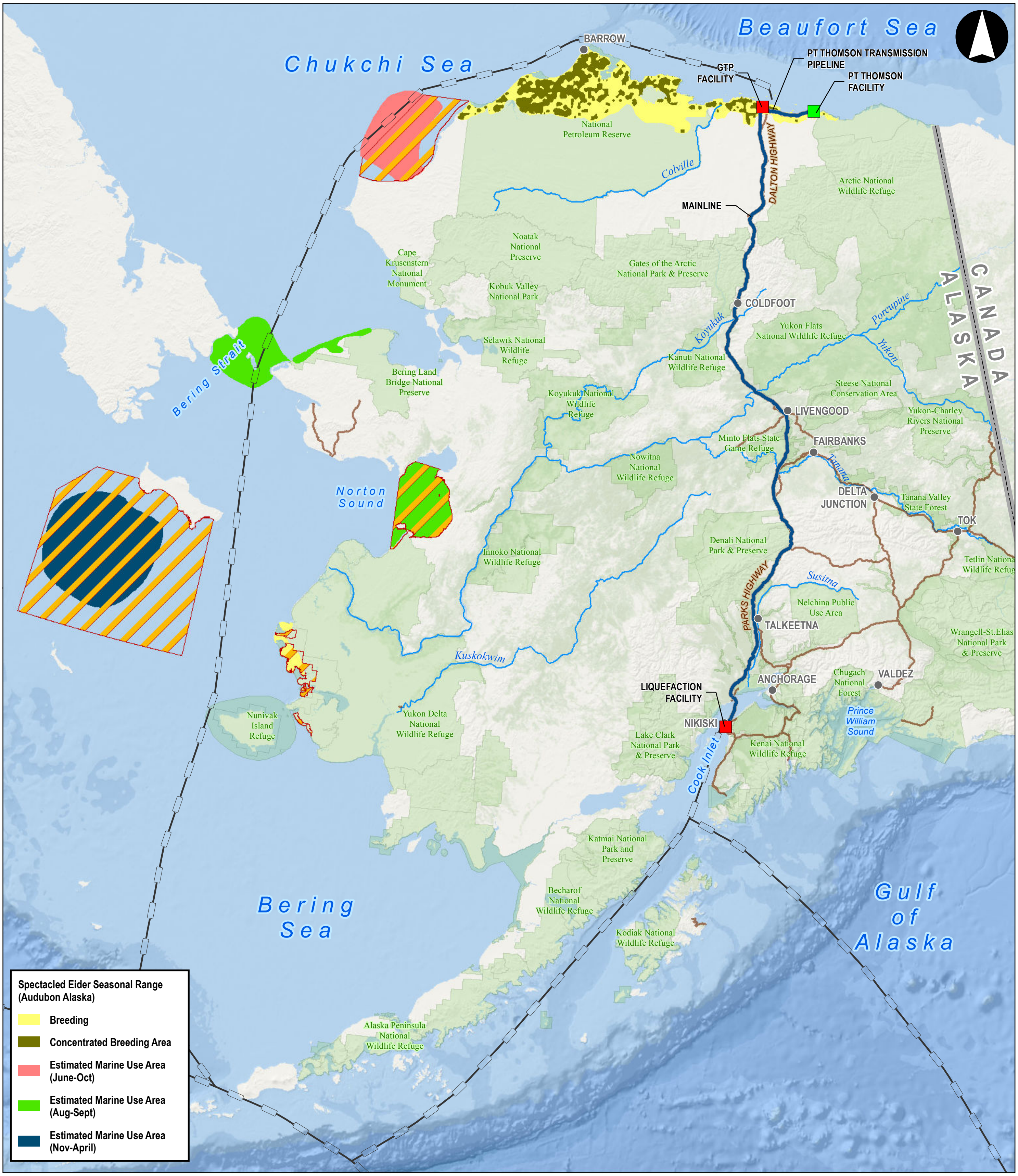
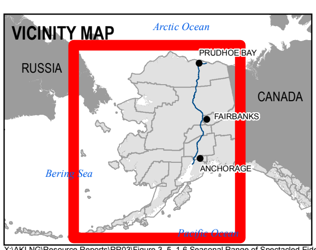
WOOD BISON NONESSENTIAL EXPERIMENTAL POPULATION AREA AND REINTRODUCTION SITE

FIGURE 3.5.1-5

ALASKA LNG

X:\AKLNG\Resource Reports\RR03\Figure 3_5_1-5 Wood Bison Nonessential Experimental Population Area and Reintroduction Site.mxd





LEGEND

- Project Facility
- Existing Facility
- Alaska Place Names
- Alaska LNG Rev C2 Route
- Major Highways
- Marine Transportation
- Major Rivers
- Critical Habitat of Spectacled Eider
- State and Federal Conservation Lands

0 50 100 200 Miles

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SEASONAL RANGE OF SPECTACLED EIDERS

FIGURE 3.5.1-6

ALASKA LNG

X:\AKLNG\Resource Reports\RR03\Figure 3_5_1-6 Seasonal Range of Spectacled Eiders.mxd

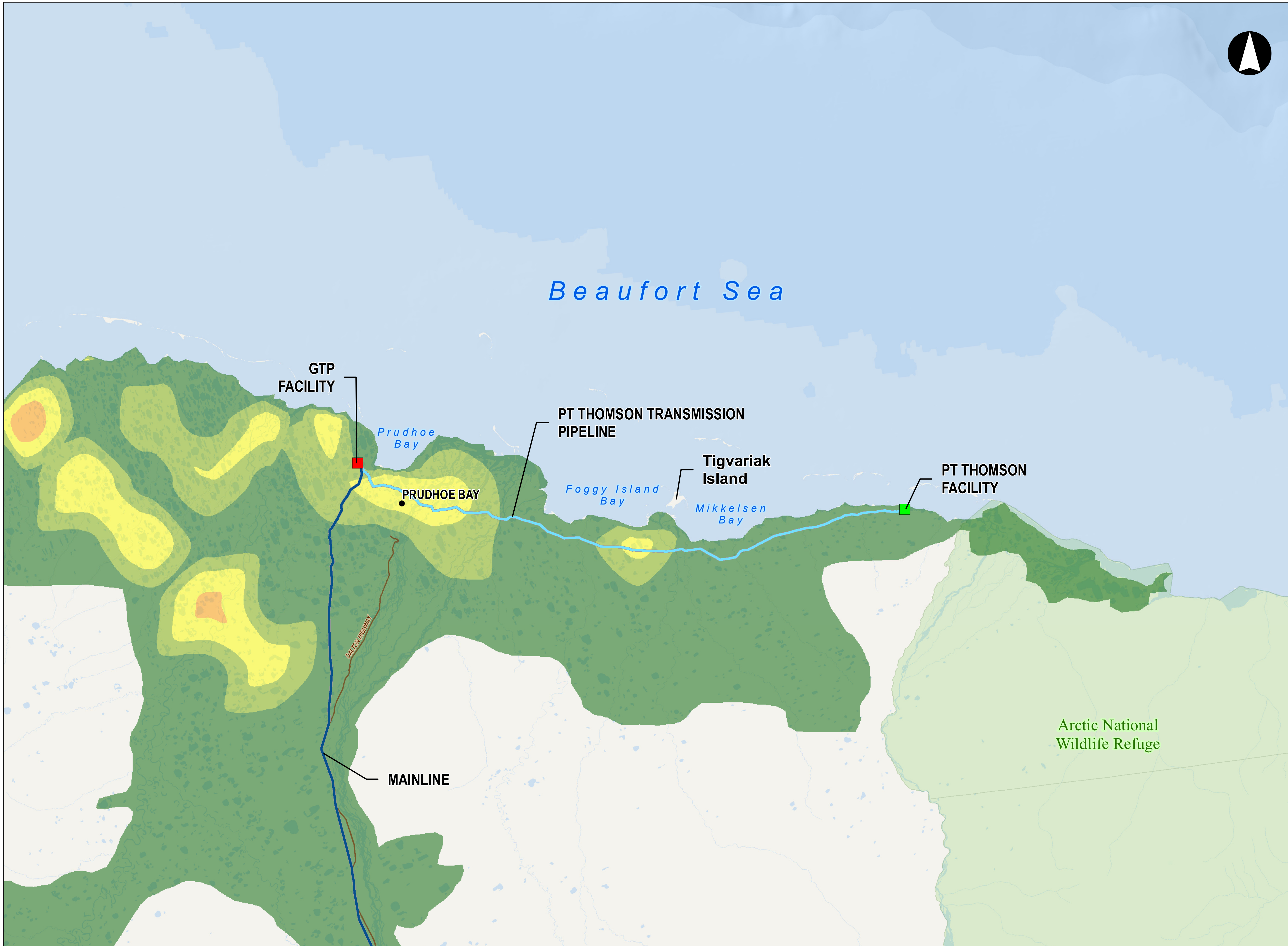
Established pairs migrate together to nesting grounds generally located within 12 miles from the coast where they use a variety of tundra habitat types (Petersen et al., 2000). Nests are generally constructed by the female and average 3 feet from water with many nests on shorelines, islands, or peninsulas (Petersen et al., 2000). Spectacled eider breeding density, based on 2009 to 2012 aerial breeding waterfowl surveys, is shown in Figure 3.5.1-7. Comparison of 2009 to 2012 density surfaces to previous density surfaces (Stehn et al., 2012) shows consistent moderate use of areas south and east of Prudhoe Bay, and southwest of Tigvariak Island (Figure 3.5.1-7). The female incubates the eggs for an average of 24 days and hatching begins in early July (Petersen et al., 2000). Broods are reared near water, where they feed on invertebrates along pond edges (Petersen et al., 2000).

After breeding, males move to nearshore marine waters in late June, where they undergo a complete molt of their flight feathers. Nesting females remain on the coastal tundra until late August to early September and then congregate to molt. Spectacled eiders breeding in Arctic Alaska primarily molt in Ledyard Bay, where males arrive in late June and remain through mid-October. Nonbreeding females or those with failed nests arrive in molting areas in late July, while successfully breeding females arrive in late August and stay through October. Movement between nesting and molting areas takes several weeks, and the eiders make several stops along the Beaufort and Chukchi Sea coasts. Concentrations of migrant spectacled eiders along the central Beaufort Sea include areas near West Dock, Harrison Bay, and Smith Bay (Sexson et al., 2011). After molting, eiders travel to their wintering areas where they remain from October through March (Figure 3.5.1-6).

SPECTACLED EIDER BREEDING PAIR DENSITY BASED ON 2009-2012 AERIAL BREEDING PAIR SURVEYS

FIGURE 3.5.1-7

ALASKA LNG



LEGEND

- Project Facility
- Existing Facility
- Alaska Place Names
- Alaska LNG Rev C2 Route
- Point Thomson Transmission Line (PTTL)
- Major Highways
- Major Rivers
- State and Federal Conservation Lands

Spectacled Eider - USFWS (2009-2012)
Est. Birds Per Sq Kilometer

- 0.000 - 0.028
- 0.028 - 0.111
- 0.011 - 0.236
- 0.236 - 0.425

0 3 6 12 Miles

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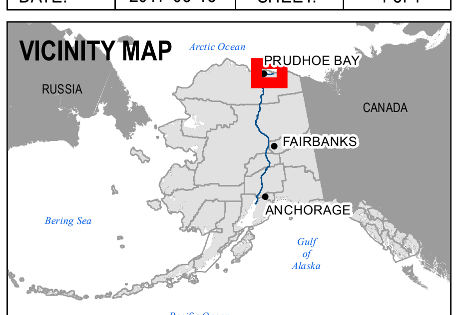
VICINITY MAP



X:\AKLNG\Resource Reports\RR03\Figure 3_5_1-7 Spectacled Eider Breeding Pair Density Based on 2009-2012 Aerial Breeding Pair Surveys.mxd

3.5.2 Special-Status Species

3.5.2.1 BLM-Sensitive and Watch List Species

In implementing its obligations under the FLPMA, BLM designates sensitive species and implements measures to conserve certain species and their habitats on BLM land. All federally designated candidate, proposed, and delisted species within the 5 years following their delisting are conserved as BLM-sensitive species. The Liquefaction Facility would not be located on BLM-managed lands. Interdependent Project Facilities would cross lands managed by BLM.

Tables 3.5.2-1 and 3.5.2-2 list the fish, mammals, and birds with potential to occur in the Project area that BLM has identified as sensitive on BLM-managed lands or that are on the watch list, which may occur on BLM-managed lands, but have not been documented. The Alaskan hare, included as a sensitive mammal on BLM's list for BLM-managed lands, occurs in western Alaska outside of the Project area.

3.5.2.1.1 Liquefaction Facility

One BLM sensitive fish may occur in streams near the Liquefaction Facility on the Kenai Peninsula, the Alaskan brook lamprey (*Lampetra alaskense*); however, the Liquefaction Facility is not within or near BLM lands.

3.5.2.1.2 Interdependent Project Facilities

The Alaskan brook lamprey may also occur in the Project area along the Mainline route (Table 3.5.2-1). The Alaskan brook lamprey is listed throughout its range in Alaska and may potentially occur in several drainages crossed by the Mainline.

TABLE 3.5.2-1

BLM Sensitive and Watch List Fish and Mammals Potentially Occurring in the Project Area

Common Name	Ecoregion	Presence in Project Area
Alaskan Brook Lamprey[a]	Tanana-Kuskokwim Lowlands; Alaska Range; Cook Inlet Basin	Rivers on the Kenai peninsula; Chatanika and Chena rivers.
Osgood's Arctic Ground Squirrel[a]	Yukon-Old Crow Basin, Yukon-Tanana Uplands – east of the Project area	Unlikely; potentially present in dry Arctic tundra, bluffs, rocky slopes and mountainous habitats
Alaska Tiny Shrew[a]	Brooks Range, Kobuk Ridges and Valleys, Ray Mountains, Yukon-Tanana Uplands, Tanana-Kuskokwim Lowlands, Alaska Range, Cook Inlet Basin;	Unknown; habitat preference unknown; boreal forest; tall shrub; grass; riparian zone; rocks, caves
Kenai Marten[a]	Cook Inlet Basin	Kenai Peninsula; mature old growth spruce communities with well-established understory and groundcover to support rodents and other prey

Sources: MacDonald and Cook, 2009; BLM, 2010; AKNHP, 2014a; ADF&G, 2014a
[a] Alaska BLM Sensitive Species
[b] Alaska BLM Sensitive Species Watch List

Nineteen birds are included on the BLM sensitive or watch list. Of these, 16 are potentially found in the Project area (Table 3.5.2-2). BLM-listed loons and shorebirds primarily occur in the wetlands and tidal flats of the Beaufort Coastal Plain Ecoregion and Cook Inlet Basin ecoregions, whereas listed passerines may occur in all ecoregions south of the Brooks Range. Murrelets only occur in the Cook Inlet Basin Ecoregion.

TABLE 3.5.2-2

BLM Sensitive and Watch List Birds Potentially Occurring in the Project Area

Common Name	Ecoregion	Potential Habitat
Yellow-billed Loon[a]	Beaufort Coastal Plain; marine waters	Freshwater lakes in the Arctic tundra of Alaska on the Beaufort Coastal Plain
Red-throated Loon[b]	Beaufort Coastal Plain, Brooks Foothills, Tanana-Kuskokwim Lowlands; Alaska Range; Cook Inlet Basin	Freshwater lakes and ponds
Red Knot[a]	Beaufort Coastal Plain; Cook Inlet Basin	Beaches and tidal flats in northern Alaska
Buff-Breasted Sandpiper[b]	Beaufort Coastal Plain	Alaskan tundra close to water
Hudsonian Godwit[b]	Alaska Range; Cook Inlet Basin	Open wet meadow or bogs intermixed with forest; beaches, tidal mudflats
Bar-Tailed Godwit[b]	Beaufort Coastal Plain	Arctic tundra
Golden Eagle[a]	Entire Project area	Mountain, bluffs in the foothill, along rivers
Short-eared Owl[a]	Entire Project area	Arctic tundra, bogs in Interior
Trumpeter Swan[a]	Kobuk Ridges and Valleys; Ray Mountains; Tanana-Kuskokwim Lowlands; Alaska Range; Cook Inlet Basin	Freshwater lakes and wetlands in the Interior
Olive-Sided Flycatcher[a]	Kobuk Ridges and Valleys; Ray Mountains; Tanana-Kuskokwim Lowlands; Alaska Range; Cook Inlet Basin	Bogs, shrublands, open forests
Blackpoll Warbler[a]	Kobuk Ridges and Valleys; Ray Mountains; Tanana-Kuskokwim Lowlands; Alaska Range; Cook Inlet Basin	Riparian shrub thickets and, or early successional spruce forests
Rusty Blackbird[a]	Kobuk Ridges and Valleys; Ray Mountains; Tanana-Kuskokwim Lowlands; Alaska Range; Cook Inlet Basin	Open spruce forests and woodlands
Townsend's Warbler[b]	Tanana-Kuskokwim Lowlands; Alaska Range; Cook Inlet Basin	Open and closed spruce forest
Gray-Cheeked Thrush[b]	Kobuk Ridges and Valleys; Ray Mountains; Tanana-Kuskokwim Lowlands; Alaska Range; Cook Inlet Basin	Shrublands, woodlands, and dwarf forests
Marbled Murrelet[a]	Cook Inlet Basin; Marine waters	Old growth forest; marine waters
Kittlitz's Murrelet[a]	Cook Inlet Basin; Marine waters	Coastal cliffs, barren ground, rock ledges, and talus above timberline in coastal mountains near glaciers; marine waters

Sources: BLM, 2010; AKNHP, 2014a
[a] Alaska BLM Sensitive Species
[b] Alaska BLM Sensitive Species Watch List

BLM maintains a list of sensitive plants known to occur on BLM-managed lands in Alaska and a separate watch list, which are rare plants that potentially occur on BLM lands, but have not been documented. These lists were used in conjunction with data received from the AKNHP, plant surveys conducted in the Project area (e.g., Carroll et al., 2003; Lipkin and Parker, 1995; Cortes-Burns et al., 2009), and Project biologists' knowledge of the Project area to develop a list of BLM sensitive and watch list plants that potentially occur in the Project area (Table 3.5.2-3).

TABLE 3.5.2-3

BLM Sensitive and Watch List Plants on BLM Lands Potentially Occurring in the Project Area

Facility	Location	Plants		Ecoregions[a]			Status			Distance to Nearest Facility (miles)	Distance to Pipeline (miles)
	Milepost	Common Name	Scientific Name	Arctic Tundra	Beringia Boreal	Alaska Range	Global Rank	State Rank	Federal Listings		
Mainline	MP 130	Muir's fleabane	*Erigeron muirii*	BLM			G2G3	S2S3	BLM Sensitive	0.02	1.22
	MP 212	Longstem Sandwort	*Arenaria longipedunculata*	BLM			G3G4Q	S3S4	BLM Watch	0.59	0.60
	MP 213	Longstem Sandwort	*Arenaria longipedunculata*	BLM			G3G4Q	S3S4	BLM Watch	0.38	0.39
	MP 229	Yukon Aster	*Symphyotrichum yukonense*	BLM			G3	S3	BLM Watch	1.08	1.10
	MP 229	Longstem Sandwort	*Arenaria longipedunculata*	BLM			G3G4Q	S3S4	BLM Watch	0.93	0.96
	MP 230	Longstem Sandwort	*Arenaria longipedunculata*	BLM			G3G4Q	S3S4	BLM Watch	0.19	0.20
	MP 230	Longstem Sandwort	*Arenaria longipedunculata*	BLM			G3G4Q	S3S4	BLM Watch	0.51	0.52
	MP 230	Yukon Aster	*Symphyotrichum yukonense*	BLM			G3	S3	BLM Watch	0.88	0.90
	MP 231	Field Locoweed	*Oxytropis tananensis*	BLM			GNR	S3S4Q	BLM Watch	0.21	0.23

Sources: AKNHP, 2014c; Nawrocki et al., 2013; NRCS, 2014

Note: **Plants indicated are reported occurrences within 1.9 miles of Project footprint.** Shaded rows indicate that rare plant observation was less than 0.25 miles from pipeline ROW or Nearest Facility

[a] Presence = X, Presence on BLM land = BLM

Status Codes:

G = Global, S = State

1 = Critically imperiled (typically 5 or fewer occurrences); 2 = Imperiled (6-20 occurrences); 3 = Vulnerable to extirpation or extinction (21-100 occurrences); 4 = Apparently secure (Usually more than 100 occurrences); 5 = Demonstrably secure; ? = Inexact numeric rank

3.5.2.2 USFWS Sensitive Species

3.5.2.2.1 Birds of Conservation Concern

3.5.2.2.1.1 Migratory Bird Treaty Act (MBTA)

Migratory birds include bird species that nest in the U.S. and Canada during the summer and migrate south to warmer regions of the U.S., Mexico, Central and South America, and the Caribbean for the winter. The Project footprint is located on the northern limits of the Pacific and Central flyways, which are important corridors for migratory birds during both spring and fall. Consequently, numerous migratory birds may occur within the Project area.

The MBTA, enacted in 1918, protects migratory birds within the U.S. Under provisions of the MBTA, except as authorized by the USFWS, it is illegal to pursue, hunt, take, capture, kill migratory birds, or attempt to take, capture, kill, or possess them. It is also illegal to offer for sale, export, import, or transport any migratory bird, part (e.g., feathers), nest, or egg of such birds. (16 USC § 703). The lead federal agency for the Project, FERC, finalized a Memorandum of Understanding (MOU) with the USFWS in March 2011, which includes commitments related to migratory birds and their habitat. Additional federal guidance relevant to the MBTA and the conservation of migratory bird populations includes Executive Order 13186, Responsibilities of Federal Agencies to Protect Migratory Birds, 66 Fed. Reg. 3853, (January 17, 2001); a December 2008 MOU between USFWS and the United States Forest Service (USFS); and an August 2010 MOU between USFWS and BLM.

Many migratory birds, including raptors, can be sensitive to disturbance when nesting and roosting, depending on site-specific conditions, including terrain, presence of trees, unrestricted line of sight, and adaption to development. Vegetation from the construction areas will be removed in the winter or during other parts of the year when the migratory birds are not nesting and roosting, prior to the planned construction season, such as trenching and pipeline installation. This removal avoids potential disturbance to nesting species due to construction activities.

3.5.2.2.1.2 Bald and Golden Eagle Protection Act (BGEPA)

The BGEPA provides additional protection to bald and golden eagles and their nests. It also prohibits the take, possession, sale, purchase, barter, offer to sell, purchase, or barter, transport, export or import of any bald or golden eagle, alive or dead, including any part, nest, or egg, unless allowed by permit (16 USC § 668[a]). Both bald and golden eagle occur in the Project area, from the Beaufort Sea coast to the Gulf of Alaska (ADF&G, 2016).

3.5.2.2.1.3 Fish and Wildlife Conservation Act (USFWS Birds of Conservation Concern)

The 1988 amendment to the Fish and Wildlife Conservation Act (FWCA) mandates that the USFWS "identify species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become candidates for listing under the ESA of 1973." The overall goal of the FWCA is to accurately identify the migratory and nonmigratory bird species (beyond those already designated as federally threatened or endangered) that represent the highest conservation priorities of the USFWS. Bird species considered for inclusion on lists in this resource report include nongame birds, gamebirds without hunting seasons, subsistence-hunted nongame birds in Alaska, and ESA candidate, proposed endangered or threatened, and recently delisted species.

The Project crosses two Bird Conservation Regions (BCRs): BCR 3 – Arctic Plains and Mountains and BCR 4 – Northwestern Interior Forest (NABCI, 2000). Nineteen bird species and subspecies in the Project area are currently designated as Birds of Conservation Concern in these regions (USFWS, 2008). These include: red-throated loon, yellow-billed loon, horned grebe, peregrine falcon, lesser yellowlegs, solitary sandpiper, upland sandpiper, whimbrel, Hudsonian godwit, bar-tailed godwit, red knot (*Calidris canutus roselaari*), rock sandpiper, dunlin (*Calidris alpine arcticola*), buff-breasted sandpiper, short-billed dowitcher, Arctic tern, olive-sided flycatcher, Smith's longspur, and rusty blackbird (Table 3.5.2-4; USFWS, 2008).

TABLE 3.5.2-4

USFWS Birds of Conservation Concern Potentially Occurring in the Project Area

Common Name	Ecoregions	Potential Habitat
Red-Throated Loon [b]	Beaufort Coastal Plain, Brooks Foothills, Tanana-Kuskokwim Lowlands; Alaska Range; Cook Inlet Basin	Freshwater lakes and ponds
Yellow-Billed Loon [b]	Beaufort Coastal Plain; marine waters	Large freshwater lakes in the Arctic tundra of Alaska in the Beaufort Coastal Plain
Horned Grebe [b]	Kobuk Ridges and Valleys, Ray Mountains; Tanana-Kuskokwim Lowlands; Alaska Range	Small to medium shallow ponds and marshes with emergent vegetation and open water
Spectacled Eider [a]	Beaufort Coastal Plain; marine waters	Sedge meadow tundra, shallow ponds and lakes (refer to Section 3.5)
Steller's Eider [a]	Beaufort Coastal Plain; marine waters	Coastal tundra adjacent to ponds with lake basins; edges of low-centered near ponds with emergent vegetation (refer to Section 3.5)
Bald Eagle [c]	Tanana-Kuskokwim Lowlands; Alaska Range; Cook Inlet Basin	Mature forests near large bodies of water; beaches; mudflats
Golden Eagle [c]	Entire Project area	Mountain, bluffs in the foothill, along rivers
Peregrine Falcon [b]	Every ecoregion in the Project area	Various open habitats especially near mountains
Lesser Yellowlegs [b]	Kobuk Ridges and Valleys; Ray Mountains; Tanana-Kuskokwim Lowlands; Alaska Range; Cook Inlet Basin	Muskeg and freshwater marshes in open boreal forests and forest-tundra transition habitats
Solitary Sandpiper [b]	Kobuk Ridges and Valleys, Ray Mountains; Tanana-Kuskokwim Lowlands; Alaska Range; Cook Inlet Basin	Wooded wetlands in muskeg bogs, spruce forests and deciduous riparian woodlands
Upland Sandpiper [b]	Kobuk Ridges and Valleys; Ray Mountains; Tanana-Kuskokwim Lowlands; Alaska Range; Cook Inlet Basin	Extensive open tracts of short grassland habitat; peatlands; scattered woodlands near timberline
Eskimo Curlew [a]	Brooks Foothills	Arctic tundra and open grasslands
Whimbrel [b]	Beaufort Coastal Plain, Brooks Foothills, Brookes Range, Kobuk Ridges and Valleys, Tanana-Kuskokwim Lowlands, Alaska Range; Cook Inlet Basin.	Wet, flat, dwarf shrub ridges and steep slopes; open tundra; beaches, marshes, estuaries, flooded fields
Hudsonian Godwit [b]	Alaska Range; Cook Inlet Basin	Open wet meadow or bogs intermixed with forest; beaches, tidal mudflats
Bar-Tailed Godwit [b]	Beaufort Coastal Plain	Arctic tundra
Red Knot [b]	Beaufort Coastal Plain; Cook Inlet Basin	Beaches and tidal flats in northern Alaska
Rock Sandpiper [b]	Cook Inlet Basin	Low elevation heath tundra; montane Subarctic tundra; open coastal mudflats

TABLE 3.5.2-4

USFWS Birds of Conservation Concern Potentially Occurring in the Project Area

Common Name	Ecoregions	Potential Habitat
Dunlin [b]	Beaufort Coastal Plain; Cook Inlet Basin	Moist wet tundra with ponds; coastal estuaries, bays, and seasonal wetlands
Buff-Breasted Sandpiper [b]	Beaufort Coastal Plain	Alaskan tundra close to water
Short-Billed Dowitcher [b]	Cook Inlet Basin	Muskegs; sedge meadow, sedge-hummock, bogs in floodplains; open coastal mudflats and ponds.
Arctic Tern [b]	Entire Project area	Open terrain near water; barrier beaches; glacial moraines; marshes, bogs and grassy meadows; tidal flats
Olive-Sided Flycatcher [b]	Ray Mountains; Tanana-Kuskokwim Lowlands; Alaska Range; Cook Inlet Basin	Bogs, shrublands, open forests
Smith's Longspur [b]	Brooks Foothills; Brooks Range Kobuk Ridges and Valleys; Alaska Range	Moist tussock meadows in alpine valleys, dry ridge tundra
Rusty Blackbird [b]	Kobuk Ridges and Valleys; Ray Mountains; Tanana-Kuskokwim Lowlands; Alaska Range; Cook Inlet Basin	Open spruce forests and woodlands

Source: USFWS, 2008; AKNHP, 2014a

[a] ESA listed, candidate, or proposed species (refer to Section 3.5 for more detail)

[b] USFWS Bird of Conservation Concern

[c] Species protected by BGEPA

BCR 3 – Arctic Plains and Mountains includes low-lying, coastal tundra and uplands within the Arctic Tundra Ecoregion, as described in Section 3.4.5.2. Permafrost across the region prevents infiltration of surface water which dominates the landscape, and the freeze-thaw cycle forms a patterned mosaic of polygon ridges and ponds. Because of the abundant wetlands, nesting waterbirds and shorebirds are abundant (NABCI, 2000).

BCR 4 – Northwestern Interior Forests includes an extensive patchwork of ecological types such as boreal forests; tall shrub communities along rivers, drainages, and near treeline; low shrub bogs and shrub-graminoid communities in the lowlands; and alpine dwarf scrub throughout mountainous regions (NABCI, 2000). This BCR spans the Intermountain Boreal Ecoregion and the Alaska Range Transition Ecoregion, as described in Section 3.4.5.2.

3.5.2.3 State-Sensitive Species

3.5.2.3.1.1 Endangered Species

ADF&G is responsible for determining and maintaining a list of endangered species in Alaska under AS 16.20.190. The state endangered species list currently includes two birds—short-tailed albatross and Eskimo curlew—and three marine mammals (blue whale, humpback whale, and right whale, see 3.5.1.1).

The Eskimo curlew is a large shorebird that formally migrated through eastern and northwestern Canada from wintering areas in South America to nest on the Arctic tundra. The Eskimo curlew no longer occurs in Alaska, and activities associated with the Project would have no effect on the Eskimo curlew. The other state-listed endangered species do not occur in the Project area.

3.5.2.3.1.2 Species of Special Concern

As of August 15, 2011, ADF&G no longer maintains a Species of Special Concern list (ADF&G, 2014b). The list has not been reviewed and revised since 1998 and is no longer considered to be in effect. ADF&G currently uses the *Alaska Wildlife Action Plan* to assess the needs of species with conservation concerns and to prioritize conservation actions and research (ADF&G, 2014b; ADF&G 2015c).

In August 2015, ADF&G published a draft updated *Wildlife Action Plan (WAP)* identifying wildlife conservation needs, suggesting appropriate actions to address those needs, and categorizing wildlife based on their role: stewardship, culturally important, economically important, ecologically important, sentinel, as well as at risk species (ADF&G, 2015c). ADF&G currently uses the Alaska WAP to assess the needs of species with conservation concerns and to prioritize conservation actions and research (ADF&G, 2014b; ADF&G 2015c). Stewardship fish and wildlife are those species (or subspecies) with a significant percentage (e.g., more than 60 percent) of their range or North American population within Alaska (ADF&G 2015c). Culturally important fish and wildlife are those animals that are important for subsistence purposes (e.g., harvest) as reported by ADF&G Division of Subsistence (ADF&G 2015c). Economically important fish and wildlife are those animals that are commercially harvested (ADF&G 2015c). Ecologically important fish and wildlife are those animals whose foraging impact habitat and vegetation, that are prey for other animals, or that exhibit control on the ecological community structure (ADF&G 2015c). Sentinel fish and wildlife are those animals that serve as indicators of environmental change or ecosystem health, including habitat loss and climate change (ADF&G 2015c). At risk species are those species categorized as critically endangered, endangered, vulnerable, or near threatened according to the ESA or IUCN Red List scoring rules (ADF&G 2015c).

The list of Species of Greatest Conservation Need developed in the draft *WAP* is intentionally large, including entire orders of some invertebrates and over 323 vertebrate species and subspecies, many of which may occur within the Project area that spans Alaska from the Beaufort Coastal Plain Ecoregion to Cook Inlet (ADF&G, 2015c). The *Alaska WAP* previously used the Alaska Species Ranking System to determine which species are in greatest need of conservation and to prioritize how to best meet the needs of Alaska's wildlife (ADF&G, 2006; Gotthardt et al., 2012). Of the 101 Priority I and II Red animals categorized by Gotthardt et al. (2012), 50 species may occur within the Project area, all of which are addressed in preceding sections as either common, federally protected, or sensitive animals.

3.5.3 Potential Construction and Operational Impacts and Mitigation Measures

3.5.3.1 Federally Listed Proposed, Threatened, Endangered, or Candidate Species

Potential construction and operation-related impacts and mitigation measures for federally listed species would be similar to those described in sections 3.4.10 and 3.4.11. The potential for specific Project impacts with preliminary conservation measures for federally-listed species are described in section 3.5.1 above, and the Project *BA* included as Appendix C. This section provides a brief overview for each species and the impacts on those species from construction and operations, whereas Appendix C provides a detailed analysis. Other federal agencies will review the BA once FERC has completed the draft BA with NMFS and USFWS. Rather than repeat these analyses here, the results of the preliminary assessments are summarized in Table 3.5.3-1.

TABLE 3.5.3-1

Summary of Potential Impacts and Mitigation for Federally Listed Proposed, Threatened, Endangered, and Candidate Species Potentially Occurring in the Project Action Area

Common Name with DPS or ESU	Federal Status	Detailed Analysis	Preliminary Findings[a]		Potential Habitat	Threats	Potential Impact	Proposed Mitigation
			Species	Critical Habitat				
MARINE MAMMALS – NMFS								
Beluga Whale, Cook Inlet *Delphinapterus leucas*	E	Yes	LAA	NLAA	Cook Inlet; associated with salmon runs, river deltas	Small population - catastrophic events; cumulative and synergistic effects of multiple stressors; and noise; disease agents; habitat loss or degradation;	Construction and operation noise and disturbance; vessel operations; spills. May impact Critical habitat with vessel traffic.	Letter of Authorization (LOA) – implement marine mammal monitoring and mitigation plans prepared in accordance with all local, state, and federal permits and authorizations stipulations. Typical mitigation measures could include: placing marine mammal monitors (protected species observers PSOs) on marine structures/docks; avoiding construction activities during sensitive marine mammal periods/seasons (i.e. breeding, calving, feeding, subsistence hunting; commercial fishing seasons); establishing ramp up and power-down procedures; and operating aircraft at maximum distances possible from marine mammal; implement *SPCC Plan*
Blue Whale *Balaenoptera musculus*	E	No	NLAA	ND	Gulf of Alaska, Bering Sea; pelagic	Vessel strikes; acoustic habitat degradation	Very low potential for vessel strikes	Implement marine mammal monitoring and mitigation plans prepared in accordance with all local, state, and federal permits and authorizations stipulations. Typical mitigation measures could include: placing marine mammal monitors (protected species observers PSOs) on marine structures/docks; avoiding construction activities during sensitive marine mammal periods/seasons (i.e. breeding, calving, feeding, subsistence

TABLE 3.5.3-1

Summary of Potential Impacts and Mitigation for Federally Listed Proposed, Threatened, Endangered, and Candidate Species Potentially Occurring in the Project Action Area

Common Name with DPS or ESU	Federal Status	Detailed Analysis	Preliminary Findings[a]		Potential Habitat	Threats	Potential Impact	Proposed Mitigation
			Species	Critical Habitat				
								hunting; commercial fishing seasons); establishing ramp up and power-down procedures; and operating aircraft at maximum distances possible from marine mammal; implement
Bowhead Whale *Balaena mysticetus*	E	Yes	NLAA	ND	Chukchi and Beaufort Seas; shelf waters	Vessel strikes	Construction noise, and disturbance, vessel operations, spills	Incidental Harassment Authorization (IHA) – implement marine mammal monitoring and mitigation plans prepared in accordance with all local, state, and federal permits and authorizations stipulations. Typical mitigation measures could include: placing marine mammal monitors (protected species observers PSOs) on marine structures/docks; avoiding construction activities during sensitive marine mammal periods/seasons (i.e. breeding, calving, feeding, subsistence hunting; commercial fishing seasons); establishing ramp up and power-down procedures; and operating aircraft at maximum distances possible from marine mammal; enter into a Conflict Avoidance Agreement process with Native whalers; implement *SPCC Plan*
Fin Whale *Balaenoptera physalus*	E	No	NLAA	ND	Gulf of Alaska, Bering and Chukchi seas; pelagic	Vessel strikes; fishing gear entanglement; habitat degradation (e.g., changes in prey distribution) and oil and gas activities	Very low potential for vessel strikes.	Implement marine mammal monitoring and mitigation plans prepared in accordance with all local, state, and federal permits and authorizations stipulations. Typical mitigation measures could include: placing marine mammal monitors (protected species

TABLE 3.5.3-1

Summary of Potential Impacts and Mitigation for Federally Listed Proposed, Threatened, Endangered, and Candidate Species Potentially Occurring in the Project Action Area

Common Name with DPS or ESU	Federal Status	Detailed Analysis	Preliminary Findings[a] Species	Preliminary Findings[a] Critical Habitat	Potential Habitat	Threats	Potential Impact	Proposed Mitigation
								observers PSOs) on marine structures/docks; avoiding construction activities during sensitive marine mammal periods/seasons (i.e. breeding, calving, feeding, subsistence hunting; commercial fishing seasons); establishing ramp up and power-down procedures; operating aircraft at maximum distances possible from marine mammal; and implement *SPCC Plan.*
Gray Whale, Western North Pacific DPS *Eschrichtius robustus*	E	No	NLAA	ND	Gulf of Alaska, Bering, Chukchi, and Beaufort seas; coastal shelf waters	Offshore oil and gas development in important feeding areas; fishing gear entanglement; industrialization and shipping congestion; pollution; vessel strikes	Very low potential for vessel strikes	Implement marine mammal monitoring and mitigation plans prepared in accordance with all local, state, and federal permits and authorizations stipulations. Typical mitigation measures could include: placing marine mammal monitors (protected species observers PSOs) on marine structures/docks; avoiding construction activities during sensitive marine mammal periods/seasons (i.e. breeding, calving, feeding, subsistence hunting; commercial fishing seasons); establishing ramp up and power-down procedures; and operating aircraft at maximum distances possible from marine mammal; implement *SPCC Plan*
Humpback Whale, Western Pacific DPS	T	No	NLAA	ND	Gulf of Alaska, Bering Sea;	Energy development; competition with	Very low potential for vessel strikes	Implement marine mammal monitoring and mitigation plans prepared in accordance with all local, state, and

TABLE 3.5.3-1

Summary of Potential Impacts and Mitigation for Federally Listed Proposed, Threatened, Endangered, and Candidate Species Potentially Occurring in the Project Action Area

Common Name with DPS or ESU	Federal Status	Detailed Analysis	Preliminary Findings[a]		Potential Habitat	Threats	Potential Impact	Proposed Mitigation
			Species	Critical Habitat				
Megaptera novaeangliae					pelagic and coastal	fisheries; fishing gear entanglement; vessel strikes		federal permits and authorizations stipulations. Typical mitigation measures could include: placing marine mammal monitors (protected species observers PSOs) on marine structures/docks; avoiding construction activities during sensitive marine mammal periods/seasons (i.e. breeding, calving, feeding, subsistence hunting; commercial fishing seasons); establishing ramp up and power-down procedures; operating aircraft at maximum distances possible from marine mammal; and implement *SPCC Plan*
North Pacific Right Whale *Eubalaena japonica*	E	No	NLAA	No Effect	Gulf of Alaska, Bering Sea; pelagic	Vessel strikes; fishing gear entanglement; acoustic habitat degradation	Very low potential for vessel strikes	Implement marine mammal monitoring and mitigation plans prepared in accordance with all local, state, and federal permits and authorizations stipulations. Typical mitigation measures could include: placing marine mammal monitors (protected species observers PSOs) on marine structures/docks; avoiding construction activities during sensitive marine mammal periods/seasons (i.e. breeding, calving, feeding, subsistence hunting; commercial fishing seasons); establishing ramp up and power-down procedures; operating aircraft at maximum distances possible from marine mammal; and implement *SPCC Plan*

TABLE 3.5.3-1

Summary of Potential Impacts and Mitigation for Federally Listed Proposed, Threatened, Endangered, and Candidate Species Potentially Occurring in the Project Action Area

Common Name with DPS or ESU	Federal Status	Detailed Analysis	Preliminary Findings[a] Species	Preliminary Findings[a] Critical Habitat	Potential Habitat	Threats	Potential Impact	Proposed Mitigation
Sei Whale *Balaenoptera borealis*	E	No	NLAA	ND	Gulf of Alaska; pelagic	Vessel strikes; fishing gear entanglement	Very low potential for vessel strikes	Implement marine mammal monitoring and mitigation plans prepared in accordance with all local, state, and federal permits and authorizations stipulations. Typical mitigation measures could include: placing marine mammal monitors (protected species observers PSOs) on marine structures/docks; avoiding construction activities during sensitive marine mammal periods/seasons (i.e. breeding, calving, feeding, subsistence hunting; commercial fishing seasons); establishing ramp up and power-down procedures; operating aircraft at maximum distances possible from marine mammal; implement *SPCC Plan*
Sperm Whale *Physeter macrocephalus*	E	No	NLAA	ND	Gulf of Alaska, Bering Sea; pelagic	Vessel strikes; fishing gear entanglement; acoustic habitat degradation	Very low potential for vessel strikes	Implement marine mammal monitoring and mitigation plans prepared in accordance with all local, state, and federal permits and authorizations stipulations. Typical mitigation measures could include: placing marine mammal monitors (protected species observers PSOs) on marine structures/docks; avoiding construction activities during sensitive marine mammal periods/seasons (i.e. breeding, calving, feeding, subsistence hunting; commercial fishing seasons); establishing ramp up and power-down procedures; operating aircraft and

TABLE 3.5.3-1

Summary of Potential Impacts and Mitigation for Federally Listed Proposed, Threatened, Endangered, and Candidate Species Potentially Occurring in the Project Action Area

Common Name with DPS or ESU	Federal Status	Detailed Analysis	Preliminary Findings[a]		Potential Habitat	Threats	Potential Impact	Proposed Mitigation
			Species	Critical Habitat				
								vessels at maximum distances possible from marine mammal; implement *SPCC Plan*
Steller Sea Lion, Western DPS *Eumetopias jubatus*	E	Yes	NLAA	NLAA	Gulf of Alaska, Cook Inlet, Bering Sea; coastal	Vessel strikes; vessel groundings with oil spills; fishing gear entanglement	Low potential for construction noise, and disturbance; summer dredging; vessel operations, spills	LOA – implement marine mammal monitoring and mitigation plans prepared in accordance with all local, state, and federal permits and authorizations stipulations. Typical mitigation measures could include: placing marine mammal monitors (protected species observers PSOs) on marine structures/docks; avoiding construction activities during sensitive marine mammal periods/seasons (i.e. breeding, calving, feeding, subsistence hunting; commercial fishing seasons); establishing ramp up and power-down procedures; operating aircraft at maximum distances possible from marine mammal; implement *SPCC Plan*
MARINE MAMMALS – USFWS								
Northern Sea Otter, Southwest Alaska DPS *Enhydra lutris kenyoni*	T	Yes	NLAA	NLAA	Gulf of Alaska, Cook Inlet; coastal	Predation; overharvest; fishery interactions; disease; oil spills	Low potential for construction noise, and disturbance; summer dredging; vessel operations, spills	LOA – implement marine mammal monitoring and mitigation plans prepared in accordance with all local, state, and federal permits and authorizations stipulations. Typical mitigation measures could include: placing marine mammal monitors (protected species observers PSOs) on marine structures/docks; avoiding construction activities during sensitive

TABLE 3.5.3-1

Summary of Potential Impacts and Mitigation for Federally Listed Proposed, Threatened, Endangered, and Candidate Species Potentially Occurring in the Project Action Area

Common Name with DPS or ESU	Federal Status	Detailed Analysis	Preliminary Findings[a] Species	Preliminary Findings[a] Critical Habitat	Potential Habitat	Threats	Potential Impact	Proposed Mitigation
								marine mammal periods/seasons (i.e. breeding, feeding, subsistence hunting; commercial fishing seasons); establishing ramp up and power-down procedures; operating aircraft at maximum distances possible from marine mammal; implement *SPCC Plan*
Pacific Walrus *Odobenus rosmarus divergens*								
Polar Bear *Ursus maritimus*	T	Yes	LAA	ND	Beaufort Sea, Beaufort Coastal Plain Ecoregion; land, nearshore, sea ice	Loss of sea ice	Construction and operation activities; habitat disturbance; human interaction; spills	Implement *Wildlife Avoidance and Interaction Plan*; LOA – implement marine mammal monitoring and mitigation plans prepared in accordance with all local, state, and federal permits and authorizations stipulations. Typical mitigation measures could include: placing marine mammal monitors (protected species observers PSOs) on marine structures/docks; avoiding construction activities during sensitive marine mammal periods/seasons (i.e. breeding, calving, feeding, subsistence hunting; commercial fishing seasons); establishing ramp up and power-down procedures; operating aircraft at maximum distances possible from marine mammal; implement *SPCC Plan*.

TABLE 3.5.3-1

Summary of Potential Impacts and Mitigation for Federally Listed Proposed, Threatened, Endangered, and Candidate Species Potentially Occurring in the Project Action Area

Common Name with DPS or ESU	Federal Status	Detailed Analysis	Preliminary Findings[a]		Potential Habitat	Threats	Potential Impact	Proposed Mitigation
			Species	Critical Habitat				
								Polar bear den surveys would be conducted prior to conducted blasting or other work with heavy equipment. Work is not allowed within 1 mile of a denning polar bear.
TERRESTRIAL MAMMALS – USFWS								
Wood Bison, Nonessential Experimental Population *Bison athabascae*	T		No Effect	ND	Lower Innoko/Yukon River	Habitat loss; predation	Very low potential for vehicle strikes	Implement wildlife interaction and avoidance plan prepared in accordance with all with all local, state, and federal permits and authorizations stipulations. Typical wildlife vehicle collision mitigation measures could include: consistent vegetation and snow removal along road system; signage; wildlife safety education training of workers; traveling at low speeds; stopping at sight of terrestrial mammals; and use of bear guards/wildlife safety specialists during construction and operations as appropriate
BIRDS – USFWS								
Eskimo Curlew Numenius borealis	E	No	No Effect	ND	Considered extirpated	Habitat loss; vessel or vehicle collisions; oil spills; contaminants	None	None proposed
Short-tailed Albatross *Phoebastria albatrus*	E	No	No Effect	ND	Gulf of Alaska, Bering Sea; pelagic	Small population – catastrophic events; ocean regime shift; fishery gear	Very low potential for vessel strikes	Typical mitigation measures could include vessel streamer (bird-scaring) lines, acoustic deterrents, water cannon); ensure proper food and waste

TABLE 3.5.3-1

Summary of Potential Impacts and Mitigation for Federally Listed Proposed, Threatened, Endangered, and Candidate Species Potentially Occurring in the Project Action Area

Common Name with DPS or ESU	Federal Status	Detailed Analysis	Preliminary Findings[a]		Potential Habitat	Threats	Potential Impact	Proposed Mitigation
			Species	Critical Habitat				
						entanglement; contaminants; ingestion of plastics; vessel collision; oil spills		management (cover and secured waste) on vessels and docks to limit bird attractants
Spectacled Eider Somateria fischeri	T	Yes	LAA	NLAA	Beaufort Coastal Plain Ecoregion, coastal Chukchi and Beaufort Sea waters nesting and migration	Declining population; lead contamination; illegal harvest; predation; vessel or vehicle collisions; oil spills; contaminants	Construction and operation activities; habitat loss; collision mortality; spills	Typical mitigation measures include: reduce habitat loss and disturbance; identify habitat using radio and satellite telemetry to identify nesting and: brood-rearing areas and bird movements relative to facilities and identify molting, staging, and wintering areas; follow recommended guidance for towers and lighting; ensure proper food and waste management (cover and secure waste to prevent bird predator increase); use visual (colors) bird deterrents; implement nest-structure program in approved locations to deter nesting in Project area; reducing operation and construction activities during the nesting season; conduct bird nest surveys prior to construction in nesting season; Maintaining minimum flight altitudes to prevent disturbances; implement SPCC Plan
Steller's Eider, Alaska-breeding Population *Polysticta stelleri*	T	Yes	NLAA	NLAA	Beaufort Coastal Plain Ecoregion, coastal Chukchi and Beaufort Sea	Declining population; illegal harvest; predation; vessel or vehicle collisions; oil spills; contaminants	Construction and operation activities; vessel operations; collision mortality	Typical mitigation measures include: reduce habitat loss and disturbance; conduct bird nest surveys prior to construction in nesting season; identify habitat using radio and satellite telemetry to identify nesting and brood-

TABLE 3.5.3-1

Summary of Potential Impacts and Mitigation for Federally Listed Proposed, Threatened, Endangered, and Candidate Species Potentially Occurring in the Project Action Area

Common Name with DPS or ESU	Federal Status	Detailed Analysis	Preliminary Findings[a]		Potential Habitat	Threats	Potential Impact	Proposed Mitigation
			Species	Critical Habitat				
					waters nesting and migration, coastal Cook Inlet waters in winter			rearing areas and bird movements relative to facilities and identify molting, staging, and wintering areas; follow recommended guidance for towers and lighting; ensure proper food and waste management (cover and secure waste to prevent bird predator increase); use visual (colors) bird deterrents; implement nest-structure program in approved locations to deter nesting in Project area; reducing operation and construction activities during the nesting season; Maintaining minimum flight altitudes to prevent disturbances; implement *SPCC Plan*
FISH – NMFS								
Chinook Salmon 6 ESUs* *Oncorhynchus tshawytscha*	T/E	No	NLAA	No Effect	Gulf of Alaska, Aleutian Islands, Bering Sea, coastal and pelagic	Freshwater spawning habitat loss; displacement by hatchery stock; overharvest	Very low potential for vessel disturbance	Typical mitigation measures include: reduce impacts to fish and fish habitat by reducing impacts to water quality: limit turbidity and sedimentation from construction activities (i.e. minimizing length of time equipment is in the water; use of oil water separators for vessel deck drainage; use open-cut isolation method to reduce sedimentation dispersal/turbidity; use temporary bridges to reduce erosion of stream banks; implement *SPCC Plan*
Steelhead Trout 6 DPSs*	T/E	No	NLAA	No Effect	Gulf of Alaska, Aleutian Islands,	Freshwater spawning habitat loss; overharvest	Very low potential for	Typical mitigation measures include: reduce impacts to fish and fish habitat by reducing impacts to water quality: limit turbidity and sedimentation from

TABLE 3.5.3-1

Summary of Potential Impacts and Mitigation for Federally Listed Proposed, Threatened, Endangered, and Candidate Species Potentially Occurring in the Project Action Area

Common Name with DPS or ESU	Federal Status	Detailed Analysis	Preliminary Findings[a] Species	Preliminary Findings[a] Critical Habitat	Potential Habitat	Threats	Potential Impact	Proposed Mitigation
Oncorhynchus mykiss					coastal and pelagic		vessel disturbance	construction activities (i.e. minimizing length of time equipment is in the water; use of oil water separators for vessel deck drainage; use open-cut isolation method to reduce sedimentation dispersal/turbidity; use temporary bridges to reduce erosion of stream banks; implement *SPCC Plan*

Source: NMFS, 2015e; USFWS, 2014a; Appendix C

C = Candidate, DPS = Distinct Population Segment, E = Endangered, ESU = Evolutionarily Significant Unit, N = None, T = Threatened

[a] NLAA – May affect, not likely to adversely affect

NLAM – Not likely to adversely modify.

LAA – May affect, likely to adversely affect.

NLJ – Not likely to jeopardize continued existence

ND – No critical habitat designated

[b] On July 25, 2014, the U.S. District Court for the District of Alaska issued a memorandum decision in a lawsuit challenging the listing of bearded seals under the ESA (Alaska Oil and Gas Association v. Pritzker, Case No. 4:13-cv-00018-RRB). The decision vacated NMFS's listing of the Beringia DPS of bearded seals as a threatened species. NMFS filed an appeal for that decision in May 2015. In the interim, under section 7(a)(2) of the ESA NMFS continues to address effects to bearded seals, even though the listing of this species is not in effect.

*These fish/stocks spawn on the West Coast outside of Alaska, but may occur in lower Cook Inlet and Gulf of Alaska waters during the marine phase of their life cycle.

Note that effects to Critical Habitats is addressed in Appendix C.

3.5.3.2 Special-Status Species

3.5.3.2.1 BLM-Sensitive and Watch List Species

Potential construction and operation-related impacts and mitigation measures for BLM Sensitive and Watch List Species would be similar to those described in sections 3.2.7 and 3.2.8; sections 3.3.7 and 3.3.8; and sections 3.4.10 and 3.4.11. The potential for specific Project-related impacts for BLM Sensitive and Watch List Species are presented in Table 3.5.3-2. Mitigation has not been developed specifically for these species as it is not required, although mitigation developed to protect fish, vegetation, and wildlife would also generally be protective of BLM Sensitive and Watch List Species.

TABLE 3.5.3-2

Summary of Potential Impacts and Mitigation for BLM Sensitive and Watch-List Species Potentially Occurring in the Project Area

Common Name Scientific Name	Group	Ecoregions	Breeding Habitat/Nesting Season	Occurrence of Preferred Breeding Habitat in Project Area	Potential Impacts	Proposed Mitigation
Alaskan Brook Lamprey[a] *Lampetra alaskense*	Fish	TKL, AR, CIB	Rivers on the Kenai Peninsula, Chatanika and Chena rivers.	Likely – multiple stream crossings within range	Stream crossings; hydrostatic testing,	See sections 3.2.7 and 3.2.8
Osgood's Arctic Ground Squirrel[a] *Spermophilus parryii*	Mammals – Rodents	YTU – east of the Project area	Potentially present in dry Arctic tundra, bluffs, rocky slopes and mountainous habitats	Unlikely, range is east of the Project area	None	None proposed
Alaska Tiny Shrew[a] *Sorex yukonicus*	Mammals – Shrews	BR, KRV, RM, YTU, TKL, AR, CIB	Habitat preference unknown; boreal forest; tall shrub; grass; riparian zone; rocks, caves Unknown – shrews generally have several litters of 5 to 8 per year, rarely live more than 18 months	Possible – range is widespread but scarce, includes the Project area	Construction disturbance, collision injury, mortality	None Proposed
Kenai Marten[a] *Martes americana kenaiensis*	Mammals – Weasels	CIB	Mature old growth spruce communities with well-established understory and ground cover to support rodents and other prey	Possible – limited impacts to old growth spruce forests	Construction disturbance, collision injury, mortality	None Proposed
Red-throated Loon[b] *Gavia stellata*	Birds – Loons and Grebes	BCP, BF, TKL, AR, CIB	Nests on ground in low-lying wetlands usually on margins of shallow pond Breeds/Nests from May through September	Likely – Breeding/ nesting habitat present; confirmed observation in vicinity based on USFWS Surveys and BBS	Construction disturbance, habitat impacts; vessel or vehicle collisions; oil spills; contaminants	See Appendix E
Yellow-billed Loon[a] *Gavia adamsii*	Birds – Loons and Grebes	BCP, marine waters	Nests on ground on margins or peninsulas of lakes – usually large Arctic lakes Breeds/Nests from June through September	Likely – Breeding/ nesting habitat present; confirmed observations in vicinity based on USFWS Surveys and BBS	Construction disturbance, habitat impacts; vessel or vehicle collisions; oil spills; contaminants	See Appendix E

TABLE 3.5.3-2

Summary of Potential Impacts and Mitigation for BLM Sensitive and Watch-List Species Potentially Occurring in the Project Area

Common Name Scientific Name	Group	Ecoregions	Breeding Habitat/Nesting Season	Occurrence of Preferred Breeding Habitat in Project Area	Potential Impacts	Proposed Mitigation
Trumpeter Swan [a] *Cygnus buccinator*	Birds - Waterfowl	KRV, RM, TKL, AR, CIB	Nests on mat of vegetation constructed on muskrat or beaver houses, or on foundation built by pair usually in emergent vegetation Breeds/Nests from May through September	Likely – Breeding/ nesting habitat present; confirmed observations within 0.5 miles from USFWS Surveys	Construction disturbance, habitat impacts; vessel or vehicle collisions; oil spills; contaminants	See Appendix E
Golden Eagle [a] *Aquila chrysaetos*	Birds – Raptors	Entire Project area	Nests usually on cliffs, may also use trees Breeds/Nests from April through August	Likely – Breeding/ nesting habitat present; confirmed nesting in vicinity potential nests within 0.5 miles based on 2015 raptor survey	Construction disturbance, habitat impacts; vehicle collisions; oil spills; contaminants	Eagle Permits See Appendix E
Short-eared Owl [a] *Asio flammeus*	Birds - Owls	Entire Project area	Nests on ground in herbaceous cover, tundra in northern Alaska and bogs or marshes in Interior or Southcentral Alaska Breeds/Nests from mid-March through June	Likely – Breeding/ nesting habitat present; multiple confirmed observations based on BBS	Construction disturbance, habitat impacts; vehicle collisions; oil spills; contaminants	See Appendix E
Bar-Tailed Godwit [b] *Limosa lapponica baueri*	Birds – Shorebirds	BCP	Nests on ground in sedge and/or dwarf shrub tundra, moist tussock tundra near wetlands Breeds/Nests from late-May through mid-August	Possible – Breeding/ nesting habitat present; has been observed nesting at Prudhoe Bay	Construction disturbance, habitat impacts; vessel or vehicle collisions; oil spills; contaminants	See Appendix E
Buff-Breasted Sandpiper [b] *Calidris subruficollis*	Birds – Shorebirds	BCP	Nests on ground in moist or wet sedge-graminoid meadows, occasionally on dry prostrate scrub habitat, males display on leks Breeds/Nests from June through August	Possible – Breeding/ nesting habitat present; has been observed nesting at Prudhoe Bay	Construction disturbance, habitat impacts; vessel or vehicle collisions; oil spills; contaminants	See Appendix E

TABLE 3.5.3-2

Summary of Potential Impacts and Mitigation for BLM Sensitive and Watch-List Species Potentially Occurring in the Project Area

Common Name Scientific Name	Group	Ecoregions	Breeding Habitat/Nesting Season	Occurrence of Preferred Breeding Habitat in Project Area	Potential Impacts	Proposed Mitigation
Hudsonian Godwit b *Limosa haemastica*	Birds – Shorebirds	AR, CIB	Nests on ground on dry tops of hummocks in string bogs or sedge marsh often under dwarf birch, sweet gale Breeds/Nests from mid-May through July	Possible – Breeding/ nesting habitat present; confirmed observation in CIB based on BBS	Construction disturbance; habitat impacts; vessel or vehicle collisions; oil spills; contaminants	See Appendix E
Red Knot [a] *Calidris canutus roselaari*	Birds – Shorebirds	BCP, CIB	Nests on ground in dry Dryas tundra Breeds/Nests from June through August	Not likely – not known to breed in the vicinity of the Project; passes through Cook Inlet during spring/fall migration	Construction disturbance; habitat impacts; vessel or vehicle collisions; oil spills; contaminants	None Proposed, but measures in Appendix E would benefit this species.
Kittlitz's Murrelet [a] *Brachyramphus brevirostris*	Birds – Seabirds	Cook Inlet Basin; Marine waters	Nests on ground on scree and talus slopes associated with present and past glaciation Breeds/Nests from mid-May through August	Not likely – Breeding/ nesting habitat may be present, but Project is not within breeding range	None	None Proposed
Marbled Murrelet [a] *Brachyramphus marmoratus*	Birds – Seabirds	Cook Inlet Basin; Marine waters	Nests on high moss-covered branches of coastal old growth spruce or hemlock trees or occasionally on ground Breeds/Nests from mid-May through July	Not likely – Breeding/ nesting habitat not likely present in Project vicinity	None	None Proposed
Blackpoll Warbler [a] *Setophaga striata*	Birds – Passerine	KRV, RM, TKL, AR, CIB	Nests primarily in deciduous forests, tall shrub habitats Breeds/Nests from late May to early August	Likely – Breeding/ nesting habitat present; multiple confirmed observations based on BBS	Construction disturbance; habitat impacts; vehicle collisions; oil spills; contaminants	See Appendix E

TABLE 3.5.3-2

Summary of Potential Impacts and Mitigation for BLM Sensitive and Watch-List Species Potentially Occurring in the Project Area

Common Name Scientific Name	Group	Ecoregions	Breeding Habitat/Nesting Season	Occurrence of Preferred Breeding Habitat in Project Area	Potential Impacts	Proposed Mitigation
Gray-Cheeked Thrush [b] *Catharus minimus*	Birds – Passerine	KRV, RM, TKL, AR, CIB	Nests built in branch crotches of willow or alder shrubs, or horizontal or slanted fallen trees, tops of broken trees or stumps, or on ground Breeds/Nests from late May to early August	Likely – Breeding/ nesting habitat present; multiple confirmed observations based on BBS	Construction disturbance; habitat impacts; vehicle collisions; oil spills; contaminants	See Appendix E
Olive-Sided Flycatcher [a] *Contopus cooperi*	Birds – Passerine	KRV, RM, TKL, AR, CIB	Nests primarily in spruce trees – black spruce primarily Breeds/Nests from late May to mid-July	Likely – Breeding/nesting habitat present; multiple confirmed observations based on BBS	Construction disturbance; habitat impacts; vessel or vehicle collisions; oil spills; contaminants	See Appendix E
Rusty Blackbird [a] *Euphagus carolinus*	Birds – Passerine	KRV, RM, TKL, AR, CIB	Nest in living or dead spruce, tamarack, willow, birch, alder trees or shrubs, on stumps or ground near water Breeds/Nests from May through July	Likely – Breeding/nesting habitat present; multiple confirmed observations based on BBS	Construction disturbance; habitat impacts; vessel or vehicle collisions; oil spills; contaminants	See Appendix E
Townsend's Warbler [b] *Setophaga townsendi*	Birds – Passerine	TKL, AR, CIB	Nests in coniferous trees; white spruce, but occasionally birch Breeds/Nests from mid-May to mid-July	Likely – Breeding/ nesting habitat present; multiple confirmed observations based on BBS	Construction disturbance; habitat impacts; vessel or vehicle collisions; oil spills; contaminants	See Appendix E
Muir's fleabane [a] *Erigeron muirii*	Plant	BCP, BF, BR	Perennial herb with thick taproot, alpine slopes, ridges, rock outcrops, river bluffs, terraces, pingos; scree, gravel rock; dry, snow banks	Possible – documented on BLM lands near MP 130	Construction disturbance, habitat impacts	None Proposed
Longstem Sandwort [b] *Arenaria longipedunculata*	Plant	BCP, BF, BR, RM, AR, CIB	Perennial herb, matted; gravel, moist places in mountains,	Possible – documented at multiple locations on BLM lands near Mainline	Construction disturbance, habitat impacts	None Proposed

TABLE 3.5.3-2

Summary of Potential Impacts and Mitigation for BLM Sensitive and Watch-List Species Potentially Occurring in the Project Area

Common Name Scientific Name	Group	Ecoregions	Breeding Habitat/Nesting Season	Occurrence of Preferred Breeding Habitat in Project Area	Potential Impacts	Proposed Mitigation
Yukon Aster [b] *Symphyotrichum yukonense*	Plant	BR, KRV	Perennial herb, tufts or colonies; river bars, terraces, floodplains, sand blowouts, dunes; sand, silt grave; moist to wet	Possible – documented on BLM lands near MP 231	Construction disturbance, habitat impacts	None Proposed
Field Locoweed [b] *Oxytropis tananensis*	Plant	PCP, BF, BR, RM, AR, CIB	Perennial herb, legume, dry sandy places, dry tundra	Possible – documented on BLM lands near MP 231	Construction disturbance, habitat impacts	None Proposed
Robbins' Pondweed [b] *Potamogeton robbinsii*	Plant	AR, CIB	Perennial herb, aquatic, muddy water	Possible – documented on BLM lands near MP 575	Construction disturbance, habitat impacts	None Proposed

Sources: MacDonald and Cook, 2009; BLM, 2010; AKNHP, 2014a; ADF&G, 2014a; AKNHP, 2014c; Nawrocki et al., 2013; NRCS, 2014; Hulten, 1968

Ecoregions: BCP = Beaufort Coastal Plain, BF = Brooks Foothills, BR = Brooks Range, KRV = Kobuk Ridges and Valleys, RM = Ray Mountains, YTU = Yukon-Tanana Uplands, TKL = Tanana-Kuskokwim Lowlands, AR = Alaska Range, CIB = Cook Inlet Basin

[a] Alaska BLM Sensitive Species
[b] Alaska BLM Watch List

3.5.3.2.2 USFWS Sensitive Species

Potential construction and operation-related impacts and mitigation measures for USFWS Birds of Conservation Concern would be similar to those described in sections 3.4.10 and 3.4.11. The potential for specific Project-related impacts for birds protected under the MBTA, BGEPA, and birds of conservation concern (BCC) are presented in Table 3.5.3-3. Analysis for potential impacts to bald and golden eagles and other raptors are provided in Appendix E. At this time, no specific mitigation has been developed for BCC, although mitigation developed to protect birds in the Draft *APP* (Appendix E) would also generally be protective of BCC.

TABLE 3.5.3-3

Summary of Potential Impacts and Mitigation for USFWS Birds of Conservation Concern Potentially Occurring in the Project Area

Common Name Scientific Name	Ecoregions	Breeding Habitat/Nesting Season	Occurrence of Preferred Breeding Habitat in Project Area	Potential Impacts	Proposed Mitigation
Loons and Grebes					
Horned Grebe [b] *Podiceps auritus*	KRV, RM, TKL, AR	Nests on a mat of vegetation constructed usually floating at margin of small pond or marsh Breeds/Nests from mid-May through September	Likely – Breeding/ nesting habitat present; confirmed past observations in vicinity based on Breeding Bird Survey (BBS)s	Construction disturbance, habitat impacts, vehicle collisions, contaminants, oil spills	See Appendix E
Red-Throated Loon [b] *Gavia stellata*	BCP, BF, TKL; AR; CIB	Nests on ground in low-lying wetlands usually on margins of shallow pond Breeds/Nests from May through September	Likely – Breeding/ nesting habitat present; confirmed observation in vicinity based on USFWS Surveys and BBS	Construction disturbance, habitat impacts	See Avian Appendix E
Yellow-Billed Loon [b] *Gavia adamsii*	BCP; marine waters	Nests on ground on margins or peninsulas of lakes – usually large Arctic lakes Breeds/Nests from June through September	Possible – Breeding/ nesting habitat present; confirmed observations in vicinity based on USFWS Surveys and BBS	Construction disturbance, habitat impacts	See Appendix E
Waterfowl					
Spectacled Eider [a] *Somateria fischeri*	BCP; marine waters	Nests on ground on small islands, peninsulas, pond shorelines and dry areas in wet meadow tundra Breeds/Nests from late May through August	Likely - Breeding/ nesting habitat present; confirmed observations within 0.5 miles from USFWS Surveys	Construction disturbance, habitat impacts, collision mortality	See Biological Assessment (Appendix C)
Steller's Eider [a] *Polysticta stelleri*	BCP, CIB; marine waters	Nests on ground in open tundra near water Breeds/Nests from June through late-August	Not likely – Breeding/ nesting habitat primarily located west of Project may molt and overwinter in Cook Inlet	Construction disturbance, habitat impacts, collision mortality	See Biological Assessment (Appendix C)
Raptors					
Bald Eagle [c] *Haliaeetus leucocephalus*	TKL; AR, CIB	Nests in large spruce and cottonwood trees, may also use cliffs and ridges Breeds/Nests from March through September	Likely – Breeding/ nesting habitat present; confirmed nesting in vicinity active nests within 0.5 miles based on 2015 raptor survey	Construction disturbance, habitat impacts	Eagle Permits See Appendix E
Golden Eagle [c] *Aquila chrysaetos*	Entire Project Area	Nests usually on cliffs, may also use trees Breeds/Nests from April through August	Likely – Breeding/ nesting habitat present; confirmed nesting in vicinity potential nests within 0.5 miles based on 2015 raptor survey	Construction disturbance, habitat impacts	Eagle Permits See Appendix E

TABLE 3.5.3-3

Summary of Potential Impacts and Mitigation for USFWS Birds of Conservation Concern Potentially Occurring in the Project Area

Common Name Scientific Name	Ecoregions	Breeding Habitat/Nesting Season	Occurrence of Preferred Breeding Habitat in Project Area	Potential Impacts	Proposed Mitigation
Peregrine Falcon [b] *Falco peregrinus*	Entire Project Area	Nests on pingo tops, road cuts, common raven nests, cliff walls, artificial structures Breeds/Nests from late May through August	Likely – Breeding/ nesting habitat present; confirmed nesting in vicinity no nests within 0.5 miles based on 2015 raptor survey	Construction disturbance, habitat impacts	See Appendix E
Shorebirds					
Bar-Tailed Godwit [b] *Limosa lapponica baueri*	BCP	Nests on ground in sedge and/or dwarf shrub tundra, moist tussock tundra near wetlands Breeds/Nests from late May through mid-August	Possible – Breeding/ nesting habitat present; has been observed nesting at Prudhoe Bay	Construction disturbance, habitat impacts	See Appendix E
Buff-Breasted Sandpiper [b] *Calidris subruficollis*	BCP	Nests on ground in moist or wet sedge-graminoid meadows, occasionally on dry prostrate scrub habitat, males display on leks Breeds/Nests from June through August	Possible – Breeding/ nesting habitat present; has been observed nesting at Prudhoe Bay	Construction disturbance, habitat impacts	See Appendix E
Dunlin [b] *Calidris alpine articola*	BCP, CIB	Nests on strangs or around moist, low-centered polygons in or next to clumps of grass or sedge Breeds/Nests from June through July	Likely – Breeding/ nesting habitat present; commonly observed nesting at Prudhoe Bay	Construction disturbance, habitat impacts, vessel or vehicle collisions, oil spills, contaminants	See Appendix E
Eskimo Curlew [a] *Numenius borealis*	BF	Nests likely on ground in treeless, dwarf shrub, graminoid tundra Breeds/Nests from mid-May through July	Not likely – considered likely extinct	None	See Appendix E
Hudsonian Godwit [b] *Limosa haemastica*	AR, CIB	Nests on ground on dry tops of hummocks in string bogs or sedge marsh often under dwarf birch, sweet gale Breeds/Nests from mid-May through July	Possible – Breeding/ nesting habitat present; confirmed observation in CIB based on BBS	Construction disturbance, habitat impacts, vehicle collisions, oil spills, contaminants	See Appendix E
Lesser Yellowlegs [b] *Tringa flavipes*	KRV, RM, TKL, AR, CIB	Nests on ground on dry, mossy ridges or hummocks next to fallen branches and logs underneath low shrubs or small trees	Likely – Breeding/ nesting habitat present; multiple confirmed observations based on BBS	Construction disturbance, habitat impacts, vehicle	See Appendix E

TABLE 3.5.3-3

Summary of Potential Impacts and Mitigation for USFWS Birds of Conservation Concern Potentially Occurring in the Project Area

Common Name **Scientific Name**	**Ecoregions**	**Breeding Habitat/Nesting Season**	**Occurrence of Preferred Breeding Habitat in Project Area**	**Potential Impacts**	**Proposed Mitigation**
		Breeds/Nests from late May through July		collisions, oil spills, contaminants	
Red Knot [b] *Calidris canutus roselaari*	BCP, CIB	Nests on ground in dry Dryas tundra Breeds/Nests from June through August	Not likely – not known to breed in the vicinity of the Project; passes through Cook Inlet during spring/fall migration	Construction disturbance, habitat impacts, vehicle collisions, oil spills, contaminants	See Appendix E
Rock Sandpiper [b] *Calidris ptilocnemis*	CIB	Nests in heath tundra, low shrub heath meadows Breeds/Nests from May through July	Not known to breed in the vicinity of the Project; winters along coast in Cook Inlet	Construction disturbance, habitat impacts, vehicle collisions, oil spills, contaminants	See Appendix E
Short-Billed Dowitcher [b] *Limnodromus griseus*	CIB	Nests on ground in wet meadows, muskeg with sedges, cotton grass, small willows usually near woody vegetation Breeds/Nests from June to early-august	Possible – Breeding/ nesting habitat present; confirmed observation in CIB based on BBS	Construction disturbance, habitat impacts, vehicle collisions, oil spills, contaminants	See Appendix E
Solitary Sandpiper [b] *Tringa solitaria cinnomomea*	KRV, RM, TKL, AR, CIB	Nests in coniferous or deciduous trees in abandoned passerine nests Breeds/Nests beginning late May	Likely – Breeding/ nesting habitat present multiple confirmed observations based on BBS	Construction disturbance, habitat impacts, vehicle collisions, oil spills, contaminants	See Appendix E
Upland Sandpiper [b] *Bartramia longicauda*	KRV, RM, TKL, AR, CIB	Nests on ground in low vegetation Breeds/Nests from May through June	Possible – Breeding/ nesting habitat present multiple confirmed observations based on BBS	Construction disturbance, habitat impacts, vehicle collisions, oil spills, contaminants	See Appendix E
Whimbrel [b] *Numenius phaeopus rufiventris*	BCP, BF, BR, KRV, TKL, AR, CIB.	Nests on ground in dwarf shrub tundra, taiga, wet sedge or upland shrub habitats Breeds/Nests from mid-May through late August	Likely – Breeding/ nesting habitat present multiple confirmed observations based on BBS	Construction disturbance, habitat impacts, vehicle collisions, oil spills, contaminants	See Appendix E

TABLE 3.5.3-3

Summary of Potential Impacts and Mitigation for USFWS Birds of Conservation Concern Potentially Occurring in the Project Area

Common Name Scientific Name	Ecoregions	Breeding Habitat/Nesting Season	Occurrence of Preferred Breeding Habitat in Project Area	Potential Impacts	Proposed Mitigation
Seabirds					
Arctic Tern [b] *Sterna paradisaea*	Entire Project area	Nests on ground in open areas often with loose substrate or low vegetation Breeds/Nests from late May through early August	Likely – Breeding/ nesting habitat present; multiple confirmed observations based on USFWS Surveys and BBS	Construction disturbance, habitat impacts, vessel or vehicle collisions, oil spills; contaminants	See Appendix E
Passerines					
Olive-Sided Flycatcher [b] *Contopus cooperi*	KRV, RM, TKL, AR, CIB	Nests primarily in spruce trees – black spruce primarily Breeds/Nests from late-May to mid-July	Likely – Breeding/ nesting habitat present; multiple confirmed observations based on BBS	Construction disturbance, habitat impacts, vehicle collisions, oil spills, contaminants	See Appendix E
Rusty Blackbird [b] *Euphagus carolinus*	KRV, RM, TKL, AR, CIB	Nest in living or dead spruce, tamarack, willow, birch, alder trees or shrubs, on stumps or ground near water Breeds/Nests from May through July	Likely – Breeding/ nesting habitat present; multiple confirmed observations based on BBS	Construction disturbance, habitat impacts, vehicle collisions, oil spills, contaminants	See Appendix E
Smith's Longspur [b] *Calcarius pictus*	BF, BR, KRV, AR	Nests on ground on or next to hummocks or tufts of sedges or grasses Breeds/Nests from June through July	Likely – Breeding/ nesting habitat present; multiple confirmed observations based on BBS	Construction disturbance, habitat impacts, vehicle collisions, oil spills, contaminants	See Appendix E

Source: USFWS, 2008; AKNHP, 2014a; Birds of North America Online (see references); Troy, 1985; Liebezeit, 2004; Sauer et al., 2015

Ecoregions: BCP = Beaufort Coastal Plain, BF = Brooks Foothills, BR = Brooks Range, KRV = Kobuk Ridges and Valleys, RM = Ray Mountains, YTU = Yukon-Tanana Uplands, TKL = Tanana-Kuskokwim Lowlands, AR = Alaska Range, CIB = Cook Inlet Basin

a ESA listed, candidate, or proposed species (refer to Section 3.5 for more detail)
b USFWS Bird of Conservation Concern
c Species protected by BGEPA

3.5.3.2.3 State-Sensitive Species

The state-listed endangered Eskimo curlew no longer occurs in Alaska. Activities associated with the Project would have no effect on the Eskimo curlew. The other state-listed endangered species are addressed in Section 3.5.3.1.

3.6 NON-JURISDICTIONAL FACILITIES

3.6.1 Potential Construction and Operation Impacts and Mitigation Measures

3.6.1.1 PTU Expansion Project

The PTU Expansion project is an incremental development of the Point Thomson Initial Production System (IPS), which was reviewed under the National Environmental Policy Act and for which an EFH consultation was conducted. The IPS consisted of proposed activities that are very similar in type, magnitude, and location as those considered for the proposed PTU Expansion project. USACE (2012) prepared an EFH assessment of the Point Thomson Project, and concluded that the activities may adversely affect EFH. NMFS (2012) concurred but noted that the proposed mitigation measures could avoid and minimize impacts on fish and EFH. Mitigation included ensuring that the bridges and culverts at fish-bearing streams were designed to enable fish passage. Water withdrawal from waterbodies was noted as also having the potential to affect EFH. However, most water withdrawal was associated with ice road construction that would take place in winter when salmon and Arctic cod are not present, and water withdrawals from lakes are subject to approval from ADNR DMLW and ADF&G to protect overwintering fish. Construction and operations impacts to EFH are anticipated to be similar in kind but lower intensity than those of the IPS project because there is less infrastructure development near and over streams. Measures that would be implemented to avoid potential impacts to fish, wildlife, and vegetation resources from construction and operation of the PTU Expansion project include BMPs that have been developed by the industry for North Slope developments and for development within the PTU.

3.6.1.1.1 Fisheries and EFH

Most activities associated with the PTU Expansion project would not be proximate to fish habitats, therefore, would not be expected to have adverse effects on fish. Installation of the new West and East Gathering Lines would be supported by ice road. Four streams with summer seasonal fish use, one of which has documented summer use by anadromous Dolly Varden just downstream from the crossing, would be crossed by ice roads. None of the streams have winter discharge or are deep enough to provide fish overwintering habitat. The potential effects of ice roads on hydrology and streams have been discussed previously for the PTTL (Section 3.4.10.2.1.2) and effects here would be similar, particularly as pipeline would be collocated (including sharing VSMs with the new West Gathering Line to the tie-in point at Central Pad). One fish-bearing stream (unnamed tributary to B Creek) would be crossed by the East Pad Road. This stream reach has not been determined to be anadromous, but downstream sections of B Creek have been designated anadromous for supporting anadromous Dolly Varden. The crossing would include a fish-passage culvert that has already been permitted along with the East Pad Road and would be installed as part of the PTU Expansion project. Effects are anticipated to be minimal. Water needed for the PTU Expansion project would be from existing permitted sources, such as nearby flooded material sites. One new material site would be needed to provide material for expansion of the East, West and Central pads, however, the site is not within or near any fish-bearing waterbodies.

Minor modifications of the marine facilities at Central Pad would be required to support a single sealift. The sectional bridge opposite the sealift bulkhead would be extended to support the width of the new modules by installing new piles. Two new mooring dolphins, which are necessary for guiding barges into designated berths, would also be installed to support module delivery. Pile installation would occur during winter and would likely have minimal potential to impact EFH species that may be in the area.

TABLE 3.6.1-1

Marine Essential Fish Habitat Occurring in the Area of the PTU Expansion project

Facility/ Milepost	Waterbody Name	Fisheries Management Plan	Fish	Potential Source/Season	Habitat Loss (acres)	EFH
PTU EXPANSION PROJECT						
PTU Marine Infrastructure Improvements	Beaufort Sea	Arctic FMP; Alaska EEZ Salmon FMP	Arctic cod, saffron cod, snow crab; Salmon[1] – marine stages	In-water Construction/Winter	2 acres temporary	Arctic cod; Pacific salmon marine EFH

Notes: [1] Alaska EEZ Salmon FMP, Chinook salmon, chum salmon, coho salmon, pink salmon, sockeye salmon
Sources: Resource Report No. 1; NPFMC, 2009, 2014; NPFMC et al., 2012

3.6.1.1.2 Vegetation

The PTU Expansion project would require construction of the East Pad and enlarging the Central Pad and the West Pad, as well as constructing a new granular material site that would affect about 136 acres of tundra vegetation. Expansion of the Central Pad would affect a small area of Arctic tidal marsh – a vegetation community of conservation concern (Boggs et al. 2014). A new road would be constructed between the East Pad and the Alaska State C-1 Pad. The overall Project footprint has been reduced to the extent practical so as to have the least overall impact on tundra and vegetation as possible. Fill would be sufficiently thick to provide insulation and prevent thermokarst. Most tundra habitats that would be affected by expansion are common throughout the region.

A new pipeline would be constructed between the East Pad and the Central Pad. A new pipeline would also be constructed between the Central Pad and West Pad. Impacts would be related only to construction of the ice road and work pads. Ice roads would be constructed for winter access and transport of materials, supplies, and fuel. In general, wet sedge habitats typically show little to no effect from ice roads, while ice road construction over drier tundra habitats or ridges may create more damage. Construction of ice roads can damage tundra through scraping or compression. The most notable effects generally occur in low snow areas in tussock tundra when tussocks are broken or scraped. In areas where ice roads are constructed in multiple subsequent years, the alignment is altered each year to lessen the probability of tundra damage and allow the tundra to recover from any effects of ice road compression. Impacts to tundra vegetation from ice roads typically requires no restoration and recovers naturally within about 10 years (NSSI, 2013).

3.6.1.1.3 Wildlife

3.6.1.1.3.1 Marine Mammals

The PTU Expansion project would require minor modifications to Point Thomson marine infrastructure to enable delivery of large sealift modules. Modifications would require pile driving, installation of two new mooring dolphins, and dredging. Most work would be completed during winter with little potential to affect marine mammals. Barge traffic to deliver the modules, as well as coastal barges to deliver materials, supplies, and fuel, would create sounds during docking and may disturb a few ringed seals, bearded seals, or other marine mammals. Measures that would be implemented to avoid and reduce impacts to marine mammals would include monitoring for marine mammal presence, following standard industry practices for the North Slope. Mitigations measures for impacts to marine mammal habitats from introduction or spread of aquatic invasive organisms from barges would include emptying and drying ballast tanks prior to loading barges for shipment to Point Thomson and using and discharging ballast water from the local area.

3.6.1.1.3.2 Large and Small Terrestrial Mammals

Granular material would be placed and mined for the pad expansions during winter when few animals remain in the Beaufort Coastal Plain Ecoregion. A few caribou and muskoxen could remain in the region in winter. Construction of granular pad expansions and ice roads and pads for pipeline construction could destroy ground squirrel burrows or fox dens and would result in mortality to hibernating Arctic ground squirrels. During ice road construction, the first pass with equipment may compress the dens and they may be flooded during ice construction. Most brown bears would be expected to den further south than the PTU.

Excavation, transportation, placement, and compaction of the granular material by equipment could cause some additional disturbance that could displace animals from the active construction site, or prevent them from using it. Caribou use the region along the coast for insect-relief habitat. Speed limits would be imposed on gravel and ice roads to avoid wildlife-vehicle collisions, and an air traffic plan would be developed with minimum operating altitudes to reduce disturbance to caribou from overflights of calving and insect-relief habitats. Food waste would be contained and incinerated to reduce attraction of wildlife to camps and facilities, and the corridor on the east side of Central Pad would be kept clear to allow for free passage of wildlife. Loud sounds generated by compressors and other equipment would be reduced through use of noise enclosures, acoustic panels, low-noise electrical generators, and hospital grade silencers on diesel engines. Site-specific mitigation measures and restoration of material sites would be determined during the permitting phase of the Project.

3.6.1.1.3.3 Birds

Winter construction of the pad expansions, material source (mine), and pipeline would avoid destruction of any migratory bird nests. About 43 acres of habitat would be lost or changed from tundra to water as a result of the expansion (Table 8.2.2-2 Resource Report No. 8). The West Gathering Line would be placed on VSMs shared with the PTTL and would therefore have no additional impacts on bird habitats in the area. Addition of the taller process modules and increased air traffic could increase bird collision mortality risks. Measures would include designing facilities to reduce potential for bird strikes and implementing a PTU *Bird Strike Avoidance and Lighting Plan* to reduce potential impacts to birds. Loud sounds generated by compressor and other equipment would be reduced through use of noise enclosures, acoustic panels, low-noise electrical generators, and hospital-grade silencers on diesel engines. Appendix E *Draft Avian Protection Plan* provides BMPs and mitigation measures in order to reduce injury or mortality to birds.

3.6.1.1.3.4 Protected Wildlife

Polar bears are the protected wildlife most likely to be affected by the PTU Expansion project. Bowhead whales could also potentially be affected.

Loud sounds from bow thrusters during barge docking could potentially disturb bowhead whales. Most bowheads migrate farther offshore than the very shallow lagoon and docking area within the barrier islands so any effects would be minor and short-term. Potential impacts associated with the Point Thomson marine infrastructure improvements would be very similar to those described for the dock expansion at West Dock.

Spectacled eiders nest in low density in the proposed PTU Expansion project areas (0.000 to 0.0730 eiders per square mile; Figure 3.5.1-7; 2009–2012 density polygons from USFWS Anchorage). Spectacled eiders are at the edge of their range in the PTU area, so few if any nesting birds would be encountered. Coastal areas may be used during post-breeding, brood-rearing, and migration. Placement of granular material during winter would avoid any destruction of spectacled eider nests. Installation of additional process modules and increased air traffic could increase collision mortality risks. Measures would include designing facilities to reduce potential for bird strikes and implementing a PTU *Bird Strike Avoidance and Lighting Plan* to reduce potential impacts to spectacled eiders and other birds.

Polar bears may occur year-round at the PTU, although they are most likely to occur in the late summer and fall. No onshore polar bear dens have been located within 5 miles of the pad expansions, material site, or the routes for the West and East Gathering Lines (Figure 3.5.1-4). Little potentially suitable den habitat, ridges that collect sufficient snow to support a polar bear den, occur near these facilities (Figure 3.5.1-4). Most suitable den habitat and documented dens in the region are located on Flaxman Island and the Canning River delta. Winter ice road and pipeline construction has the potential to disturb denning bears. Mitigation measures used for winter construction would include using forward looking infrared (FLIR) conducted over the area within 1 mile or more of all planned work areas in polar bear critical habitat to identify any den sites that coincide with construction activities. Polar bears also present a potential hazard to workers within the PTU. Other potential measures that could be implemented to reduce any potential construction and operation effects on polar bears are described in the Biological Opinion for Point Thomson (USACE and USFWS, 2012).

3.6.1.1.3.5 Sensitive Wildlife Habitat Areas

The PTU borders the Arctic NWR, but all facilities associated with the PTU Expansion project would be located to the west and outside of the Arctic NWR.

3.6.1.2 PBU Major Gas Sales Project

Measures that would be implemented to reduce potential impacts to vegetation, fish, and wildlife from construction and operation of the PBU Major Gas Sales (MGS) Project include BMPs that have been developed by the industry for North Slope developments and for development within the PBU. With these measures, potential effects on vegetation, fish and wildlife are expected to be minor.

3.6.1.2.1 Fisheries and EFH

Expansion of the CGF pad would not occur in fish bearing waters and would not be anticipated to have adverse impacts on fish. The PBU MGS project pipelines would be constructed during winter on either existing or new VSMs. Approximately 44 miles of new byproducts lines are proposed. One pipeline would run east from the CGF over the Putuligayuk, Little Putuligayuk, and West Channel Sagavanirktok rivers. The other pipelines would run west from the CGF and would cross Fawn and Leech creeks, and the Kuparuk and Sakonowyak rivers. All of the creeks and rivers crossed are fish bearing and the Putuligayuk, Little Putuligayuk rivers, and Fawn Creek are used by anadromous whitefish and other species predominantly during summer at the crossing locations. Both the Kuparuk and West Channel Sagavanirktok rivers are used by anadromous whitefish, Dolly Varden, and Pacific salmon species, as well as resident species of fish. Chum and pink salmon use the West Channel Sagavanirktok and pink salmon spawning has been documented within the lower 15 miles of the river. The crossing location is one of a small number of isolated overwintering pools used by high numbers of anadromous whitefish for overwintering. The Kuparuk River is used by anadromous whitefish, Dolly Varden, and pink salmon, as well as resident fish species. Pink salmon spawning has been documented in the lower 20 miles of the river and it is likely that fish overwintering occurs at isolated pools throughout the lower river. The existing Kuparuk Pipeline crosses at the downstream end of a deeper pool that ranges from 7 to 11 feet deep. The crossing location ranges from 2.5 to 6 feet deep. The byproducts pipeline crossing area may contain overwintering habitats in some years. All other stream crossings, including the anadromous Putuligayuk and Little Putuligayuk rivers, would likely be frozen to their beds and not contain fish during winter.

All pipeline construction would be conducted during winter using ice roads. Ice road crossings of streams would not affect overwintering at most locations because fish would not be present. Ice pad construction would likely be needed to support construction of the West Channel Sagavanirktok River pipeline crossing. There is potential for the level of disturbance and loss of snow cover over the overwintering hole, located at the existing pipeline crossing, to cause reduced water temperatures within the overwintering hole. Reduced temperatures could lead to a reduction in habitat availability within the hole and reduced survival of overwintering fish. Timing construction to as late in the season as possible, or general minimization of snow removal at the work location, could reduce the potential for adverse impacts to fish. Similarly, efforts to reduce the overall disturbance over the potential overwintering hole at the Kuparuk River crossing could reduce potential effects to fish as well.

Water withdrawal would be required for construction of ice roads and hydrostatic testing of the PBU MGS project pipelines referenced above. Potential effects of water withdrawal have previously been addressed (Section 3.2.2.7.2.1.5). Approximately 115 million gallons of water would be required to build the ice roads need for pipeline construction. Water would be withdrawn consistent with agency permit requirements and screens designed to prevent the impingement, entrapment, and entrainment of sensitive fish life stages would be employed.

Three modules would be sealifted to West Dock for trucking to the PBU MGS project installation location.. As a contingency, modifications to East Dock could be made and modules sealifted to East Dock. Dredging of an unknown area and volume would be needed. Dredging would occur during winter and would require one season of maintenance dredging during summer for the sealift. Effects to EFH and EFH species would be similar to those described.

3.6.1.2.2 Vegetation

Expansion of the CGF would cover about 5 acres of tundra vegetation and water on the northwest edge of the pad. Placement of granular fill at the CGF would cover primarily wet sedge (*Carex aquatilis*) marsh, mesic sedge-dwarf shrub tundra, and water within an old drained basin complex (Boggs et al., 2012). Placement of about 1 acre of fill near Skid 50, just north of Pump Station 1, would cover flat top polygons with wet to moist sedge tundra with deep troughs. Granular material would be obtained from an existing permitted source or from the GTP material source with no additional impacts to tundra vegetation. There have been no rare plants documented near the proposed expansion areas.

The 44 miles of new byproduct pipelines would be constructed and maintained from ice roads and pads with limited vegetation disturbance from installation of the VSMs. Where pipelines are installed on existing VSMs within the PBU, many with multiple pipelines in low elevation racks (less than 5 feet above ground level), potential vegetation impacts could include increased shading and snow drifting. Most of the new pipelines would be constructed in areas with wet sedge and moist sedge-dwarf shrub tundra. One rare plant, Vahl's alkaligrass (*Puccinellia vahliana*), has been documented near the proposed byproduct and gas pipeline route.

Ice road construction over wet sedge habitats typically shows little to no effect from ice roads, while ice road construction over drier tundra habitats or ridges may create more damage. Construction of ice roads can damage tundra through scraping or compression. The most notable affects generally occur in low snow areas in tussock tundra when tussocks are broken or scraped. Impacts to tundra vegetation from ice roads typically requires no restoration and recovers naturally within about 10 years (NSSI, 2013).

Temporary placement of the byproduct, fuel gas and propane pipelines on wood cribbing on the tundra would result in minor damage to tundra from cover of vegetation with the blocks. Snow management could result in delayed melt, as well as spread of granular material and potential contaminants to tundra wetlands. BMPs would be used to reduce any potential damage to tundra vegetation.

3.6.1.2.3 Wildlife

3.6.1.2.3.1 Marine Mammals

Modules for the CGF expansion similar to those for the GTP would be delivered by sealift at West Dock. The modules would likely be delivered in a single sealift to West Dock. Alternatives would be trucking smaller modules on the Dalton Highway or sealift to East Dock. Sealift to East Dock would require dredging and dredge disposal, which would affect marine mammals and their habitats through loud sounds, removal or cover of invertebrates, and increased turbidity. Dredging would likely occur during winter when most marine mammals are not present in the region. Measures to avoid and reduce impacts to marine mammals would likely include obtaining an IHA for any dredging and monitoring for marine mammal presence when sounds above thresholds for injury or harassment are produced, following standard industry practices for the North Slope. Potential impacts to marine mammals could include disturbance from noise created by bow thrusters as barges are positioned at the dock. Non-ESA listed marine mammals that could be exposed to this noise would include beluga whales and spotted seals.

3.6.1.2.3.2 Large and Small Terrestrial Mammals

Granular material would be placed within the pad expansion area during winter, when few animals remain in the Beaufort Coastal Plain Ecoregion. Construction of granular pad expansions, ice roads, and pads for pipeline construction could destroy ground squirrel burrows or fox dens and would result in mortality to hibernating Arctic ground squirrels. Brown bears have been known to den in the PBU. Summer working of the granular material by equipment could cause some additional disturbance that could displace some animals from the active construction site. Temporary placement of the fuel gas and propane pipelines between the CGF, the GTP, and the GTP camp on wood cribbing on the tundra could result in delayed or blocked movements of young caribou calves, depending on the diameter of the pipelines.

The 44 miles of new pipelines would be located on VSMs at elevations of over 7 feet above the ground, or they may be placed on existing VSMs with existing pipelines. The pipeline routes generally follow existing routes, many of which are located next to roads. Many existing pipeline bundles in the PBU are located low to the ground and are an impediment to caribou movement through the field. To mitigate for this blockage of free movement of caribou through the fields, crossing structures (granular ramps over pipeline bundles) have been added, although this mitigation has had mixed success. Some ramps may lead across pipelines on one side of the road that is blocked by a low pipeline bundle on the opposite side of the road. Current mitigation recommendations for pipelines within North Slope oilfields include a 500-foot minimum separation between roadway, and pipeline and a pipeline elevation of more than 5 feet above the ground to facilitate caribou movements through the fields. These mitigations were developed because of pipeline-road and low pipeline bundles within older parts of the PBU that have been observed to hinder caribou movements (Cronin et al., 1994). The new pipelines would be constructed within existing ROWs; therefore, additional impediments to animal movements are not expected.

There would be some additional habitat fragmentation and crowding of the existing open spaces and natural habitat within the PBU due to new granular pads, wells, and pipelines. All of the proposed facilities would be sited adjacent to or within areas already disturbed by oil and gas activities in the PBU. In addition, facilities would be built and maintained following existing best practices approved by regulators for operations in the PBU. In collaboration with state, federal, and local agencies, the oil and gas industry has been able to site facilities in such a manner that has not resulted in population level impacts to species.

3.6.1.2.3.3 Birds

Winter construction of the pad expansions and pipelines would avoid destruction of migratory bird nests. The gas pipeline between the Apex Gas Injection (AGI) to Gas Gathering Center No. 1 (GC1) would not be located next to any existing infrastructure, although it would cross the newly constructed access road for the GTP and the Northstar pipeline. The elevated pipeline would provide vantage perches for ravens, gulls, and raptors, which could facilitate depredation of waterfowl, shorebirds, and passerines that nest on the ground. Snow drifts accumulating under and around the new pipelines could further reduce available tundra nesting habitats.

Temporary placement of the fuel gas, propane, and byproduct pipelines along with electric and fiberoptic cables between the CGF, the GTP, and the GTP camp on wood cribbing on the tundra could result in delayed or blocked movements of waterfowl broods and could facilitate predation through distraction while the broods try to cross the structure. Addition of the flare at the CGF and modules could increase collision risk. Addition of the vent stacks to the CGF and W Pad could increase entrapment risk for small passerines, such as Lapland longspurs and snow buntings, if left uncovered. Measures to reduce potential injury or mortality to birds would follow BMPs appropriate for the North Slope (Appendix E).

3.6.1.2.3.4 Protected Wildlife

Polar bears and spectacled eiders are the protected wildlife most likely to be affected by the PBU MGS project.

Bowhead whales could be affected by loud sounds from bow thrusters during barge docking. Mitigation to reduce impacts are described in the Project *Draft Marine Mammal Mitigation and Monitoring Plan* (Appendix N) and would include the following measures: PSOs, and conducting work outside of peak bowhead migration.

Spectacled eiders nest throughout the PBU and have been documented in the basin wetland complex north of the proposed CGF expansion. Placement of granular fill during winter would avoid any destruction of spectacled eider nests. Addition of the flare and modules would increase collision mortality risk. Addition of the new aboveground pipeline between the AGI and GC1 could increase vantage perches for potential nest predators. Addition of pipelines to existing pipe racks would be unlikely to result in any new potential impacts to spectacled eiders. The granular expansion areas would be located within areas of relatively low densities of spectacled eiders: Skid 50 – 0.073 to 0.287 spectacled eiders per square mile; CGF – 0.000 to 0.073 spectacled eiders per square mile (2009–2012 density estimate, USFWS unpublished data). Mitigation measures for spectacled eiders are described in the Project Draft *Avian Protection Plan* (Appendix E).

Polar bears may occur year-round in the PBU. While few polar bears den within the oilfields, there have been multiple den sites located in the Sagavanirktok River delta area and potentially suitable den habitat; ridges that collect sufficient snow to support a polar bear den have been mapped throughout the PBU. Winter ice road and pipeline construction has the potential to disturb denning bears. Polar bears also present a potential hazard to workers within the PBU. Polar bear mitigation measures would be implemented to reduce any potential construction and operation effects on polar bears. Mitigation measures typically used for winter construction are described in the Project *Wildlife Avoidance and Interaction Plan* (Appendix J) and would include, when applicable: using FLIR to identify den sites near construction activities; maintain buffer distances around active dens, provide training on polar bear awareness to applicable personnel, embed qualified bear guards at construction areas that are near polar bear habitat, manage waste to reduce attractants, and coordinate with local communities to reduce any potential for impacts to subsistence activities.

3.6.1.3 Kenai Spur Highway Relocation

The Kenai Spur Highway is a state-owned, two-lane highway located in the vicinity of the Nikiski industrial area. It is part of the National Highway System that provides intermodal connection between the Sterling

Highway to the port facility owned and operated by Offshore Systems Kenai, which is located at the north end of Nikishka Beach Road, just north of the Kenai Spur Highway at about Highway MP 26.5.

The planned Liquefaction Facility location would require that an approximately 1.33-mile segment of the existing Kenai Spur Highway be relocated to the east to allow for site safety and security buffer zones. The Kenai Spur Highway reroute area currently being analyzed is nominally 100 acres (assuming a 200-foot ROW) and located generally east of the Liquefaction Facility site and west of Miller Loop Road beginning near Kenai Spur Highway MP 18 and ending near MP 25. Four alternatives have also been evaluated and range in length from 2.73 miles to 3.97 miles (see Resource Report No. 1, Figure 1.3.3-3). Actual planned acreage for the Kenai Spur Highway relocation project would be provided when a proposed route is selected. Project representatives are working with ADOT&PF and Kenai Peninsula Borough on the highway relocation planning including routing discussions, public engagement, permitting, and construction.

The ADOT&PF has started its highway relocation process and would provide Project representatives with updates as it progresses through the routing, public engagement, permitting, and construction of the relocation. It is anticipated that the relocation would be completed prior to the start of Project construction.

Measures that would be implemented to avoid potential impacts from construction and use of the relocated Kenai Spur Highway include use of BMPs developed by the ADOT&PF for road construction and maintenance and BMPs developed by Kenai Peninsula Borough for any highway construction affecting the KPB Road Service Area. The Kenai Spur Highway reroute is planned to be completed before construction of the Liquefaction Facility begins to reduce disruptions to community traffic requirements. Typical highway construction mitigation measures include stormwater pollution prevention measures and installation of stormwater control measures including vegetative buffers to prevent surface water contamination from runoff, and lighting.

3.6.1.3.1 Fisheries and EFH

The proposed Kenai Spur Highway relocation project area is located near the Liquefaction Facility within the Kenai Peninsula drainage and would occur in the vicinity of fish-bearing waters of Upper Cook Inlet. There are no major freshwater waterbodies or streams, or cataloged anadromous waters in the immediate vicinity of the proposed Kenai Spur Highway relocation routes, therefore impacts to inland anadromous fisheries are unlikely to occur.

3.6.1.3.2 Vegetation

The Kenai Spur Highway relocation project area is located in the Cook Inlet Basin Ecoregion a description of the terrain and vegetation communities within this ecoregion is provided in Section 3.1.1.1 Cook Inlet Basin. The proposed reroute of the Kenai Spur Highway would affect about 100 acres (assuming a 200-foot ROW) of developed land and vegetated habitats. The current Kenai Spur Highway reroute would cover about 100 acres, of which 54 acres would be vegetated. These acres would be impacted permanently during construction and operation of the highway. Construction activities that would impact vegetation cover include vegetation clearing, grading, placement of fill, and excavation for the construction of the Kenai Spur Highway reroute. Direct vegetation impacts from construction of the Kenai Spur Highway relocation project would primarily affect forested habitats. Forest communities affected by Kenai Spur

Highway reroute construction would be predominately mixed forest (44 percent; 38 acres) and evergreen forest (6 percent; 5 acres). Scrub communities affected by Kenai Spur Highway relocation project construction would be open low scrub, and herbaceous communities. Potential impacts to waters and wetlands are provided in Resource Report No. 2.

Potential impacts to surrounding vegetation of the proposed Kenai Spur Highway relocation project would occur during clearing and grading activities and could include loss of forested and shrub habitats, cover by fugitive dust, and a loss or alteration of natural effective buffers and filtration systems for surface runoff resulting in erosion and sediment deposition. These effects would be minor and long-term. Most of the site will be maintained clear of natural vegetation for safety and fire prevention, so effects on vegetation in these areas would be minor and long-term. Drainage structures along road system would be incorporated into the highway design.

Potential impacts to vegetation could also occur from spills from fuel trucks, during fueling, from improperly maintained equipment, and the improper use and storage of fuels, lubricants, and other hazardous materials. All fuel handling necessary for construction of the Kenai Spur Highway would be in accordance with ADEC requirements and the Project's *SPCC Plan*. Adherence to the Project's proposed protective measures outlined in the *SPCC Plan* would greatly reduce the likelihood of such impacts, as well minimize the resulting impacts should a spill occur. As such, significant adverse impacts to vegetation due to a release are unlikely.

Potential impacts from invasive plants likely to occur near the Kenai Spur Highway reroute area include: oxeye daisy, butter and eggs, reed canarygrass, common dandelion, and white clover. Measures described in the *Noxious and Invasive Plant and Animal Control Plan* (Appendix K) would be implemented to prevent the introduction or spread of invasive plants. Preventative measures include identifying locations and the extent of existing infestations, mapping and flagging infested areas, treatment of infested areas prior to work, establishing cleaning stations, and inspecting field equipment and vehicles before entering Kenai Spur Highway reroute road construction areas.

3.6.1.3.3 Marine Mammals

General construction sounds from vehicles and machinery usually do not reach levels that would be injurious or harassing to marine mammals. Potential effects on water quality that could reach marine mammal habitats would be avoided and minimized through measures in the Project's *SWPPP* and *SPCC Plan*. Construction and operation the Kenai Spur Highway relocation project are not expected to affect marine mammals.

3.6.1.3.4 Large and Small Terrestrial Mammals

Construction and operation the Kenai Spur Highway relocation project would be located in areas that have experienced both industry and residential development. Construction and operation would result in habitat loss and alteration that could result in both temporary and permanent displacement of large mammals, furbearers, and small mammals that are likely to occur in the area, including voles, squirrels, porcupine, hares, foxes, beavers (see Table 3.4.5-1). Moose, black bear, wolves, caribou from the Kenai Peninsula herds, and brown bear may also occur in the Kenai Spur Highway reroute area but would rarely be encountered (see Liquefaction Facility in Table 3.4.4-1). Long-term habitat loss or alteration would occur over the 100-acre reroute area. Habitat loss would be similar to Liquefaction Facility construction and would result in a reduction in available land for foraging, cover, and prey availability. Habitats lost would include mixed forests that are likely to support moose in the area (Table 3.4.10-2).

Habitat loss in the form of fragmentation would affect dispersal of large and small mammals. Removal of vegetation such as trees, shrubs, and grasses that provide legumes, berries, and grains for furbearers and small mammals. Habitats lost would include mixed and deciduous forests and low scrub that are likely to support foxes, squirrels, porcupines, weasels, and rodents (Table 3.4.10-2). Habitat for furbearers and small mammals is abundant on the Kenai Peninsula, and large tracts of undisturbed habitat occur east and north of the Kenai Spur Highway relocation project in the Kenai NWR.

3.6.1.3.5 Birds

The Kenai Spur Highway relocation project is located in an area that has ongoing industrial and residential development. There has been previous onshore and shoreline habitat fragmentation by roads, buildings, and docks; as well as residential development in the surrounding area.

Sound from Kenai Spur Highway reroute construction during the bird nesting season may create disturbance that could displace nesting birds from habitats in the surrounding area. If birds begin to nest prior to initiation of construction disturbance, active nests with eggs or young may be abandoned. If initiation of construction disturbance occurs early during nesting, displaced birds may re-nest farther away from the disturbance. Nesting habitat for birds is abundant on the Kenai Peninsula, and large tracts of undisturbed habitats occur east and northeast of the Kenai Spur Highway relocation project in the Kenai NWR. Potential effects from habitat loss to birds would be minor and effects from construction disturbance would be temporary.

Vegetation clearing, grading, and paving of the Kenai Spur Highway reroute would result in habitat loss and alteration for terrestrial and aquatic invertebrates. Vegetation clearing would occur during winter and would permanently remove vegetative habitat for terrestrial invertebrates, as well as removing areas where ponded water provides habitat for aquatic invertebrates. Impacts would be minor due to the wide distribution of terrestrial and aquatic invertebrates and abundance of unaffected habitats across Alaska.

Construction and operation of the Kenai Spur Highway relocation project including clearing, gravel placement, and paving would result in nesting habitat loss primarily through vegetation clearing that could result in displacement of birds, primarily passerines, based on breeding bird densities for survey routes near the proposed Liquefaction Facility and Kenai Spur Highway reroute ROW (Table 3.4.10-3). Because vegetation clearing would occur outside of the nesting season, active nests with young are not expected to be impacted by construction. The Heavy Haul road cut through the bluff may also remove swallow nesting habitat, although this area currently does not appear to support nest burrows.

3.6.1.3.6 Amphibians

Vegetation clearing, grading, and paving associated with the Kenai Spur Highway relocation project would be similar to the Liquefaction Facility construction and would result in habitat loss and alteration for wood frogs. Vegetation clearing would primarily occur during winter. Mortality to hibernating wood frogs could occur from the operation of heavy equipment during vegetation clearing and placement of granular material.

Noise from road construction activities of the Kenai Spur Highway reroute during the breeding season could interfere with wood frog calling and mate finding. Construction noise could also result in a physiological stress response that is energetically costly to frogs. These impacts could result in diminished reproductive success or survival of individual wood frogs. Impacts would be minor due to the wide distribution of wood frogs across Alaska.

3.6.1.3.7 Terrestrial and Aquatic Invertebrates

Vegetation clearing, grading, and paving for the Kenai Spur Highway reroute would result in habitat loss and alteration for terrestrial and aquatic invertebrates. Vegetation clearing would occur during winter and would permanently remove vegetative habitat for terrestrial invertebrates, as well as removing areas where ponded water provides habitat for aquatic invertebrates. Impacts would be minor due to the wide distribution of terrestrial and aquatic invertebrates and abundance of unaffected habitats across Alaska.

3.6.1.3.8 Protected Wildlife

An active bald eagle nest was identified in the southeast corner of Liquefaction Facility footprint on an undeveloped tract of land approximately 1,000 feet east of the proposed Kenai Spur Highway reroute corridor (see Table 3.4.6-5). The Kenai Spur Highway relocation project would have similar impact to eagles as construction of the Liquefaction Facility and include construction noise disturbance and loss of habitat. Project-related impacts for birds protected under the MBTA, BGEPA, and birds of conservation concern (BCC) are presented in Table 3.5.3-3. Analysis for potential impacts to bald and golden eagles and other raptors are provided in Appendix E.

The Alaska-breeding population of Steller's eiders was listed as threatened under the ESA in 1997 (62 FR 31748). Very few Steller's eiders would occur in the Kenai Spur Highway relocation project area. Stellar eiders generally use habitats along the coastal shores and could be present along the eastern shore of Upper Cook Inlet near Nikiski. BLM Sensitive and Watch List species located in the Cook Inlet Basin (CIB) ecoregion that may occur in the Kenai Spur Highway relocation project area are listed in Table 3.5.2-1.

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