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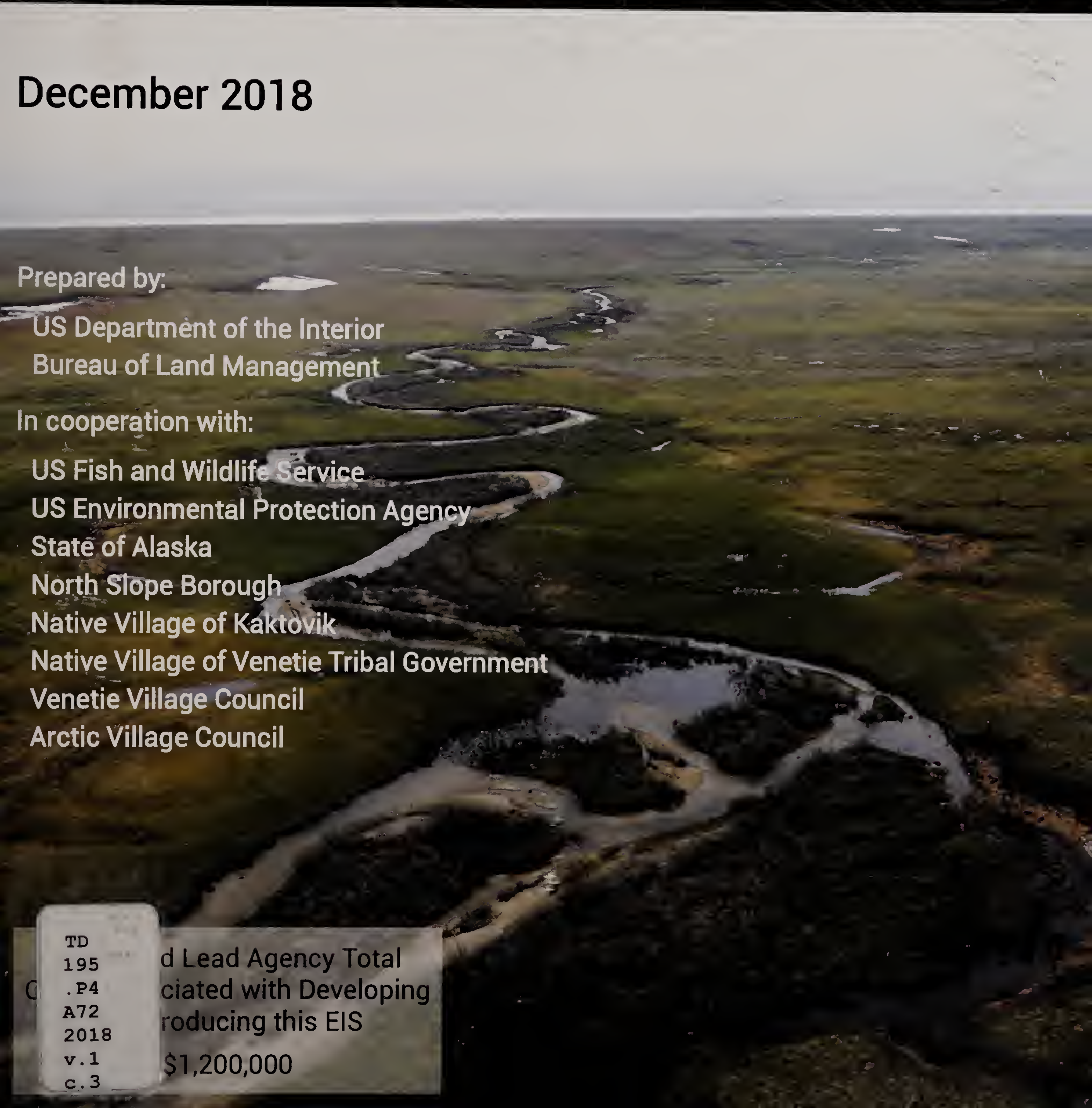
Coastal Plain Oil and Gas Leasing Program Draft Environmental Impact Statement

Volume I: Executive Summary, Chapters 1-3, References, Glossary



December 2018

Prepared by:

US Department of the Interior
Bureau of Land Management

In cooperation with:

US Fish and Wildlife Service
US Environmental Protection Agency
State of Alaska
North Slope Borough
Native Village of Kaktovik
Native Village of Venetie Tribal Government
Venetie Village Council
Arctic Village Council

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Cover Photo: Northward view in central coastal plain area near the Sadlerochit River showing gently rolling topography typical of the area. Natural oil indications are visible of an oil seep that occurs along the coast (Barter Island). Photo by David Houseknecht (USGS).

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United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Alaska State Office
222 West Seventh Avenue, #13
Anchorage, Alaska 99513-7504
www.blm.gov/alaska

In Reply, Refer To
1793 (930)

December 2018

Dear Reader:

I am pleased to present the Coastal Plain Oil and Gas Leasing Program Draft Environmental Impact Statement (Leasing EIS) for your review. It addresses a list of issues and contains three action alternatives for the Bureau of Land Management's (BLM) implementation of an oil and gas program in the Coastal Plain of the Arctic National Wildlife Refuge (Arctic Refuge). This program is required by the Tax Cuts and Jobs Act of 2017, Public Law 115-97 (PL 115-97).

The Coastal Plain is within the political boundary of the North Slope Borough and is predominantly managed by the US Fish and Wildlife Service as part of the Arctic Refuge. The decisions to be made as part of this Leasing EIS concern which areas of the Coastal Plain would be offered for oil and gas leasing and the terms and conditions to be applied to such leases and subsequent authorizations for oil and gas activities.

The action alternatives discussed in the Leasing EIS include lease stipulations and required operating procedures designed to mitigate impacts on natural resources and their uses. All future on-the-ground actions requiring BLM approval, including potential exploration and development proposals, will require further National Environmental Policy Act analysis based on the site-specific proposal.

The BLM will evaluate all comments received and address substantive comments in the final Leasing EIS scheduled to be released in 2019.

The most useful comments are specific and address one or more of the following:

- Identification of new information that would have a bearing on the analysis.
- Inaccuracies or discrepancies in information or any errors in our portrayal of the resources and uses of the program area.
- Suggestions for improving implementation of an oil and gas leasing program, consistent with the purposes of the Arctic Refuge.
- Identification of new impacts, alternatives, or potential mitigation measures.

When you share your comments with us, please be as specific as possible. Identify the specific concern or correction you are suggesting, where it appears in the Leasing EIS, and the modification you feel is necessary or appropriate.

I appreciate your comments on the Leasing EIS and there are three ways to submit them:

- Electronically at https://goo.gl/HVo5Mj
- By mail to:

  Ms. Nicole Hayes
  Project Manager
  BLM Alaska State Office
  222 West 7th Avenue, #13
  Anchorage, AK 99513
- In person at the BLM Public Information Center, located on the first floor in the James M. Fitzgerald United States Courthouse and Federal Building, 222 W. 7th Avenue, Anchorage, Alaska, or at the public meetings.

The 45-day public comment period for the Leasing EIS begins with the Notice of Availability published by the Environmental Protection Agency in the *Federal Register*. The precise dates of the comment period, as well as information about public meetings and subsistence hearings pursuant to Section 810 of the Alaska National Interest Lands Conservation Act, will be posted on our website at www.blm.gov/Alaska.

Submitted comments will be publicly available and may be published as part of the Final Leasing EIS. Before including your address, phone number, email address, or other personal identifying information in your comment, be aware that your entire comment, including your personal identifying information, may be made publicly available at any time. While you can ask us in your comment to withhold your personal identifying information from public review, we cannot guarantee that we will be able to do so. All submissions from organizations and businesses and from individuals identifying themselves as representatives or officials of organizations and businesses will be available for public inspection in their entirety.

For additional information about the public comment process or the Leasing EIS, please go to the program website at: https://www.blm.gov/programs/planning-and-nepa/plans-in-development/alaska/coastal-plain-eis

Sincerely,

Ted A. Murphy
Acting State Director

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Coastal Plain Oil and Gas Leasing Program
Draft Environmental Impact Statement

Lead Agency: United States (US) Department of the Interior, Bureau of Land Management (BLM)

Cooperating Agencies: US Fish and Wildlife Service, US Environmental Protection Agency (EPA), State of Alaska, North Slope Borough, Native Village of Kaktovik, Native Village of Venetie Tribal Government, Venetie Village Council, and the Arctic Village Council

Proposed Action: In accordance with the Section 20001 of Public Law 115-97 (PL 115-97), establish and administer a competitive oil and gas program for the leasing, development, production, and transportation of oil and gas in and from the Coastal Plain in the Arctic National Wildlife Refuge (Arctic Refuge).

Abstract: The BLM will establish and administer an oil and gas leasing program for the Coastal Plain in the Arctic Refuge, as required by PL 115-97. The Coastal Plain Oil and Gas Leasing Program Draft Environmental Impact Statement (Leasing EIS) will inform the BLM's implementation of PL 115-97, Section 20001(c)(1), which requires the BLM to hold multiple oil and gas lease sales. The Leasing EIS considers three action alternatives. The No Action Alternative, Alternative A, is included for comparison only; it does not meet the purpose and need of the EIS. Alternatives B, C, and D propose a range of the extent of the Coastal Plain that would be available for lease sale—from 66 to 100 percent of the 1.56 million-acre Coastal Plain—while balancing biological and ecological concerns. These alternatives also include lease stipulations and required operating procedures designed to mitigate impacts on resources and their uses. Alternative D contains two sub-alternatives, Alternatives D1 and D2, for varied analysis of caribou summer habitat lease stipulations. There is no preferred alternative. The Leasing EIS considers and analyzes the environmental impact of these various leasing alternatives, including the areas to offer for sale, and the indirect impacts that could result in consideration of the hypothetical development scenario. These include potential effects from future on-the-ground post-lease activities on climate and meteorology, air quality, noise, physiography, geology and minerals, petroleum resources, paleontological resources, sand and gravel, soil, water, solid and hazardous waste, vegetation and wetlands, wildlife, landownership and uses, cultural resources, subsistence uses and resources, sociocultural systems, environmental justice, recreation, visual resources, special designations (including marine protected areas, eligible and suitable wild and scenic rivers, and wilderness characteristics, qualities, and values), transportation, public health, and the economy.

Review Period: The review period on the Leasing EIS is 45 calendar days. The review period began when the EPA published a notice of availability in the *Federal Register* on December 28, 2018. The comment period ends on February 11, 2019.

Further Information: Contact Nicole Hayes of the BLM at (907) 271-4354 or visit the Leasing EIS website at https://goo.gl/HVo5Mj.

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Acronyms and Abbreviations

Acronyms and Abbreviations	Full Phrase
μg/m3	micrograms per cubic meter
μPa	micro Pascal
AAAQS	Alaska Ambient Air Quality Standards
AAC	Alaska Administrative Code
ACCS	Alaska Center for Conservation Science
ACP	Arctic Coastal Plain
ACRC	Alaska Climate Research Center
ADEC	Alaska Department of Environmental Conservation
ADFG	Alaska Department of Fish and Game
ADNR	Alaska Department of Natural Resources
ADOLWD	Alaska Department of Labor and Workforce Development
AHRS	Alaska Heritage Resources Survey
ANCSA	Alaska Native Claims Settlement Act
ANILCA	Alaska National Interest Lands Conservation Act of 1980
AOGCC	Alaska Oil and Gas Conservation Commission
APD	Application for Permit to Drill
APDES	Alaska Pollutant Discharge Elimination System
AQRV	air quality related value
ARCP	Arctic Refuge Coastal Plain
[Arctic] Refuge	Arctic National Wildlife Refuge
asl	above sea level
ASRC	Arctic Slope Regional Corporation
AWOS	automated weather observing system
bbl	blue barrel
BBO	billion barrels of oil
BLM	Bureau of Land Management
BMP	best management practice
BOEM	Bureau of Ocean Energy Management
BOPD	barrels of oil per day
BS	Beaufort Sea stock
CAA	conflict avoidance agreement
CAH	Central Arctic Herd
CASTNET	Clean Air Status and Trends Network
CCP	Comprehensive Conservation Plan
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CI	confidence interval
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
CPF	central processing facility

CSU	controlled surface use
dB	decibels
dBA	A-weighted decibel
DEW	Distant Early Warning
DOD	Department of Defense
DOI	Department of the Interior
DPS	distinct population segment
dv	deciview
ECS	Eastern Chukchi Sea stock
EFH	Essential Fish Habitat
EIS	environmental impact statement
EO	executive order
EPA	US Environmental Protection Agency
ESA	Endangered Species Act of 1973
°F	Fahrenheit
FAA	Federal Aviation Administration
FLIR	forward-looking infrared radiometry
FY	fiscal year
GFUR	general fund unrestricted revenue
GHG	greenhouse gas
GIS	Geographic Information System
GMT2	Greater Mooses Tooth 2
GMU	Game Management Unit
HCP	hydrocarbon potential
IAP	Integrated Activity Plan
IHLC	Iñupiat History, Language, and Cultural Division
IMPROVE	Interagency Monitoring for the Protection of Visual Environments
ITR	Incidental Take Regulation
kg/ha-yr	kilograms per hectacre per year
kHz	kilohertz
KIC	Kaktovik Iñupiat Corporation
Leasing EIS	Coastal Plain Oil and Gas Leasing Program Environmental Impact Statement
LOA	Letter of Authorization
LRRS	long-range radar sites
M	magnitude

Acronym	Full Phrase
MMPA	Marine Mammal Protection Act
MMT	million metric tons
MPA	Marine Protected Area
mya	millions of years ago
NAAQS	National Ambient Air Quality Standards
NDVI	Normalized Difference Vegetation Index
NEPA	National Environmental Policy Act of 1969
NHPA	National Historic Preservation Act of 1966
NMFS	National Marine Fisheries Service
NO_2	nitrogen dioxide
NOAA	National Oceanographic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPR-A	National Petroleum Reserve-Alaska
NRHP	National Register of Historic Places
NSB	North Slope Borough
NSO	no surface occupancy
NWI	National Wetland Inventory
NWS	National Weather Service
NWT	Northwest Territory
O_3	ozone
ORV	outstandingly remarkable value
Pb	lead
PCH	Porcupine Caribou Herd
PDO	Pacific decadal oscillation
PFYC	Potential Fossil Yield Classification
PL	Public Law
PM_{10}	particulate matter less than 10 microns in diameter
$PM_{2.5}$	particulate matter less than 2.5 microns in diameter
PSO	protected species observer
ROD	record of decision
ROP	required operating procedure
ROW	right-of-way
RS	Revised Statute
SAR	stock assessment report
SBS	Southern Beaufort Sea
SCC	social cost of carbon
SEIS	Supplemental Environmental Impact Statement
SHPO	State Historic Preservation Office
SO	Secretarial Order

SO_2	sulfur dioxide
STP	seawater treatment plant
TAPS	Trans-Alaska Pipeline System
TCF	trillion cubic feet
TCP	Traditional Cultural Property
TL	timing limitation
TLUI	Traditional Land Use Inventory
US	United States
USACE	US Army Corps of Engineers
USC	United States Code
USFWS	US Fish and Wildlife Service
USGS	US Geological Survey
VOC	volatile organic compound
VRI	Visual Resource Inventory
VSM	vertical support member
WSR	wild and scenic river

Executive Summary

Introduction

The United States (US) Department of the Interior (DOI), Bureau of Land Management (BLM), Alaska State Office, is preparing this environmental impact statement (EIS) in accordance with the National Environmental Policy Act of 1969, as amended (NEPA), to implement an oil and gas leasing program in the Arctic National Wildlife Refuge (Arctic Refuge) Coastal Plain. Congress identified the Coastal Plain in Section 1002 of the Alaska National Interest Lands Conservation Act of 1980 (ANILCA) for its oil and natural gas potential; legislation was passed in December 2017 lifting a prohibition on oil and gas development imposed by Section 1003 of ANILCA and requiring BLM to implement an oil and gas leasing program. The Coastal Plain program area is composed of approximately 1,563,500 acres in the approximately 19.3-million-acre Arctic Refuge (**Map 1-1**, Program Area, in **Appendix A**). The oil and gas leasing program must also consider the Arctic Refuge purposes set out in Section 303(B)(2) of ANILCA, as amended, and modified by Section 20001 of Public Law (PL) 115-97 (Dec. 22, 2017) (PL 115-97).

Purpose and Need

Section 20001 of PL 115-97 requires the Secretary of the Interior, acting through the BLM, to establish and administer a competitive oil and gas program for the leasing, development, production, and transportation of oil and gas in and from the Coastal Plain area within the Arctic Refuge. Further, Section 20001 of PL 115-97 requires that at least two lease sales be held by December 22, 2024, and that each sale offer for lease at least 400,000 acres of the highest hydrocarbon potential (HCP) lands within the Coastal Plain, allowing for up to 2,000 surface acres of Federal land to be covered by production and support facilities.

The BLM is undertaking this Coastal Plain Oil and Gas Leasing Program Environmental Impact Statement (Leasing EIS) to implement the leasing program consistent with PL 115-97. The Leasing EIS will serve to inform BLM's implementation of PL 115-97, Section 20001(c)(1), which is the requirement to hold multiple lease sales. It may also inform post-lease activities, including seismic and drilling exploration, development, and transportation of oil and gas in and from the Coastal Plain. Specifically, the Leasing EIS considers and analyzes the environmental impact of various leasing alternatives, including the areas to offer for sale, and the indirect impacts that could result in consideration of the hypothetical development scenario. The alternatives analyze various terms and conditions (i.e., lease stipulations and required operating procedures [ROPs]) to be applied to leases and associated oil and gas activities, to properly balance oil and gas development with protection of surface resources.

Future on-the-ground actions requiring BLM approval, including potential exploration and development proposals, would require further NEPA analysis based on the site-specific proposal. Potential applicants would be subject to the terms of the lease; however, the BLM Authorized Officer may require additional site-specific terms and conditions before authorizing any oil and gas activity based on the project level NEPA analysis.

Decisions to Be Made

The BLM's decisions will include which tracts of land will be offered for lease and the terms and conditions to be applied to such leases and subsequent authorizations for oil and gas activities. The decisions evaluated in this Leasing EIS and its record of decision (ROD) would not authorize any on-the-ground activity associated with the exploration or development of oil and gas resources on the Coastal Plain.

Program Area

The US Fish and Wildlife Service (USFWS) is the predominant land manager in the program area. Other lands in the Coastal Plain include Alaska Native lands conveyed pursuant to Alaska Native Claims Settlement Act (ANCSA) and Native allotments (see **Table ES-1** and **Map 1-1** in **Appendix A**). The program area excludes a northern coastal portion of Air Force-administered lands near Kaktovik. Lands outside the BLM's oil and gas leasing authority are those excluded from the definition of the Coastal Plain in PL 115-97, Native conveyed, and Native selected lands.

Table ES-1
Land Administration

Included in PL 115-97 Coastal Plain and Subject to the BLM's Oil and Gas Leasing Authority	Acres	Included in PL 115-97 Coastal Plain but Outside the BLM's Oil and Gas Leasing Authority	Acres
USFWS-managed lands, including submerged lands	1,562,600	Native-conveyed	24,400
Native allotment	900	Native-selected	4,400
Total	**1,563,500**	**Total**	**28,800**

Source: BLM Geographic Information Systems (GIS) 2018
Note: Acreages are rounded up or down to nearest 100.

Scoping and Issues

As part of the scoping process, the BLM considered public comments provided during scoping meetings held in Anchorage, Arctic Village, Fairbanks, Kaktovik, Utqiaġvik, and Venetie, Alaska, and in Washington, DC, during May and June 2018, when developing the alternatives for analysis in the Leasing EIS. It also considered input from cooperating agencies, tribes, and Native corporations. For more information on the scoping process, see the final scoping report on the BLM's project website: https://goo.gl/HVo5Mj.

Issues such as fish and wildlife, including the Porcupine caribou herd (PCH), special status species, including polar bear, analysis of oil and gas activities, and subsistence use and traditional ways of life, were identified during scoping and addressed in this Leasing EIS. The full list of issue summaries is available in the final scoping report.

Alternatives

Alternative A—No Action Alternative

Under Alternative A (No Action Alternative), no federal minerals in the Coastal Plain would be offered for future oil and gas lease sales after the ROD for this EIS is signed. Alternative A would not comply with the directive under PL 115-97 to establish and administer a competitive oil and gas program for leasing, developing, producing, and transporting oil and gas in and from the Coastal Plain. Under this alternative, current management actions would be maintained, and resource trends are expected to continue, as described in the Arctic National Wildlife Refuge Revised Comprehensive Conservation Plan (CCP) (USFWS 2015a).

Alternative A would not meet the purpose and need of the action, which is the BLM's implementation of PL 115-97, including the requirement to hold multiple lease sales and to permit associated post-lease oil and gas activities; however, Alternative A is being carried forward for analysis to provide a baseline for comparing impacts under the action alternatives, in accordance with the Council on Environmental Quality (CEQ) NEPA regulations.

Alternative B

The entire program area under Alternative B could be offered for lease sale, and there would be the fewest acres with no surface occupancy (NSO) stipulations. In addition to applicable lease stipulations, several ROPs would apply to post-lease oil and gas activities to reduce potential impacts. Approximately 1,563,500 acres would be offered for lease, 359,400 acres would be subject to a NSO stipulation, and 585,400 acres would be subject to timing limitations (TLs). Standard terms and conditions would apply to approximately 618,700 acres.

Alternative C

The entire program area could also be offered for lease sale under Alternative C; however, a large portion of the program area would be subject to NSO. The BLM would rely on the same ROPs as under Alternative B to reduce potential impacts from post-lease oil and gas activities. Approximately 1,563,500 acres would be offered for lease, 932,500 acres would be subject to NSO, and 317,100 acres would be subject to TLs. Standard terms and conditions would apply to approximately 313,900 acres.

Alternative D

Under Alternative D, portions of the Coastal Plain would not be offered for lease sale to protect biological and ecological resources. In addition, a large portion of the remaining area would be subject to NSO. In some instances, more prescriptive ROPs are analyzed under Alternative D, than under Alternatives B and C.

Alternative D contains two sub-alternatives, Alternatives D1 and D2, for the issue of caribou summer habitat. The two sub-alternatives use different approaches to mitigate impacts on caribou summer habitat through lease stipulations. Under both sub-alternatives, approximately 1,037,200 acres would be offered for lease, 708,600 acres would be subject to NSO, and 123,900 acres would be subject to controlled surface use (CSU). Alternative D1 would have no areas subject to TLs but would have approximately 204,700 acres subject to standard terms and conditions. Alternative D2 would have approximately 204,700 acres of TLs and no areas subject to standard terms and conditions.

The complete list of lease stipulations and ROPs under each alternative are presented in **Table 2-2** in **Chapter 2**.

Hypothetical Development Scenario

The BLM developed a hypothetical development scenario for oil and gas exploration, development, production, and abandonment in the PL 115-97 Coastal Plain. The agency used this to analyze the environmental impacts of leasing and development over approximately the next 50 years. An estimated 427,900 acres of the program area has high potential for petroleum resources, 658,400 acres have medium potential, and 477,200 acres have low potential. This hypothetical baseline scenario assumes all potentially productive areas can be open under standard lease terms and conditions, except those areas outside the BLM's oil and gas leasing authority. This hypothetical baseline scenario allows decision-makers to analyze the effect that different discretionary management decisions could have on future oil and gas activities in the program area. The BLM then developed different hypothetical scenarios, with different terms and conditions relating to environmental protection, so that a range of impacts on resources could be analyzed.

The program area contains an estimated 7.687 billion barrels of technically recoverable oil and 7.04 trillion cubic feet (TCF) of technically recoverable natural gas (Attanasi 2005). Due to high costs associated with operating in the Arctic, it is extremely unlikely that all technically recoverable resources would be produced. The US Energy Information Administration estimated that a total of approximately 3.4 billion barrels of oil (BBO) would be produced in the Arctic Refuge by 2050 (Van Wagner 2018). Estimated natural gas production from the Coastal Plain ranges from 0 to 7 TCF of gas produced (Attanasi 2005). See **Appendix B** for more information on development potential, assumptions behind potential estimates, and estimates for the baseline future hypothetical development scenario for petroleum.

Impact Analysis

Issuance of oil and gas leases under the directives of Section 20001(c)(1) of PL 115-97 would have no direct impacts on the environment because by itself a lease does not authorize any on the ground oil and gas activities; however, a lease does grant the lessee certain rights to drill for and extract oil and gas subject to further environmental review and reasonable regulation, including applicable laws, terms, conditions, and stipulations of the lease. The impacts of such future exploration and development activities that may occur because of the issuance of leases are considered potential indirect impacts of leasing. Such post-lease activities could include seismic and drilling exploration, development, and transportation of oil and gas in and from the Coastal Plain. Therefore, the analysis in Chapter 3 is of potential direct, indirect, and cumulative impacts from on-the-ground post-lease activities, which can be considered potential indirect impacts of leasing.

The geographic scope of the analysis includes marine vessel traffic from the shore of the refuge to Dutch Harbor, Alaska. Direct and indirect impacts cannot be analyzed on a site-specific basis within this EIS, but they are analyzed for the program area generally, based on the hypothetical development scenario. Additional site-specific analyses would be conducted during the permit review process for subsequent exploration and development applications.

If leases were explored and developed, the following general impacts would be expected from future oil and gas exploration, development, and production activities:

- Potential impacts on subsistence users, both from impacts on subsistence species and from direct disturbance of hunts, displacement of resources from traditional harvest areas, and hunter avoidance of industrialized areas
- Impacts on water quality caused by water extraction and construction of ice roads and pads, gravel mining, and wastewater discharges from a central processing facility (CPF)
- Impacts from routine activities on air quality due to release of pollutants
- Greenhouse gas (GHG) emissions from exploration and development
- Potential impacts on birds from predators and increased human presence
- Potential impacts on marine mammals, including human-polar bear interactions; vehicle, aircraft and boat traffic and noise disturbance; and accidental, unplanned take by vessel strikes or oil spills
- Impacts on terrestrial mammals, including disturbance from vehicle and aircraft noise, human presence, and habitat fragmentation and loss
- Disturbance and loss of permafrost, vegetation, and wetlands
- Potential impacts on state employment, labor income, and revenues
- Potential impacts on North Slope Borough (NSB) employment, income, and revenue
- Potential impacts on cultural resources by lease development
- Visual impacts from infrastructure and artificial light
- Loss or reduced quality of some access to recreation and use opportunities around areas leased for energy infrastructure

Residents of Kaktovik are the primary users of the program area and would therefore be most likely to experience potential impacts from future development. The community of Nuiqsut could experience impacts on caribou, waterfowl, and fish harvests from development. Residents of Arctic Village, Venetie, and other communities that use the PCH and Central Arctic Caribou Herd (CAH) could experience potential impacts from future development on caribou and, to a lesser extent, waterfowl. Most visitors to the Arctic Refuge come specifically to locations within the program area. With expected increases in recreation, coupled with decreased access to recreation in areas, users of the Coastal Plain would be likely to experience impacts from future post-lease development.

Collaboration and Coordination

The BLM is the lead agency for this EIS. Cooperating agencies are the USFWS, US Environmental Protection Agency (EPA), State of Alaska, NSB, Native Village of Kaktovik, Native Village of Venetie Tribal Government, Venetie Village Council, and the Arctic Village Council.

The BLM, as the lead federal agency, consulted with federally recognized tribal governments during preparation of this EIS. The BLM has contacted the Arctic Village Council, Inupiat Community of the Arctic Slope, Native Village of Kaktovik, Venetie Village Council, Native Village of Venetie Tribal Government, Beaver Village Council, Birch Creek Tribal Council, Chalkyitsik Village Council, Gwichyaa Zhee Gwich'in Tribal Government (Fort Yukon), Naqsragmiut Tribal Council (Anaktuvuk Pass), Native Village of Barrow Iñupiat Traditional Government, Native Village of Nuiqsut, and Native Village of Stevens. The BLM offered these entities the opportunity to participate in formal government-to-government consultation, to participate as cooperating agencies, or to simply receive information about the project. The dates and locations of government-to-government meetings that have taken place are provided in **Appendix C**.

The BLM is also consulting with the Arctic Slope Regional Corporation (ASRC) and Kaktovik Iñupiat Corporation (KIC) under the DOI's Policy for Consultation with ANCSA Corporations. The BLM also held consultations with Doyon, Limited, to discuss the EIS process (see **Appendix C**).

The BLM is consulting with the Alaska State Historic Preservation Office (SHPO), in accordance with Section 106 of the National Historic Preservation Act of 1966 (NHPA). This is to determine how proposed activities could affect cultural resources listed on or eligible for listing on the National Register of Historic Places (NRHP).

To comply with Section 7(a)(2) of the Endangered Species Act of 1973 (ESA), the BLM began consulting with the USFWS and National Marine Fisheries Service (NMFS) early in the EIS process. Both provided input on issues, data collection and review, and alternatives development. The BLM is consulting with the USFWS and NMFS to identify ESA issues and to develop the draft biological assessment.

Section 810 of ANILCA focuses on issues related to the effects of proposed activities on subsistence use. An ANILCA Section 810 notice and public hearing process is required if a proposed action may significantly restrict subsistence uses and needs. A preliminary evaluation and proposed finding of effects on subsistence uses and needs from actions that could be undertaken under the four alternatives considered in this EIS is provided in **Appendix E**. The preliminary evaluation finds that the cumulative case, when taken in conjunction with Alternatives B, C, D1, and D2 may significantly restrict subsistence uses and needs for the community of Kaktovik. Due to these preliminary findings, a public subsistence hearing will be held in the potentially affected community of Kaktovik.

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Chapter 1. Introduction

1.1 Overview

The BLM Alaska State Office is preparing this EIS in accordance with NEPA, as amended, to implement an oil and gas leasing program in the Arctic Refuge Coastal Plain. Congress identified the Coastal Plain in Section 1002 of ANILCA for its oil and natural gas potential. Legislation was passed in December 2017, PL 115-97, lifting a prohibition on oil and gas development imposed by Section 1003 of ANILCA and requiring BLM to implement an oil and gas leasing program. The Coastal Plain program area is composed of approximately 1,563,500 acres in the approximately 19.3-million-acre Arctic Refuge (**Map 1-1**, Program Area, in **Appendix A**). The oil and gas leasing program must consider the Arctic Refuge purposes set out in Section 303(2)(B) of ANILCA, as amended by Section 20001 of PL 115-97.

BLM is developing the EIS to implement Section 20001(c)(1) of PL 115-97, and, specifically, to analyze the environmental impacts of issuing oil and gas leases in accordance with that directive. Issuance of an oil and gas lease does not have any direct effects on the environment since it does not authorize drilling or any other ground disturbing activities; however, a lease does grant the lessee certain rights to drill for and extract oil and gas subject to reasonable regulation, including applicable laws, terms, conditions, and stipulations of the lease. Although the BLM cannot ascertain the precise extent of the effects of granting those rights until it receives and reviews potential future site-specific proposals for exploration and development, in order to meet the intent of NEPA, and as described in the CEQ *Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations*, the BLM has developed a hypothetical development scenario consistent with those leases, in a good faith effort to identify indirect effects that are not known at this time but nonetheless could be considered "reasonably foreseeable" (40 Code of Federal Regulations [CFR] Section 1508.8(b)) (see **Appendix B**).

The BLM developed the hypothetical development scenario in recognition of not only the rights granted by an oil and gas lease but also PL 115-97's direction to the Secretary to "manage the oil and gas program in the Coastal Plain in a manner similar to the administration of lease sales under the Naval Petroleum Reserves Production Act of 1976 (including regulations)." However, there is tremendous uncertainty regarding potential exploration and development on the Coastal Plain and any development scenario at this point is highly speculative given that it is unknown whether or where leases will be issued, whether or where exploratory drilling may occur under such leases, whether or where economically developable oil and gas discoveries may be made, the remoteness and lack of previous exploration and development of the Coastal Plain as well as its harsh environment and challenging engineering considerations, and the extended time it has taken to go from leasing to development in other regions of the North Slope of Alaska including in the National Petroleum Reserve-Alaska (NPR-A).

1.2 Purpose and Need

Section 20001 of PL 115-97 requires the Secretary of the Interior, acting through the BLM, to establish and administer a competitive oil and gas program for the leasing, development, production, and transportation of oil and gas in and from the Coastal Plain area within the Arctic Refuge. Further, Section 20001 of PL 115-97 requires that at least two lease sales be held by December 22, 2024, and that each sale offer for lease at least 400,000 acres of the highest HCP lands within the Coastal Plain, allowing for up to 2,000 surface acres of Federal land to be covered by production and support facilities.

The BLM is undertaking this Leasing EIS to implement the leasing program consistent with PL 115-97. The Leasing EIS will serve to inform BLM's implementation of PL 115-97, Section 20001(c)(1), which is the requirement to hold multiple lease sales. It may also inform post-lease activities, including seismic and drilling exploration, development, and transportation of oil and gas in and from the Coastal Plain. Specifically, the Leasing EIS considers and analyzes the environmental impact of various leasing alternatives, including the areas to offer for sale, and the indirect impacts that could result in consideration of the hypothetical development scenario. The alternatives analyze various terms and conditions (i.e., lease stipulations and ROPs) to be applied to leases and associated oil and gas activities, to properly balance oil and gas development with protection of surface resources.

Future on-the-ground actions requiring BLM approval, including potential exploration and development proposals, would require further NEPA analysis based on the site-specific proposal. Potential applicants would be subject to the terms of the lease; however, the BLM Authorized Officer may require additional site-specific terms and conditions before authorizing any oil and gas activity based on the project level NEPA analysis.

1.3 Decisions to be Made

The BLM's decisions will include which tracts of land will be offered for lease and the terms and conditions to be applied to such leases and subsequent authorizations for oil and gas activities. The decisions evaluated in this Leasing EIS and its ROD would not authorize any on-the-ground activity associated with the exploration or development of oil and gas resources on the Coastal Plain.

1.4 Program Area

The USFWS is the predominant land manager in the program area. Other lands in the Coastal Plain include Alaska Native lands conveyed pursuant to ANCSA and Native allotments (see **Table 1-1**).

Table 1-1
Land Administration

Included in PL 115-97 Coastal Plain and Subject to the BLM's Oil and Gas Leasing Authority	Acres	Included in PL 115-97 Coastal Plain but Outside the BLM's Oil and Gas Leasing Authority	Acres
USFWS-managed lands, including submerged lands	1,562,600	Native-conveyed	24,400
Native allotment	900	Native-selected	4,400
Total	**1,563,500**	**Total**	**28,800**

Source: BLM GIS 2018
Note: Acreages are rounded up or down to nearest 100.

The Coastal Plain program area was previously referred to as the 1002 Area. The program area includes all Federal lands and waters comprising the approximately 1,563,500 acres of the Coastal Plain within the 19.3 million-acre Arctic Refuge (**Map 1-1** in **Appendix A**). The program area excludes a northern coastal portion of Air Force-administered lands near Kaktovik. Lands outside the BLM's oil and gas leasing authority are those lands excluded from the definition of the Coastal Plain in PL 115-97, Native conveyed lands, and Native selected lands.

1.5 Scoping and Issues

The BLM conducted formal scoping for the Leasing EIS following publication of a Notice of Intent in the *Federal Register* on April 20, 2018. In May and June 2018, the BLM held scoping meetings in Alaska, in

Anchorage, Arctic Village, Fairbanks, Kaktovik, Utqiaġvik, and Venetie, and also in Washington, DC. Oral comments were captured by a court reporter at all meetings. The BLM formally accepted scoping comments through June 15, 2018. For more information on the scoping process, see the final scoping report on the BLM's project website: https://goo.gl/HVo5Mj.

The following summaries highlight a few of the issues identified during scoping and addressed in this Leasing EIS. The full list of summaries is available in the final scoping report.

- **Fish and wildlife**—Commenters stated concerns about impacts on fish and wildlife, including caribou and other large terrestrial mammals, marine mammals, migratory birds, and fish and other aquatic species. Potential impacts on the PCH were of particular concern. Commenters requested that the EIS evaluate the use and importance of the program area to herd movement during different life stages and seasons and how the proposed program might affect calving grounds, insect relief areas, and migration routes.
- **Special status species**—Commenters noted that the proposed program could reduce and fragment available terrestrial denning habitat for the Southern Beaufort Sea (SBS) subpopulation of polar bear, which is listed as threatened under the ESA. Commenters requested that the BLM analyze impacts on all special status species, including marine mammals, such as ringed seals, bearded seals, and bowhead whales.
- **Oil and gas**—Commenters requested that the EIS analysis consider direct, indirect, and cumulative impacts of all aspects of oil and gas exploration and development; examples given were access routes, support facilities, and other infrastructure needed for exploration and development and their potential future impacts.
- **2,000-acre disturbance limit**—Commenters requested further definition of the 2,000-acre surface disturbance limit, as defined in PL 115-97, and asked for clarification on what types of surface disturbance would be included and how the 2,000-acre footprint would be measured.
- **Subsistence and sociocultural systems**—Commenters noted that local tribes are culturally tied to the Coastal Plain and the PCH and requested that the BLM analyze impacts on their traditional way of life. They asked that the BLM consider the positive and negative economic changes to communities, impacts on traditional subsistence-based economy, food scarcity, changes to access to traditional subsistence use areas, and subsistence food resources.

Issues outside of the scope of the EIS were also identified during scoping, as follows:

- Comments advocating keeping the Coastal Plain closed to oil and gas leasing
- Comments about land management actions outside of BLM's jurisdiction
- Comments on issues that do not meet the stated purpose and need of the EIS, such as investing in renewable energy alternatives instead of an oil and gas leasing program

1.6 EIS Process

The Leasing EIS process began with the notice of intent to prepare the EIS, followed by the formal scoping period (see **Section 1.5**, Scoping and Issues). After the scoping period and after receiving additional input from the public, the BLM consulted with the cooperating agencies, tribes, and ANCSA corporations, researched information on the resources and uses of the area, developed a range of reasonable management alternatives, and analyzed the impacts of those alternatives. These analyses underwent review within the BLM and among the cooperating agencies, resulting in this draft EIS. This is the second major public step in the EIS process.

The public and agencies will be able to comment on this document. Based on these comments and any new studies or information that may come to light after publication of the draft EIS, the BLM will revise the document and issue a final EIS. The BLM will not issue its decision on the leasing program, called the ROD, until at least 30 days after the EPA publishes the Notice of Availability of the final EIS in the *Federal Register*.

1.7 Collaboration and Coordination

1.7.1 Lead and Cooperating Agencies

The BLM is the lead agency for this EIS. Participating in the Leasing EIS as cooperating agencies are the USFWS, EPA, State of Alaska, NSB, Native Village of Kaktovik, Native Village of Venetie Tribal Government, Venetie Village Council, and Arctic Village Council. The BLM requested their participation because of their expertise; their participation does not constitute their approval of the analysis, conclusions, or alternatives presented in this EIS; for these, the BLM is solely responsible. The list of preparers for the Leasing EIS is in **Appendix C**.

1.7.2 Consultation with Tribes and ANCSA Corporations

The BLM, as the lead federal agency, consulted with federally recognized tribal governments during preparation of this EIS and identified 16 tribes potentially affected by the leasing program. Consistent with DOI policy on government-to-government consultation with tribes, the BLM first sent a letter of notification and inquiry on March 2, 2018, to the Arctic Village Council, the Inupiat Community of the Arctic Slope, the Native Village of Kaktovik, the Venetie Village Council, and the Native Village of Venetie Tribal Government. In its letter, the BLM offered these entities the opportunity to participate in formal government-to-government and Section 106 consultations, to participate as cooperating agencies, or to simply receive information about the project.

The BLM sent a second invitation letter on April 23, 2018, to the following tribal entities: Beaver Village Council, Birch Creek Tribal Council, Chalkyitsik Village Council, Gwitchyaa Zhee Gwich'in Tribal Government (Fort Yukon), Naqsragmiut Tribal Council (Anaktuvuk Pass), Native Village of Barrow Iñupiat Traditional Government, Native Village of Nuiqsut, and the Native Village of Stevens. The dates and locations of government-to-government meetings that have taken place are provided in **Appendix C**. Discussions with potentially affected tribal governments will occur throughout the EIS process.

The BLM also sent a letter of notification and inquiry on March 2, 2018, to ASRC and KIC, offering the opportunity to participate in formal ANCSA corporations consultation. The BLM has held consultations with both ANCSA corporations, as well as Doyon, Limited, to discuss the EIS process (see **Appendix C**).

1.7.3 Coordination and Consultation with Local, State, and Federal Agencies

The BLM is consulting with the Alaska SHPO, in accordance with Section 106 of the NHPA. This is to determine how proposed activities could affect cultural resources listed on or eligible for listing on the NRHP. Formal consultations with the SHPO also may be required when individual projects are implemented. SHPO consultations for the leasing program are ongoing and will be completed by the time the ROD is signed.

To comply with Section 7(a)(2) of the ESA, the BLM began consulting with the USFWS and NMFS early in the EIS process. The USFWS and NMFS provided input on issues, data collection and review, and alternatives development. The BLM is consulting with the USFWS and NMFS to identify ESA issues and to develop the draft biological assessment.

1.8 Requirements for Further Analysis

The decision on oil and gas leasing resulting from this EIS will authorize multiple lease sales. Any lease sales based on this EIS could be conducted after the ROD is issued. For impact analysis, this EIS assumes that no fewer than 400,000 acres of land that the ROD determines to be available for leasing would be offered in the first two lease sales; however, the first sale and subsequent sales might offer only a portion of the lands identified in the ROD as available, making possible a phased approach to leasing and development.

The timing of subsequent lease sales and the lands offered therein would depend in part on the response to the first sale and the results of the exploration that follows. This EIS is intended to fulfill NEPA requirements for lease sales conducted at least through December 2027 and potentially thereafter. Before it conducts the second and each subsequent lease sale, the BLM will evaluate the adequacy of the EIS in light of new information and circumstances to determine whether it requires supplementation or revision in order to comply with NEPA.

Future on-the-ground actions requiring BLM approval, including potential exploration and development proposals, would require further NEPA analysis based on the site-specific proposal. Potential applicants would be subject to the terms of the lease; however, the BLM Authorized Officer may require additional site-specific terms and conditions before authorizing any oil and gas activity based on the project level NEPA analysis.

1.9 International Agreements, Laws, Regulations, and Permits

In implementing the Coastal Plain Oil and Gas Leasing Program, the BLM would comply with applicable international agreements, federal, state, and local laws, regulations, and executive orders (EOs). Secretarial Order (SO) 3349, American Energy Independence, issued on March 29, 2017, directed the DOI, under EO 13783, Promoting Energy Independence and Economic Growth (March 28, 2017), to "review all existing regulations, orders, guidance documents, policies, and any other similar actions that potentially burden the development or utilization of domestically produced energy resources." This SO can be viewed in its entirety at https://elips.doi.gov/elips/0/doc/4512/Page1.aspx. SO 3360, issued on December 22, 2017, rescinded orders and guidance that were found to be inconsistent with SO 3349. The SO can be viewed in its entirety at https://elips.doi.gov/elips/0/doc/4628/Page1.aspx.

In 1987, the United States and Canadian governments signed the Agreement between the Government of the United States of America and the Government of Canada on the Conservation of the Porcupine Caribou Herd. The main objectives of the agreement are to conserve the herd and its habitat through international cooperation and coordination. The goal is to minimize the risk of irreversible damage or long-term adverse effects, including cumulative effects, as a result of use of caribou or their habitat. Further, it ensures opportunities for customary and traditional uses of the PCH. The agreement set up the International Porcupine Caribou Board, composed of delegated representatives from both countries, who give advice and recommendations to the countries on the conservation and management of the herd.

For a summary of other applicable international agreements, federal, state, and local laws, regulations, permits, and EOs, refer to **Appendix D**. The BLM will continue to consult with regulatory agencies, as appropriate, during the NEPA process and before oil and gas activities are authorized, to ensure that all requirements are met.

1.9.1 Tax Cuts and Jobs Act of 2017 (Public Law 115-97)

Section 20001(c)(3) of PL 115-97 states:

> SURFACE DEVELOPMENT—In administering this section, the Secretary shall authorize up to 2,000 surface acres of Federal land on the Coastal Plain to be covered by production and support facilities (including airstrips and any area covered by gravel berms or piers for support of pipelines) during the term of the leases under the oil and gas program under this section.

The BLM interprets this provision of PL 115-97 as limiting to 2,000 the total number of surface acres of *all* Federal land across the Coastal Plain, regardless of whether such land is leased, which may be covered by production and support facilities *at any given time*. BLM is applying this acreage limit to non-leased Federal lands because Section 20001(c)(2) of PL 115-97 provides for the issuance of rights-of-way (ROWs) or easements across the Coastal Plain regardless of lease status and since in some cases production and support facilities (e.g., pipelines) may be constructed pursuant to such ROWs or easements. BLM is applying this limit to the total acreage of production and support facilities existing at any given moment in time, as opposed to the cumulative total acreage of production and support facilities that may ever exist, because the language "during the term of the leases" in Section 20001(a)(3) indicates a temporal limit was intended by Congress. Under this interpretation the reclaimed acreage of Federal land formerly containing production and support facilities would no longer count towards the 2,000-acre limit.

The BLM interprets this limitation to generally refer to acres of land directly occupied by facilities that are primarily used for the purpose of development, production, and transportation of oil and gas in and from the Coastal Plain. In applying that standard, 1) "facility" is given its ordinary dictionary definition, which is something that is built, installed, or established to serve a particular purpose; here, the development, production, and transportation of oil and gas in and from the Coastal Plain; 2) the limitation does not apply to surface disturbance indirectly related to or resulting from those facilities, as those surface acres are not "covered by" the facilities themselves; and 3) given the explicit language of PL 115-97 relating to "piers" for supporting pipelines, the limitation applies only to those portions of oil and gas facilities that actually touch the land's surface. Thus, BLM interprets the types of "production and support" facilities that will count toward the 2,000-acre limit as including any type of gravel or other fill constructed facility which touches the land's surface, to include: gravel pads used for processing facilities (including wells), production facilities, or pump or compressor stations; gravel airstrips or roads; and any other area covered by gravel berms or piers for support of pipelines. Examples of types of facilities or disturbance that will not count toward the 2,000-acre limit include facilities constructed with snow or ice (e.g., ice roads/pads) and the portion of facilities that do not touch the land's surface (e.g., elevated pipelines). Facilities constructed with snow or ice have a fleeting existence, and thus this aspect of BLM's interpretation is consistent with the temporal limit intended by Congress. Moreover, inclusion of such facilities would make Congress's clear purpose – establishment of an oil and gas program on the Coastal Plain – impracticable. In addition, the BLM interprets "production and support facilities" to exclude gravel mines given that they supply raw materials for construction of oil and gas facilities but are not themselves oil and gas facilities any more than are mills that supply steel for construction of pipelines and other facilities.

The BLM employs this interpretation of Section 20001(c)(3) of PL 115-97 as an assumption in each of the action alternatives analyzed in the EIS. This interpretation limits surface use in any instance where the construction of facilities substantially disturbs the tundra surface but does not restrict the use of winter snow/ice surfaces which melt away each summer and leave the tundra surface largely undisturbed. It also appropriately conserves surface resources and provides an incentive to rapidly reclaim impacted land while still allowing for a reasonable amount of practical and feasible oil and gas development to occur.

The BLM welcomes public comment on its interpretation of PL 115-97 provision Section 20001(c)(3), in addition to comment on the draft EIS generally.

1.10 ANILCA Section 810 Evaluation

Section 810 of ANILCA focuses on issues related to the effects of proposed activities on subsistence use. An ANILCA Section 810 notice and public hearing process is required if a proposed action may significantly restrict subsistence uses and needs. A preliminary evaluation and proposed finding of effects on subsistence uses and needs from actions that could be undertaken under the four alternatives considered in this EIS is provided in **Appendix E**. The preliminary evaluation finds that the cumulative case, when taken in conjunction with Alternatives B, C, D1, and D2 may significantly restrict subsistence uses and needs for the community of Kaktovik. Due to these preliminary findings, a public subsistence hearing will be held in the potentially affected community of Kaktovik.

1.11 Translation

This EIS may be translated into a language other than English to facilitate public participation in the decision process. The English-language version has been prepared by BLM and is the official version of the document for all purposes. Any translated version of this document has been prepared for the convenience of non-English-speaking members of the public. In the event of any discrepancy, the English-language version controls.

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Chapter 2. Alternatives

2.1 Introduction

The alternatives presented in this chapter address the public's concerns, particularly those comments expressed during the formal scoping period, as well as those raised through consultation with tribes, Native corporations, and cooperating agencies. The range of alternatives presented in this chapter was developed by the BLM's Alaska State Office, in coordination with the cooperating agencies. The alternatives respond to the purpose and need for action, including the legislative requirement to establish and administer a competitive oil and gas program in the Coastal Plain in the Arctic Refuge.

The alternatives have benefitted from the insights and expertise of the cooperating agencies, though those agencies are not responsible for the range of alternatives examined in this Leasing EIS (see **Section 1.7.1**, Lead and Cooperating Agencies, for a list of the cooperating agencies). The BLM as the lead agency is solely responsible for the alternatives in this Leasing EIS.

The action alternatives (Alternatives B, C, and D) described in **Section 2.2**, Description of the Alternatives, include a mix of lease stipulations and ROPs that contain measures to avoid or mitigate surface damage and minimize ecological disturbance throughout the program area. There is no BLM-preferred alternative. A preferred alternative will be identified in the final EIS.

The BLM is analyzing this range of alternatives to ensure that a wide range of management options are considered, consistent with applicable law and the purposes of the Arctic Refuge, and to address public scoping suggestions and agency concerns to protect resources. Any decision that the BLM makes following the analysis in this Leasing EIS must be consistent with PL 115-97. It must also conform to other applicable laws and regulations. The oil and gas leasing program must also consider the Refuge purposes set out in Section 303(B)(2) of ANILCA, as amended, and modified by Section 20001 of PL 115-97.

2.2 Description of the Alternatives

Table 2-1 highlights the key differences among alternatives relative to areas available for leasing and lease stipulations. **Table 2-2** is a complete description of all decisions proposed for each alternative.

Table 2-1
Quantitative Summary of Lease Stipulations by Alternative

Lease Availability/Stipulations		Alternative (Acres)			
		B	**C**	**D1**	**D2**
Available for lease sale	Subject to NSO	359,400	932,500	708,600	708,600
	Subject to CSU	0	0	123,900	123,900
	Subject to TLs	585,400	317,100	0	204,700
	Subject to only standard terms and conditions	618,700	313,900	204,700	0
	Total available for lease sale	**1,563,500**	**1,563,500**	**1,037,200**	**1,037,200**
Not offered for lease sale		**0**	**0**	**526,300**	**526,300**

Source: BLM GIS 2018

2.2.1 Alternative A—No Action Alternative

Under Alternative A, the No Action Alternative, no federal minerals in the Coastal Plain would be offered for future oil and gas lease sales after the ROD for this EIS has been signed. Alternative A would not comply with the directive under PL 115-97 to establish and administer a competitive oil and gas program for leasing, developing, producing, and transporting oil and gas in and from the Coastal Plain in the Arctic Refuge. Under this alternative, current management actions would be maintained, and resource trends are expected to continue, as described in the Arctic Refuge Revised CCP (USFWS 2015a).

Alternative A would not meet the purpose and need of the action, which is the BLM's implementation of PL 115-97, including the requirement to hold multiple lease sales and to permit associated post-lease oil and gas activities; however, Alternative A is being carried forward for analysis to provide a baseline for comparing impacts under the action alternatives, as required by the CEQ NEPA regulations.

2.2.2 Alternative B

The entire program area under Alternative B could be offered for lease sale and there would be the fewest acres with NSO stipulations. In addition to applicable lease stipulations, several ROPs would apply to post-lease oil and gas activities to reduce potential impacts. Areas of the Coastal Plain that are available for lease sale under Alternative B are shown in **Map 2-1**, Alternative B, and **Map 2-2**, Alternative B, Lease Stipulations.

2.2.3 Alternative C

The entire program area could also be offered for lease sale under Alternative C; however, a large portion of the program area would be subject to NSO. The BLM would rely on the same ROPs as under Alternative B to reduce potential impacts from post-lease oil and gas activities. Areas of the Coastal Plain that are available for lease sale under Alternative C are shown in **Map 2-3**, Alternative C, and **Map 2-4**, Alternative C, Lease Stipulations.

2.2.4 Alternative D

Under Alternative D, portions of the Coastal Plain would not be offered for lease sale to protect biological and ecological resources. In addition, a large portion of the remaining area would be subject to NSO. In some instances, more prescriptive ROPs are analyzed under Alternative D than under Alternatives B and C.

Alternative D contains two sub-alternatives, Alternatives D1 and D2, which use different approaches to mitigate impacts on caribou summer habitat through lease stipulations. Areas of the Coastal Plain that are available for lease sale under Alternative D1 are shown in **Map 2-5**, Alternative D1, and **Map 2-6**, Alternative D1, Lease Stipulations. Alternative D2 lands available for lease sale are shown in **Map 2-7**, Alternative D2, and **Map 2-8**, Alternative D2, Lease Stipulations.

2.2.5 Lease Stipulations and Required Operating Procedures

Protective measures in Alternatives B, C, and D are of two types: lease stipulations and ROPs (see **Table 2-2**, below).

Lease Stipulations

Appropriate stipulations are attached to the lease before the BLM issues it. As part of a lease contract, stipulations are specific to the lease. All oil and gas activity permits issued to a lessee must comply with the lease stipulations appropriate to the activity under review, such as exploratory drilling or production pad construction.

A stipulation included in an oil and gas lease would be subject to the following, as appropriate:

- A waiver—A permanent exemption to a stipulation on a lease
- An exception—A one-time exemption to a lease stipulation, determined on a case-by-case basis
- A modification—A change attached to a lease stipulation, either temporarily or for the life of the lease

The BLM Authorized Officer may authorize a modification to a lease stipulation only if they determine that the factors leading to the stipulation have changed sufficiently to make the stipulation no longer justified; the proposed operation would still have to meet the objective stated for the stipulation.

While the BLM may grant a waiver, exception, or modification of a stipulation through the permitting process, it may also impose additional requirements through permitting terms and conditions to meet the objectives of any stipulation. This would be the case if the BLM Authorized Officer considers that such requirements are warranted to protect the land and resources, in accordance with the BLM's responsibility under relevant laws and regulations.

Required Operating Procedures

The ROPs under Alternatives B, C, and D describe the protective measures that the BLM would impose on applicants during the permitting process. Together with the lease stipulations, the ROPs also provide a basis for analyzing the potential impacts of the alternatives in this Leasing EIS.

Any applicant requesting authorization for an activity from the BLM will have to address the applicable ROPs in one of the following ways:

- Before submitting the application (e.g., performing and documenting subsistence consultation or surveys)
- As part of the application proposal (e.g., including in the proposal statements that the applicant will meet the objective of the ROP and how the applicant intends to achieve that objective)
- As a term imposed by the BLM in a permit

At the permitting stage, the BLM Authorized Officer would not include those ROPs that, because of their location or other inapplicability, are not relevant to a specific permit application. Note also that at the permit stage, the BLM Authorized Officer may establish additional requirements as warranted to protect the land and resources, in accordance with the BLM's responsibility under relevant laws and regulations.

Table 2-2
Lease Stipulations, Required Operating Procedures, and Lease Notice by Alternative[1]

Alternative B	Alternative C	Alternative D
LEASE STIPULATIONS		
PROTECTIONS THAT APPLY IN SELECT BIOLOGICALLY SENSITIVE AREAS		
Lease Stipulation 1—Rivers and Streams (Map 2-2) Objective: Minimize the disruption of natural flow patterns and changes to water quality; the disruption of natural functions resulting from the loss or change to vegetative and physical characteristics of floodplain and riparian areas; the loss of spawning, rearing, or overwintering fish habitat; the loss of cultural and paleontological resources; the loss of raptor habitat; impacts on subsistence cabins and campsites; and the disruption of subsistence activities. Protect the water quality, quantity, and diversity of fish and wildlife habitats and populations associated with springs and aufeis across the Coastal Plain. Requirement/Standard: (NSO) Permanent oil and gas facilities, including gravel pads, roads, airstrips, and pipelines, are prohibited in the streambed and within the described setback distances outlined below, from the southern boundary of the Coastal Plain to the stream mouth. For streams that are entirely in the Coastal Plain, the setback extends to the head of the stream, as identified in the National Hydrography Dataset. On a case-by case basis, essential pipeline and road crossings would be permitted through setback areas. The setbacks may not be practical in river deltas; in these	***Lease Stipulation 1—Rivers and Streams (Map 2-4)*** Objective: Same as Alternative B. Requirement/Standard: (NSO) Same NSO requirements and setback distances as described under Alternative B; the setback distances for the following rivers have changed under Alternative C: a. Canning River: from the western boundary of the Coastal Plain to 2 miles east of the eastern edge of the active floodplain b. Hulahula River: 2 miles in all directions from the active floodplain c. Okpilak River: 2 miles from the banks' ordinary high-water mark	***Lease Stipulation 1—Rivers and Streams (Map 2-6 and Map 2-8)*** Objective: Minimize the disruption of natural flow patterns and changes to water quality; the disruption of natural functions from the loss or change to vegetation and physical characteristics of floodplain and riparian areas; the loss of spawning, rearing, or overwintering habitat for fish; the loss of cultural and paleontological resources; the loss of raptor habitat; impacts on subsistence cabins and campsites; the disruption of subsistence activities; impacts on hunting and recreation; and impacts on scenic and other resource values. Protect the water quality, quantity, and diversity of fish and wildlife habitats and populations associated with springs and aufeis across the Coastal Plain. Requirement/Standard: (NSO) Same NSO requirements as Alternative B. River setback distances under Alternative D are the following: a. Canning River: From the western boundary of the Coastal Plain to 3 miles east of the eastern edge of the active floodplain b. Hulahula River: 4 miles in all directions from the active floodplain c. Aichilik River: 3 miles from the eastern edge of the Coastal Plain boundary d. Okpilak River: 3 miles from the banks' ordinary

[1]While the language in **Table 2-2** refers only to the BLM or its Authorized Officer, it is understood that all activities, including plan development and consideration of exceptions, modifications, or waivers would include coordination with the USFWS as the surface management agency. In addition, the BLM would coordinate with other appropriate federal, state, and NSB agencies, tribes, and ANCSA corporations.

<table>
<tr><th>Alternative B</th><th>Alternative C</th><th>Alternative D</th></tr>
<tr><td>situations, permanent facilities would be designed to withstand a 200-year flood.
a. Canning River: from the western boundary of the Coastal Plain to 1 mile east of the eastern edge of the active floodplain
b. Hulahula River: 1 mile in all directions from the active floodplain
c. Aichilik River: 1 mile from the eastern edge of the Coastal Plain boundary
d. Okpilak River: 1 mile from the banks' ordinary high-water mark
e. Jago River: 1 mile from the banks' ordinary high-water mark
f. The following rivers and creeks will have a 0.5-mile setback from the banks' ordinary high-water mark:
i. Sadlerochit River
ii. Tamayariak River
iii. Okerokovik River
iv. Katakturuk River
v. Marsh Creek</td><td></td><td>high-water mark
e. The following rivers would have a 1-mile setback from the banks' ordinary high-water mark:
i. Sadlerochit River
ii. Jago River
f. The following rivers and creeks would have a 0.5-mile setback from the banks' ordinary high-water mark:
i. Tamayariak River
ii. Katakturuk River
iii. Nularvik River
iv. Okerokovik River
v. Niguanak River
vi. Sikrelurak River
vii. Angunwill River
viii. Kogotpak River
ix. Marsh Creek
x. Carter Creek
xi. Itkilyariak Creek</td></tr>
<tr><td colspan="2">Lease Stipulation 2—Canning River Delta and Lakes

<u>Objective</u>: Protect and minimize adverse effects on the water quality, quantity, and diversity of fish and wildlife habitats and populations, subsistence resources, and cultural resources; protect and minimize the disruption of natural flow patterns and changes to water quality, the disruption of natural functions resulting from the loss or change to vegetation and physical characteristics of floodplain and riparian areas; the loss of passage, spawning, rearing, or overwintering habitat for fish; the loss of cultural and paleontological resources; and the loss of migratory bird habitat.

<u>Requirement/Standard:</u> See ROP 9 for additional requirements/standards</td><td>Lease Stipulation 2—Canning River Delta and Lakes (Map 2-6 and Map 2-8)

<u>Objective:</u> Same as Alternatives B and C.

<u>Requirement/Standard</u>: (NSO) Permanent oil and gas facilities, including gravel pads, roads, airstrips, and pipelines, are prohibited within 0.5 miles of the ordinary high-water mark of any waterbody[2] in Townships 8 and 9, north of the Canning and Tamyariak watersheds. On a case-by-case basis, essential pipelines, road crossings, and other permanent facilities may be considered through the permitting process in these areas where the</td></tr>
</table>

[2]For the purposes of this document, waterbody is defined as any feature included in the National Hydrography Dataset. This is a feature-based database that interconnects and uniquely identifies the stream segments or reaches that make up the nation's surface water drainage system.

Alternative B	Alternative C	Alternative D
		lessee/operator/contractor can demonstrate on a site-specific basis that impacts would be minimal.
Lease Stipulation 3—Springs/Aufeis Objective: Protect the water quality, quantity, and diversity of fish and wildlife habitats and populations associated with springs and aufeis across the Coastal Plain. River systems with springs provide year-round habitat and host the most diverse and largest populations of fish, aquatic invertebrates, and wildlife; they are associated with major subsistence activity and cultural resources. An aufeis is a unique feature associated with perennial springs. It helps sustain river flow during summer and provides insect relief for caribou. Because the subsurface flow paths to perennial springs are unknown and could be disturbed by drilling or fracking, use buffer areas around the major perennial springs that support fish populations in which no leasing is permitted. Requirement/Standard: a. Before drilling, the lessee/operator/permittee would conduct studies in areas containing springs to ensure drilling would not disrupt flow of the perennial springs, unless such studies have already been completed. Study plans would be developed in consultation with the BLM, USFWS, and other agencies, as appropriate. See **Lease Stipulation 1** for additional requirements/standards.		***Lease Stipulation 3—Springs/Aufeis (Map 2-6** and **Map 2-8)*** Objective: Same as Alternatives B and C. Requirement/Standard: Same as Alternatives B and C, with the addition of the following areas identified that would not be offered for lease sale or identified as NSO: a. No leasing and no new non-subsistence infrastructure would be permitted within 3 miles adjacent to or above Sadlerochit Spring (04N031E) nor within a 1-mile buffer below the spring to where it enters the Sadlerochit River and along the aufeis formation (04N031E and 05N031E). This spring supports an isolated, dwarf population of Dolly Varden, unique plant and invertebrate communities, and an extensive aufeis field that persists through much of the summer, providing insect relief habitat for caribou. b. No leasing would be permitted within 3 miles adjacent to or above the perennial spring at Fish Hole 1 on the Hulahula River (05N032E). Further, no new non-subsistence infrastructure would be permitted within 4 miles of the perennial spring at Fish Hole 1 on the Hulahula River (05N032E), per **Lease Stipulation 1**, nor within 1 mile of the aufeis field (05N032E and 06N032E). The Fish Hole 1 spring provides overwintering habitat for arctic grayling and a large population of anadromous Dolly Varden. Residents of Kaktovik routinely harvest Dolly Varden in Fish Hole 1 during winter. The spring produces an extensive aufeis field that persists through much of the summer.

Alternative B	Alternative C	Alternative D
		c. No leasing would be permitted within 3 miles adjacent to or above the perennial Tamayariak Spring, and no new non-subsistence infrastructure would be permitted within 1 mile of the associated aufeis field (07N026E). d. No leasing would be permitted within 3 miles adjacent to or above the perennial Okerokavik Spring (04N036E), and no new non-subsistence infrastructure would be permitted within 1 mile of the associated aufeis field in the Jago River drainage (05N035E and 05N036E). e. NSO within 3 miles of the eastern bank of the Canning River, including through the delta. The Canning River is the largest river crossing the Coastal Plain. It has several perennial springs originating upstream of the Coastal Plain that provide steady flow under ice across the Coastal Plain. The river supports several fish species, including arctic grayling and a large population of anadromous Dolly Varden. Aufeis fills the river corridor across the Coastal Plain and extends well into the delta, providing insect relief to caribou during the early summer.
Lease Stipulation 4—Nearshore marine, lagoon, and barrier island habitats of the Southern Beaufort Sea within the boundary of the Arctic Refuge (Map 2-2** *and* **Map 2-4) Objective: Protect fish and wildlife habitat, including that for waterfowl and shorebirds, caribou insect relief, marine mammals, and polar bear summer and winter coastal habitat; preserve air and water quality; and minimize impacts on subsistence activities, recreation, historic travel routes, and cultural resources on the major coastal water bodies. Requirement/Standard: (NSO) Exploratory well drill pads, production well drill pads, or a CPF for oil or gas would not be permitted in coastal waters, lagoons, or barrier islands within the boundaries of the Coastal Plain. a. The BLM Authorized Officer may approve infrastructure necessary for oil and gas activities in these critical and sensitive coastal habitats, such as barge landing, docks, spill response staging and storage areas, and pipelines. Approval would be on a case-by-case basis, in consultation with the USFWS or NMFS or both, as appropriate.		***Lease Stipulation 4—Nearshore marine, lagoon, and barrier island habitats of the Southern Beaufort Sea within the boundary of the Arctic Refuge (Map 2-6** *and* **Map 2-8)*** Objective: Same as Alternatives B and C. Requirement/Standard: (NSO) Same as Alternatives B and C, with the following additional requirements: a. The BLM Authorized Officer may approve infrastructure necessary for oil and gas activities in these critical and sensitive coastal habitats, such as barge landing, docks, spill response staging and storage areas, and pipelines.

Alternative B	Alternative C	Alternative D
		Approval would be on a case-by-case basis, in consultation with the USFWS or NMFS or both, as appropriate. b. All lessees/operators/contractors involved in authorized activities in the coastal area must coordinate construction and use infrastructure with all other prospective Arctic Refuge users or user groups. Before conducting open water activities, the lessee/operator/contractor would consult with the Alaska Eskimo Whaling Commission, the NSB, and local whaling captains' associations to minimize impacts on subsistence whaling and other subsistence activities of the communities of the North Slope. In a case in which the BLM authorizes permanent oil and gas infrastructure in the coastal area, the lessee/operator/contractor would develop and implement an impact and conflict avoidance and monitoring plan. This would be used to assess, minimize, and mitigate the effects of the infrastructure and its use on these Coastal Area habitats and their use by wildlife and people, including the following: i. Design and construct facilities to minimize impacts on subsistence uses, travel corridors, and seasonally concentrated fish and wildlife resources. ii. Daily operations, including use of support vehicles, watercraft, and aircraft, alone or in combination with other past, present, and reasonably foreseeable activities, would be conducted to minimize impacts on subsistence and other public uses, travel corridors, and seasonally concentrated fish and wildlife resources. iii. The location of oil and gas facilities, including artificial islands, platforms, associated pipelines, ice or other roads,

Alternative B	Alternative C	Alternative D
		bridges or causeways, would be sited and constructed to not pose a hazard to public navigation, using traditional high-use subsistence-related travel routes into and through the major coastal lagoons and bays, as identified by the community of Kaktovik and the NSB. iv. Operators would be responsible for developing comprehensive prevention and response plans, including Oil Discharge Prevention and Contingency Plans and spill prevention, control, and countermeasure plans and maintain adequate oil spill response capability to effectively respond during periods of broken ice or open water, based on the statutes, regulations, and guidelines of the EPA, Alaska Department of Environmental Conservation (ADEC), and the Alaska Oil and Gas Conservation Commission (AOGCC), as well as best management practices (BMPs), stipulations, and policy guidelines of the BLM. (TL) Oil and gas exploration operations, such as drilling, seismic exploration, and testing, are not allowed on the major coastal water bodies and coastal islands between May 15 and November 1 or when sea ice extent (as defined by Fetterer et al. 2017) is beyond 10 miles of the coast each season, whichever is later. Requests for approval of any activities must be submitted in advance and must be accompanied by evidence and documentation that demonstrates to the satisfaction of the BLM Authorized Officer that the actions or activities meet all the following criteria: a. Exploration would not unreasonably conflict with subsistence uses or significantly affect seasonally concentrated fish and wildlife

Alternative B	Alternative C	Alternative D
		resources. The location of exploration and related activities would be sited to not pose a hazard to navigation by the public using high-use, subsistence-related travel routes into and through the major coastal waterbodies, as identified by the NSB and the Native Village of Kaktovik, recognizing that marine and nearshore travel routes change over time and are subject to shifting environmental conditions.
Lease Stipulation 5—Coastal Polar Bear Denning River Habitat Objective: Minimize disturbance to denning polar bears, and disturbance or alteration of key river and creek maternal denning habitat areas. Requirement/Standard: Comply with ESA and Marine Mammal Protection Act (MMPA) requirements.		***Lease Stipulation 5—Coastal Polar Bear Denning River Habitat (Map 2-6** and **Map 2-8)*** Objective: Same as Alternatives B and C. Requirement/Standard: The following requirements/standards apply from the coastline to 5 miles inland within the program area boundary. This area encompasses approximately **105,400** acres: a. (NSO) From the coastline to 5 miles inland, no permanent oil and gas infrastructure would be within 1 mile of potential polar bear denning habitat on the Niguanak River, Katakturuk River, Marsh Creek, Carter Creek, and Sadlerochit River, and all associated tributaries as defined by Durner et al. (2006), unless the BLM Authorized Officer approves alternative protective measures. b. (TL) From the coastline to 5 miles inland, between October 30 and April 15 of any year, the lessee/operator/contractor would not conduct oil and gas activities within 1 mile of potential polar bear denning habitat on the Niguanak River, Katakturuk River, Marsh Creek, Carter Creek, and Sadlerochit River, and all associated tributaries as defined by Durner et al. (2006), unless the BLM Authorized Officer approves alternative

<table>
<tr><th>Alternative B</th><th>Alternative C</th><th colspan="2">Alternative D</th></tr>
<tr><td colspan="2"></td><td colspan="2">protective measures.</td></tr>
<tr><td colspan="2" rowspan="2">Lease Stipulation 6—Caribou Summer Habitat

Note: All lands in the Arctic Refuge Coastal Plain are recognized as habitat of the PCH and CAH and would be managed to ensure unhindered movement of caribou through the area.

<u>Objective:</u> Minimize disturbance and hindrance of caribou or alteration of caribou movements.

<u>Requirement/Standard:</u> See ROP 23.</td><td colspan="2">Lease Stipulation 6—Caribou Summer Habitat (Map 2-8)

Note: Same as Alternatives B and C.

<u>Objective:</u> Same as Alternatives B and C.</td></tr>
<tr><td>ALTERNATIVE D1

<u>Requirement/Standard:</u> Same as Alternatives B and C.</td><td>ALTERNATIVE D2

<u>Requirement/Standard:</u> Same as Alternatives B and C, with the following additional requirement:

(TL) Major construction activities using heavy equipment, but not drilling from existing production pads, would be suspended from no later than May 20 through no earlier than July 20, unless approved by the BLM Authorized Officer, in consultation with the appropriate federal, state, and NSB regulatory and resource agencies. The intent of this requirement and allowance for deviation is to restrict activities that would disturb caribou during calving and insect-relief periods</td></tr>
</table>

Alternative B	Alternative C	Alternative D	
			but allow for activity if caribou are unlikely to be disturbed in significant numbers. If caribou arrive on the calving grounds before May 20, or if they remain in the area past July 20 in significant numbers (greater than approximately 10 percent of the estimated calving cow population or 1,000 during insect-relief periods), major construction would be suspended. The lessee would submit with the development proposal a stop work plan that considers this, and any other mitigation related to caribou early arrival or late departure. Major equipment, materials, and supplies to be used at oil and gas work sites would be stockpiled before or after the period of May 20 through July 20 to minimize road traffic.

Alternative B	Alternative C	Alternative D
Lease Stipulation 7—Porcupine Caribou Primary Calving Habitat Area (Map 2-2) <u>Note:</u> *PCH primary calving habitat area was defined as the area with a higher-than-average density of cows about to give birth during more than 40 percent of the years surveyed.* <u>Objective:</u> Minimize disturbance and hindrance of caribou or alteration of their movements in the south-southeast portion of the Coastal Plain, which has been identified as important caribou habitat during calving. <u>Requirement/Standard:</u> (TL) Major construction activities using heavy equipment, but not drilling from existing production pads, would be suspended in the PCH primary calving habitat area from May 20 through June 20, unless approved by the BLM Authorized Officer, in consultation with the appropriate federal, State, and NSB regulatory and resource agencies. These areas encompass approximately **721,200** acres. If caribou arrive on the calving grounds before May 20, major construction would be suspended. The lessee should submit with the development proposal a stop work plan that considers this, and any other mitigation related to caribou early arrival. The intent of this latter requirement is to provide flexibility to adapt to changing climate conditions that may occur during the life of fields in the region. a. The following ground and air traffic restrictions would apply to permanent oil and gas-related roads in the areas and time periods indicated: i. Within the calving habitat area, from May 20 through June 20, traffic speed should	***Lease Stipulation 7—Porcupine Caribou Primary Calving Habitat Area (Map 2-4)*** <u>Note:</u> *Same as Alternative B.* <u>Objective:</u> Same as Alternative B. <u>Requirement/Standard:</u> a. (NSO) Approximately **606,200** acres of the PCH primary calving habitat area may be offered for lease but subject to NSO. b. (TL) Approximately **115,000** acres may be offered for lease but subject to the same TLs under Alternative B.	***Lease Stipulation 7—Porcupine Caribou Primary Calving Habitat Area (Map 2-6*** *and* ***Map 2-8)*** <u>Note:</u> *Same as Alternative B.* <u>Objective:</u> Same as Alternative B. <u>Requirement/Standard:</u> a. (No leasing) Approximately **476,600** acres of the PCH primary calving habitat area would not be offered for lease and would not be available for surface occupancy. b. (NSO) Approximately **244,600** acres may be offered for lease but subject to NSO.

Alternative B	Alternative C	Alternative D
not exceed 15 miles per hour when caribou are within 0.5 mile of the road. Additional strategies may include limiting trips and using convoys and different vehicle types, to the extent practicable. The lessee should submit with the development proposal a vehicle use plan that considers these and any other mitigation. The plan should include a vehicle-use monitoring plan. The BLM Authorized Officer would require adjustments if resulting disturbance is determined to be unacceptable. a. Major equipment, materials, and supplies to be used at oil and gas work sites in the calving habitat area should be stockpiled prior to the period of May 20 through June 20 to minimize road traffic during that period.		
Lease Stipulation 8—Porcupine Caribou Post-Calving Habitat Area <u>Note:</u> *The PCH post-calving area was defined as the area with a higher-than-average density of cows during the post-calving period for more than 40 percent of the years. This includes and extends beyond the primary calving area.* <u>Objective:</u> To protect key surface resources and subsistence resources/activities resulting from permanent oil and gas development and associated activities in areas used by caribou during post-calving and insect-relief periods. <u>Requirement/Standard:</u> See **ROP 23**.	***Lease Stipulation 8—Porcupine Caribou Post-Calving Habitat Area (Map 2-4)*** <u>Note:</u> *Same as Alternative B.* <u>Objective:</u> Same as Alternative B. <u>Requirement/Standard:</u> (TL) Sections of road would be evacuated whenever an attempted crossing by a large number of caribou (approximately 100 or more) appears to be imminent (June 15–July 20). This area encompasses approximately **985,500** acres.	***Lease Stipulation 8—Porcupine Caribou Post-Calving Habitat Area (Map 2-6 and Map 2-8)*** <u>Note:</u> *Same as Alternative B.* <u>Objective:</u> Same as Alternative B. <u>Requirement/Standard:</u> (CSU) No CPFs would be allowed in the PCH post-calving habitat area. Well pads, roads, airstrips, and pipelines would be permitted, in accordance with **ROP 23**. This area encompasses approximately **264,300** acres. Infrastructure would be limited across the area to 100 acres per township, not to exceed 510 acres total in this area. (TL) Sections of road would be evacuated whenever an attempted crossing by a large number of caribou (approximately 100 or more) appears to

Alternative B	Alternative C	Alternative D
		be imminent (June 15–July 20). This area encompasses approximately **264,300** acres.
Lease Stipulation 9—Coastal Area (Map 2-2) <u>Objective:</u> Protect coastal waters, lagoons, barrier islands, shorelines, and their value as fish and wildlife habitat, including for waterfowl, shorebirds, and marine mammals; minimize the hindrance or alteration of caribou movement in caribou coastal insect-relief areas; minimize hindrance or alteration of polar bear use and movement in coastal habitats; protect and minimize disturbance from oil and gas activities to coastal habitats for polar bears and seals; prevent loss and alteration of important coastal bird habitat; and prevent impacts on coastal subsistence resources and activities. <u>Requirement/Standard:</u> Before beginning exploration or development within 2 miles of the coast, the lessee/operator/contractor would develop and implement an impact and conflict avoidance and monitoring plan to assess, minimize, and mitigate the effects of the infrastructure and its use on these coastal habitats and their use by wildlife and people.	***Lease Stipulation 9—Coastal Area (Map 2-4)*** <u>Objective:</u> Same as Alternative B. <u>Requirement/Standard:</u> Same as Alternative B, plus: (NSO) Exploratory well drill pads, production well drill pads, or CPFs for oil and gas would not be permitted within 1 mile inland of the coast. The BLM Authorized Officer may approve infrastructure necessary for oil and gas activities in these critical and sensitive coastal habitats, such as barge landing, docks, spill response staging and storage areas, or pipelines. Approval would be on a case-by-case basis, in consultation with the USFWS, or the NMFS, or both, as appropriate. All lessees/operators/contractors involved in authorized activities in the coastal area must coordinate construction and use infrastructure with all other prospective Arctic Refuge users or user groups. Before conducting open water activities, the lessee/operator/contractor would consult with the Alaska Eskimo Whaling Commission, the NSB, and local whaling captains' associations to minimize impacts on subsistence whaling and other subsistence activities of the communities of the North Slope.	***Lease Stipulation 9—Coastal Area (Map 2-6*** *and* ***Map 2-8)*** <u>Objective</u>: Same as Alternative B. <u>Requirement/Standard:</u> Same as Alternative C, plus: (NSO) Exploratory well drill pads, production well drill pads, or CPFs for oil or gas would not be permitted within 2 miles inland of the coast.
Lease Stipulation 10—Wilderness Boundary No similar objective or requirement/standard.		***Lease Stipulation 10—Wilderness Boundary (Map 2-6*** *and* ***Map 2-8)*** <u>Objective:</u> Protect wilderness values in the Mollie Beattie Wilderness Area. <u>Requirement/Standard:</u> (NSO) Surface occupancy, including exploratory and production well drill pads, structures and facilities, and gravel and ice roads, would not be allowed within 3 miles of the

Alternative B	Alternative C	Alternative D
		southern and eastern boundaries of the Coastal Plain where they are near designated wilderness. To the extent practicable, aircraft operations would be planned to minimize flights below 2,000 feet when flying within 3 miles of the Mollie Beattie Wilderness Area boundary.

REQUIRED OPERATING PROCEDURES

WASTE PREVENTION, HANDLING, DISPOSAL, SPILLS, AND PUBLIC SAFETY

Required Operating Procedure 1

Objective: Protect public health, safety, and the environment by disposing of solid and waste and garbage, in accordance with applicable federal, State, and local laws and regulations.

Requirement/Standard: Areas of operation would be left clean of all debris.

Required Operating Procedure 2

Objective: Minimize impacts on the environment from nonhazardous and hazardous waste generation. Encourage continuous environmental improvement. Protect the health and safety of oil and gas field workers, local communities, Arctic Refuge subsistence users, Arctic Refuge recreationists, and the general public. Avoid human-caused changes in predator populations. Minimize attracting predators, particularly bears, to human use areas.

Requirement/Standard: The lessee/operator/contractor would prepare and implement a comprehensive waste management plan for all phases of exploration, development, and production, including seismic activities. The plan would include methods and procedures to use bear resistant containers for all waste materials and classes. The plan would be submitted to the BLM Authorized Officer for approval, in consultation with federal, State, and NSB regulatory and resource agencies, as appropriate (based on agency legal authority and jurisdictional responsibility), as part of a plan of operations or other similar permit application.

Management decisions affecting waste generation would be addressed in the following order of priority: (1) prevention and reduction, (2) recycling, (3) treatment, and (4) disposal. The plan would consider and take into account the following requirements:

a. Methods to avoid attracting wildlife to food and garbage: The plan would identify precautions that are to be taken to avoid attracting wildlife to food and garbage. The use of bear-resistant containers for all waste would be required.
b. Disposal of rotting waste: Requirements prohibit burying garbage. Lessees/operators/contractors would have a written procedure to ensure that rotting waste would be handled and disposed of in a manner that prevents the attraction of wildlife. All rotting waste would be incinerated, backhauled, or composted in a manner approved by the BLM Authorized Officer. All solid waste, including incinerator ash, would be disposed of in an approved waste-disposal facility, in accordance with EPA and ADEC regulations and procedures. Burying human waste is prohibited, except as authorized by the BLM Authorized Officer. The use of bear-resistant containers for all waste would be required.
c. Disposal of pumpable waste products: Except as specifically provided, the BLM requires that all pumpable solid, liquid, and sludge waste be disposed of by

<table>
<tr><th>Alternative B</th><th>Alternative C</th><th>Alternative D</th></tr>
<tr><td colspan="3">injection, in accordance with the EPA, ADEC, and the AOGCC regulations and procedures. On-pad temporary muds and cuttings storage, as approved by the ADEC, would be allowed as necessary to facilitate annular injection and backhaul operations.
d. <u>Disposal of wastewater and domestic wastewater</u>: The BLM prohibits wastewater discharges or disposal of domestic wastewater into bodies of fresh, estuarine, and marine water, including wetlands, unless authorized by a National Pollutant Discharge Elimination System (NPDES) or State permit.</td></tr>
<tr><td colspan="2">Required Operating Procedure 3

<u>Objective</u>: Minimize the impact of contaminants from refueling operations on fish, wildlife, and the environment.

<u>Requirement/Standard</u>: Refueling equipment within 100 feet of the active floodplain of any waterbody is prohibited. Fuel storage stations would be located at least 100 feet from any waterbody, except for small caches (up to 210 gallons) for motor boats, float planes, and ski planes, and for small equipment, such as portable generators and water pumps. The BLM Authorized Officer may allow storage and operations at areas closer than the stated distances if properly designed to account for local hydrologic conditions.</td><td>Required Operating Procedure 3

<u>Objective</u>: Same as Alternatives B and C.

<u>Requirement/Standard</u>: Refueling equipment within 500 feet of the active floodplain of any waterbody is prohibited. Fuel storage stations would be at least 500 feet from any waterbody, except for small caches (up to 210 gallons) for motor boats, float planes, ski planes, and small equipment, such as portable generators and water pumps. The BLM Authorized Officer may allow storage and operations at areas closer than the stated distances if properly designed to account for local hydrologic conditions.</td></tr>
<tr><td colspan="3">Required Operating Procedure 4

<u>Objective</u>: Minimize conflicts from the interaction between humans and bears during oil and gas activities.

<u>Requirement/Standard</u>: The lessee/operator/contractor, as a part of lease operation planning, would prepare and implement bear-interaction plans to minimize conflicts between bears and humans. These bear interaction plans would be developed in consultation with and approved by the USFWS and the Alaska Department of Fish and Game (ADFG). The plans would include specific measures identified in the current USFWS Polar Bear Mitigation Plan and would be adapted as needed for grizzly bears.</td></tr>
<tr><td colspan="3">Required Operating Procedure 5

<u>Objective</u>: Reduce air quality impacts.

<u>Requirement/Standard</u>: All oil and gas operations (vehicles and equipment) that burn diesel fuels must use ultra-low sulfur diesel, as defined by the EPA.</td></tr>
<tr><td colspan="3">Required Operating Procedure 6

<u>Objective:</u> Prevent unnecessary or undue degradation of the lands and protect health.

<u>Requirement/Standard:</u></td></tr>
</table>

Alternative B	Alternative C	Alternative D
a. To support the BLM's NEPA analysis for an application to develop a CPF, production pad/well, airstrip, road, gas compressor station, or other potential air pollutant emission source (hereafter called project), the BLM Authorized Officer may require the project proponent to provide a minimum of 1 year of baseline ambient air monitoring data for any pollutant of concern, as determined by the BLM. This would go into effect if no representative air monitoring data are available for the project area or if existing representative ambient air monitoring data are insufficient, incomplete, or do not meet minimum air monitoring standards set by the ADEC or the EPA. If the BLM determines that baseline monitoring is needed, this pre-analysis data must meet ADEC and EPA air monitoring standards and cover the year before the submittal. Pre-project monitoring may not be appropriate where the life of the project is less than 1 year. b. To inform analysis of subsequent proposals and allow ongoing assessment of air quality conditions, the BLM may require monitoring for the life of the project, depending on the magnitude of potential air emissions from the project, proximity to a federally mandated Class I area, population center, or location in or near a nonattainment or maintenance area, meteorological or geographic conditions, existing air quality conditions, magnitude of existing development in the area, or issues identified during NEPA analysis for the project. c. For an application to develop a CPF, production pad/well, airstrip, road, gas compressor station, or other potential substantial air pollutant emission source, the BLM may require the operator to submit for BLM approval an emissions inventory that includes quantified emissions of regulated air pollutants from all direct and indirect sources related to the proposed project, including reasonably foreseeable air pollutant emissions of criteria air pollutants, volatile organic compounds (VOCs), hazardous air pollutants, and GHGs estimated for each year for the life of the project. The BLM uses this estimated emissions inventory to identify pollutants of concern and to determine the appropriate air analysis methodology for the proposed project. The BLM also uses the information in the analysis. d. For an application to develop a CPF, production pad/well, airstrip, road, gas compressor station, or other potential substantial air pollutant emission source, the BLM may require the proponent to provide, for the BLM's analysis, an emissions reduction plan that includes a detailed description of operator-committed measures to reduce project related air pollutant emissions, including GHGs, mercury and other heavy metals, and fugitive dust. e. The BLM's analysis of the air quality impacts from a proposed CPF, production pad/well, airstrip, road, gas compressor station, or other potential substantial air pollutant emission source may require air quality modeling, depending on the magnitude of potential air emissions from the project or activity, the duration of the proposed action, the proximity to a federally mandated Class I area, population center, location in a nonattainment or maintenance area, meteorological or geographic conditions, existing air quality conditions, magnitude of existing development in the area, or issues identified during NEPA analysis. The BLM would determine the information required for a project-specific modeling analysis to determine if sufficient data exists to perform a quantitative air quality analysis. The BLM Authorized Officer would consult with appropriate federal, State, or local agencies regarding modeling to inform his or her modeling decision and avoid duplication of effort. The modeling would compare predicted impacts with local, State, and federal air quality standards and increments, as well as other scientifically defensible significance thresholds, such as impacts on air quality related values (AQRVs) and incremental cancer risks. f. If the air quality analysis shows potential future exceedances of National Ambient Air Quality Standards (NAAQS) or Alaska Ambient Air Quality Standards (AAAQS) or impacts above specific levels of concern for AQRVs, the BLM would require air quality mitigation measures and strategies within its authority and in consultation with local, State, federal, and tribal agencies with responsibility for managing air resources, in addition to regulatory requirements and proponent committed emission reduction measures and for emission sources not otherwise regulated by the ADEC or EPA. g. If ambient air monitoring indicates that project-related emissions are causing or contributing to impacts that would unnecessarily or unduly degrade the lands, exceed NAAQS, or fail to protect health (either directly or through use of subsistence resources), the BLM Authorized Officer may at any time require changes in activities, within the scope of BLM's authority, to minimize or reduce impacts on air quality through additional emission control strategies. h. Publicly available reports on air quality baseline monitoring, emissions inventory and modeling results developed in conformance with this ROP would be		

<table>
<tr><th>Alternative B</th><th>Alternative C</th><th>Alternative D</th></tr>
<tr><td colspan="3">provided by the project proponent to the NSB and to local communities and tribes in a timely manner.</td></tr>
<tr><td colspan="3">Required Operating Procedure 7

<u>Objective</u>: Ensure that permitted activities do not create human health risks by contaminating subsistence foods.

<u>Requirement/Standard</u>: A lessee/operator/contractor proposing a permanent oil and gas development would design and implement a monitoring study of contaminants in locally used subsistence foods. The monitoring study preparers would examine subsistence foods for all contaminants that could be associated with the proposed development. The study would identify the level of contaminants in subsistence foods before the proposed permanent oil and gas development and would monitor the level of these contaminants throughout the operation and abandonment phases. If ongoing monitoring detects a measurable and persistent increase in a contaminant in subsistence foods, the operator would design and implement a study to determine how much, if any, of the increase originates from the operator's activities. If the study preparers determine that a portion of the increase in contamination is caused by the operator's activities, the BLM Authorized Officer may require changes in the operator's processes to reduce or eliminate emissions of the contaminant. The design of the study must meet the approval of the BLM Authorized Officer, who may coordinate with appropriate entities before approving the study design. The BLM Authorized Officer may require or authorize changes in the design of the studies throughout the operations and abandonment period or terminate or suspend studies if results warrant.</td></tr>
<tr><td colspan="3">WATER USE FOR PERMITTED ACTIVITIES</td></tr>
<tr><td colspan="3">Required Operating Procedure 8

<u>Objective</u>: Maintain natural hydrologic regimes and populations of, and adequate habitat for, fish, and aquatic invertebrates.

<u>Requirement/Standard</u>: Withdrawal of unfrozen water from springs, rivers and streams during winter is prohibited. The removal of ice aggregate from grounded areas 4 feet deep or less may be authorized from rivers on a site-specific basis.</td></tr>
<tr><td colspan="2">Required Operating Procedure 9

<u>Objective</u>: Maintain natural hydrologic regimes in soils surrounding lakes and ponds, and maintain populations of, and adequate habitat for, fish, birds, and aquatic invertebrates.

<u>Requirement/Standard</u>: Withdrawal of unfrozen water from lakes and the removal of ice aggregate from grounded areas 4 feet deep or less during winter and withdrawal of water from lakes during the summer may be authorized on a site-specific basis, depending on water volume and depth, the fish community, and connectivity to other lakes or streams. Current water use guidelines are as follows:

<u>Winter Water Use</u>
a. Lakes with sensitive fish (i.e., any fish except ninespine stickleback or Alaska blackfish): unfrozen water available for withdrawal is limited to 15 percent of calculated volume deeper than 7 feet; only ice aggregate may be removed from lakes that are 7 feet deep or less.
b. Lakes with only non-sensitive fish (i.e., ninespine stickleback or Alaska blackfish): unfrozen water available for withdrawal is limited to 30 percent of calculated volume deeper than 5 feet; only ice</td><td>Required Operating Procedure 9

<u>Objective</u>: Same as Alternatives B and C.

<u>Requirement/Standard</u>: Same as Alternatives B and C, with the following additional requirement:
a. Additional modeling and monitoring of lake recharge may be required to ensure natural hydrologic regime, water quality, and aquatic habitat for migratory birds.</td></tr>
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<table>
<tr><th>Alternative B</th><th>Alternative C</th><th>Alternative D</th></tr>
<tr><td colspan="2">aggregate may be removed from lakes that are 5 feet deep or less.
c. Lakes with no fish, regardless of depth: water available for use is limited to 20 percent of total lake volume.
d. In lakes where unfrozen water and ice aggregate are both removed, the total use would not exceed the respective 15 percent, 20 percent, or 30 percent volume calculations above.
e. Compacting snow cover or removing snow from fish-bearing water bodies would be prohibited, except at approved ice road crossings, water pumping stations on lakes, or areas of grounded ice.

<u>Summer Water Use</u>
f. Requests for summer water use must be made separately, and the volume allowance would be evaluated on a case-by-case basis. Approval from the BLM Authorized Officer is required.

<u>All Water Use</u>
g. Any water intake structures in fish-bearing or non-fish-bearing waters would be designed, operated, and maintained to prevent fish entrapment, entrainment, or injury. Note: All water withdrawal equipment must be equipped with and use fish screening devices approved by the ADFG, Division of Habitat.
h. Additional modeling or monitoring may be required to assess water level and water quality conditions before, during, and after water use from any fish-bearing lake or lake of special concern.</td><td></td></tr>
<tr><td colspan="3">WINTER OVERLAND MOVES AND SEISMIC WORK
The following ROPs apply to overland and over-ice moves, seismic work, and any similar cross-country vehicle use and heavy equipment on surfaces without roads during winter. These restrictions do not apply to the use of such equipment on ice roads after they are constructed.</td></tr>
<tr><td colspan="2">Required Operating Procedure 10

<u>Objective</u>: Protect grizzly bear, polar bear, and marine mammal denning and birthing locations.

<u>Requirement/Standard</u>:
a. Cross-country use of all vehicles, equipment, and oil and gas activity is prohibited within 0.5 miles of occupied grizzly bear dens identified by the ADFG, unless alternative protective measures are approved by the BLM Authorized Officer, in consultation with the ADFG.
b. All oil and gas activity, including cross-country use of vehicles, equipment, and seismic survey activity, is prohibited within 1 mile of known or observed polar bear dens, unless alternative protective measures are approved by the BLM Authorized Officer and are consistent with incidental take regulations (ITRs) and letters of authorization (LOA) issued by the USFWS as part of MMPA regulations.</td><td>Required Operating Procedure 10

<u>Objective</u>: Same as Alternatives B and C.

<u>Requirement/Standard</u>: Same as Alternatives B and C, with the following additional requirements:
a. Specific to ringed seals and seismic operations
i. Before the seismic survey begins, the operator will conduct a sound source verification test to measure the distance of vibroseis[3] sound levels through grounded ice to the 120 decibels (dB) re 1 μPa threshold in open water. Once that distance is determined, it will be shared with the BLM and NMFS. The distance will be used</td></tr>
</table>

3 Vibroseis is a truck-mounted system that uses a large oscillating mass to put a range of frequencies into the earth.

Alternative B	Alternative C	Alternative D
		to buffer all on-ice seismic survey activity operations from any open water or ungrounded ice throughout the project area. The operator will draft a formal study proposal that will be submitted to the BLM and NMFS for review and approval before the activity begins. ii. Maintain airborne sound levels of seismic equipment below 120 dB. If different equipment will be used than was originally proposed, the applicant must inform the BLM Authorized Officer and share sound levels and air and water attenuation information for the new equipment. iii. Operations after May 1 would employ a full-time trained protected species observer (PSO) on vibroseis vehicles to ensure all basking seals are avoided by vehicles by at least 500 feet and would ensure that all equipment with airborne noise levels above 100 dB re 20 μPa were operating at distances from observed seals that allowed for the attenuation of noise to levels below 100 dB. All sightings of seals will be reported to the BLM using a NMFS-approved observation form. iv. Ice paths must not be greater than 12 feet wide. No driving beyond the shoulder of the ice path or off planned routes unless necessary to avoid ungrounded ice or for other human or marine mammal safety reasons. v. No unnecessary equipment or operations (e.g., camps) will be placed or used on sea ice. b. Between October 30 and April 15 of any year, a lessee/operator/contractor working in polar bear denning and seal birthing habitat would

<table>
<tr><th>Alternative B</th><th>Alternative C</th><th>Alternative D</th></tr>
<tr><td></td><td></td><td>conduct a survey for polar bear dens and seal birthing lairs, in consultation with the USFWS, or NMFS, or both, as appropriate, throughout the planned area of activities and before initiating activities.</td></tr>
<tr><td colspan="2">Required Operating Procedure 11

<u>Objective</u>: Protect stream banks and freshwater sources, minimize soils compaction and the breakage, abrasion, compaction, or displacement of vegetation.

<u>Requirement/Standard</u>:
a. Ground operation would be allowed when soil temperatures at 12 inches below the tundra surface (defined as the top of the organic layer) reaches 23 degrees Fahrenheit (°F) and snow depths are an average of 9 inches, or 3 inches of snow water equivalent, whichever is less. Ground operations would cease when the spring snowmelt begins (approximately May 5 in the foothills, where elevations reach or exceed 500 feet and approximately May 15 in the northern coastal areas). The exact dates would be determined by the BLM Authorized Officer.
b. Low ground pressure vehicles used for off-road travel would be defined by the BLM Authorized Officer. These vehicles would be selected and operated in a manner that eliminates direct impacts on the tundra by shearing, scraping, or excessively compacting the tundra. Note: This provision does not include the use of heavy equipment required during ice road construction; however, heavy equipment would not be allowed on the tundra until conditions in “a,” above, are met.
c. Bulldozing tundra mat and vegetation, trails, or seismic lines is prohibited. Clearing or smoothing drifted snow is allowed to the extent that the tundra mat is not disturbed. Only smooth pipe snow drags would be allowed for smoothing drifted snow.
d. To reduce the possibility of excessive compaction, vehicle operators would avoid using the same routes for multiple trips, unless necessitated by serious safety or environmental concerns and approved by the BLM Authorized Officer. This provision does not apply to hardened snow trails or ice roads.
e. Ice roads would be designed and located to avoid the most sensitive and easily damaged tundra types as much as practicable. Ice roads may not use the same route each year; ice roads would be offset to avoid portions of an ice road route from the previous 2 years.
f. Conventional ice road construction may not begin until off-road travel conditions are met (as described in “a,” above) within the ice road route and approval to begin construction is given by the BLM Authorized Officer.
g. Snow fences may be used in areas of low snow to increase snow depths within an ice road or snow trail route.
h. Seismic operations and winter overland travel may be monitored by agency representatives, and the</td><td>Required Operating Procedure 11

<u>Objective</u>: Same as Alternatives B and C.

<u>Requirement/Standard</u>:
a. Ground operation would be allowed when soil temperature at 12 inches below the tundra surface (defined as the top of the organic layer) reaches 23 °F and snow depth and density amounts to no less than a snow water equivalent of 3 inches over the highest tussocks. Ground operations would cease when the spring snowmelt begins (approximately May 5 in the foothills, where elevations reach or exceed 500 feet, and approximately May 15 in the northern coastal areas). The exact dates would be determined by the BLM Authorized Officer.
b. Low ground pressure vehicles used for off-road travel would be defined by the BLM Authorized Officer. These vehicles would be selected and operated in a manner that eliminates direct impacts on the tundra by shearing, scraping, or excessively compacting it. Note: This provision does not include the use of heavy equipment required during ice road construction; however, heavy equipment would not be allowed on the tundra until conditions in “a,” above, are met.
c. Bulldozing tundra mat and vegetation, trails, or seismic lines is prohibited. Clearing or smoothing drifted snow is allowed, to the extent that the tundra mat is not disturbed. Only smooth pipe snow drags would be</td></tr>
</table>

Alternative B	Alternative C	Alternative D
operator may be required to accommodate the representative during operations. i. Incidents of damage to the tundra would be reported to the BLM Authorized Officer within 72 hours of occurrence. Follow-up corrective actions would be determined in consultation with and approved by the BLM Authorized Officer.		allowed for smoothing drifted snow. d. To reduce the possibility of excessive compaction, vehicle operators would avoid using the same routes for multiple trips unless necessitated by serious safety or environmental concerns and approved by the BLM Authorized Officer. This provision does not apply to hardened snow trails or ice roads. e. Ice roads would be designed and located to avoid the most sensitive and easily damaged tundra types as much as practicable. Ice roads may not use the same route each year; they would be offset to avoid portions of an ice road route from the previous 2 years. f. Conventional ice road construction may not begin until off-road travel conditions are met (as described in "a," above) within the ice road route and approval to begin construction is given by the BLM Authorized Officer. g. To minimize changes in snow distribution resulting from oil and gas activities that could affect bear denning habitat and water quality and quantity, snow fences may be used in areas of low snow to increase snow depths within an ice road or snow trail route, with the approval of the BLM Authorized Officer. h. Seismic operations and winter overland travel may be monitored by agency representatives, and the operator may be required to accommodate the representative during operations. i. Incidents of damage to the tundra would be reported to the BLM Authorized Officer within 72 hours of occurrence. Follow-up corrective actions would be determined in consultation with and approved by the BLM Authorized Officer and the USFWS.

<table>
<tr><th>Alternative B</th><th>Alternative C</th><th>Alternative D</th></tr>
<tr><td colspan="3">Required Operating Procedure 12

Objective: Maintain natural spring (breakup) runoff patterns and fish passage, minimize flooding from human-made obstructions, prevent streambed sedimentation and scour, and protect water quality and stream banks.

Requirement/Standard: Waterway courses would be crossed using a low-angle approach. Crossings that are reinforced with additional snow or ice (bridges) would be removed, breached, or slotted before spring breakup. Ramps and bridges would be substantially free of soil and debris.</td></tr>
<tr><td colspan="3">Required Operating Procedure 13

Objective: Avoid additional freeze-down of aquatic habitat harboring overwintering fish and aquatic invertebrates that fish prey on.

Requirement/Standard: Travel up and down streambeds is prohibited unless it can be demonstrated that there would be no additional impacts from such travel on overwintering fish, the aquatic invertebrates they prey on, and water quality. Rivers, streams, and lakes would be crossed at areas of grounded ice or with the approval of the BLM Authorized Officer and when it has been demonstrated that no additional impacts would occur on fish or aquatic invertebrates.</td></tr>
<tr><td colspan="2">Required Operating Procedure 14

Objective: Minimize the effects of high-intensity acoustic energy from seismic surveys on fish.
Requirement/Standard:
a. When conducting vibroseis-based surveys above potential fish overwintering areas (water 6 feet deep or greater, ice plus liquid depth), lessees/operators/contractors would follow recommendations by Morris and Winters (2005): only a single set of vibroseis shots would be conducted if possible; if multiple shot locations are required, these would be conducted with minimal delay; multiple days of vibroseis activity above the same overwintering area would be avoided, if possible.</td><td>Required Operating Procedure 14

Objective: Same as Alternatives B and C.
Requirement/Standard:
a.. Seismic surveys would not be conducted over unfrozen water with fish overwintering potential.</td></tr>
<tr><td colspan="3">Required Operating Procedure 15
Objective: Reduce changes in snow distribution associated with the use of snow fences to protect water quantity and wildlife habitat, including snow drifts used by denning polar bears.

Requirement/Standard: The use of snow fences to reduce or increase snow depth requires permitting by the BLM Authorized Officer.</td></tr>
<tr><td colspan="3">OIL AND GAS EXPLORATORY DRILLING</td></tr>
<tr><td colspan="3">Required Operating Procedure 16

Objective: Protect water quality in fish-bearing water bodies and minimize alteration of riparian habitat.

Requirement/Standard: Exploratory drilling is prohibited in fish-bearing rivers and streams and other fish-bearing water bodies. On a case-by-case basis, the BLM Authorized Officer may consider exploratory drilling in floodplains of fish-bearing rivers and streams.</td></tr>
</table>

Alternative B	Alternative C	Alternative D
Required Operating Procedure 17 Objective: Minimize surface impacts from exploratory drilling. Requirement/Standard: Construction of a gravel road for permanent oil and gas facilities would be prohibited for exploratory drilling. Use of a previously constructed road or pad may be permitted if it is environmentally preferred.		
FACILITY DESIGN AND CONSTRUCTION		
Required Operating Procedure 18 Objective: Protect subsistence use and access to subsistence hunting and fishing areas and minimize the impact of oil and gas activities on air, land, water, fish, and wildlife resources. Requirement/Standard: All roads must be designed, constructed, maintained, and operated to create minimal environmental impacts and to avoid or minimize impacts on subsistence use and access to subsistence hunting and fishing areas. The BLM Authorized Officer would consult with appropriate entities before approving construction of roads. Subject to approval by the BLM Authorized Officer, the construction, operation, and maintenance of oil and gas field roads is the responsibility of the lessee/operator/contractor, unless the construction, operation, and maintenance of roads are assumed by the appropriate governing entity.		
Required Operating Procedure 19 Objective: Protect water quality and the diversity of fish, aquatic invertebrates, and wildlife populations and habitats. Requirement/Standard: a. Permanent oil and gas facilities, including roads, airstrips, and pipelines, are prohibited within 500 feet, as measured from the ordinary high-water mark, of fish-bearing water bodies, unless further setbacks are stipulated under **Lease Stipulation 1**. Pipeline and road crossings would be permitted on a case-by-case basis by the BLM Authorized Officer, following coordination with the appropriate entities. b. Temporary winter exploration and construction camps are prohibited on frozen lakes and river ice. c. Siting temporary winter exploration and construction camps on river sand and gravel bars is allowed and encouraged. Where trailers or modules must be leveled and the surface is vegetation, they would be leveled using blocking in a way that preserves the vegetation.		
Required Operating Procedure 20 Objective: Maintain free passage of marine and anadromous fish, protect subsistence use and access to subsistence hunting and fishing and anadromous fish, and protect subsistence use and access to subsistence and non-subsistence hunting and fishing. Requirement/Standard: a. Causeways and docks are prohibited in river mouths and deltas. Artificial gravel islands and bottom-founded structures are prohibited in river mouths and active stream channels on river deltas. b. Causeways, docks, artificial islands, and bottom-founded drilling structures would be designed to ensure free passage of marine and anadromous fish and to		

<table>
<tr><th>Alternative B</th><th>Alternative C</th><th>Alternative D</th></tr>
<tr><td colspan="3">prevent significant changes to nearshore oceanographic circulation patterns and water quality characteristics. A monitoring program, developed in coordination with appropriate entities, would be required to address the objectives of water quality and free passage of fish.</td></tr>
<tr><td colspan="3">Required Operating Procedure 21

<u>Objective</u>: Minimize impacts of the development footprint.

<u>Requirement/Standard</u>: Facilities would be designed and located to minimize the development footprint and impacts on other purposes of the Arctic Refuge. Issues and methods that are to be considered are as follows:
a. Using maximum extended-reach drilling for production drilling to minimize the number of pads and the network of roads between pads
b. Sharing facilities with existing development
c. Collocating all oil and gas facilities with drill pads, except airstrips, docks, base camps, and seawater treatment plants (STPs)
d. Using gravel-reduction technologies, e.g., insulated or pile-supported pads
e. Using impermeable liners under gravel infrastructure to minimize the potential for hydrocarbon spills
f. Harvesting the tundra organic layer within gravel pad footprints for use in rehabilitation
g. Coordinating facilities with infrastructure in support of adjacent development
h. Locating facilities and other infrastructure outside areas identified as important for wildlife habitat, subsistence uses, and recreation
i. Where aircraft traffic is a concern, balancing gravel pad size and available supply storage capacity with potential reductions in the use of aircraft to support oil and gas operations</td></tr>
<tr><td colspan="3">Required Operating Procedure 22

<u>Objective</u>: Reduce the potential for ice-jam flooding, damage from aufeis, impacts on wetlands and floodplains, erosion, alteration of natural drainage patterns, and restriction of fish passage.

<u>Requirement/Standard</u>:
a. To allow for sheet flow and floodplain dynamics and to ensure passage of fish and other organisms, bridges are preferred over culverts, if technically feasible. When necessary, culverts could be constructed on smaller streams, if they are large enough to avoid restricting fish passage or adversely affecting natural stream flow.
b. To ensure that crossings provide for fish passage, all proposed crossing designs would adhere to the BMPs outlined in Fish Passage Design Guidelines, developed by the USFWS Alaska Fish Passage Program (McDonald & Associates 1994), Stream Simulation: An Ecological Approach to Providing Passage for Aquatic Organisms at Road-Stream Crossings (Forest Service 2008), and other generally accepted best management procedures prescribed by the BLM Authorized Officer and the USFWS.
c. In addition to the BMPs outlined in the aforementioned documents for stream simulation design, the design engineer would ensure that crossing structures are designed for aufeis, permafrost, sheet flow, additional freeboard during breakup, and other unique conditions of the arctic environment.</td></tr>
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<table>
<tr><th>Alternative B</th><th>Alternative C</th><th>Alternative D</th></tr>
<tr><td colspan="3">Required Operating Procedure 23

Objective: Minimize disruption of caribou movement and subsistence use.

Requirement/Standard: Pipelines and roads would be designed to allow the free movement of caribou and the safe, unimpeded passage of those participating in subsistence activities. Listed below are the accepted design practices.
a. Aboveground pipelines would be elevated a minimum of 7 feet, as measured from the ground to the bottom of the pipeline at vertical support members (VSMs).
b. In areas where facilities or terrain would funnel caribou movement or impede subsistence or public access, ramps of appropriate angle and design over pipelines, buried pipelines, or pipelines buried under roads may be required by the BLM Authorized Officer, in coordination with the appropriate entity.
c. A minimum distance of 500 feet between pipelines and roads would be maintained. Separating roads from pipelines may not be feasible within narrow land corridors between lakes and where pipelines and roads converge on a drill pad. Where it is not feasible, alternative pipeline routes, designs, and possible burial under the road for pipeline road crossings would be considered by the BLM Authorized Officer.
d. Aboveground pipelines would have a nonreflective finish.
e. When laying out oil and gas field developments, lessees would orient infrastructure to avoid impeding caribou migration and to avoid corralling effects.
f. Before the construction of permanent facilities is authorized (limited as they may be by restricted surface occupancy areas established in other lease stipulations), the lessee would design and implement and report a study of caribou movement, unless an acceptable study specific to the PCH and CAH has been completed within the last 10 years and approved by the BLM Authorized Officer.
g. A vehicle use management plan would be developed by the lessee/operator/contractor and approved by the BLM Authorized Officer, in consultation with the appropriate federal, State, and NSB regulatory and resource agencies. The management plan would minimize or mitigate displacement during calving and would avoid, to the extent feasible, delays to caribou movements and vehicle collisions during the midsummer insect season, with traffic management following industry practices. By direction of the BLM Authorized Officer, traffic may be stopped throughout a defined area for up to 4 weeks, to prevent displacement of calving caribou. If required, a monitoring plan could include collection of data on vehicle counts and caribou interaction.</td></tr>
<tr><td colspan="2">Required Operating Procedure 24

Objective: Minimize the impact of mineral materials mining on air, land, water, fish, and wildlife resources.

Requirement/Standard: Gravel mine site design and reclamation would be done in accordance with a plan approved by the BLM Authorized Officer. The plan would be developed in coordination with the appropriate entity and would take into consideration the following:
a. Locations outside the active floodplain
b. Design and construction of gravel mine sites in active floodplains to serve as water reservoirs for future use
c. Potential use of the site for enhancing fish and wildlife habitat
d. Potential storage and reuse of sod/overburden for the mine site or at other disturbed sites on the North Slope</td><td>Required Operating Procedure 24

Objective: Same as Alternatives B and C.

Requirement/Standard: Gravel mine site design, construction, and reclamation would be done in accordance with a plan approved by the BLM Authorized Officer. The plan would be developed in coordination with the appropriate entity and would take into consideration the following:
a. Construction of gravel mine sites or water reservoirs may not be considered within the active floodplains of the four rivers that support populations of freshwater, anadromous, or endemic fish (Canning, Sadlerochit, Hulahula,</td></tr>
</table>

Alternative B	Alternative C	Alternative D
		and Aichilik Rivers) b. Design and construction of gravel mine sites may be considered at locations outside the active floodplain c. Design and construction of gravel mine sites that may also serve as water reservoirs may be considered in active floodplains, except for waters identified in "a," above d. Potential storage and reuse of sod/overburden for the mine site or at other disturbed sites on the North Slope e. All constructed water storage reservoirs should be a sufficient distance from drill sites, fueling stations, or other temporary or permanent site that generates or maintains more than 220 gallons of fuel, drilling fluids, or other hazardous materials to avoid contamination via surface or groundwater of the storage reservoir; the lessee should implement a water quality and contaminants monitoring program for any constructed water storage facility

Required Operating Procedure 25

Objective: Avoid human-caused changes in predator populations of ground-nesting birds.

Requirement/Standard:

a. Lessee/operator/contractor would use best available technology to prevent facilities from providing nesting, denning, or shelter sites for ravens, raptors, and foxes. The lessee/operator/contractor would provide the BLM Authorized Officer with an annual report on the use of oil and gas facilities by ravens, raptors, and foxes as nesting, denning, and shelter sites.
b. Feeding of wildlife and allowing wildlife to access human food or odor-emitting waste is prohibited.

Required Operating Procedure 26

Objective: Reduction of risk of attraction and collisions between migrating birds and oil and gas and related facilities during low light conditions.

Requirement/Standard: All structures would be designed to direct artificial exterior lighting, from August 1 to October 31, inward and downward, rather than upward and outward, unless otherwise required by the Federal Aviation Administration (FAA).

Alternative B	Alternative C	Alternative D
Required Operating Procedure 27 Objective: Minimize the impacts to bird species from direct interaction with oil and gas facilities. Requirement/Standard: a. To reduce the possibility of birds colliding with aboveground utility lines (power and communication), such lines would either be buried in access roads or would be suspended on VSMs, except in rare cases, limited in extent. Exceptions are limited to the following situations: i. Overhead power or communication lines may be allowed when located entirely within the boundaries of a facility pad; ii. Overhead power or communication lines may be allowed when engineering constraints at the specific and limited location make it infeasible to bury or connect the lines to a VSM; or iii. Overhead power or communication lines may be allowed in situations when human safety would be compromised by other methods. b. To reduce the likelihood of birds colliding with them, communication towers would be located, to the extent practicable, on existing pads and as close as possible to buildings or other structures and on the east or west side of buildings or other structures, if possible. Support wires associated with communication towers, radio antennas, and other similar facilities, would be avoided to the extent practicable. If support wires are necessary, they would be clearly marked along their entire length to improve visibility to low-flying birds. Such markings would be developed through consultation with the USFWS.		
Required Operating Procedure 28 Objective: Use ecological mapping as a tool to assess wildlife habitat before developing permanent facilities to conserve important habitat types. Requirement/Standard: An ecological land classification map of the area would be developed before approval of facility construction. The map would integrate geomorphology, surface form, and vegetation at a scale and level of resolution and position accuracy adequate for detailed analysis of development alternatives. The map would be prepared in time to plan one season of ground-based wildlife surveys, if deemed necessary by the BLM Authorized Officer, before the exact facility location and facility construction is approved.		
Required Operating Procedure 29 Objective: Protect cultural and paleontological resources. Requirement/Standard: The lessee/operator/contractor would conduct a cultural and paleontological resources survey before any ground-disturbing activity, based on a study designed and approved by the BLM Authorized Officer. If any potential cultural or paleontological resource is found, the lessee/operator/contractor would notify the BLM Authorized Officer and would suspend all operations in the immediate area until she or he issues a written authorization to proceed.		
Required Operating Procedure 30 Objective: Prevent or minimize the loss of nesting habitat for cliff-nesting raptors. Requirement/Standard: a. Removing greater than 100 cubic yards of bedrock outcrops, sand, or gravel from cliffs displaying evidence of raptor nests would be prohibited.		

<table>
<tr><th>Alternative B</th><th>Alternative C</th><th>Alternative D</th></tr>
<tr><td colspan="3">b. Any extraction of sand or gravel from an active river or stream channel would be prohibited, unless preceded by a hydrological study that indicates no potential impact on the integrity of the river bluffs.</td></tr>
<tr><td colspan="3">Required Operating Procedure 31

<u>Objective</u>: Prevent or minimize the loss of raptors due to electrocution by power lines.

<u>Requirement/Standard</u>: Comply with the most up-to-date, industry-accepted, suggested practices for raptor protection on power lines. Current accepted standards were published in Suggested Practices for Avian Protection on Power Lines: The State of the Art in 2006, by the Avian Power Line Interaction Committee (APLIC 2006) and are updated as needed.</td></tr>
<tr><td colspan="3">Required Operating Procedure 32

<u>Objective</u>: Avoid and reduce temporary impacts on productivity from disturbance near Steller's or spectacled eider nests.

<u>Requirement/Standard</u>: Ground-level vehicle or foot traffic within 656 feet of occupied Steller's or spectacled eider nests, from June 1 through July 31, would be restricted to existing thoroughfares, such as pads and roads. Construction of permanent facilities, placement of fill, alteration of habitat, and introduction of high noise levels within 656 feet of occupied Steller's or spectacled eider nests would be prohibited. Between June 1 and August 15, support/construction activity must occur off existing thoroughfares, and USFWS-approved nest surveys must be conducted during mid-June before the activity is approved. Collected data would be used to evaluate whether the action could occur based on a 656-foot buffer around nests or if the activity would be delayed until after mid-August once ducklings are mobile and have left the nest site. The BLM would also work with the USFWS to conduct nest surveys or oil spill response training in riverine, marine, and intertidal areas that is within 656 feet of shore outside sensitive nesting/brood-rearing periods. The protocol and timing of nest surveys for Steller's or spectacled eiders would be determined in cooperation with and must be approved by the USFWS. Surveys would be supervised by biologists who have previous experience with Steller's or spectacled eider nest surveys.</td></tr>
<tr><td colspan="3">Required Operating Procedure 33

<u>Objective</u>: Provide information to be used in monitoring and assessing wildlife movements during and after construction.

<u>Requirement/Standard</u>: A representation, in the form of ArcGIS-compatible shape-files, of all new infrastructure construction would be provided to the BLM Authorized Officer and State of Alaska. During the planning and permitting phase, GIS shape files representing proposed locations would be provided. Within 6 months of construction completion, shape-files (within Global Positioning System accuracy) of all new infrastructure would be provided. Infrastructure includes all gravel roads and pads, facilities built on pads, pipelines, and independently constructed power lines (as opposed to those incorporated in pipeline design). Gravel pads would be included as polygon features. Roads, pipelines, and power lines may be represented as line features but must include ancillary data to denote such data as width and number of pipes. Poles for power lines may be represented as point features. Ancillary data would include construction beginning and ending dates.</td></tr>
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<table>
<tr><th>Alternative B</th><th>Alternative C</th><th>Alternative D</th></tr>
<tr><td colspan="3">USE OF AIRCRAFT FOR PERMITTED ACTIVITIES</td></tr>
<tr><td colspan="2">Required Operating Procedure 34

<u>Objective</u>: Minimize the effects of low-flying aircraft on wildlife, subsistence activities, local communities, and recreationists of the area, including hunters and anglers.

<u>Requirement/Standard</u>: The operator would ensure that operators of aircraft used for permitted oil and gas activities and associated studies maintain altitudes according to the following guidelines (Note: This ROP is not intended to restrict flights necessary to survey wildlife to gain information necessary to meet the stated objectives of the lease stipulations and ROPs; however, such flights would be restricted to the minimum necessary to collect such data.):
a. Land users would submit an aircraft use plan as part of an oil and gas exploration or development proposal, which includes a plan to monitor flights and includes a reporting system for subsistence hunters to easily report flights that disturb subsistence harvest. The plan would address strategies to minimize impacts on subsistence hunting and associated activities, including the number of flights, type of aircraft, and flight altitudes and routes, and would also include a plan to monitor flights. Proposed aircraft use plans would be reviewed by the appropriate Alaska Native or subsistence organization. Consultations with these same agencies would be required if unacceptable disturbance is identified by subsistence users. Adjustments, including possible suspension of all flights, may be required by the BLM Authorized Officer, if resulting disturbance is determined to be unacceptable. The number of takeoffs and landings to support oil and gas operations with necessary materials and supplies would be limited to the maximum extent possible. During the design of proposed oil and gas facilities, larger landing strips and storage areas would be considered to allow larger aircraft to be used, resulting in fewer flights to the facility.
b. Use of aircraft, especially rotary wing aircraft, would be kept to a minimum near known subsistence camps and cabins or during sensitive subsistence hunting periods (spring goose hunting, summer caribou, and fall moose hunting) and when recreationists are present.
c. Operators of aircraft used for permitted activities would maintain an altitude of at least 1,500 feet above ground level (except for takeoffs and landings) within 0.5 miles of cliffs identified as raptor nesting sites, and over caribou calving range, unless doing so would endanger human life or violate safe flying practices.
d. Minimize the number of helicopter landings in caribou calving ranges from May 20 through June 20.
e. Pursuing running wildlife is hazing. Hazing wildlife by aircraft pilots is prohibited, unless otherwise authorized. If wildlife begins to run as an aircraft approaches, the aircraft is too close, and the operator must break away.</td><td>Required Operating Procedure 34

<u>Objective</u>: Same as Alternatives B and C.

<u>Requirement/Standard</u>: Same as Alternatives B and C, except that requirements "c" and "d" include the caribou post-calving and calving range, and "d" minimizes the number of helicopter landings in caribou calving ranges from May 20 through July 20.</td></tr>
</table>

Alternative B	Alternative C	Alternative D
OIL AND GAS FIELD ABANDONMENT		
Required Operating Procedure 35 Objective: Ensure ongoing and long-term reclamation of land to its previous condition and use. Requirement/Standard: Before final abandonment, land used for oil and gas infrastructure—including well pads, production facilities, access roads, and airstrips—would be reclaimed to ensure eventual restoration of ecosystem function. The leaseholder would develop and implement a BLM-approved abandonment and reclamation plan. The plan would describe short-term stability, visual, hydrological, and productivity objectives and steps to be taken to ensure eventual ecosystem restoration to the land's previous hydrological, vegetation, and habitat condition. The BLM Authorized Officer may grant exceptions to satisfy stated environmental or public purposes.		***Required Operating Procedure 35*** Objective: Same as Alternatives B and C. Requirement/Standard: a. Oil and gas infrastructure, including gravel pads, roads, airstrips, wells and production facilities, would be removed and the land restored on an ongoing basis, as extraction is complete. b. Before final abandonment, land used for oil and gas infrastructure—including well pads, production facilities, access roads, and airstrips—would be restored to ensure eventual restoration of ecosystem function and meet minimal standards to restore general wilderness characteristics. The leaseholder would develop and implement a BLM-approved abandonment and reclamation plan. The plan would describe short-term stability, visual, hydrological, and productivity objectives and steps to be taken to ensure eventual ecosystem restoration to the land's previous hydrological, vegetation, and habitat condition, wild and scenic river (WSR) eligibility/suitability, and intent to restore general wilderness characteristics of the area. The BLM Authorized Officer may grant exceptions to satisfy stated environmental or public purposes.
SUBSISTENCE CONSULTATION FOR PERMITTED ACTIVITIES		
Required Operating Procedure 36 Objective: Provide opportunities for subsistence users to participate in planning and decision-making to prevent unreasonable conflicts between subsistence uses and other activities. Requirement/Standard: The lessee/operator/contractor would coordinate directly with affected communities, using the following guidelines: a. Before submitting an application to the BLM, the applicant would work with directly affected subsistence communities, the Native Village of Kaktovik, NSB, and the North Slope and Eastern Interior Alaska Subsistence Regional Advisory Councils. They would discuss the siting, timing, and methods of their		

Alternative B	Alternative C	Alternative D
proposed operations to help discover local traditional and scientific knowledge. This is to minimize impacts on subsistence uses. Through this coordination, the applicant would make every reasonable effort, including such mechanisms as conflict avoidance agreements (CAAs) and mitigating measures, to ensure that proposed activities would not result in unreasonable interference with subsistence activities. In the event that no agreement is reached between the parties, the BLM Authorized Officer would work with the involved parties and determine which activities would occur, including the time frames. b. Applicants would submit documentation of coordination as part of operation plans to the North Slope and Eastern Interior Alaska Subsistence Regional Advisory Councils for review and comment. Applicants must allow time for the BLM to conduct formal government-to-government consultation with Native Tribal governments if the proposed action requires it. c. A plan would be developed that shows how the activity, in combination with other activities in the area, would be scheduled and located to prevent unreasonable conflicts with subsistence activities. The plan would also describe the methods used to monitor the effects of the activity on subsistence use. The plan would be submitted to the BLM Authorized Officer as part of the plan of operations. The plan would address the following items: i. A detailed description of the activities to take place (including the use of aircraft). ii. A description of how the applicant would minimize or address any potential impacts identified by the BLM Authorized Officer during the coordination process. iii. A detailed description of the monitoring to take place, including process, procedures, personnel involved, and points of contact both at the work site and in the local community. iv. Communication elements to provide information on how the applicant would keep potentially affected individuals and communities up-to-date on the progress of the activities and locations of possible, short-term conflicts (if any) with subsistence activities. Communication methods could include holding community open house meetings, workshops, newsletters, and radio and television announcements. v. Procedures necessary to facilitate access by subsistence users to conduct their activities. vi. Barge operators requiring a BLM permit are required to demonstrate that barging activities will not have unmitigable adverse impacts, as determined by NMFS, on the availability of marine mammals to subsistence hunters. vii. All operators of vessels over 50 feet in length engaged in operations requiring a BLM permit must have an automatic identification system transponder system on the vessel. d. During development, monitoring plans must be established for new permanent facilities, including pipelines, to assess an appropriate range of potential effects on resources and subsistence, as determined on a case-by-case basis, given the nature and location of the facilities. The scope, intensity, and duration of such plans would be established in consultation with the BLM Authorized Officer and North Slope and Eastern Interior Subsistence Advisory Panels. e. Permittees who propose transporting facilities, equipment, supplies, or other materials by barge to the Coastal Plain in support of oil and gas activities in the Arctic Refuge would notify, confer, and coordinate with the Alaska Eskimo Whaling Commission, the appropriate local community whaling captains' associations, and the NSB to minimize impacts from the proposed barging on subsistence whaling.		
Required Operating Procedure 37 Objective: Avoid conflicts between subsistence activities and seismic exploration. Requirement/Standard: In addition to the coordination process described in **ROP 36** for permitted activities, before seismic exploration begins, applicants would notify the local search and rescue organizations in proposed seismic survey locations for that operational season. For the purpose of this standard, a potentially affected cabin or campsite is defined as one used for subsistence purposes and located within the boundary of the area subject to proposed geophysical exploration or within 1 mile of actual or planned travel routes used to supply the seismic operations. a. Because of the large land area covered by typical geophysical operations and the potential to affect a large number of subsistence users during the		

Alternative B	Alternative C	Alternative D
exploration season, the permittee/operator would notify all potentially affected subsistence use cabin and campsite users. b. The official recognized list of subsistence users of cabins and campsites is the NSB's most current inventory of cabins and campsites, which have been identified by the subsistence users' names. c. A copy of the notification letter, a map of the proposed exploration area, and the list of potentially affected users would also be provided to the office of the appropriate Native Tribal government. d. The BLM Authorized Officer would prohibit seismic work within 1 mile of any known subsistence use cabin or campsite, unless an alternate agreement between the owner or user is reached through the consultation process and presented to the BLM Authorized Officer. e. Each week, the permittee would notify the appropriate local search and rescue of the operational location in the Coastal Plain. This notification would include a map indicating the extent of surface use and occupation, as well as areas previously used or occupied during the operation. The purpose of this notification is to give hunters up-to-date information regarding where seismic exploration is occurring and has occurred, so that they can plan their hunting trips and access routes accordingly. A list of the appropriate search and rescue offices to be contacted can be obtained from the coordinator of the North Slope and Eastern Interior Alaska Subsistence Regional Advisory Councils in the BLM's Arctic Field Office.		
Required Operating Procedure 38 Objective: Minimize impacts from non-local hunting and trapping activities on subsistence resources. Requirement/Standard: Hunting and trapping by lessees/operators/contractors are prohibited when persons are on work status. This is defined as the period during which an individual is under the control and supervision of an employer. Work status is terminated when workers' shifts ends, and they return to a public airport or community (e.g., Kaktovik, Utqiaġvik, or Deadhorse). Use of operator/permittee facilities, equipment, or transport for personnel access or aid in hunting and trapping is prohibited.		
Required Operating Procedure 39 Objective: Prevent disruption of subsistence use and access. Requirement/Standard: Before starting exploration or development, lessees/operators/contractors are required to develop a subsistence access plan, in coordination with the Native Village of Kaktovik and the City of Kaktovik, to be approved by the BLM Authorized Officer.		
ORIENTATION PROGRAMS ASSOCIATED WITH PERMITTED ACTIVITIES		
Required Operating Procedure 40 Objective: Minimize cultural and resource conflicts. Requirement/Standard: All personnel involved in oil and gas and related activities would be provided with information concerning applicable lease stipulations, ROPs, standards, and specific types of environmental, social, traditional, and cultural concerns that relate to the region. The operator would ensure that all personnel involved in permitted activities would attend an orientation program at least once a year. The proposed orientation program would be submitted to the BLM Authorized Officer for review and approval and would accomplish the following: a. Provide sufficient detail to notify personnel of applicable lease stipulations and ROPs and to inform individuals working on the project of specific types of environmental, social, traditional, and cultural concerns that relate to the region.		

Alternative B	Alternative C	Alternative D
b. Address the importance of not disturbing archaeological and biological resources and habitats, including endangered species, fisheries, bird colonies, and marine mammals, and provide guidance on how to avoid disturbance, including on the preparation, production, and distribution of information cards on endangered or threatened species. c. Be designed to increase sensitivity and understanding of personnel to community values, customs, and lifestyles in areas in which personnel would be operating. d. Include information concerning avoidance of conflicts with subsistence and pertinent mitigation. e. Include information for aircraft personnel concerning subsistence activities and areas and seasons that are particularly sensitive to disturbance by low-flying aircraft; of special concern is aircraft use near traditional subsistence cabins and campsites, flights during spring goose hunting and fall caribou and moose hunting seasons, and flights near potentially affected communities. f. Provide that individual training is transferable from one facility to another, except for elements of the training specific to a site. g. Include on-site records of all personnel who attend the program for so long as the site is active, though not to exceed the 5 most recent years of operations; this record would include the name and dates of attendance of each attendee. h. Include a module discussing bear interaction plans to minimize conflicts between bears and humans. i. Provide a copy of 43 CFR 3163 regarding noncompliance assessment and penalties to on-site personnel. j. Include training designed to ensure strict compliance with local and corporate drug and alcohol policies; this training would be offered to the NSB Health Department for review and comment. k. Include employee training on how to prevent transmission of communicable diseases, including sexually transmitted diseases, to the local communities; this training would be offered to the NSB Health Department for review and comment.		
ENDANGERED SPECIES ACT SECTION 7 CONSULTATION		
Lease Notice 1. The lease areas may now or hereafter contain plants, animals, or their habitats determined to be threatened or endangered. The BLM may require modifications to exploration and development proposals to further its conservation and management objective to avoid BLM-approved activities that would contribute to the need to list such a species or their habitat. The BLM would not approve any activity that may affect any such species or critical habitat until it completes its obligations under applicable requirements of the ESA, as amended (16 United States Code [USC] 1531 et seq.), including completion of any required procedure for conference or consultation.		
SUMMER VEHICLE TUNDRA ACCESS		
Required Operating Procedure 41 Objective: Protect stream banks and water quality; minimize compaction and displacement of soils; minimize the breakage, abrasion, compaction, or displacement of vegetation; protect cultural and paleontological resources; maintain populations of and adequate habitat for birds, fish, and caribou and other terrestrial mammals; and minimize impacts on subsistence activities. Requirement/Standard: On a case-by-case basis, the BLM Authorized Officer, in consultation with the USFWS, may permit low-ground-pressure vehicles to travel off gravel pads and roads during times other than those identified in **ROP 11**. Permission for such use would be granted only after an applicant has completed the following: a. Submitted studies satisfactory to the BLM Authorized Officer of the impacts on soils and vegetation of the specific low-ground-pressure vehicles to be used; these studies would reflect use of such vehicles under conditions like those of the route proposed and would demonstrate that the proposed use would have no more than minimal impacts on soils and vegetation.		

Alternative B	Alternative C	Alternative D
b. Submitted surveys satisfactory to the BLM Authorized Officer of subsistence uses of the area as well as of the soils, vegetation, hydrology, wildlife, and fish (and their habitats), paleontological and archaeological resources, and other resources, as required by the BLM Authorized Officer. c. Designed or modified the use proposal to minimize impacts to the BLM Authorized Officer's satisfaction; design steps to achieve the objectives and based on the studies and surveys may include timing restrictions (generally it is considered inadvisable to conduct tundra travel before August 1 to protect ground-nesting birds), shifting work to winter, rerouting, and not proceeding when certain wildlife are present or subsistence activities are occurring. At the discretion of the BLM Authorized Officer, the plan for summer tundra vehicle access may be included as part of the spill prevention and response contingency plan required by 40 CFR 112 (Oil Pollution Act).		
GENERAL WILDLIFE AND HABITAT PROTECTION		
Required Operating Procedure 42 Objective: Minimize disturbance and hindrance of wildlife or alteration of wildlife movements through the Coastal Plain. Requirement/Standard: Chasing wildlife with ground vehicles is prohibited. Particular attention would be given to avoid disturbing caribou.		
Required Operating Procedure 43 Objective: Prevent the introduction or spread of nonnative, invasive species in the Coastal Plain. Requirement/Standard: Certify that all equipment and vehicles (including barges) intended for use either off or on roads are free of nonnative invasive species before transiting into the Coastal Plain. Monitor annually along roads for nonnative invasive species and begin effective weed control measures on evidence of their introduction. Before beginning operations in the Coastal Plain, submit a plan for the BLM's approval, detailing the methods for cleaning equipment and vehicles, and monitoring for nonnative, invasive species and identifying control measures.		
Required Operating Procedure 44 Objective: Minimize loss of populations and habitat for plant species designated as sensitive by the BLM in Alaska. Requirement/Standard: If a development is proposed in an area that provides potential habitat for a BLM sensitive plant species, the development proponent would conduct surveys at appropriate times of the summer season and in appropriate habitats for the sensitive plant species. The results of these surveys would be submitted to the BLM with the application for development.		
Required Operating Procedure 45 Objective: Minimize loss of individuals and habitat for mammalian species designated as sensitive by the BLM in Alaska. Requirement/Standard: If a development is proposed in an area that provides potential habitat for the Alaska tiny shrew, the development proponent would conduct surveys at appropriate times of the year and in appropriate habitats into detect the presence of the shrew. The results of these surveys would be submitted to the BLM with the application for development.		

Alternative B	Alternative C	Alternative D

MARINE VESSEL TRAFFIC-ASSOCIATED ACTIVITIES

Required Operating Procedure 46

Objective: Minimize impacts on marine mammals from vessel traffic.

Requirement/Standard:

General Vessel Traffic

a. Operational and support vessels would be staffed with dedicated PSOs to alert crew of the presence of marine mammals and to initiate adaptive mitigation responses.
b. When weather conditions require, such as when visibility drops, support vessel operators must reduce speed and change direction, as necessary (and as operationally practicable), to avoid the likelihood of injuring marine mammals.
c. The transit of operational and support vessels is not authorized before July 1. This operating condition is intended to allow marine mammals the opportunity to disperse from the confines of the spring lead system and minimize interactions with subsistence hunters. Exemption waivers to this operating condition may be issued by the NMFS and USFWS on a case-by-case basis, based on a review of seasonal ice conditions and available information on marine mammal distributions in the area of interest.
d. The transit route for the vessels would avoid NMFS-identified known fragile ecosystems.
e. Vessels may not be operated in such a way as to separate members of a group of marine mammals from other members of the group.
f. Operators should take reasonable steps to alert other vessel operators in the vicinity of marine mammals.
g. Operators should report any dead or injured listed marine mammals to NMFS and the USFWS.

Vessels in Vicinity of Whales

a. Vessel operators should avoid groups of 5 or more whales.
b. All nonessential boat and barge traffic would be scheduled to avoid periods when bowhead whales are migrating through the area to where they may be affected by sound from the project.
c. If the vessel approaches within 1 mile of observed whales, except when providing emergency assistance to whalers or in other emergency situations, the operator would take reasonable precautions to avoid potential interaction with the whales by taking one or more of the following actions, as appropriate:
   i. Reducing vessel speed to less than 5 knots within 300 yards of the whale
   ii. Steering around the whale if possible
   iii. Operating the vessel to avoid causing a whale to make multiple changes in direction
   iv. Checking the waters around the vessel to ensure that no whales will be injured when the propellers are engaged
   v. Reducing vessel speed to 9 knots or less when weather conditions reduce visibility to avoid the likelihood of injury to whales
d. Special consideration of North Pacific right whale and their critical habitat:
   i. Vessel operators will avoid transit in North Pacific right whale critical habitat. If this cannot be avoided, operators must exercise caution and reduce speed to 10 knots while in North Pacific right whale critical habitat.
   ii. Vessels transiting through North Pacific right whale critical habitat must have PSOs sighting marine mammals. Vessel operators will maneuver to keep 875 yards away from any observed North Pacific right whale, while within their designated critical habitat, and avoid approaching whales head-on, consistent with vessel safety.

<table>
<tr><th>Alternative B</th><th>Alternative C</th><th>Alternative D</th></tr>
<tr><td colspan="3">Vessels in Vicinity of Pacific Walruses and Polar Bears
a. Operators should take all reasonable precautions, such as reduce speed or change course heading, to maintain a minimum operational exclusion zone of 0.5 mile around groups of feeding walruses.
b. Except in an emergency, vessel operators would not approach within 0.5 mile of observed polar bears, within 0.5 mile of walrus observed on ice, or within 1 mile of walrus observed on land.
Vessels in Vicinity of Seals
a. Vessels used as part of a BLM-authorized activity would be operated in a manner that minimizes disturbance to wildlife in the coastal area. Vessel operators would maintain a 1-mile buffer from the shore when transiting past an aggregation of seals (primarily spotted seals) when they have hauled out on land, unless doing so would endanger human life or violate safe boating practices.
Vessels in Ledyard Bay
a. Follow USFWS guidelines in relation to Ledyard Bay and Steller's and spectacled eider critical habitat area.</td></tr>
</table>

2.3 Alternatives Considered But Eliminated From Detailed Analysis

The BLM considered an alternative that would make only 800,000 acres available for lease sales, which is the minimum acreage necessary to comply with the requirement in Section 20001(c)(1) of PL 115-97 to hold not fewer than two lease sales, each of which offers not fewer than 400,000 acres of the areas having the highest potential for discovery of hydrocarbons. The best available information regarding hydrocarbon discovery potential in the Coastal Plain provides a rough estimate of 427,900 acres of high HCP, 658,400 acres of medium HCP, and 477,200 acres of low HCP. Acreages within low and medium HCP areas must be made available, in addition to the high HCP areas, for the two lease sales to meet the 800,000-acre minimum under PL 115-97. In addition, the actual potential development area would be much less with the 2,000-acre limitation on surface disturbance. This alternative would also be similar in concept to Alternatives D1 and D2, which make only 1,037,200 acres available for lease sales. For all these reasons, an alternative that considered only 800,000 acres available for leasing was eliminated from detailed analysis.

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Chapter 3. Affected Environment and Environmental Consequences

3.1 Introduction

This chapter combines the description of baseline environmental conditions and the analysis of environmental impacts for each resource. Though these two aspects are often in separate chapters in an EIS, they are combined here to facilitate continuity for the reader from baseline conditions to potential impacts on each resource. Following the description of baseline conditions, the discussion of potential direct, indirect, and cumulative impacts from future oil and gas development under each resource provides the scientific and analytic basis for evaluating the potential impacts of each of the alternatives described in **Chapter 2**. The approach to impact analysis is discussed further in **Appendix F**.

Issuance of oil and gas leases under the directives of Section 20001(c)(1) of PL 115-97 would have no direct impacts on the environment because by itself a lease does not authorize any on the ground oil and gas activities; however, a lease does grant the lessee certain rights to drill for and extract oil and gas subject to further environmental review and reasonable regulation, including applicable laws, terms, conditions, and stipulations of the lease. The impacts of such future exploration and development activities that may occur because of the issuance of leases are considered potential indirect impacts of leasing. Such post-lease activities could include seismic and drilling exploration, development, and transportation of oil and gas in and from the Coastal Plain. Therefore, the analysis in **Chapter 3** is of potential direct, indirect, and cumulative impacts from on-the-ground post-lease activities.

The proposed leasing alternatives are a result of surface resource and management considerations and describe areas to offer for lease and the terms and conditions that would apply to post-lease exploration and development activities; they do not specifically propose development of oil and gas resources. For this reason, the analysis relies on a hypothetical development scenario consistent with those alternatives and PL 115-97 in a good faith effort to identify indirect effects of leasing that are not known at this time but nonetheless could be considered "reasonably foreseeable" (40 CFR Section 1508.8(b)) (see **Appendix B**).

The regulations governing leasing and development provide for multiple decision stages prior to any ground-disturbing activities being authorized and require further compliance with applicable laws, including NEPA, during post-leasing decision stages. Until the BLM receives and evaluates an application for an exploration permit, permit to drill, or other authorization that includes site-specific information about a particular project, impacts of actual exploration and development that might follow lease issuance are speculative, as so much is unknown as to location, scope, scale, and timing of that exploration and development. At each decision stage, the BLM retains the authority to approve, deny, or reasonably condition any proposed on the ground-disturbing activity based on compliance with the terms and conditions of the lease and applicable laws and policies. Therefore, the analysis of effects of exploration and development in this Leasing EIS necessarily reflects a more general, programmatic approach than could occur at the post-lease project-specific stage.

There are many uncertainties associated with projecting future petroleum exploration and development. These uncertainties include the amount and location of technically and economically recoverable oil; the timing of oil field discoveries and associated development; the future prices of oil and gas, and, more to the point, the many exploration companies' individual assessment of future prices and other competitive calculations that play into corporate investment decisions; and the ability of industry to find petroleum and to mobilize the requisite technology to exploit it.

To address these uncertainties, the BLM has made reasonable assumptions based on the previous two-dimensional seismic exploration of the Coastal Plain, the history of development in the NPR-A and other North Slope developments, its own knowledge of the almost entirely unexplored petroleum endowment of the Coastal Plain and current industry practice, and professional judgment. In making these assumptions, the BLM has striven to minimize the chance that the resultant impact analysis will understate potential impacts; therefore, the hypothetical development scenarios (**Appendix B**) are intended to represent optimistic high-production, successful discovery, in a situation of favorable market prices.

The BLM has relied on the best available science to inform its consideration of the environmental impacts surrounding an oil and gas leasing program in the Coastal Plain; however, the nature, abundance, and quality of the data often vary, depending on the action, the geographic region in which it occurs, and the environmental resources that may be affected. All these variables influence the understanding of how certain oil and gas exploration and development activities may affect environmental features. Where information is missing, this EIS complies with 40 CFR 1502.22.

3.2 Physical Environment

3.2.1 Climate and Meteorology

Affected Environment

Climate is described by the National Weather Service (NWS) as the most recent 30-year averages of meteorological parameters, such as temperature, precipitation, humidity, and winds; thus, climate change is treated here as the longer-term change in such variables. Climate change can be driven by natural forces, such as volcanic activity, solar output variability, and the earth's orbital variations, or by human activity, such as land use changes or GHG emissions. Much attention in recent decades has focused on the potential climate change effects of GHGs, especially carbon dioxide (CO_2), which has been increasing in concentration in the global atmosphere since the end of the last ice age.

For a description of climate trends in the Arctic and on the North Slope, the reader is referred to Section 3.2.3.1 of the Greater Mooses Tooth 2 (GMT2) Development Project Final Supplemental Environmental Impact Statement (GMT2 Final SEIS), issued in August 2018 (BLM 2018a). Because climate is defined as weather conditions over the most recent three decades, the information contained in the GMT2 Final SEIS is applicable to the program and thus is incorporated here by reference.

The program area is in the Arctic Refuge in northeast Alaska, along the Beaufort Sea, which is part of the Arctic Ocean. The area is considered an arctic climate zone, with cold winters spanning approximately 8 months of the year (October through May) and cool summers, spanning approximately 4 months of the year (June through September).

Weather data measured at the Kaktovik Airport on Barter Island from late 1947 through mid-2016 are available on the Western Regional Climate Center website under the historical climate data pages. The period of record climatological data summary for this location is shown in **Table 3-1**.

Table 3-1
Kaktovik Airport Period of Record Monthly Climate Summary

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average max. temperature (F)	-7.7	-13.9	-8.8	6.7	26.3	38.4	45.4	43.8	35.4	20.3	5.1	-5.8	15.4
Average min. temperature (F)	-20.3	-26.3	-22.5	-9.3	15.7	30.4	34.8	34.4	27.9	10.1	-6.7	-18.3	4.1
Average total precipitation (in.)	0.48	0.23	0.21	0.19	0.31	0.53	1.03	1.1	0.68	0.77	0.41	0.26	6.19
Average total snowfall (in.)	5	2.7	2.6	2.4	3	1.6	0.5	1.5	4.9	9.2	5	3.4	41.8
Average snow depth (in.)	12	14	15	15	10	2	0	0	1	5	8	10	8

Source: WRCC 2018a. Historical Climate Summaries. https://wrcc.dri.edu/cgi-bin/cliMAIN.pl?ak0558.

Percent of possible observations from September 23, 1947, to June 7, 2016: maximum temperature: 98.6; minimum temperature: 99.7; precipitation: 99.7; snowfall: 95.7; snow depth: 98.5

Based on the Kaktovik climate data, average monthly precipitation in the area is heaviest in July and August, with slightly more than an inch in each of these months. Annual total precipitation averages a little greater than 6 inches of liquid equivalent. Monthly snowfall is highest in October, with slightly more than 9 inches, on average. Snow is typically on the ground for approximately 10 months of the year, with only July and August usually having little or no snow depth. July is the warmest month, with an average maximum temperature around 45°F and an average minimum temperature around 35°F. February is the coldest month, with an average maximum temperature of around -14°F and an average minimum temperature of around -26°F.

Wind speed and direction is measured on Barter Island, at the Kaktovik Airport, as part of the automated weather observing system (AWOS) network, operated and controlled by the FAA. The Kaktovik AWOS station is near the coast, next to the Coastal Plain area. Using the Iowa State University, Iowa Environmental Mesonet website, the Barter Island wind data for the most recent 10 full years, 2008–2017, were plotted to produce the wind rose in **Figure 3-1**, Wind Rose Plot for Barter Island, Kaktovik, Alaska, in **Appendix A** (ISU 2018). The wind rose shows a very strong predominance of winds from the east and the west, with east winds being the most common. Winds from northerly and southerly directions are very infrequent in this area. Average wind speed is also relatively high at 13.8 miles per hour, which would imply relatively rapid dispersion of any emitted air pollutants most of the time. Calm winds are recorded less than 5 percent of the time.

Farther inland, near the Brooks Range, monthly mean wind speeds are slightly lower (9.4 miles per hour; Olsson et al. 2002), but strong winds from the south, readily exceeding exceed 45 miles per hour, can originate as katabatic[1] flows down the many north-oriented valleys of the Brooks Range (Sturm and Stuefer 2013). In general, snow depth and snow water equivalent decrease from inland to the coast (snow water equivalent values of 6 to 8 inches near the foothills to 2 to 5 inches near the coast; Liston and Sturm 1998), while bulk snow density and the prevalence of wind slabs increase (Sturm and Liston 2003).

Wind speed and direction are important to the dilution and transport of air pollutants; wind direction determines where the air pollutants emitted in the area are transported. Based on the Kaktovik wind rose,

[1]Caused by local downward motion of cool air

air pollutants are most often transported in a westerly direction, and secondarily, in an easterly direction. Wind speed affects the concentration of air pollutants. This is because dispersion and turbulence increase with increasing wind speeds, thereby decreasing air pollutant concentrations resulting from an emitted plume of pollutants.

The degree of stability in the atmosphere is also a key factor in the dispersion of emitted pollutants. During stable conditions, vertical movement in the atmosphere is limited, and the dispersion of pollutants is inhibited. Conversely, during unstable conditions, upward and downward movement in the atmosphere is enhanced, and dispersion of pollutants in the atmosphere increases. Conditions where temperatures increase with height, known as temperature inversions, can result in very stable conditions, with virtually no vertical air motion. The program area typically experiences more large-scale temperature inversions in the winter than in the summer due to colder stable air masses settling closer to the ground during winter. Summer periods in the program area typically have greater instability, due to warming and solar-induced vertical (convective) air currents.

Recorded climate trends in Alaska, including the North Slope, show a significant increase in temperatures, mostly occurring as a step change in 1977, when the Pacific decadal oscillation (PDO) changed from a negative phase to a positive phase. The positive phase of the PDO correlates with more southerly winds over Alaska in the winter, leading to positive temperature anomalies.

The only North Slope weather station summarized for temperature trends by the Alaska Climate Research Center (ACRC) is in Utqiaġvik. Temperature records there show an increase in annual average temperature of 6.3°F from 1949 to 2016; a 5.9°F increase has occurred since the PDO shift in 1977. Conversely, the 18 other primary reporting stations distributed throughout Alaska show an average of less than 1.0°F warming since 1977 (ACRC 2018); thus, it is likely that a reduction in ice cover along the north coast of Alaska has had a disproportionate effect on temperature trends since 1977 along the northern coast, compared with the rest of Alaska. This is apparent by looking at changes in monthly ice concentration on the north Alaska coast and its correlation with changes in temperature (Wendler et al. 2014).

In contrast to temperature, annual average total precipitation shows no discernable trend from 1925 through 2016 in the North Slope climate division of Alaska (WRCC 2018b).

In addition to weather data provided by the FAA and NWS stations in northern Alaska, such as at Kaktovik and Utqiaġvik, the US Geological Survey (USGS) operates a 16-station, permafrost monitoring network in the NPR-A (12 stations) and the Arctic Refuge (4 stations) to help detect changes in meteorological conditions and soil temperatures. This network, known as the DOI/Global Terrestrial Network for Permafrost Observing System, began operations at some sites as early as 1998, and now has over 10 years of data from each site. The four Arctic Refuge stations include three in the program area: Marsh Creek, Camden Bay, and Niguanak. The data collected can be found in the 2016 annual report for this monitoring network (Urban and Clow 2018) at the following website: https://pubs.usgs.gov/ds/1092/ds1092.pdf.

An inventory of recent GHG emissions at various geographic scales is provided in **Table 3-2**, in units of million metric tons (MMT) per year. Development-related emissions can be compared against these values to provide an estimate of the relative contribution of such emissions at various geographic scales. Note that the emissions in the table do not include sinks that tend to remove some of the emissions from the

Table 3-2
GHG Emissions at Various Geographic Scales in 2015

Geographic Area	Data Source	Annual Emissions (MMT/year)	Percent of Global Emissions
Alaska	ADEC 2018a	41.3	0.084
US	EPA 2018a	6,638	13.5
Global	Olivier et al. 2017	49,100	100

Source: Olivier et al. 2017; ADEC 2018a; EPA 2018a

atmosphere. For example, a significant fraction of CO_2 emitted by human sources each year is taken up by the biosphere, which is gaining mass in response to the emissions.

Local and Global Direct and Indirect Impacts

Issuance of oil and gas leases under the directives of Section 20001(c)(1) of PL 115-97 would have no direct impacts on the environment because by itself a lease does not authorize any on the ground oil and gas activities; however, a lease does grant the lessee certain rights to drill for and extract oil and gas subject to further environmental review and reasonable regulation, including applicable laws, terms, conditions, and stipulations of the lease. The impacts of such future exploration and development activities that may occur because of the issuance of leases are considered potential indirect impacts of leasing. Such post-lease activities could include seismic and drilling exploration, development, and transportation of oil and gas in and from the Coastal Plain. Therefore, the analysis is of potential direct, indirect, and cumulative impacts on the climate from on-the-ground post-lease activities.

This assessment deals primarily with climate, defined as longer-term (30 years or more) variations in meteorological conditions. Any potential effects of post-lease oil and gas activities on meteorological conditions would be on a very small scale (microscale) and would cover very small portions of the program area, for example, such as a decrease in localized wind speeds and the creation of snowdrifts immediately downwind of structures; therefore, impacts on meteorological conditions are not addressed further in this section. Also, the climate and meteorology impacts of the Coastal Plain oil and gas leasing program are generally similar between the action alternatives being considered.

Regarding the potential effects of climate change on the region in general, the reader is referred to Section 3.2.4 of the GMT2 Final SEIS for a detailed discussion (BLM 2018a). With respect to climate change effects of post-lease oil and gas activities, there are two aspects of potential indirect climate impacts that are addressed below:

1. Impacts associated with potential development on climate change (due to emissions of GHGs)
2. Climate change impacts on potential development

Impacts Associated with Potential Development on Climate Change

The potential impacts of post-lease oil and gas activities on the climate could occur at the microscale, due to building structures and installing combustion sources that can heat localized areas near development. These effects would be very small and of little effect in the vast majority of the program area.

The macroscale effects on climate change would be through GHG emissions that can contribute to a change in the composition of the global atmosphere, thereby increasing the so-called greenhouse effect on the planet's heat retention. The GHG emissions that could result from post-lease oil and gas activities would be through combustion of fossil fuels (mainly natural gas, diesel fuel and gasoline) for construction, drilling, production, processing, and transport of the petroleum products. There is also a potential for additional GHG emissions from combustion of the products themselves in the global marketplace.

Estimates of potential GHG emissions changes resulting from future development following the leasing decision can be described as either direct emissions or indirect emissions. The direct emissions are those resulting from construction, drilling, production, processing, and transportation. The indirect emissions are those resulting from the combustion of the petroleum products, due to a relatively small increase in US demand for liquid petroleum products, which could result from increased US supply due to potential development. The natural gas produced as a result of future oil and gas development may initially be re-injected to conserve the natural gas and maintain reservoir pressure for oil recovery, as is currently done with excess gas that is not used as fuel on the North Slope. Some amount of natural gas would be produced as a byproduct of oil production in some formations. Use of this natural gas on the global markets is anticipated at some point in the future; the State of Alaska is pursuing a plan to build a natural gas transport pipeline from the North Slope to access markets in Asia. Gas transported through the pipeline is expected to come from established fields with proven reserves initially but could eventually include natural gas from the Coastal Plain.

Direct GHG Emissions from Future Development

To provide an approximation of total potential GHG emissions from construction, drilling, production, processing, and transportation of post-lease oil and gas activities (not accounting for the fact that such emissions are likely not entirely additive in a global context), the GMT2 Final SEIS (BLM 2018a) projections for direct GHG emissions were scaled according to the respective total amounts of estimated oil production from GMT2, versus the ranges projected for the Coastal Plain leasing program. For the GMT2 development, total recoverable oil is estimated at approximately 170 million barrels (BLM 2018a). For the Coastal Plain development, total production potential is estimated to range from 1.5 to 10 BBO, or anywhere from 9 to 59 times as much as for GMT2.

Assuming that the potential direct GHG emissions are directly proportional to oil production, and using the GMT2 emissions estimates (BLM 2018a, Table 79) as a basis for scaling the Coastal Plain development emissions, a comparison of estimated oil production and related maximum annual GHG emissions for the Coastal Plain development is provided in **Table 3-3**. The GHG emissions in **Table 3-3** are estimated as carbon dioxide equivalents (CO_2e). Note that based on the GMT2 Final SEIS, the estimated GHG emissions vary substantially by year of the development; thus, the GMT2 Final SEIS annual average over an assumed 37-year construction, drilling, and production period is used for this analysis. The Coastal Plain production could extend much longer than 37 years, perhaps from 50 to 100 years; 70 years is assumed for purposes of making annual GHG projections for this Leasing EIS. While a 100-year production duration would substantially decrease annual average emissions from the Coastal Plain, the effect on total development GHG emissions would not change. This is because the Coastal Plain development would still represent approximately 9 to 59 times the estimated oil production and therefore 9 to 59 times the direct GHG emissions of the GMT2 development.

Table 3-3
Projected Oil Production and Direct GHG Emissions Estimates

Development	Total Oil Produced (Million Barrels)	Average Annual Oil Produced (Million Barrels)	Average Annual GHG Emissions (Metric Tons of CO_2e)
GMT2	170.1	4.6	12,180
Coastal Plain	1,500 to 10,000	21 to 143	56,739 to 378,261

Source: BLM 2018a

Indirect GHG Emissions from Future Development

While petroleum is obviously a global commodity, the analysis here is based on changes in US demand, projected from estimates made with a market demand model called MarketSim, developed by the Bureau of Ocean Energy Management (BOEM). The MarketSim model considers only the US supply and demand for petroleum; thus, the accuracy of the change (increase) in petroleum demand estimated from MarketSim projections is limited, given its scope is just the US market; however, any type of supply and demand projections must be considered as quite uncertain, given the inherent difficulties in economic projections.

According to the US Department of Energy, Energy Information Administration (EIA 2018), global petroleum liquids production and consumption in 2018 is projected to average approximately 100 million barrels of oil (equivalents) per day. The proposed Coastal Plain oil and gas leasing program is expected to result in potential production totaling in the range of 1.5 to 10 BBO. Assuming a 70-year period for this production, the average for this development over its operating life would therefore range from 0.06 to 0.39 million barrels per day; thus, post-lease oil and gas activities could supply in the range of 0.1 to 0.5 percent of global oil production, once the field has reached peak production. Given that global oil production continues to increase, the development that could occur with the Coastal Plain oil and gas leasing program would represent a smaller fraction of global production as the years pass. The potential natural gas production estimate for the Coastal Plain ranges from 0 to 7 trillion cubic feet (TCF) of gas produced (Attanasi 2005).

BOEM applied its MarketSim model for the Coastal Plain development on the North Slope, for both the low- and high-end production cases (BOEM 2018a). The BOEM projections show that without the Coastal Plain production, US oil demand would be lower by an amount equal to 3.4 percent, in barrels of oil equivalent, of the low-end production case, and 3.9 percent lower for the high-end production case. Looking at it another way, post-lease oil and gas activities is projected to increase US oil demand by 3.4 percent (low-end case) to 3.9 percent (high-end case) of the projected Coastal Plain leasing production. Conversely, over 96 percent of the Coastal Plain oil production is projected to replace other US (and likely global) production that would not happen if development goes forward. The BOEM projections include production of both oil and natural gas from the Coastal Plain, expressed as barrels of oil equivalent. For natural gas, the analysis assumes the production eventually makes its way to the US or global market, regardless of whether some of the natural gas production is initially reinjected.

Using the MarketSim projections for the incremental (Action minus No-Action) production in barrels of oil equivalent, BOEM applied its Greenhouse Gas Lifecycle model (GHG Model) to estimate total GHG emissions with and without Coastal Plain development. Based on this analysis, and assuming a 70-year production and consumption period for the Coastal Plain, the incremental (Action minus No-Action) annual indirect GHG emissions estimates are shown in **Table 3-4**.

Table 3-4
Projected Oil Production and Indirect GHG Emissions Estimates for the Coastal Plain

Case	Total Oil Produced (Million Barrels)	MarketSim Fraction of Coastal Plain Demand Increase (%)	Annual GHG Emissions Increase (Million Metric Tons of CO_2e)
Low-end Case	1,500	3.4	0.7
High-end Case	10,000	3.9	5.0

Source: BOEM 2018a

The estimated Coastal Plain oil and gas development potential direct and indirect emissions portion of estimated 2015 global emissions are shown in **Table 3-5**, along with the percentage of development-related GHG emissions at the state and national scales. The projected annual average Coastal Plain drilling and operational direct emissions represent up to 0.0008 percent of 2015 global emissions. The estimated indirect emissions resulting from development due to post-lease oil and gas activities represent up to approximately 0.01 percent of global GHG emissions, as shown in **Table 3-5**. As discussed above, the direct emissions are those from production, processing and transport activities, while the indirect emissions are those from combustion of the net fuels production exported to markets.

Table 3-5
Estimated Future Development GHG Emissions versus 2015 Emissions at Various Geographic Scales

Geographic Area	Inventory Year	Data Source	Annual CO_2e Emissions (Million Metric Tons of CO_2e)	Portion of US Emissions (%)	Portion of Global Emissions (%)
Coastal Plain Direct Emissions	NA	Projected	0.06 to 0.38	0.0009 to 0.006	0.0001 to 0.0008
Coastal Plain Minimum Indirect Emissions	NA	Projected	0.7	0.01	0.0014
Coastal Plain Maximum Indirect Emissions	NA	Projected	5.0	0.08	0.01
Alaska	2015	ADEC 2018a	41.3	0.62	0.084
US	2015	EPA 2018a	6,638	100	13.5
Global	2015	Olivier et al. 2017	49,100	740	100

Source: Olivier et al. 2017; ADEC 2018a; EPA 2018a
MMT = million metric tons of GHG measured as CO_2e.

In addition to the combustion-related emissions estimates provided above, some of the reservoir hydrocarbons, most importantly methane, escape to the atmosphere without being combusted. These methane emissions are due to leaks during the drilling, production, processing and transport of natural gas. It is difficult to obtain accurate estimates of the amount of GHG emissions (as CO_2e) from such leaks as compared to the GHG emissions from combustion processes. The 2016 emission inventory from the EPA estimates that 81 percent of US GHG emissions (as CO_2e) are CO_2, 10 percent are methane, and the remainder are other GHGs (EPA 2018b). EPA estimates that 31 percent of the 2016 methane contribution is from oil and gas production activities, which would mean that 3.1 percent of US total GHG emissions are from methane associated with oil and gas production. Nationally, the EPA estimate of methane's GHG contribution from petroleum production processes represents on the order of 5 percent of the CO_2e contribution from the nationwide petroleum and natural gas combustion. Thus, this would represent a marginal incremental amount of GHG emissions, equal to roughly 5 percent of the estimated indirect emissions from combustion of Coastal Plain products shown in **Table 3-4** for the low-end and high-end cases.

Social Costs of GHG Emissions

Another approach to analyzing possible climate change impacts on potential development is to calculate what is commonly known as the social cost of carbon (SCC). **Section F2.1** in **Appendix F** provides detail on the reasons why the use of the SCC protocol was not included in this EIS.

Impacts of Climate Change on Potential Development

The impacts of climate change on potential development could include a shorter winter construction season. This is defined as the time when the ground and lakes are adequately frozen to support heavy equipment movement. Permafrost is not likely to disappear in the program area during the life of any oil and gas development in the program area; however, if temperatures continue to warm in the area, the warm season active zone (thawed soil zone) would go deeper, making equipment movement more difficult in warm months, possibly increasing road maintenance frequency and costs. If summer active soil depth increases substantially, allowances would need to be made for more substantial structural supports that rely on permafrost, perhaps requiring deeper anchoring of such supports.

Summer sea ice extent in the Arctic has risen slightly from the lows of the past decade, with July 2018 monthly average sea ice extent the highest it has been of any July since 2005, at 3.66 million square miles. This is approximately 20 percent lower than the maximum measured July average Arctic sea ice extent of 4.56 million square miles in 1983, and about 12 percent higher than the lowest July extent of 3.27 million square miles measured in 2012 (DMI 2018). The period of record for these satellite measurements goes back only to 1979, which is likely near a modern peak in Arctic ice, given the shift in the PDO that occurred in 1977. After 1977 there was a dramatic shift upward in annual mean temperatures in Alaska, along with a multi-decade decrease in Arctic ice extent. Continued recovery or further declines in Arctic sea ice can have their most significant impacts on temperatures in North Slope coastal areas, such as the program area. Inland areas are buffered from the moderating effects of open water, so the program area would be more sensitive to changes in sea ice, compared to developments farther inland.

At current rates of sea level rise, from around 7 inches per century (tide gauge record) to 12 inches per century (satellite measurements), sea waters are not expected to encroach on any potential development within an approximate 50-year life of production facilities or access roads for the program area.

Cumulative Impacts

GHG emissions disperse through the global atmosphere relatively quickly relative to the time scales of concern for climate, which are decades to centuries. The emissions projections above compare the effects of post-lease oil and gas activities in the context of statewide, US, and global GHG emissions, which continue to increase. The potential cumulative climate impacts of global development and associated GHG emissions have been discussed extensively in the published literature, including several reports by the Intergovernmental Panel on Climate Change and numerous scientific journals, and therefore, are not repeated here (BLM 2018a; IPCC 2014; Melillo et al. 2014; ACIA 2005).

3.2.2 Air Quality

Affected Environment

Air quality is measured by the concentration of air pollutants in a geographic area. Wind, temperature, humidity, and geographic features, in addition to natural and anthropogenic emissions sources, are factors that have the potential to affect the resource. Indicators of impacts on air quality are the inability to meet NAAQS and a degradation of air quality-related values, such as visibility and deposition.

Air Quality

The federal Clean Air Act provides the framework for protecting air quality at the national, state, and local level. The act designates the EPA as the chief governing body of air resources in the US; however, it provides states with the management authority to implement their own air quality legislation, monitoring, and control measures. With EPA approval, state and local air districts can implement their own permitting and emissions control regulations to implement federal requirements, and the state and local requirements cannot be less stringent than the federal requirements. The ADEC is the regulating authority to enforce the Alaska Air Quality Control Regulations under 18 Alaska Administrative Code (AAC) 50.

Under the authority of the Clean Air Act, the EPA has set time-averaged NAAQS for six criteria air pollutants considered to be key indicators of air quality: carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), sulfur dioxide (SO_2), lead (Pb), and two categories of particulate matter (less than 10 microns in diameter [PM_{10}] and less than 2.5 microns in diameter [$PM_{2.5}$]) (EPA 2018c). These standards may be updated periodically based on peer-reviewed scientific data. States may set their own ambient air quality standards for criteria pollutants and other pollutants, but their criteria pollutant standards must be at least as stringent as the federal standards. AAAQS are the same as the NAAQS, except for the addition of a standard for ammonia. The program area is in attainment or unclassifiable (treated as attainment for regulatory purposes) for each of the NAAQS (EPA 2018d). The nearest nonattainment area is in Fairbanks, approximately 350 miles southwest of the Coastal Plain; Fairbanks is in a nonattainment status for the $PM_{2.5}$ NAAQS (EPA 2018d).

The Clean Air Act requires each state to identify areas that have ambient air quality in violation of federal standards using monitoring data collected through state and federal monitoring networks. There are no state or federal air quality monitoring stations in or near the program area. Industry monitoring that conforms to EPA guidance is the only available quantitative indicator of air quality on the North Slope. There are two monitoring stations that report complete, multiyear data near the program area: BPXA's A-Pad Meteorological and Ambient Air Monitoring Station, approximately 60 miles west of the Coastal Plain boundary, and the ConocoPhillips Alaska, Inc.'s Nuiqsut Ambient Air Quality and Meteorological Monitoring Station, approximately 110 miles west of the Coastal Plain boundary. **Table 3-6**, below, shows the average pollutant concentrations at each of these stations for the most recent 3 years of verified data (2014–2016) and the percentage of the relevant NAAQS/AAAQS for the 3-year average.

In addition, ADEC reports monitoring values for short-term, project-specific air quality monitors used in the air permitting process. There are nine monitors on the North Slope, including the two described in **Table 3-6**, from which data have been collected and verified since 2009, usually for 1 year. None of the data from any of these monitors have shown exceedances of the NAAQS/AAAQS (ADEC 2018b). Based on the limited oil and gas development and the small size of the resident population near the Coastal Plain, it is likely that the baseline air quality pollutant concentrations in the program area are lower than those reported by A-Pad, Nuiqsut, and other monitoring stations on the North Slope.

Table 3-6
Average Air Pollutant Monitoring Values, 2014-2016

Pollutant	Average Time	A-Pad Monitoring Station Average Background Conc. (2014-2016) [a]	Nuiqsut Monitoring Station Average Background Conc. (2014-2016) [b]	NAAQS/ AAAQS [c]	Percent of NAAQS	
					A-Pad	Nuiqsut
CO	1-hour	—	1,230 μg/m³	40,000 μg/m³	—	3
CO	8-hour	—	1,230 μg/m³	10,000 μg/m³	—	12
O_3	8-hour	89.0 μg/m³	—	140 μg/m³	64	—
NO_2	1-hour	59.3 μg/m³	41.9 μg/m³	188 μg/m³	32	22
NO_2	Annual	5.2 μg/m³	3.8 μg/m³	100 μg/m³	5	4
SO_2	1-hour	10.4 μg/m³	5.9 μg/m³	196 μg/m³	5	3
SO_2	3-hour	7.5 μg/m³	6.2 μg/m³	1,300 μg/m³	0.6	0.5
SO_2	24-hour	1.8 μg/m³	4.8 μg/m³	365 μg/m³	0.5	1
SO_2	Annual	0.5 μg/m³	0.003 μg/m³	—	0.6	—
PM_{10}	24-hour	—	—	150 μg/m³	—	30
$PM_{2.5}$	24-hour	—	7.3 μg/m³	35 μg/m³	—	21
$PM_{2.5}$	Annual	—	2.1 μg/m³	12 μg/m³	—	18

Source: [a] ADEC 2018b; [b] BLM 2018a, [c] Standards converted to micrograms per cubic meter (μg/m³)

In addition to criteria pollutants, the Clean Air Act regulates toxic air pollutants, or hazardous air pollutants, that are known or suspected to cause cancer or other serious health effects or adverse environmental impacts. The hazardous air pollutant regulatory process identifies specific chemical substances that are potentially hazardous to human health. It sets emission standards to regulate the amount of those substances that can be released by individual facilities or by specific types of equipment. Controls can be required at the source, either through manufacturer requirements, or via add-on control devices, to limit the release of these air toxics into the atmosphere. The hazardous air pollutants most relevant to oil and gas operations are formaldehyde, n-hexane, benzene, toluene, ethylbenzene, xylenes, acetaldehyde, ethylene glycol, and methanol; other compounds may be identified as potentially hazardous air pollutants and evaluated during project-specific analysis. There are limited sources for these pollutants on the Coastal Plain.

Visibility

Haze is a form of air pollution that occurs from refraction of sunlight on particles in the atmosphere. The result of haze is impaired visibility. In 1999, the EPA published the Regional Haze Rule, implementing a visibility protection program for certain areas; these are national parks and wilderness areas classified as Class I areas. The Class I area nearest to the program area is Denali National Park, which lies about 425 miles southwest. In a NEPA context, analysis is sometimes done to assess potential visibility impacts in areas considered sensitive in the context of preserving the visitor experience, such as federally managed national parks, monuments, wilderness areas, and wildlife refuges that were not designated as Class I areas. The nearest such areas are the Arctic Refuge, in which the Coastal Plain is located, and Gates of the Arctic National Park, approximately 125 miles southwest of the Coastal Plain.

Visibility in some of these areas is monitored through the Interagency Monitoring for the Protection of Visual Environments (IMPROVE). Visibility is described by two units of measure: haze index in deciviews (dv) and standard visual range. Visibility at Gates of the Arctic National Park (Bettles Field Station), the closest monitored location to the program area, is shown in **Figure 3-2**, Visibility Data for Gates of the Arctic National Park, in **Appendix A** (IMPROVE 2018a). Data collected at the monitor showed an improvement in conditions on the haziest days and essentially constant visibility conditions for the clearest days from 2010 to 2014. The 4 dv measure on the clearest days corresponds to a visual range of about 160 miles; the approximately 13 to 9 dv on the haziest days corresponds to a visual range of 65 to 100 miles (IMPROVE 2018b).

Deposition

In atmospheric deposition, air pollutants are removed from the atmosphere and subsequently deposited in aquatic and land-based ecosystems. This can occur through precipitation or through the dry gravitational settling of particles onto soil, water, and vegetation. A primary issue of atmospheric deposition is the formation of acids, particularly nitrogen and sulfur species. This can happen as acid rain and snow and the subsequent deterioration of lakes, streams, soils, nutrient cycling, and biological diversity. Additional compounds that can accumulate from atmospheric deposition are air toxins, heavy metals, such as mercury, and nutrients, such as nitrates and ammonium.

Gates of the Arctic National Park, described above under *Visibility*, is the nearest area where nitrogen critical loads have been analyzed and recorded. The critical load ranged between 1 and 3 kilograms per hectare per year (kg/ha-yr), based on 2010 and 2011 estimates, while the maximum nitrogen deposition was 0.94 kg/ha-yr, based on recorded values from 2008 through 2015 (BLM 2018a).

The National Acid Deposition Program/National Trends Network measures concentrations and deposition rates of constituents removed from the atmosphere by precipitation (wet deposition). It focuses on those that affect rainfall acidity and those that may cause adverse ecological effects. Trends for ammonium, nitrate, and sulfate ions show that for Gates of the Arctic National Park, recorded deposition is decreasing (BLM 2018a, Figures 3.2-4 to 3.2-6).

The Clean Air Status and Trends Network (CASTNET) measures air quality and deposition trends in rural areas. In conjunction with other national monitoring networks, CASTNET data are used to assess relationships between regional pollution and total deposition patterns and to evaluate the effectiveness of national and regional emission control programs. For dry deposition, CASTNET logs flux data from monitoring stations across the country; flux is the rate at which dry particles reach the ground. The nearest monitor with recent data is in Denali National Park. From 1998 through 2016, sulfate ion dry deposition reached its maximum at 2.5 kg/ha/yr, in 2006. Nitrate ion dry deposition reached its maximum just below 2.0 kg/ha/yr in 2004, and ammonium ion dry deposition reached its maximum of 1.4 kg/ha/yr, in 2004. The annual average trend for all three ion fluxes has been consistent over the period of record for this monitoring station (BLM 2018a, Figure 3.2-7).

Air Pollutant Sources

There are few sources of air pollutants on the Coastal Plain. The primary pollutant sources are residential and commercial heating sources and mobile sources, such as snowmachines, vehicles, and aircraft. Additional emission sources on the wider region of the North Slope are oil and gas facilities, with lesser contributions by electricity generation and waste treatment. The nearest oil and gas facilities occur in the Point Thompson, Badami, Liberty, and Duck Island oil and gas units, west of the Coastal Plain (Alaska Division of Oil and Gas 2017). As of 2003, there were more than 4,800 exploratory and production wells on Alaska's North Slope (NRC 2003); as of 2018, there were approximately 2.7 million acres of active leases there (Alaska Division of Oil and Gas 2018). There are no active leases or active wells in the Coastal Plain.

Direct and Indirect Impacts

Issuance of oil and gas leases under the directives of Section 20001(c)(1) of PL 115-97 would have no direct impacts on the environment because by itself a lease does not authorize any on the ground oil and gas activities; however, a lease does grant the lessee certain rights to drill for and extract oil and gas subject to further environmental review and reasonable regulation, including applicable laws, terms, conditions, and stipulations of the lease. The impacts of such future exploration and development activities that may occur because of the issuance of leases are considered potential indirect impacts of leasing. Such post-lease activities could include seismic and drilling exploration, development, and transportation of oil and gas in and from the Coastal Plain. Therefore, the analysis is of potential direct and indirect impacts on air quality from on-the-ground post-lease activities.

This section describes the potential impacts of future Coastal Plain oil and gas development on air resources. Oil and gas leasing would have no direct impacts on air quality or AQRVs, as it would not authorize any on-the-ground actions. This EIS may lead to indirect impacts because its ROD would authorize lease sales and the issuance of leases that then could result in on-the-ground oil and gas activities being permitted. These post-lease activities would emit air pollutants from a variety of sources during exploration, development, and production. These pollutants could affect air quality and AQRVs on the Coastal Plain and in nearby areas.

Alternative A

Under Alternative A, no federal minerals in the program area would be offered for future oil and gas lease sales following the ROD for this EIS. No potential impacts on air quality or AQRVs from oil and gas development on the Coastal Plain would occur. Local and regional air emission sources, described above under *Affected Environment*, would continue to contribute air pollutants at levels commensurate with the increase or decrease in these emission sources over time.

Impacts Common to All Action Alternatives

Potential increases in pollutant emissions and associated impacts on air resources are expected to be similar across all action alternatives. While the locations of facilities would vary by alternative based on the lease stipulations that would be applied to protect other resources, the overall levels of surface disturbance and well development would be the same across alternatives (**Appendix B**). In addition, similar air quality ROPs would be applied across all alternatives (**Table 2-2** in **Chapter 2**). Where potential impacts on air quality can be differentiated, these are described under the specific alternatives, below.

The types of air emission sources associated with oil and gas development on the North Slope of Alaska are described in detail in a number of recent studies, including the NPR-A Final Integrated Activity Plan (IAP)/EIS (BLM 2012), the air analysis prepared for the GMT2 Final SEIS (BLM 2018a), and the BOEM Arctic Air Quality Modeling Study reports (BOEM 2014, 2016, 2017). These studies detail the oil and gas development phases and the associated emission sources required during each phase to bring oil and gas resources on the North Slope to production. The types of emissions sources analyzed in those studies are assumed to be similar to those required to recover oil and gas resources on the Coastal Plain. Future development proposals on the Coastal Plain are anticipated to be similar in scope to the GMT2 project described and analyzed in the GMT2 Final SEIS (BLM 2018a).

As described by these reports, emissions and emission sources would vary based on the phase of development, as summarized below:

- During seismic surveying, emissions would be produced by vibreosis rubber tracked vehicles, helicopters, and bulldozers or larger tracked vehicles used to pull the camp trains. Pollutant emissions would consist primarily of nitrogen oxides and CO, with lower levels of other criteria pollutants.
- During exploratory drilling, emissions would be produced mainly by drilling equipment required for exploratory and delineation wells. Additional sources of emissions would be support equipment and vehicles and intermittent activities such as mud degassing and well testing. Pollutant emissions would be dominated by nitrogen oxides, with more moderate levels of VOCs and CO, and lower levels of other criteria and hazardous pollutants.
- During the development phase, emissions would be produced by heavy construction equipment used to construct the CPFs, satellite well pads, ice roads, and pipelines; well drilling and completion drilling engines/turbines; and support vehicles and aircraft. The primary emissions would be nitrogen oxides and CO, with lesser amounts of VOCs, particulate matter, and SO_2.
- During the production phase, the primary source of emissions would be power generation for heating, oil pumping, and water injection. The emissions would consist primarily of CO and nitrogen oxides, with smaller amounts of particulate matter. There would also be minimal evaporative losses of VOCs from oil/water separators, pump and compressor seals, valves, and storage tanks. Venting and flaring could be an intermittent source of nitrogen oxides, VOCs, and possibly SO_2.

Emissions from seismic surveying and exploratory drilling are expected to be low compared with emissions from development and production. The emissions inventory developed for the BOEM Arctic Air Modeling Study estimated that for all phases of onshore oil and gas development (seismic surveys, exploratory drilling, and development/production), seismic survey operations accounted for less than 1 percent of each type of criteria or hazardous air pollutant emitted, and exploratory drilling accounted for less than 20 percent of VOCs and less than 10 percent of each other type of pollutant emitted (BOEM 2014, Table VI-4). The seismic survey activities evaluated in the BOEM emissions inventory report (BOEM 2014, page III-1) would be similar in scale to seismic survey activities on the Coastal Plain (Brumbaugh pers comm 2018)[2]. Thus, potential emissions in the short term would be less than emissions in the long term, assuming that exploration ultimately led to the buildout of oil and gas facilities as described by the hypothetical development scenario (**Appendix B**).

Since the program area is undeveloped, oil and gas resource development would require the construction of a system of gravel and ice roads and airstrips to access the CPFs and satellite well pads, as well as construction of the CPFs and satellite pads themselves. This construction would require the development of gravel pits, which are not included in the 2,000-acre limit on the surface development of production and support facilities. Infrastructure and gravel pit development would be sources of localized fugitive particulate matter emissions, both during construction of these features and during use of the roads and operation of the gravel pits (e.g., blasting, loading, and hauling).

Because the location, timing, and level of future oil and gas development on the Coastal Plain is unknown at this time, a qualitative analysis is being performed. At this initial leasing stage, there is a lack of location- and timing-specific information regarding any potential on-the-ground oil and gas activities that may result from leasing. Thus, a quantitative analysis would be highly speculative and result in a worst-case scenario

[2]Brumbaugh, Robert. Personal communication. Email from Robert Brumbaugh, BLM to Amy Cordle, EMPSi on September 4, 2018 regarding seismic survey activity levels.

outcome that is not helpful to the understanding of decision makers and the public. Future on-the-ground actions requiring BLM approval, including seismic surveys, exploratory drilling, and specific development proposals, would each require further NEPA analysis based on specific and detailed information about where and what kind of activity is proposed. Potential emissions from future development proposals are anticipated to be of a type and scale evaluated in the GMT2 Final SEIS (BLM 2018a) and included in the BOEM air study (BOEM 2016) onshore oil and gas emissions assumptions.

Based on the air analyses performed for the NPR-A, GMT2, and BOEM Air Modeling Study (BLM 2012; BLM 2018a; BOEM 2016, 2017, respectively), the monitoring data reported by ADEC for nine oil and gas development projects on the North Slope (ADEC 2018b), the low levels of criteria air pollutants in the ambient air (**Table 3-6**), and the meteorological conditions of the Coastal Plain described in **Section 3.2.1**, Climate and Meteorology, it is unlikely that a future project-specific proposal on the Coastal Plain would exceed a project-level Prevention of Significant Deterioration increment or cause ambient conditions to exceed an NAAQS/AAAQS, a critical visibility threshold, or a deposition analysis threshold as determined through project-specific air modeling.

However, because air quality conditions at the time of future project proposals would be different than air quality conditions today and because oil and gas development on the North Slope is expected to increase and contribute to cumulative air quality impacts over time, each project-specific NEPA analysis would require a determination of potential direct, indirect, and cumulative impacts on air quality and AQRVs.

In addition, ADEC would require air emission permits and dispersion modeling to assess potential impacts of specific facilities in accordance with EPA and Alaska rules and guidance. Air pollutant emissions from a proposed future project would be subject to federal and state air quality regulations under the Clean Air Act. Air pollution impacts are limited by air quality regulations and standards, and state implementation plans, established under the federal Clean Air Act and the Clean Air Act amendments of 1990. In Alaska, air pollution impacts are managed by ADEC under the Alaska Air Quality Control Regulations (18 AAC 50) and the EPA-approved state implementation plan. In Alaska, portable oil and gas operations must be authorized under an ADEC minor air quality permit. Future projects would be required to obtain all applicable state air quality permits.

Site-specific terms and conditions that may be required prior to authorizing any future oil and gas activity would be determined as part of future NEPA analyses and may include one or more of the following as outlined in detail in ROP 6 (**Chapter 2**):

- Collecting baseline ambient air data for a time period sufficient to support air quality modeling to analyze direct, indirect, and cumulative impacts (typically, one year) prior to initiation of NEPA analysis and air permit application review if no monitoring data are available
- Preparing an emissions inventory to determine pollutants of concern
- Preparing an emissions reduction plan to reduce project-related air emissions, fugitive dust, or GHGs
- Conducting air modeling to analyze direct, indirect, and cumulative impacts
- Implementing mitigation measures and strategies in addition to regulatory requirements if the air quality analysis shows potential future impacts on NAAQS/AAAQS or AQRVs
- Conducting monitoring for the life of the project depending on the magnitude of potential air emissions from the project, proximity to population centers, or other factors

- Modifying activities if monitoring indicates that emissions are causing or contributing to impacts that would cause unnecessary or undue degradation of the lands, cause exceedances of NAAQS, or fail to protect health
- Providing air quality baseline monitoring, emissions inventory, and modeling results to the state, local communities, tribes, and other entities in a timely manner

Alternatives B through D

Potential impacts under Alternatives B through D would be the same as described under *Impacts Common to All Action Alternatives*. In addition to ROP 6, all oil and gas operations (vehicles and equipment) that burn diesel fuels must use "ultra-low sulfur" diesel as defined by the EPA, which would minimize certain emissions from these sources.

Cumulative Impacts

Potential cumulative effects on air quality and AQRVs over the life of this EIS would result from existing sources of air pollutants in combination with the reasonably foreseeable future actions described in **Appendix F**. The cumulative effects analysis area for air quality includes the North Slope and the areas described under Affected Environment as sensitive in the context of preserving visitor experience, including the Arctic Refuge and Gates of the Arctic National Park. The nearest federal Class I area, Denali National Park and Preserve, is over 425 miles south of the Coastal Plain and is therefore not included in the cumulative effects analysis area.

No quantitative cumulative analysis has been prepared specifically for this EIS. Air analyses prepared for the GMT2 Final SEIS (BLM 2018a) and the BOEM Arctic Air Quality Modeling Study's Photochemical Modeling Report (BOEM 2016) are used to inform the cumulative effects analysis for this EIS, recognizing that these efforts did not include oil and gas development on the Coastal Plain in the modeling of potential cumulative effects on air quality and AQRVs. No such development had been proposed at the time of those analyses.

The methodology for analyzing cumulative effects on air quality in the GMT2 Final SEIS was described in Section 4.6.5 of that document (BLM 2018a). This included evaluating the effects of 14 onshore and offshore oil and gas development sources and the Deadhorse Power Plant. The results were included in Tables 4.6-5 through 4.6-8 in BLM 2018a. Cumulative criteria air pollutant concentrations in the Arctic Refuge (Table 4.6-5, BLM 2018a) and Gates of the Arctic National Park (Table 4.6-6, BLM 2018a) were modeled to be well under the NAAQS/AAAQS. Cumulative visibility impacts were estimated at a change of less than 5 dv at the Arctic Refuge and approximately 1 dv at Gates of the Arctic National Park (Table 4.6-7, BLM 2018a). Cumulative deposition impacts were estimated at 0.025 kg/ha-yr for nitrogen and 0.006 kg/ha-yr for sulfur at the Arctic Refuge and 0.004 kg/ha-yr for nitrogen and 0.001 kg/ha-yr for sulfur at Gates of the Arctic National Park (Table 4.6-8, BLM 2018a). As described above under the *Affected Environment*, measured maximum nitrogen deposition was 0.94 kg/ha-yr at Gates of the Arctic National Park; adding the cumulative nitrogen deposition level of 0.004 kg/ha-yr would yield a value of 0.944 kg/ha-yr, which is below the critical load range of 1 to 3 kg/ha-yr. Nitrogen deposition and critical load information for the Arctic Refuge was not available to make a similar calculation. Future development proposals on the Coastal Plain are anticipated to be similar in scope to the GMT2 project, though cumulative impacts would depend on the location and extent of other air emissions sources at the time of project proposal.

The BOEM Photochemical Modeling Report (BOEM 2016) evaluated the potential for cumulative effects on air quality and AQRVs from BOEM-authorized offshore oil and gas development along the North Slope in combination with other offshore vessel traffic, onshore oil and gas fields, airports, the Trans-Alaska Pipeline System (TAPS), and onshore non-oil and gas activities such as power plants, stationary fuel combustion sources, on- and off-road mobile sources, waste burning, wastewater treatment, fuel dispensing operations, and road dust (BOEM 2014, Table 1-1). The study showed local and regional concentrations of criteria air pollutants below the NAAQS for all pollutants except PM_{10} and $PM_{2.5}$. The study showed potential exceedances of the PM_{10} and $PM_{2.5}$ NAAQS only in Utqiaġvik, approximately 260 miles northwest of the program area boundary at the northern point of the North Slope; these exceedances were attributed to high projected levels of unpaved road dust and sea salt contributions and were reported to not have a high level of certainty because the road dust concentrations were extrapolated from other parts of the state (BOEM 2016, Section 7.1). Modeled visibility impacts from new oil and gas sources showed a change in visibility of 1 dv or greater on 160 days of the year at the Arctic Refuge's Coastal Plain and on 24 days of the year at Gates of the Arctic National Park (BOEM 2016, Section 7.3, Table 7-4). Deposition levels were modeled above 0.01 kg/ha-yr for nitrogen and sulfur in the Arctic Refuge and above 0.01 kg/ha-yr for nitrogen in the Gates of the Arctic National Park (BOEM 2016, Section 7.3.2, Tables 7-6 to 7-8). Cumulative visibility impacts and deposition levels for all sources included in the BOEM analysis were above thresholds and warrant additional quantitative (project and cumulative level) analysis.

As described above, the cumulative analyses for the GMT2 Final SEIS and the BOEM Arctic Air Quality Modeling Study did not account for proposed oil and gas development in the Coastal Plain, and therefore the potential cumulative effects of future oil and gas activities are not fully known at this time. As described by ROP 6, the direct, indirect, and cumulative effects of proposed oil and gas development proposals would be analyzed at the time of a specific project proposal to fully assess the effect of Coastal Plain development on air resources.

In addition, the BLM is undertaking its own study, the Cumulative Alaska North Slope Air Quality Regional Model, to assess the cumulative effects of BLM-authorized oil and gas development on the North Slope, including on the Coastal Plain. This study would tier off the BOEM study to provide an up-to-date assessment of the potential cumulative effects of North Slope onshore and offshore oil and gas development on air quality and AQRVs in the region. The BLM anticipates that this model would provide the foundation for future updated analyses. Because it is expected that the growth of oil and gas activities on the North Slope would continue for many years, the model would be updated periodically to reflect actual development rates and locations, allowing the BLM, other federal land managers, and the state to monitor the effects oil and gas development is having on air quality and AQRVs so that appropriate measures can be put in place to minimize the impact on these resources as needed. The modeling study would not be tied to a specific NEPA effort; rather, it would be used to inform future oil and gas-related NEPA analyses on the North Slope.

3.2.3 Acoustic Environment

Affected Environment

This section excerpts the analysis and incorporates by reference the Acoustical Environment section from the GMT2 Final SEIS (BLM 2018a), specifically for its overview of acoustical principles. Because the greater Nuiqsut area, the focus of the GMT2 Final SEIS, has a different acoustical setting than the Coastal Plain, the 2010 background acoustic monitoring done by the US Army Corps of Engineers (USACE) at Point Thomson, next to the western Coastal Plain boundary, is used as a comparable description of existing acoustic environment in the program area (USACE 2012, Appendix O).

Terrestrial Acoustic Environment

The acoustic environment is the combination of all sounds in a given area. These include natural sounds, such as those caused by wildlife, blowing wind, and running water, as well as unwanted human-caused sounds. The latter are considered noise because they have the potential to affect the natural acoustical environment and noise-sensitive resources and values. In the context of a leasing program, noise-sensitive resources, along with wildlife, are people engaged in subsistence pursuits, recreation, and other activities (BLM 2018a).

The degree to which noise may disturb wildlife and human receptors depends on many factors, such as the following (Francis and Barber 2013 in BLM 2018a):

- Wildlife responses to noise are known to vary by species
- Acoustical factors, such as the frequency, intensity (loudness), and duration of noise
- Non-acoustical factors, such as life-history stage, environmental or behavioral context, and degree of past exposure

Noise that is abrupt and unpredictable may be perceived as a threat, potentially triggering a startle response or antipredator behavior (Frid and Dill 2002; Francis and Barber 2013 in BLM 2018a). Chronic noise may affect sensory capabilities via masking of biologically important natural sounds, such as those used for communication or detection of predators or prey (Francis and Barber 2013). Similarly, human responses to noise also are contingent both on acoustical and non-acoustical factors. Examples of the latter are social context and perceived ability to exert control over the noise source (Kroesen et al. 2008; Stallen 1999 in BLM 2018a).

The spread (propagation) of sound in outdoor settings is affected by many variables: distance from the source; meteorological conditions, such as temperature, wind, and humidity; and landscape features and surface characteristics that may interfere with sound through absorption, reflection, or diffraction (Attenborough 2014 in BLM 2018a).

Among these, distance is the most significant factor. For a point source producing a constant sound, sound levels are expressed as dB and generally decrease by approximately 6 dB for each doubling of distance from the source. The same 6 dB reduction with doubling distance holds for the maximum sound level produced by a single moving source, such as an aircraft in flight, when the source is at its closest point of approach to the receptor (Attenborough 2014 in BLM 2018a). For a line of moving sources, such as vehicle traffic on a road, sound levels decrease by approximately 3 dB with doubling distance.

When wind is present, sound diminishes with distance is less than expected in the downwind direction—downwind propagation is enhanced—and greater than expected in the upwind direction. Temperature inversions reduce decreases and enhance propagation. In general, meteorological conditions tend to enhance sound levels to a lesser degree, such as 1 to 5 dB, than decrease sound levels, such as 5 to 20 dB (Attenborough 2014 in BLM 2018a).

Existing noise sources in the Coastal Plain area are the following:

- On-road and off-road vehicles and snowmobiles and community noise, such as generators and other small equipment motors, in the village of Kaktovik
- On-road and off-road vehicles and snowmobiles used for subsistence activities and travel between villages and subsistence camps

- Motorboats
- Aircraft in Kaktovik
- Tourism aircraft in the Arctic Refuge
- Aircraft and boats in the region used for recreationists and scientific researchers

Passive Acoustic Monitoring

The USACE conducted baseline acoustical monitoring in 2010 approximately 9 miles inland from the coast and 3 miles west of the Canning River. In this area, noise from human activities was generally absent (USACE 2012). Those conducting the baseline monitoring recorded hourly median sound levels of 23 to 28 A-weighted decibels (dBA) during winter conditions (April 27–June 8) and 24 to 26 dBA during summer conditions (July 12–August 12).

The program area is expected to have an acoustic environment similar to that described by the USACE (2012). In that study, the USACE noted that the low levels of sound recorded across all hours of the day, and across different seasons of the year, show loud events are rare. Natural sources, such as wildlife and wind, were the dominant sound of the sampling areas in the soundscape in both winter and summer. The USACE (2012) observed that human-caused noise, dominated by aircraft, ranged from zero to one event per hour (see also **Section 3.4.9**, Transportation).

Marine Acoustic Environment

The underwater and terrestrial acoustic environment is particularly important to marine mammals since they use noise to navigate, find prey, communicate, and detect disturbances or threats. While cetaceans typically rely on underwater acoustics, pinnipeds and polar bears perceive noises in and out of the water, such as when individuals are hauled out, spy-hopping, or traveling across the sea ice as is the case with polar bears (BOEM 2018b).

In the Beaufort Sea, natural sources of marine sound include wind stirring the surface of the ocean, storms, ice movements, and animal vocalizations and noises (including whale calls and echolocation clicks). The frequency and magnitude of noise from each of these producers can differ dramatically, as a result of variation in the seasonal presence of the sound sources. Existing human sources of sound in the Beaufort Sea include vessels (motor boats used for subsistence and local transportation, commercial shipping, research vessels, etc.); navigation and scientific research equipment (e.g., benthic trawls); airplanes and helicopters; human settlements; military activities; and offshore industrial activities. Differences in impacts of noise on wildlife among the alternatives are analyzed in **Section 3.3.4**, Terrestrial Mammals, and **Section 3.3.5**, Marine Mammals.

Direct and Indirect Impacts

Issuance of oil and gas leases under the directives of Section 20001(c)(1) of PL 115-97 would have no direct impacts on the environment because by itself a lease does not authorize any on the ground oil and gas activities; however, a lease does grant the lessee certain rights to drill for and extract oil and gas subject to further environmental review and reasonable regulation, including applicable laws, terms, conditions, and stipulations of the lease. The impacts of such future exploration and development activities that may occur because of the issuance of leases are considered potential indirect impacts of leasing. Such post-lease activities could include seismic and drilling exploration, development, and transportation of oil and gas in and from the Coastal Plain. Therefore, the analysis is of potential direct and indirect impacts on the acoustic environment from on-the-ground post-lease activities.

Impacts from noise are characterized by their effects on wildlife and the human environment. Impacts are most concentrated in places that are highly populated, highly sensitive to sound, or of disproportionate importance to people or wildlife. The village of Kaktovik is the only permanent settlement adjacent to the program area, though the broader coastal plain is used for a variety of subsistence activities, most notably hunting. The program area provides habitat for a number of species that are particularly susceptible to noise disturbance, including polar bears, especially during denning; caribou, especially during calving and post-calving activities; and migratory birds, especially during breeding and brood-rearing activities. Noise impacts specific to wildlife and subsistence users are analyzed more fully in those resource sections.

Methods of estimating noise impacts described in the GMT2 Final SEIS analysis (BLM 2018a) are applicable to this EIS. In evaluating potential impacts of future project-related noise, it is necessary to consider noise levels in relation to existing ambient sound levels at the location of the receptor:

- Noise that is 10 or more dBA below the existing ambient sound level likely would be inaudible to the human ear.
- Noise that is approximately equal to existing ambient sound level would only be marginally or slightly audible, depending on the hearing capabilities of the individual receptor.
- Noise that is 10 dBA or greater above existing ambient would become the dominant element of the acoustical environment.
- Noise with a level of 40 dBA would be readily audible in a setting with an existing ambient sound level of 35 dBA or less, but likely would be inaudible in a setting where the existing ambient sound level is 50 dBA or more.

Alternative A

Under Alternative A, no federal minerals in the Coastal Plain would be offered for future oil and gas lease sales and no changes would occur to the ambient noise environment as a result of future oil and gas development on the Coastal Plain. Alternative A would have direct or indirect impacts on the acoustic environment related to aircraft, and would retain background noise levels, which include the effect of noise generated by approximately nine flights per day to and from the Kaktovik Airport.

Impacts Common to All Action Alternatives

There are no potential impacts from future oil and gas development that are common to all action alternatives.

Alternative B

The primary noise sources associated with future oil and gas development would be ground-based equipment and aircraft.

<u>Ground-based Equipment</u>

Sources of noise associated with fluid mineral development are construction, operation, and support activities for oil and gas wells. Construction activities contribute shorter-term, temporary noises associated with the initial development of oil and gas infrastructure. This includes the construction of new roads, the use of vehicles and equipment to construct wells, and the drilling of wells.

Under Alternative B, the entire program area could be offered for lease sale, and there would be the fewest acres with restrictions on activities. **Table 2-1** in **Chapter 2** identifies acres available for lease sale subject to NSO, TL, or only to standard terms and conditions. There would be no sources of sound from ground-based equipment in areas with NSO (359,400 acres). The remaining acres available for lease sale subject to TL (585,400 acres) or only standard terms and conditions (618,700 acres) would experience sound from ground-based equipment; however, this would not occur during certain times for acres available for lease sale subject to TL. Acres available for lease sale subject to TL or only standard terms and conditions would involve ground-based equipment that can increase ambient sound level.

Median noise levels of drill rigs at 1,000 feet is estimated to be 52 dB, and maximum noise levels are estimated to be 84.4 dB. In a 35-dB ambient sound level, representative of the program area, both would be high-impact, dominant sounds. At a 50-dB ambient sound level, representative of developed coastal areas, the median noise levels would be marginally audible, but maximum sound levels would still be dominant. Assuming a diminishing rate of 6 dB per doubling of distance, sounds from onshore drilling 6 miles away would be below 24 dB at their median level. This median noise level would be inaudible in a 35-dB ambient sound level, but maximum noise levels would be audible and dominant from 6 miles away at that same ambient noise level. These impacts would not occur under Alternative A.

Aircraft

Kaktovik Airport is approximately 1 mile from the village Kaktovik and is the nearest and most central airport to the program area. The amount of air traffic through Kaktovik and routing of aircraft through the region could be strongly influenced by the future construction of additional air strips within the program area. It is difficult to estimate the magnitude of aircraft use that would result from enabling fluid mineral activity on the Coastal Plain; the rate of development and potential use of ships or vehicles on new roads are two key uncertainties that would affect air traffic.

A highly conservative estimate of the level of air traffic related to oil and gas activities in the region is represented by Deadhorse Airport, which serves as the primary hub for oil and gas activities on the North Slope of Alaska. Airport Master Records for this airport, which provides key air connections to Fairbanks and Anchorage, report a 12-month average of 91 flights per day, relative to Kaktovik Airport's average of 9 flights per day (AMR 2018a and 2018b). A 2010 USACE noise analysis that reported aircraft noise levels on the order of one event per hour is consistent with these numbers; however, the 2010 analysis could be capturing elevated levels of air traffic on the western portions of the program area from air traffic utilizing other airports (USACE 2012 Section 5.20.8).

In addition to the air traffic resulting from flights into Kaktovik, support activities using helicopters are likely to be enabled by leasing. Currently, the BLM/USFWS permit a very small number of helicopter landings in the Arctic Refuge, mostly related to scientific research and photography.

The noise reduction estimates tabulated as part of the GMT2 Final SEIS analysis (BLM 2018a, Table 4.1-45) suggest that air traffic could be discernable 5 to 10 miles from the source for the loudest aircraft routinely operating in the region (based on a background noise level of 35 dB). At a higher ambient noise level (50 dB), more typical of the environment and villages west of the Arctic Refuge, this distance can reduce to 1 to 2.5 miles. The extent to which flights are routed from Fairbanks, or routed farther north between Deadhorse and Kaktovik, could significantly alter the location, number, and intensity of affected acres.

Because of the proximity of Kaktovik Airport to the community of Kaktovik, there is a potential for high, localized impacts on the acoustic environment of the community from future oil and gas exploration, development, and production, with impacts commensurate with use of the airport. Take-offs and landings at the airport are audible and dominant sounds in Kaktovik. The different action alternatives do not present a clear basis for differences in use of the airport, so use levels are estimated to be the same among them. These use levels could be up to ten times current use levels if air traffic levels at the Deadhorse Airport are indicative of future air traffic levels at Kaktovik Airport. Although measures to manage aircraft type could influence the noise levels experienced by the community, even quieter aircraft dominate the soundscape at 1 mile under 35 dB background noise conditions. At a 50-dB level, there is an appreciable difference in audibility of noises in the 45 to 60 dB range.

Alternative B would minimize the potential effects of low-flying aircraft on wildlife, subsistence activities, local communities, and recreationists of the area, including hunters and anglers through ROP 34.

Alternative C

<u>Ground-Based Equipment</u>

The potential impacts from future oil and gas exploration, development, and production would be similar to Alternative B; however, they would occur in fewer areas. The BLM would rely on the same ROPs as under Alternative B but would apply more restrictive lease stipulations. **Table 2-1** in **Chapter 2** identifies acres available for lease sale subject to NSO, TL, or standard terms and conditions. There would be no sources of sound from ground-based equipment in areas with NSO (932,500 acres). The remaining acres available for lease sale subject to TL (317,100 acres) or standard terms and conditions only (313,900 acres) would experience sound from ground-based equipment; however, this would not occur during certain times for acres available for lease sale subject to TL. Acres available for lease sale subject to TL or standard terms and conditions would involve ground-based equipment that can increase ambient sound level, as described under Alternative B.

<u>Aircraft</u>

The potential impacts from future oil and gas exploration, development, and production would be similar to Alternative B; however, they would occur in a smaller area within the Coastal Plain, primarily due to an increase in NSO acreages from 359,400 acres to 932,500 acres.

Alternative D

<u>Ground-Based Equipment</u>

The potential impacts from future oil and gas exploration, development, and production would be similar to Alternative B; however, they would occur in a smaller area within the Coastal Plain. **Table 2-1** in **Chapter 2** identifies acres not offered for lease sale (Alternatives D1 and D2) and acres available for lease sale subject to NSO (Alternatives D1 and D2), CSU (Alternatives D1 and D2), TL (Alternative D2), or standard terms and conditions (Alternative D1). There would be no sources of sound from ground-based equipment in areas not offered for lease sale (526,300 acres) or areas with NSO stipulations (708,600 acres). The remaining acres available for lease sale subject to CSU (123,900 acres), TL in Alternative D2 (204,700 acres), or only standard terms and conditions in Alternative D1 (204,700 acres) would experience sound from ground-based equipment; however, this would not occur during certain times of the year for acres available for lease sale subject to TL. Acres available for lease sale subject to CSU, TL, or only standard terms and conditions would involve ground-based equipment that can increase ambient sound level, as described under Alternative B.

<u>Aircraft</u>

The potential impacts from future oil and gas exploration, development, and production would be similar to Alternative B; however, they would occur in a smaller area within the Coastal Plain, primarily due to an increase in areas not offered for lease sale from 0 acres to 526,300 acres and an increase in NSO acreages from 359,400 acres to 708,600 acres. Lease Stipulation 10 would protect wilderness values (including impacts from noise) in the Mollie Beattie Wilderness Area. To the extent practicable, aircraft operations would be planned to minimize flights below 2,000 feet when flying within 3 miles of the Mollie Beattie Wilderness Area boundary. As a result, fewer impacts from aircraft noise, as described under Alternative B, would be expected in that area.

Cumulative Impacts

Past activities have increased ambient sound levels on the North Slope, including those resulting from development in the NPR-A, development on state lands on the Prudhoe Bay Oil Field, offshore drilling activities, and surface, air, and marine transportation. Present and future oil and gas development on the North Slope could result in localized but additive impacts on the acoustic environment from drilling operations and air traffic levels in the region, whose reach extends at least 50 miles from any standard connection route. The action alternatives would involve similar types of potential noise from oil and gas development and transportation activities. Projected levels of air traffic have the greatest potential for contributing to cumulative impacts by increasing the number of flights over an area per day. The potential cumulative impacts on the acoustic environment would affect the community of Kaktovik and individuals throughout the program area, as well as noise-sensitive resources along aircraft flight paths outside of the program area. There would be no cumulative impacts under Alternative A.

3.2.4 Physiography

Affected Environment

Physiography describes the physical features of an area, including landforms and topography. The Coastal Plain of the Arctic Refuge occupies about 1,563,500 acres in the northeast corner of Alaska. It stretches about 100 miles from the Staines River, the westernmost distributary of the Canning River, on the west to the Aichilik River on the east. From the coast of the Beaufort Sea, the Coastal Plain extends south about 40 miles at its widest point. Elevations range from sea level along the coast to about 1,000 feet at the southern boundary. The Coastal Plain is drained by braided channel rivers, which have their headwaters in highlands to the south. These sediment-laden rivers form deltas where they flow into the sea.

A physiographic province is a region of similar topography and climate that has had a unified geomorphic history. The Coastal Plain encompasses parts of three physiographic provinces, as defined by Wahrhaftig (1965). These provinces, shown on **Map 3-1** in **Appendix A**, consist of the Arctic Coastal Plain, the Arctic Foothills, and the Arctic Mountains.

Ecoregions have also been defined for the State of Alaska, including the Coastal Plain. Besides climate and topography, ecoregions are based on additional characteristics such as soils and vegetation data. Ecoregions are described in **Section 3.3.1**, Vegetation and Wetlands.

Arctic Coastal Plain

Ninety percent of the Coastal Plain is in the Arctic Coastal Plain physiographic province, a smooth plain rising gradually from the Beaufort Sea to a maximum elevation of 600 feet above sea level (asl). The coastline has low relief and the shore is typically only 1 to 10 feet asl (Wahrhaftig 1965). Coastal cliffs in the Coastal Plain of the Arctic Refuge have a maximum height of 25 feet (Clough et al. 1987, p. 9).

Much of the Arctic Coastal Plain is dominated by a series of large alluvial fans (USFWS 2015a, p. 4-17); these are deposits occurring where the carrying capacity of the stream lessens, resulting in deposition. This often occurs where stream gradient decreases, and the deposits spread out downslope. The alluvial fans create upland terrain with moderate slopes that can extend to the coast, especially south of Camden Bay (Jorgenson et al. 2015).

The Arctic Coastal Plain province is underlain by permafrost that extends to depths of over 1,000 feet (Wahrhaftig 1965). Although permafrost generally occurs in materials where the temperature is below 32 °F, in areas of elevated salinity or liquid hydrocarbons, materials may not be frozen because the freezing point is lower.

Permafrost is covered by a surface "active layer," which freezes and thaws annually. The thickness of the active layer in the Coastal Plain is generally 1 to 4 feet (USFWS 2015a). A year-round thawed layer, termed a thaw bulb, may be present beneath lakes 7 feet deep or greater and beneath some parts of deeper rivers, such as the Canning. Based on studies of seawater and borehole temperatures, the permafrost layer in the nearshore area of the Beaufort Sea probably extends out to water depths of 500 feet (Brewer 1987).

A number of topographic features are associated with permafrost, the most prominent of which are ice-wedge polygons (Wahrhaftig 1965). These are vertical wedge-shaped veins of ice that develop in thermal-contraction cracks. These cracks form in a pattern of interconnected polygons that can vary in size. Most range from 30 to 200 feet in diameter and are visible at the surface, although some in the southern part of the Coastal Plain are masked by tussock-type tundra (Brewer 1987).

Other features associated with permafrost that can be found in the Coastal Plain are as follows:

- Beaded streams—series of small ponds connected by small streams
- Frost boils—upwellings of mud that result in barren and partially vegetated areas
- Pingos—low, ice-cored mounds formed as soil-covered water freezes and expands upward

Permafrost is described in greater detail in **Section 3.2.8**, Soil Resources.

Arctic Foothills

Most of the southern edge of the Coastal Plain is in the northern section of the Arctic Foothills physiographic province, as shown on **Map 3-1** in **Appendix A**. This province consists of rolling plateaus and low, east-west trending linear mountains. Elevations in the northern section of the Arctic Foothills province range from about 600 feet asl on the north to 1,200 feet asl on the south. Like the Arctic Coastal Plain province, the Arctic Foothills province is underlain by thick permafrost and has many of the same permafrost features described above: thaw lakes, polygonal ground, and beaded stream drainages. Other ice-related features in the Arctic Foothills are gelifluction lobes[3] and stone stripes, consisting of lines of stones that form through frost heaves (Wahrhaftig 1965; USFWS 2015a, p. 4-17).

Arctic Mountains

About 28,000 acres, or less than 2 percent, of the Coastal Plain along the southern border is in the Central and Eastern Brooks Range section of the Arctic Mountains physiographic province (see **Map 3-1** in **Appendix A**). The Central and Eastern Brooks Range consists of rugged east-west trending ridges, reaching elevations of 7,000 to 8,000 feet asl. The mountains in the Brooks Range typically have cliff-and-bench slopes formed by glacial erosion of bedded rocks (Wahrhaftig 1965).

Beaufort Sea Coast

The Coastal Plain extends outward from the coastline to the Arctic Refuge boundary, which includes tidally influenced areas of the Beaufort Sea. The Beaufort Sea coast is not identified as a separate

[3]Tongue-shaped deposits formed from slow flows of the active layer on slopes of 5 to 20 degrees

physiographic province, but it is an integral part of the Coastal Plain, with distinct physical features. The Beaufort Sea coastline is irregular, with narrow beaches and small tides. It is characterized by numerous deltas, peninsulas, offshore shoals, mudflats, spits, bars, low-lying barrier islands, and shallow lagoons. The most pronounced deltas are associated with the Canning, Hulahula-Okpilak, Jago, and Aichilik Rivers (Clough et al. 1987). Rivers of the Coastal Plain are discussed in **Section 3.2.10**, Water Resources.

Coastal bluffs are typically 4 to 5 feet high but, as noted above, can be as high as 25 feet. The highest elevation along the coast is at 3-mile-wide Barter Island, which is more than 50 feet. Lagoons and bays are generally only 3 to 12 feet deep, except for Camden Bay where depths are greater than 15 feet (Clough et al. 1987, p. 9). Camden Bay extends across more than half of the Coastal Plain coastline and is the largest single feature. The Beaufort Sea coastline is gradually receding. Coastal erosion, one factor that can contribute to a receding coastline, is discussed under geologic hazards in **Section 3.2.5**, Geology and Minerals.

Climate Change

Changes to the coast and overall topography in the Coastal Plain could occur as a result of climate warming. The general warming of the Arctic appears to have lengthened the open-water period in the Beaufort Sea (USACE 2012, Ch. 5). A longer open-water period allows for longer exposure of beaches to coastal processes and increases the fetch[4] for generating larger sea waves. These factors combine to produce more rapid coastal erosion and shoreline retreat, especially at locations not protected by barrier islands.

Direct and Indirect Impacts

Issuance of oil and gas leases under the directives of Section 20001(c)(1) of PL 115-97 would have no direct impacts on the environment because by itself a lease does not authorize any on the ground oil and gas activities; however, a lease does grant the lessee certain rights to drill for and extract oil and gas subject to further environmental review and reasonable regulation, including applicable laws, terms, conditions, and stipulations of the lease. The impacts of such future exploration and development activities that may occur because of the issuance of leases are considered potential indirect impacts of leasing. Such post-lease activities could include seismic and drilling exploration, development, and transportation of oil and gas in and from the Coastal Plain. Therefore, the analysis is of potential direct and indirect impacts on physiography from on-the-ground post-lease activities.

The effects of climate change described under *Affected Environment* above, could influence the rate or degree of the potential direct and indirect impacts.

Alternative A

Under Alternative A, current management actions would be maintained as described in the Arctic Refuge Revised CCP (USFWS 2015a). No potential impacts on physiographic features from future oil and gas exploration, development, and production would occur.

Impacts Common to All Action Alternatives

Future construction of infrastructure would affect topography in the program area and could reshape geomorphological features, such as water bodies and permafrost features.

[4]The area of water over which the wind blows in an essentially constant direction, thus generating waves.

All the action alternatives would require placement of gravel fill, which would have the potential direct impact of altering the topography within the development footprint. Gravel infrastructure would include pads, roads, and an airstrip, as described in **Chapter 2**. This potential long-term impact would begin during the construction phase and would last throughout the development phase until the gravel is removed and the site has been restored to pre-program conditions. Impacts would last longer if not all gravel infrastructure (e.g., access roads) is removed.

In addition to the potential direct effects on topography that would result from placement of gravel fill, the presence of gravel infrastructure would alter existing geomorphic features. For example, the sea barge landing and staging structures would affect the pattern of sediment erosion and deposition, which could result in local, long-term changes to the coastline configuration. Likewise, if the gravel pad for the STP is placed in water rather than on land, similar effects on physiography would occur. This impact would last throughout the development phase and for some period after the structure is removed during reclamation. Other gravel infrastructure could affect permafrost features or result in changes to stream or lake morphology. Potential direct and indirect impacts on permafrost features are further described in **Section 3.2.8**. Potential direct and indirect impacts on surface water features are further described in **Section 3.2.10**.

All action alternatives assume a surface disturbance area of approximately 2,000 acres from future oil and gas exploration, development, and production, not including the gravel pits. Most, but not all, of the surface disturbance is associated with placement of gravel fill. The size of the STP would be an estimated 15 acres under all action alternatives. For the sea barge landing, each action alternative assumes a 10-acre gravel pad for staging modular units next to a landing at Camden Bay and a 5-acre pad at a landing along the eastern coast of the Coastal Plain. The footprint of other gravel infrastructure would vary, depending on the alternative (see discussion of each alternative below).

All the action alternatives would include potential future development of a gravel mine or mines, which would also result in potential direct long-term impacts on topography. The surface area of the gravel mines would total approximately 300 acres for each action alternative (not included in the 2,000-acre limit on surface disturbance). Impacts of gravel mining on physiography would last beyond the development phase because the pits remaining from gravel extraction would typically not be completely backfilled, and any remaining depression could fill with water and become a permanent lake. Gravel mines are described further in **Section 3.2.9**, Sand and Gravel Resources.

Future ice infrastructure (e.g., pads and roads) would have negligible impacts on topography but could affect permafrost and surface water geomorphic features, as discussed further in **Section 3.2.8** and **Section 3.2.10**.

Potential changes to physiography associated with geologic hazards (e.g., subsidence or slope failure) are addressed in **Section 3.2.5**.

Alternative B

Approximate acreages associated with future gravel infrastructure specific to Alternative B are as follows:

- 204 acres for 17 satellite drill pads
- 200 acres for four CPFs
- 1,560 acres for 208 miles of gravel roads

Alternative C

Approximate acreages associated with future gravel infrastructure specific to Alternative C are as follows:

- 216 acres for 18 satellite drill pads
- 150 acres for three CPFs
- 1,598 acres for 213 miles of gravel roads

Alternative D

Approximate acreages associated with future gravel infrastructure specific to Alternative D are as follows:

- 242 acres for 21 satellite drill pads
- 100 acres for two CPFs
- 1,635 acres for 218 miles of gravel roads

Cumulative Impacts

Potential impacts on topography and geomorphic features resulting from future gravel infrastructure are generally localized to the footprint or adjacent area; therefore, the geographic area relevant for assessing cumulative impacts on physiography is the program area. While other past, present, and reasonably foreseeable future actions on the North Slope (**Appendix F**) have had or would have impacts on physiography, none of these actions have been or are proposed to be in the program area and so would not contribute to cumulative impacts on physiographic features in the Coastal Plain. The effects of climate change described under *Affected Environment* above, could influence the rate or degree of the potential cumulative impacts. Alternative A would have no cumulative impacts on physiography.

3.2.5 Geology and Minerals

Affected Environment

Geology

The Coastal Plain is in the eastern part of the North Slope geologic province and has greater geologic complexity than that found elsewhere in northern Alaska. The North Slope geologic province is part of a tectonic feature referred to as the Arctic Alaska microplate. The geologic history for this continental microplate includes three primary tectonic settings: a south-facing passive continental margin during the Devonian to Triassic, a northern rifted margin in the Jurassic to Early Cretaceous, and a southern orogenic[5] margin, with a related foreland basin and fold-and-thrust belt from the Jurassic to recent time (Bird 1999).

A thin layer of surficial deposits covers the bedrock geology in most of the Coastal Plain; therefore, information and understanding of the bedrock geology has been obtained primarily from geophysical remote sensing, observations in the mountains south of the area, and wells drilled west and north of the area (Bird 1999).

Four tectono-stratigraphic sequences characterize the Northern Alaska geologic province (see **Figure 3-3**, Stratigraphy of the Coastal Plain, in **Appendix A**) (USGS 1998a). The oldest sequence is the Franklinian, which consists of a thick succession of metamorphosed sedimentary, volcanic, and igneous rocks of Proterozoic to Early Devonian age. The overlying Ellesmerian sequence of Middle Devonian to Triassic age rocks represents the south-facing passive margin referred to above. The Beaufortian sequence

[5]Mountain building

records the Jurassic and Cretaceous rifting, which severed the continental connection of northern Alaska and opened the Canada basin. The Brookian sequence, Cretaceous to recent age, consists of sediments originating from the ancestral and modern Brooks Range and deposited in foreland basin and passive margin settings (Bird 1999). Information regarding the oil and gas potential for these sequences is provided in **Section 3.2.6**, Petroleum Resources.

Geologic structures in the Coastal Plain consist of closely spaced folds and faults in rocks that were deposited in the foreland basin setting and broad, domed faulted structures in the pre-foreland basin and basement rocks. These structures formed in one or more episodes of Brooks Range-related deformation during Cenozoic time. Devonian and possibly older structures are also present in the Coastal Plain, and these structures have controlled the orientation of some younger Cenozoic structures (Bird 1999).

A major structural feature of the Coastal Plain is the east-northeast trending Marsh Creek anticline, which formed during the Oligocene (Bird 1999). Rather than being a simple anticline, the Marsh Creek anticline is interpreted to be either a triangle zone or an anticlinorium[6] (Bird and Magoon 1987). The Marsh Creek anticline divides the Coastal Plain into two areas having different structural characteristics. Rocks northwest of the Marsh Creek anticline are in the "undeformed area" and have remained nearly undeformed since their deposition. Rocks to the southeast of the Marsh Creek anticline, the "deformed area," have been thrust faulted, folded, and uplifted (Magoon et al. 1987). The deformed area is about twice the size of the undeformed area.

Figure 3-4, Generalized Surficial Deposits of the Coastal Plain Area, in **Appendix A** is a surficial geologic map of the Coastal Plain. The plain is largely covered by a thin mantle of Quaternary unconsolidated sediments that range in thickness from a few feet to about 100 feet (Clough et al. 1987). These include river deposits (alluvium), beach deposits, colluvium, alluvial fans, terrace deposits, marine terrace deposits, glacial deposits, glaciofluvial deposits, and landslides (Marshall et al. 1998).

Only about 10 percent of the Coastal Plain was glaciated during the Pleistocene. In the southwest corner, a large valley glacier extended northeastward approximately 12 miles into the area for approximately 7 miles along the Tamayariak River. Smaller valley glaciers extended about 4 miles into the area along the Hulahula River, just across the Coastal Plain boundary along the Jago River, and 2 miles along the Aichilik River. Glaciofluvial deposits and eolian[7] materials are widespread, even in unglaciated areas (Clough et al. 1987).

As shown in **Figure 3-4** in **Appendix A**, two types of surficial deposits predominate in the Coastal Plain: gravel and sand and silt and very fine sand over gravel. Gravel and sand include deposits associated with river floodplains and terraces and upland terraces that lack a silt cover. Silt and very fine sand over gravel comprise a fine-grained cover, generally more than 6.6 to 10 feet thick and ice rich, and commonly containing fine-grained organic debris. Morainal deposits composed of compact, silty, bouldery till are present in the previously glaciated areas along the southern border of the Coastal Plain. Near the coast, surficial unconsolidated deposits typically consist of alluvial sediments (silt, sand, and gravel) overlying finer-grained marine sediments.

The cover of unconsolidated sediments is broken up by outcrops of Tertiary-Cretaceous sedimentary rocks. The largest of these outcrop areas occurs along the Marsh Creek anticline and upper Jago River. Outcrops in the Marsh Creek anticline area include the Sagavanirktok and Canning Formations (Marshall et

[6]An intensely deformed series of anticlines and synclines that together form a general arch
[7]Windblown

al. 1998). The Sagavanirktok Formation, which overlies the Canning Formation, consists of poorly consolidated gray siltstone, mudstone, sandstone, and lesser amounts of conglomerate that were deposited in non-marine and shallow marine environments. This rock unit is as much as 4,900 feet thick on the north flank of the Marsh Creek anticline and 7,500 feet thick in wells near the mouth of Canning River. The Canning Formation consists of gray shale and siltstone containing interbeds of mostly thin-bedded, very fine to fine-grained lithic sandstone; they represent turbidites deposited in a deep-water marine environment by a sediment gravity flow. The Canning Formation was measured at 4,900 to 5,000 feet thick in wells west of Canning River (Molenaar et al. 1987).

The Jago River Formation crops out in the upper Jago River area (Marshall et al. 1998). This formation consists of well hardened, thick-bedded, fine- to coarse-grained, lithic sandstone and conglomerate. There are also minor amounts of coal and carbonaceous shale deposited in a primarily nonmarine environment with minor shallow marine influence. The Jago River Formation is 9,800 feet thick in its type section along Igilatvik (Sabbath) Creek (Buckingham 1987).

Smaller bedrock outcrops occur around the Sadlerochit Mountains and in the east-central part of the Coastal Plain. In addition to the Canning Formation, these outcrops expose the Cretaceous Hue Shale, Pebble Shale unit, and Kemik Sandstone; Cretaceous-Jurassic Kingak Shale; Triassic Karen Creek Sandstone; Permian and Triassic Sadlerochit Group; and Pennsylvanian-Mississippian Lisburne Group (Marshall et al. 1998).

For more detailed information regarding the rock units and geologic structure of the Coastal Plain, refer to Bird and Magoon (1987) and Bird (1999).

Geologic Hazards

Geologic hazards are natural physical conditions that could damage land or structures and injure humans. Potential geologic hazards in the Coastal Plain are earthquakes, surface faults, landslides, land subsidence, flooding, sea ice ride-up and override, coastal erosion, and storm surge.

<u>Earthquakes and Surface Faults</u>

The USGS has prepared seismic hazard maps for Alaska that portray the probability of ground motion (peak ground acceleration) due to an earthquake (Wesson et al. 2007). For the Coastal Plain, the USGS estimates that peak ground accelerations of up to 0.2 g (where g equals the acceleration due to gravity); there is a 5 percent probability that this acceleration would be exceeded in 50 years; thus, the Coastal Plain is in an area of relatively low seismic risk. This risk may be revised in the future, based on August 2018 seismic activity, described below.

Historically the level of earthquake activity in the Coastal Plain has been low. Earthquakes of magnitude (M) 6 and larger on the Richter scale of intensity are potentially destructive; earthquakes of M 5 could cause local damage (Clough et al 1987). Prior to August 2018, epicenters of five earthquakes with M 4.5 to M 5.0 had been recorded in or within 15 miles of the Coastal Plain (USGS 2018a). Of these, three were centered in the Coastal Plain: A M 4.7 earthquake in February 2006 and M 4.5 and M 4.9 earthquakes in April 2007. Three earthquakes above M 5.0 had been recorded in the northeast corner of Alaska, the closest of which was an M 5.2 earthquake centered about 30 miles southwest of the Coastal Plain in August 1995. The largest of the three was an M 5.5 earthquake in August 2003 about 80 miles from the southwest corner of the Coastal Plain (USGS 2018a).

On August 12, 2018, an M 6.4 earthquake occurred 52 miles southwest of Kaktovik (and less than 10 miles south of the Coastal Plain) in the Sadlerochit Mountains. It was felt widely across the eastern NSB, and was, by a wide margin, the largest earthquake ever recorded north of the Brooks Range in Alaska (Alaska Earthquake Center 2018). This earthquake was followed by a number of aftershocks on the same day, including an M 6.0 earthquake about 20 miles east of the M 6.4 event. From August 13 to September 2, 2018, 13 earthquakes between M 4.0 and M 4.8 were recorded in the same area. The Alaska Earthquake Center indicated that this seismic activity is consistent with natural earthquake activity. Aftershocks are expected to slowly decline but remain active for many weeks or months.

The USGS's Quaternary fault and fold database (USGS and ADNR 2006) contains information on faults and associated folds in the US that are believed to be sources of earthquakes greater than M 6 during the Quaternary (i.e., the past 1.6 million years). This database indicates the presence of one Quaternary surface feature in the Coastal Plain, which is the Marsh Creek anticline (described above and depicted on **Map B-1**, Hydrocarbon Potential, in **Appendix B**). A group of several faults, known as the Camden faults or Camden fault zone, is offshore. The closest of these faults is about 10 miles from the coast. The most recent deformation on the Camden faults is less than 15,000 years old.

Slope Failure

Slope failure in the Coastal Plain can occur in the form of solifluction[8] and creep or slump along coastal bluffs, terrace escarpments, lake margins, and ridge slopes. Locally along a stretch of the Katakturuk River and near Marsh and Carter Creeks, landslides have occurred in weathered and soft Tertiary shale, siltstone, and sandstone. In all areas having any appreciable slope and exposed mineral soil, the soil migrates gradually downslope because of seasonal frost heaving of individual soil grains (Clough et al. 1987).

Retrogressive thaw slumps are slope failures resulting from thawing, ice-rich permafrost. They develop along streams or coastlines and expand inland to form landslide-like U-shaped scars (Lantuit et al. 2013).

Subsidence

The volume of ice in permafrost soils, particularly in the first few tens of feet below the ground surface, can be several times the volume of the mineral components (Brewer 1987). Natural and human-induced thawing of this near-surface ice generally results in uneven lowering of the ground surface, which may lead to water ponding or preferential erosion or both (Rawlinson 1993). Because of the presence of ice-rich permafrost, about one-third of the Coastal Plain has the potential for thaw settlement of 16 to 98 feet (Jorgenson et al. 2015).

Flooding and River Ice Jams

Most streams in the Coastal Plain have swift, braided courses across broad gravel flats that typically freeze to the bottom in the winter. In addition, groundwater from seeps and springs that flow throughout the winter freezes and forms thick, layered sheets of ice, called aufeis.[9] During spring when meltwater begins to flow, the presence of ice in the stream channels causes the streams to flood. As meltwater runs over the top of river ice, the ice breaks into pieces. As the ice flows downstream, it may lodge in constricted parts of the channel, creating jams and forcing more water out of the stream channel (USACE 2012, p. 3-61). Streams draining the Brooks Range also have the potential to produce significant summer

[8]Very slow deformation of the seasonally thawed surface, forming elongated shallow lobes
[9]A mass of layered ice that forms from successive flows of groundwater during freezing temperatures

precipitation-driven flood discharges (USACE 2012, p. 3-47). Flooding is discussed further in **Section 3.2.10**.

Sea Ice Ride-up and Override

On shorelines exposed to the open ocean, onshore winds can push sea ice 100 feet or more onshore and 10 to 20 feet high, in a process called sea ice ride-up and override (USACE 2012, p. 3-42). Any natural or human-made features exposed to this sea ice push are susceptible to damage, including shoreline and seabed scouring. Lagoon areas are not generally subject to this phenomenon.

Coastal Erosion and Storm Surge

Beach erosion varies greatly from place to place and year to year along the entire Beaufort coast, depending on storm intensities and the nearness of pack ice. Erosion and deposition of eroded sands and gravel also produce barrier island or spit migration, especially where established vegetation is absent (Brewer 1987). Gibbs and Richmond (2017) have calculated average and maximum shoreline change rates for two regions of the Coastal Plain. Region 1 is the shoreline from the US-Canada border to the Hulahula River, and Region 2 is the shoreline from the Hulahula River to the Staines River. For both Regions 1 and 2, the average rate of shoreline change is -3.0 feet per year over the short term and long term. The negative value indicates that, overall, erosion is greater than accretion. The maximum long-term and short-term rates of erosion observed in Region 1 are -48.6 and -64.3 feet per year; the maximum long-term and short-term rates of erosion in Region 2 are both -22.3 feet per year. In this study, erosion indicates landward movement or retreat of the shoreline and does not distinguish between physical erosion and flooding of the coast, due to land subsidence or sea level rise.

Erosion along the coast can also be caused by wind. Wind erosion is generally confined to exposed spits and barrier islands and the Canning, Hulahula, Okpilak, and Jago River deltas, where active dunes are found along their western banks (Clough et al. 1987). Abnormally high rises in sea level, referred to as storm surges, are caused by strong westerly winds and can be 4 to 6 feet above the elevation of sea level, or even greater with winds at 50 to 60 knots (USACE 2012, p. 3-31). Storm surges can cause coastal flooding, particularly along low-profile beaches common in the Coastal Plain.

Additional details regarding shoreline erosion and storm surge along the Beaufort Sea coast can be found in Barnes et al. (1992), USACE (2012, Chapter 3), and Gibbs and Richmond (2017).

Minerals

In the 1970s, before ANILCA, the USGS and former US Bureau of Mines conducted limited reconnaissance geological and mineral investigations in northeast Alaska. Limited mineral industry work was also conducted in the 1970s (USFWS 2015a, p. 4-37). Under ANILCA, the Arctic Refuge was closed to all forms of appropriation under the public land laws, including the mineral leasing and mining laws (USFWS 2015a, p. 4-1).

The BLM classifies mineral resources it manages as salable, leasable, or locatable. Salable minerals are subject to the Materials Act of 1947, as amended, and include common construction materials, such as sand, gravel, decorative rock, and building stone. Salable minerals relevant to the Coastal Plain (sand and gravel) are addressed in **Section 3.2.9**.

Leasable minerals generally include energy minerals, such as petroleum, geothermal, and coal resources, as well as potash, sodium, and phosphate; petroleum resources are addressed in **Section 3.2.6**. Geothermal resources in Alaska are associated with the Aleutian volcanic arc or thermal springs in the interior or southeastern Alaska and have not been identified around the Coastal Plain (Miller 1994).

Coal occurs in isolated areas throughout Alaska, referred to as provinces. The North Slope coal province has the largest coal deposits in Alaska, and the eastern edge of the province extends into the Coastal Plain (Flores et al. 2004; Stricker et al. 2011). The most important Cretaceous coal-bearing rocks in the province are in the Colville and Nanushuk groups west of Prudhoe Bay (Flores et al. 2004). Coal deposits in the eastern North Slope coal province primarily occur in the Tertiary Sagavanirktok Formation in two separate zones and are characterized as sub-bituminous (Stricker et al. 2011).

Locatable minerals are subject to the General Mining Law of 1872 and include metallic minerals, such as gold, silver, copper, lead, zinc, and uranium; nonmetallic minerals, such as alunite, asbestos, barite, gypsum, and mica; and certain varieties of stone. These are also referred to as hardrock minerals. The following discussion addresses locatable minerals and phosphate (a leasable mineral).

The USGS maintains a database with descriptions of mines, prospects, and mineral occurrences in Alaska. The records in the database are generally for metallic mineral commodities only but also may include certain high value industrial minerals, such as barite and rare earth elements. No mineral occurrences are documented in the Coastal Plain; however, seven mineral occurrences are documented within 15 miles (see **Table 3-7**; **Map 3-2**, Mineral Occurrences, in **Appendix A**). These minerals are copper, rare earth elements, phosphorus, uranium, and phosphates.

Hartman (1973) assessed mineral potential in the Arctic Refuge and identified granitic intrusions with metallic mineral deposits in the Romanof Mountains and along the southern edge of the Brooks Range. Closer to the Coastal Plain, Hartman identified abundant low-grade phosphate deposits in the Shublik Formation that crops out along the northern edge of the Brooks Range.

A 1978 report of the mineral resource potential for the Brooks Range included all but the northwest corner of the Coastal Plain (Grybeck and DeYoung 1978). This assessment indicates that most of the Coastal Plain has uranium potential. Just to the south are areas with copper and phosphate potential. The phosphate areas are described as deposits of marine phosphate beds with minor uranium, vanadium, and fluorite content. No information is provided regarding the areas of copper potential.

The Geochemical Atlas of Alaska (Lee et al. 2016) provides maps of the distribution of 68 elements for the state, including the Coastal Plain. The maps are based on compilation and modeling of sediment and soil samples. These maps indicate, in part, that portions of the Coastal Plain have relatively higher concentrations of gold, uranium, phosphorus, and copper. The maps can be viewed online at https://pubs.er.usgs.gov/publication/ds908.

Climate Change

Climate change produces changes in several geologic hazards, including subsidence, flooding, and coastal erosion. An increase in the active layer expected from a warming climate could result in greater areas of land subsidence. Climate change is also expected to affect the frequency and severity of extreme storms and floods. Storms with surges would be stronger and more frequent, which, combined with rising sea levels, could lead to greater coastal erosion (BLM 2012). The spring warming period would begin earlier, causing snowmelt to occur during a period of lower solar radiation, which could lead to a more protracted

Table 3-7
Documented Mineral Occurrences within 15 Miles of the Coastal Plain

Site	Latitude	Longitude	Location Description	Commodities	Ore Minerals	Geologic Description
Unnamed	69.47	-142.82	Accurate to within 5,000 feet	Copper	Chalcopyrite	Mafic volcanic rocks
Aichilik River	69.53	-143.15	Deposit along the Aichilik River; accurate to within 5,000 feet	Rare earth elements	Ytterbium, yttrium	Efflorescent salts coat outcrops of Kingak shale and accumulate along the margins of ephemeral pools at the foot of cut banks.
Itkilyariak Creek	69.63	-144.75	Accurate to within 4,000 feet	Copper	Native copper	Greenstone, probably Proterozoic
Katakturuk River	69.59	-145.6	1,890-foot hill at the confluence of two forks of the Katakturuk River, in the headwaters of the Katakturuk River, near the south flank of the Sadlerochit Mountains; accurate to within 1,500 feet	Phosphorus, uranium	Phosphate, uranium	Shublik Formation
Fire Creek	69.53	-145.2	Within 1 mile	Phosphate	-	Shublik Formation
Hulahula River	69.48	-144.38	Not provided	Phosphate	-	Shublik Formation
Unnamed	69.63	-144.42	Accurate to within 1 mile	Phosphate	-	Shublik Formation

Source: USGS 2018b
Note:
- = not applicable

melt and less intense runoff. Overall, the magnitude and frequency of high flows would decline while low flows would increase. These effects are described in more detail in the GMT2 Final SEIS (BLM 2018a, Section 3.2.4).

Direct and Indirect Impacts

Issuance of oil and gas leases under the directives of Section 20001(c)(1) of PL 115-97 would have no direct impacts on the environment because by itself a lease does not authorize any on the ground oil and gas activities; however, a lease does grant the lessee certain rights to drill for and extract oil and gas subject to further environmental review and reasonable regulation, including applicable laws, terms, conditions, and stipulations of the lease. The impacts of such future exploration and development activities that may occur because of the issuance of leases are considered potential indirect impacts of leasing. Such post-lease activities could include seismic and drilling exploration, development, and transportation of oil and gas in and from the Coastal Plain. Therefore, the analysis is of potential direct and indirect impacts on geology and minerals from on-the-ground post-lease activities.

The effects of climate change described under *Affected Environment* above, could influence the rate or degree of the potential direct and indirect impacts.

Alternative A

Under Alternative A, current management actions would be maintained as described in the Arctic Refuge CCP (USFWS 2015a). Consistent with ANILCA, the Coastal Plain would remain closed to all forms of appropriation under the public land laws, including the mineral leasing and mining laws. No potential impacts on geology or mineral resources from future oil and gas exploration, development, and production would occur.

Impacts Common to All Action Alternatives

As described above, bedrock is minimally exposed across much of the Coastal Plain; therefore, existing bedrock outcrops are highly valuable in developing the best possible surface and subsurface geologic understanding of the area. There are a number of relatively small, low-relief, but critically important bedrock outcrops exposed along the Niguanak and Jago Rivers and their tributaries in the northeastern part of the program area (specifically in the area ranging from Townships 6-8 North and Ranges 35-37 East). These exposures are reported to include strata of the Kingak shale, pebble shale unit, Hue shale, and Canning Formation (Marshall et al. 1998). This strata's structural, stratigraphic, and source rock implications remain enigmatic and warrant further geologic study.

Important bedrock exposures also occur along the Marsh Creek anticline in the western part of the program area. If gravel infrastructure is placed in these outcrop areas in the future, the bedrock would no longer be accessible for research. Potential impacts would be long term and would last until the gravel is removed.

Land within 1 mile of the Jago River and 0.5 mile of the Tamayariak River, Katakturuk River, and Marsh Creek would be subject to the NSO limitations (i.e., only essential pipeline and road crossings permitted) under all action alternatives. This would provide some protection for the outcrops in these areas. No other potential direct or indirect impacts on geology have been identified.

Oil and gas exploration, development, and production could also affect the risk of several geologic hazards identified in the *Affected Environment* section, including seismicity, slope failure, subsidence, flooding, and river ice jams.

Future development of petroleum resources would include injection of seawater or gas into the production field to maintain reservoir pressure. Also, wastewater, produced water, spent fluids, and chemicals would be disposed of in injection wells. Injection of large volumes of fluids into low permeability and brittle rocks has potential to trigger low level seismicity (earthquakes). This phenomenon is generally associated with the high volumes of waste injection associated with the high density of wells needed to fully develop tight unconventional resource plays, such as shale source rocks, rather than conventional hydrocarbon production. The potential for induced seismicity associated with the action alternatives would be low.

Slope failure could be triggered or exacerbated by placement of gravel fill in the future. Most of the program area is relatively flat and gravel infrastructure would not likely be placed on slopes with potential for ground movement. At water body crossings, roads would be constructed using methods that would minimize potential slope failure along stream banks; therefore, the potential for leasing and development to influence slope failure risk would be low. Likewise, slope failure is unlikely to affect infrastructure associated with oil and gas exploration, development, and production.

Subsidence associated with thawing permafrost could adversely affect oil and gas infrastructure. To minimize the potential for subsidence associated with thawing of near surface ice, gravel pads and roads would be constructed with a thickness sufficient to maintain a stable thermal regime (see **Chapter 2**). Future pipelines would be constructed primarily aboveground and would not contribute to permafrost thaw. All future buildings would be supported aboveground on pilings to accommodate ground settling or frost heaving.

Warm production and injection wells can cause thawed areas around the well. In 2017, an oil well in the NPR-A suffered a cracked casing due to subsidence from thawing, which resulted in an oil spill. The well's construction geometry contributed to the failure (AOGCC 2017). This type of failure can be minimized by modern well construction methods, including installing thermosyphons around wells to remove heat transfer from wellbore fluids.

Under all action alternatives, the risk of flooding and river ice jams would be mitigated by a ROP which states, "the design engineer should ensure that crossing structures are designed for aufeis, permafrost, sheet flow, additional freeboard during breakup, and other unique conditions of the arctic environment."

Alternative B

Potential impacts on geology and mineral resources from future oil and gas exploration, development, and production under Alternative B would be the same as identified above for all action alternatives.

Alternative C

Potential impacts on geology and mineral resources from future oil and gas exploration, development, and production under Alternative C would be the same as identified above for all action alternatives.

Alternative D

In addition to the potential impacts described above for all action alternatives, NSO identified under Alternative D would be allowed within 0.5 mile of the Niguanak River. While this restriction could help mitigate the potential for outcrops in these areas to be covered by gravel fill, some of the key outcrops (those in the northern part of Township 6 North, Range 36 East) are along intermittent tributaries up to 5 miles west of the Niguanak River.

Cumulative Impacts

The geographic area relevant for assessing cumulative impacts for geology and minerals is the program area. No other past, present, and reasonably foreseeable future actions that could affect geology or mineral resources have occurred or are expected to occur in the program area. The effects of climate change described under *Affected Environment* above, could influence the rate or degree of the potential cumulative impacts. Alternative A would have no contribution to cumulative impacts on geology and mineral resources.

3.2.6 Petroleum Resources

Affected Environment

Regulatory Information

Section 20001 of PL 115-97 directs the BLM to undertake an oil and gas leasing program on the Coastal Plain (also known as the 1002 Area) of the Arctic Refuge. Under the ANILCA, the Coastal Plain was not designated wilderness, and Congress reserved the area for potential future oil and gas development. The USFWS Revised CCP (2015a) recommended the area for wilderness designation and the area has been managed for wilderness characteristics. PL 115-97 opened the entire Coastal Plain to leasing, except for

Alaska Native selected lands within the program area boundary; however, it limited surface disturbance from oil and gas production and support facilities to a maximum of 2,000 acres.

Oil and Gas Resources

The Coastal Plain encompasses approximately 1,563,500 acres. Currently no acreage is open to petroleum leasing. It is estimated that approximately 427,900 acres of the program area is high potential for petroleum resources, 658,400 acres are moderate potential, and 477,200 acres are low potential. Estimates are based on best available information, but due to the limited amount of exploration that has occurred in the area, petroleum development potential and acreages should be considered rough estimates. The one exploration well drilled in the Coastal Plain is held as confidential information, so exact formation compositions and oil and gas percentages are not well established across the entire region. Existing oil and gas wells are shown in **Map 3-3**, Oil and Gas Infrastructure, in **Appendix A**. See the hypothetical development scenario (**Appendix B**) for more information on development potential, assumptions behind potential estimates, and estimates for the baseline future development scenario for petroleum.

Approximately 80 percent of petroleum resources are estimated to be in the undeformed western portion of the program area (USGS 1998b). As shown in **Table 3-8**, the identified potential plays in the undeformed area are the Topset play, Thompson play, Turbidite play, Wedge, Kemik, and Undeformed Franklinian. Potential plays in the deformed area are the Thin-Skinned Thrust Belt, Ellesmerian Thrust Belt, Deformed Franklinian, and Niguanak/Aurora (Attanasi 2005).

Table 3-8
Estimated Mean Undiscovered Petroleum Resources in the Coastal Plain

	Play Name	Oil (BBO)	Gas (TCF)	Natural Gas Liquids (Billion Barrels of Liquid)
Undeformed	Topset	4.325	1.193	0.010
	Turbidite	1.279	1.120	0.065
	Wedge	0.438	0.226	0.005
	Thompson	0.246	0.470	0.039
	Kemik	0.047	0.116	0.010
	Undeformed Franklinian	0.085	0.30	0.029
	Undeformed subtotal	*6.420*	*3.424*	*0.159*
Deformed	Thin-Skinned Thrust Belt	1.038	1.608	0.017
	Ellesmerian Thrust Belt	0.000	0.876	0.018
	Deformed Franklinian	0.046	0.86	0.046
	Niguanak/Aurora	0.183	0.273	0.016
	Deformed subtotal	*1.267*	*3.617*	*0.096*
Total		**7.687**	**7.041**	**0.225**

Source: Attanasi 2005

Note: Totals are technically recoverable amounts; oil associated gas and natural gas liquid estimates were combined with non-oil associated gas and natural gas liquid estimates.

All oil and gas volumes represent the mean estimated technically recoverable volumes unless otherwise noted. The Topset is expected to be the primary play in the Coastal Plain, with an estimated technically recoverable 4.325 BBO and 1.193 TCF of gas. The Turbidite play is the second most productive, with an estimated technically recoverable 1.279 BBO and 1.120 TCF of gas. In the deformed area, the Thin-Skinned Thrust Belt is the primary play, with an estimated technically recoverable 1.038 BBO and 1.608

TCF of gas (Attanasi 2005). In total, the undeformed area is estimated to contain a technically recoverable total of 6.420 BBO and 3.424 TCF of gas, and the deformed area is estimated to contain a technically recoverable total of 1.267 BBO and 3.617 TCF of gas. Natural gas liquids would also be produced as part of the oil and gas production process.

Trends

Due to the prior prohibition on leasing, there has been no development of oil and gas resources in the Coastal Plain to date. There has been interest in Alaska and from some Native corporations in developing the Coastal Plain ever since the 1002 Area was designated as a potential area for development in 1980 (Doyon Limited 2018; Rexford 2017). The area has had limited exploration; as further exploration occurs, a greater understanding of the size and characteristics of petroleum resources would be gained.

Ninety percent of technically recoverable resources were estimated to be economically recoverable at $55/barrel (2005 dollars, approximately $70/barrel in 2018 dollars; Attanasi 2005). The threshold price to initiate exploration was estimated to be from $20 to $21/barrel (2005 dollars). (The economics may have changed significantly since that study was published.) As of August 2018, the price of West Coast crude was approximately $75/barrel and the price of West Texas Intermediate crude was approximately $65/barrel. The US Energy Information Agency forecasts the price of crude oil to steadily rise to over $85/barrel over the next 10 years (US Energy Information Agency 2018).

Direct and Indirect Impacts

Issuance of oil and gas leases under the directives of Section 20001(c)(1) of PL 115-97 would have no direct impacts on the environment because by itself a lease does not authorize any on the ground oil and gas activities; however, a lease does grant the lessee certain rights to drill for and extract oil and gas subject to further environmental review and reasonable regulation, including applicable laws, terms, conditions, and stipulations of the lease. The impacts of such future exploration and development activities that may occur because of the issuance of leases are considered potential indirect impacts of leasing. Such post-lease activities could include seismic and drilling exploration, development, and transportation of oil and gas in and from the Coastal Plain. Therefore, the analysis is of potential direct and indirect impacts on petroleum resources from on-the-ground post-lease activities.

Alternative A

Under Alternative A (No Action Alternative), no federal minerals in the Coastal Plain would be offered for future oil and gas lease sales. Alternative A would not establish and administer a competitive oil and gas program for the leasing, development, production, and transportation of oil and gas in and from the Coastal Plain in the Arctic Refuge. Current management actions would be maintained, and resource trends would continue, as described in the Arctic Refuge CCP (USFWS 2015a). No future extraction or use of petroleum resources would occur and as a result no potential direct or indirect impacts on petroleum resources from future oil and gas exploration, development, and production would occur.

Impacts Common to All Action Alternatives

Potential future impacts on petroleum resources under all action alternatives can reasonably be expected to result in the irreversible commitment of petroleum hydrocarbon resources of the PL 115-97 through future oil and gas exploration, development, and production; however, the stated purpose of this EIS is to facilitate petroleum leasing, development, and production.

Potential impacts on petroleum resources would vary based on the amount of acreage available for leasing and restrictions on future access to available acreage. Under all action alternatives, surface disturbance is expected to reach the 2,000-acre maximum for surface disturbance.

Mean estimates for the program area suggest it contains approximately 7.687 billion barrels of technically recoverable oil and 7.04 TCF of technically recoverable natural gas (Attanasi 2005). Due to high costs associated with operating in the Arctic it is extremely unlikely that all technically recoverable resources would be produced. The US Energy Information Administration estimated that a total of approximately 3.4 BBO would be produced in the Arctic Refuge by 2050 (Van Wagner 2018). Oil would be transported to market by a connection to the TAPS.

Given the uncertainty involved in defining undiscovered resources in the program area, attempting to define variances in production by alternative is too speculative to provide value in the analysis. NSO restrictions could require that well pads be located outside optimal locations for the most efficient oil recovery under some alternatives; however, horizontal drilling technology would allow operators to recover oil and gas from NSO areas. Under some alternatives, additional pads could be required to access all areas, potentially decreasing the overall volume of oil and gas that would be economically recoverable.

A natural gas transport pipeline from the North Slope to southcentral Alaska could be expected, where the gas would be transformed into liquefied natural gas. Gas transported through the pipeline is expected to come from established fields with proven reserves initially. If proven gas resources are discovered in the Coastal Plain they could be connected to the pipeline to maintain pipeline capacity as the primary fields are depleted. Estimated natural gas production from the Coastal Plain ranges from 0 to 7 TCF of gas produced (Attanasi 2005). Any co-occurring gas produced with oil would be reinjected to maintain reservoir pressure or would be used to manufacture natural gas liquids to blend and transport with the oil (**Appendix B**). Gas flaring would be limited to the minimum necessary to safely operate processing facilities. Production wells would be fractured to stimulate initial production, but no hydraulic fracturing to produce unconventional resources is anticipated (**Appendix B**). There is no unconventional oil and gas production on Alaska's North Slope (BLM 2012) due to high development and production costs in the Arctic. The viability of hydraulic fracturing of unconventional petroleum resources has not been proven in the Arctic from a technology or commercial viability standpoint.

Under all action alternatives potential future spills and leakage of petroleum resources are expected to result in a loss of productive use of those resources. In the NPR-A the average crude oil spill rate from 1985 to 2010, for large (500 barrels or greater) spills is 0.65 spills per BBO produced, with an average spill size of 1,229 barrels. During that time the North Slope produced a total of 12.40 BBO. The historic small (less than 500 barrels) crude oil spill rate from 1989 to 2009 for the Alaska North Slope is 187 spills per billion barrels produced, with an average spill size of 2.8 barrels (117.6 gallons). During this time 9.4 BBO were produced (BLM 2012).

With an estimated 3.4 BBO of production anticipated from the Coastal Plain, and assuming the same spill rates as NPR-A, it is reasonable to anticipate a program area spill total of approximately 1,780 barrels of oil spilled in approximately 636 small spills and a total of approximately 2,716 barrels spilled in two or three large spills. In addition to damage to the environment, spills represent a loss of petroleum resources from productive use. Using a high case scenario and a USGS estimate that 9.3 BBO would be economically recoverable (Attanasi and Freeman 2009), it could be expected that there would be approximately 1,739 small spills with a total of approximately 4,869 barrels spilled, and approximately 6 large spills with a total spill size of 7,374 barrels, if the spill rate stays consistent over time. The rate of spills may decrease over time as industry practices improve.

Operators would be required to prepare and implement spill prevention and control plans in compliance with applicable federal regulations.

Alternative B

Table 3-9 shows acreages that would be subject to NSO restrictions, TLs or would be open to leasing under standard terms and conditions only. This alternative opens the entire Coastal Plain to leasing, allowing the greatest acreage for potential petroleum extraction (see **Map 3-4**, Hydrocarbon Potential, Alternative B, in **Appendix A** for more detail). Fewer restrictions on the locations of future CPFs and drill pads exist under this alternative.

Table 3-9
Lease Stipulation Acreages for Alternative B

Lease Stipulations	Low Oil Potential (acres)	Medium Oil Potential (acres)	High Oil Potential (acres)	Total (acres)
NSO	96,300	120,900	142,200	359,400
Standard Terms and Conditions Only	45,600	287,300	285,700	618,700
TL	335,300	250,100	0	585,400
Total	**477,200**	**658,300**	**427,900**	**1,563,500**

Source: BLM GIS 2018

Alternative C

Table 3-10 shows acreages that would be subject to NSO or TL restrictions, that would not be offered for leasing, or that would be open to leasing under standard terms and conditions only.

Table 3-10
Lease Stipulation Acreages for Alternative C

Lease Stipulations	Low Oil Potential (acres)	Medium Oil Potential (acres)	High Oil Potential (acres)	Total (acres)
NSO	410,200	328,200	194,000	932,400
Standard Terms and Conditions Only	100	129,400	184,500	314,000
TL	66,900	200,800	49,400	317,100
Total	**477,200**	**658,400**	**427,900**	**1,563,500**

Source: BLM GIS 2018

This alternative also opens the entire program area to leasing (see **Map 3-5**, Hydrocarbon Potential, Alternative C, in **Appendix A** for more detail). Under this alternative, 20 percent of the area would have standard terms and conditions only, including only 28 percent of the medium and high potential areas. The acreage subject to NSO would still allow for CPF and drill pad siting to maximize recovery from each pad.

Alternative D1

Table 3-11 shows acreages that would be subject to NSO, CSU, or TL restrictions, that would not be offered for leasing, or that would be open to leasing under standard terms and conditions only. A total of 1,037,200 acres would be available for leasing.

The 526,300 acres that are not offered for leasing represent approximately 34 percent of the program area. The area closed to leasing is in low and moderate petroleum potential sections of the program area projected to have small accumulations of petroleum; thus, the percentage of petroleum resources closed to leasing would be less than 34 percent of the economically recoverable petroleum resources. See **Map 3-6**, Hydrocarbon Potential, Alternative D1, in **Appendix A**.

Under this alternative, only 19 percent of the medium and high potential areas would be available for leasing with standard terms and conditions. Approximately 45 percent of the program area is subject to NSO stipulations, which would limit the location of future CPFs and drill pads, potentially resulting in changes to pad configurations and reduced oil production. NSO restrictions are in portions of the high, mediums and low areas.

Table 3-11
Lease Stipulation Acreages for Alternative D1

Lease Stipulations	Low Oil Potential (acres)	Medium Oil Potential (acres)	High Oil Potential (acres)	Total (acres)
CSU	11,000	80,500	32,400	123,900
Not offered for lease	398,300	120,700	7,300	526,300
NSO	67,900	384,600	256,200	708,600
Standard Terms and Conditions Only	0	72,800	131,900	204,700
Total	**477,200**	**658,400**	**427,900**	**1,563,500**

Source: BLM GIS 2018

Alternative D2

Table 3-12 shows acreages that would be subject to NSO, CSU, or TL restrictions or that would not be offered for leasing. No acres would be open to leasing under standard terms and conditions only; a total of 1,037,200 acres would be available for leasing. Alternative D2 has TL restrictions on lands that were available with only standard terms and conditions under Alternative D1.

Table 3-12
Lease Stipulation Acreages for Alternative D2

Lease Stipulations	Low Oil Potential (acres)	Medium Oil Potential (acres)	High Oil Potential (acres)	Total (acres)
CSU	11,000	80,500	32,400	123,900
Not offered for lease	398,300	120,700	7,300	526,300
NSO	67,900	384,400	256,300	708,600
TL	0	72,800	131,900	204,700
Total	**477,200**	**658,400**	**427,900**	**1,563,500**

Source: BLM GIS 2018

The 526,300 acres that are not offered for leasing represent approximately 34 percent of the program area. The area closed to leasing is in low and moderate petroleum potential sections of the program area projected to have small accumulations of petroleum; thus, the percentage of petroleum resources closed to leasing would be less than 34 percent of the economically recoverable petroleum resources. See **Map 3-7**, Hydrocarbon Potential, Alternative D2, in **Appendix A**.

Under this alternative, there are no medium and high potential areas available for leasing subject only to standard terms and conditions; the acres that were available for leasing subject only to standard terms and conditions under Alternative D1 have TLs applied under Alternative D2. Approximately 45 percent of the program area is subject to NSO restrictions, which would limit the location of future CPFs and drill pads, potentially resulting in changes to pad configurations and reduced oil production.

Cumulative Impacts

Oil and gas exploration, development, and production around the North Slope have resulted in and would continue to result in irreversible commitment of oil resources. The Alaska Liquid Natural Gas Project and the Alaska Stand Alone Gas Pipeline, if completed, could result in the irreversible commitment of gas resources. Scientific research could result in a better understanding of the type and size of petroleum resources in the program area. Spills of produced petroleum products associated with oil and gas exploration and development would result in an irreversible loss of those resources. Alternative A would have no potential cumulative impacts from future oil and gas exploration, development, and production on petroleum resources. The production and subsequent consumption of petroleum resources would contribute to climate change, which are discussed in **Section 3.2.1**.

3.2.7 Paleontological Resources

Affected Environment

Paleontological resources include any physical evidence of past life, including fossilized flora and fauna, imprints, and traces of plants and animals. The program area, and all the North Slope, are widely regarded as fossiliferous.[10] It has borne evidence of past habitation that has expanded the scientific community's understanding of the geologic and paleontological record worldwide (BLM 2012).

As discussed in **Section 3.2.5**, various geologic units have been identified in the program area. This includes ten bedrock geologic units, with unconsolidated surficial deposits, covering more than 80 percent of the surface area. Eight of these ten units have potential or documented fossils, though the presence of paleontological features has not been specifically noted in outcrops in the program area. Program area bedrock geologic units and their approximate acreage in the program area are shown on **Map 3-8**, Paleontological Resources, in **Appendix A**, and are noted below.

The Potential Fossil Yield Classification (PFYC) system is a tool used to assess potential occurrences of paleontological resources in mapped geologic units. It provides classifications that may be used to assist in determining the need for further assessment or actions. The PFYC system is created from available geologic maps and assigns a class value to each geological unit, representing the potential abundance and significance of paleontological resources that occur in that geological unit. PFYC values range from Class 1, Very Low, to Class 5, Very High, which indicate both the probability for the mapped unit to contain significant paleontological resources and the degree of management concern for the resource. Geologic units without enough information associated with them to assign a PFYC value may be assigned Class U, Unknown Potential. Characteristics of PFYC values are included in **Appendix G**.

The PFYC model for Alaska is in development. Preliminary PFYC values have been assigned to the mapped geologic units in the program area and are included in **Table 3-13**. Excerpts from the in-progress PFYC

[10]Rich in fossils or fossil potential

model regarding preliminary rankings and unit descriptions are included in **Appendix G**. These PFYC assignments are maintained and updated by the BLM as additional data is available. The PFYC model in development relies on the geologic mapping presented in Wilson et al. 2015; some of the mapped units are characterized differently than those presented in **Section 3.2.5**.

Pleistocene, or ice age, fossils from between 2.59 million and 11,700 years ago have been identified across the North Slope in surficial quaternary deposits. These are the same deposits that cover approximately 1.4 million acres of the program area. Most of the recorded fossils exposed in North Slope surficial deposits are a result of stream bank erosion. These fossils include remains of animals that existed at the same time as human habitation of the area: horses, mammoths, antelope, bison, bears, lions, muskoxen, caribou, and moose (BLM 2018a).

Table 3-13
PFYC Values of Program Area Geologic Bedrock Units

Geologic Unit	Acres in Program Area (Approximate)	Age (Millions of Years Ago [mya])	PFYC Value	Noted Fossil Presence in Unit
Sagavanirktok Formation	16,900	Tertiary (65–2.8)	3-4	Floral, microfauna, and mollusk fossils
Seabee Formation and Hue Shale	1,200	Cretaceous (145–66)	3-4	Ammonites, pelecypods, fish remains, bird trace fossil (footprint)
Jago River Formation	25,300	Upper Cretaceous, (100.5–66)	3	Palynomorphs, plant fossils
Sadlerochit Formation	2,800	Lower Triassic to Permian (289.9–247.2)	3	Ammonites, pelecypods, and brachiopods
Lisburne Group, undivided	500	Carboniferous (358.9–298.9)	3	Group noted as generally fossiliferous; contains corals, brachiopods, ammonites, nautiloids, and plants
Kingak Shale	200	Jurassic (201.3–145)	3	Marine mollusks and crinoids; pelecypods and ammonites
Surficial Quaternary Deposits	1,421,700	Quaternary, Pleistocene, and upper Tertiary (2.59–present)	2-3	Flora, fauna
Kemik Sandstone	200	Lower Cretaceous (146–100)	2-3	Trace fossils (footprints)
Kongakut Formation	200	Lower Cretaceous (146–100)	2-3	Pelecypods and abundant worm borings
Canning Formation	8,500	Cretaceous to Tertiary (145–2.8)	2-3	Palynomorphs

Sources: BLM GIS 2018; Breithaupt, B. BLM Regional Paleontologist, e-mail to Anna Kohl, HDR environmental scientist, on July 30, 2018, regarding preliminary PFYC rankings and unit descriptions for the program area.

Most paleontological resources identified on the North Slope have been identified in areas west of the program area. A description of the history of fossil discovery on the North Slope and conclusions regarding the fossil record is in BLM 2012, Section 3.2.7, and BLM 2018a, Section 3.2.1.6.

Climate Change

Changing climate conditions would not directly affect paleontological resources but could impact several geologic hazards, including thawing permafrost and coastal erosion. An increase in the active layer expected from a warming climate could result in greater areas of land subsidence, which may expose geologic units with paleontological resources to weathering action. Similarly, coastal erosion would expose previously protected units to weathering, which may expose and damage resources. Given the surficial context of these actions, the geologic unit with the greatest risk is the unconsolidated and poorly consolidated surficial Quaternary deposits, which may contain Pleistocene fossils.

Direct and Indirect Impacts

Issuance of oil and gas leases under the directives of Section 20001(c)(1) of PL 115-97 would have no direct impacts on the environment because by itself a lease does not authorize any on the ground oil and gas activities; however, a lease does grant the lessee certain rights to drill for and extract oil and gas subject to further environmental review and reasonable regulation, including applicable laws, terms, conditions, and stipulations of the lease. The impacts of such future exploration and development activities that may occur because of the issuance of leases are considered potential indirect impacts of leasing. Such post-lease activities could include seismic and drilling exploration, development, and transportation of oil and gas in and from the Coastal Plain. Therefore, the analysis is of potential direct and indirect impacts on paleontological resources from on-the-ground post-lease activities.

The effects of climate change described under *Affected Environment* above, could influence the rate or degree of the potential direct and indirect impacts.

Alternative A

Under Alternative A, current management actions would continue as described in the Arctic Refuge CCP (USFWS 2015a). Changes to paleontological resources, such as increased exposure due to changes in permafrost, river bank erosion, coastal erosion, and weathering, would continue to occur along current trends. There would be no potential direct or indirect impacts on paleontological resources from future oil and gas exploration, development, and production under Alternative A.

Impacts Common to All Action Alternatives

The limited bedrock outcrops and distribution of surficial quaternary deposits are the only sources for understanding the distribution and type of paleontological resources in the program area. As described in **Section 3.2.5**, if future program-related infrastructure includes gravel fill, the ability to evaluate and observe paleontological resources would be restricted; however, placement of gravel fill would also provide erosion protection, which may support preservation of the resource. Potential impacts would be long term and would last until the gravel is removed. Potential direct impacts on paleontological resources would be limited to future ground-disturbing activities, including drilling and gravel mining.

NSO restrictions associated with setbacks or exclusion from biological and ecological areas, as described in **Table 2-2** in **Chapter 2** would reduce the acreage of geologic units affected and therefore the potential for affecting paleontological resources. NSO restrictions associated with setbacks from March Creek and from the Canning, Hulahula, Aichilik, Okpilak, Jago, Sadlerochit, Tamayariak, Okerokovik, and Katakturuk Rivers would be common among all action alternatives. They would reduce ground-disturbing activities in the surficial quaternary deposits next to these water bodies. Since streambank erosion is a common mechanism to exposure Pleistocene fossils, these setbacks would prevent additional exposure of paleontological resources in surficial deposits. Marsh Creek and the Katakturuk, Jago, and Okerokovik

Rivers pass within 1 mile of several bedrock outcrops that may bear paleontological resources (Sagavanirktok, Canning, and Jago River formations); NSO setbacks from these rivers would reduce potential future impacts on paleontological resources in these outcrops simply because of the exclusion of ground-disturbing activities.

Potential future indirect impacts on paleontological resources are due to increased exposure, either to humans or the elements. Since the resources in the program area have not been extensively studied, increased exposure from infrastructure construction and operation near bedrock outcrops may support additional scientific research and identification of paleontological resources. Similarly, improving access to areas with paleontological resources may increase unauthorized fossil removal, looting, and damage. Removal of ground cover that would expose fossil-bearing units would expose the unit to weathering influences, which may disturb the resource and its context.

Alternative B

Potential future impacts on paleontological resources from oil and gas exploration, development, and production under Alternative B would be the same as identified above for all action alternatives.

Alternative C

Alternative C includes a greater acreage of NSO restrictions, as well as additional setbacks from waterbodies than Alternative B. Because the land made available for ground-disturbing activities under Alternative C is less than that under Alternative B, fewer acres of surficial quaternary deposits and bedrock outcrops that may contain paleontological resources would be exposed and potentially affected by future oil and gas exploration, development, and production.

Alternative D

Alternative D includes a greater acreage of NSO restrictions, as well as additional setbacks from waterbodies than Alternatives B and C. Because the amount of land made available for ground-disturbing activities under Alternative D is less than that under Alternatives B and C, fewer acres of surficial quaternary deposits and bedrock outcrops that may contain paleontological resources would be exposed and potentially affected by future oil and gas exploration, development, and production.

Cumulative Impacts

BLM (2018a) notes that activities with the potential to adversely affect paleontological resources are required to have professional inventories filed with BLM before specific development projects begin. These include requirements to minimize or eliminate adverse impacts on paleontological resources. No past or present actions that could affect paleontological resources have occurred in the program area. Reasonably foreseeable future actions (**Appendix F**) that could affect paleontological resources have occurred or would occur in the program area; therefore, no cumulative impacts on paleontological resources would occur. The effects of climate change described under *Affected Environment* above, could influence the rate or degree of the potential cumulative impacts. Alternative A would have no potential cumulative impacts on paleontological resources from future oil and gas exploration, development, and production.

3.2.8 Soil Resources

Affected Environment

The Coastal Plain is in the Coastal Plain physiographic sub-province and portions of the Arctic Foothills physiographic sub-province (see **Section 3.2.5**). The soils in the Coastal Plain sub-province are composed of poorly drained, unconsolidated sediments transected by fluvial deposits of rivers and stream flowing northward from the rolling foothills to the south (Wahrhaftig 1965). Most uplands in the program area are in the western half and extend from the foothills of the Sadlerochit Mountains southern boundary to near the coastline. Upland soils consist of loess, colluvium, and morainal deposits. Lowland Coastal Plain deposits east of the Hulahula River are interbedded marine and alluvial deposits associated with past marine transgressions. These soils generally include fluvial sands and gravels, silty sand, and organic silt over marine silts and clays. These soils are generally ice rich and contain ice wedges (Jorgenson et al. 2015).

Eolian deposits comprise nearly 30 percent of the surficial soil deposits in the program area and can range from 3 to 100 feet thick (Jorgenson et al. 2015; Rawlinson 1993). Eolian deposits in flat lowland areas are normally frozen, with a high ice content; hillslopes generally have a thin eolian deposit cover, less than 15 inches thick. Alluvial and fluvial deposits, including active braided channels, terraces, and deltaic deposits, consist of sands and gravels in steeper gradients near the foothills. They transition to finer grained soils in floodplains and inactive channels (Jorgenson et al. 2015).

The Sadlerochit Mountains bordering the southwestern edge of the program area are composed of Tertiary sandstone and conglomerate noncarbonate sedimentary rocks. Colluvium deposits drape the northern slopes of the Sadlerochit Mountains and are composed of loose, silty to rubbly, unsorted deposits derived directly from weathering bedrock deposits upslope. Colluvium deposits are usually vegetated (Jorgenson et al. 2015). At the southern border of the program area, the Canning River and Hulahula River drainages are capped by glacial moraine deposits, consisting of silty sands and gravels, with some cobbles and boulders (Rawlinson 1993).

The entire program area is underlain by permafrost with isolated areas of thaw near deep lakes, springs, and rivers (Bird and Magoon 1987). Depending on their depth and size, lakes and rivers influence the presence of permafrost; deeper lakes and rivers, such as the Canning River, often form a thaw bulb below the water body (Rawlinson 1993). Permafrost and ground ice characteristics are variable, due to differences in climate, topography, soil properties, cryogenic processes, and environmental history (Jorgenson et al. 2015). Massive ice occurs in the form of ice wedges, buried glacial ice in glacial deposits, and intrusive ice (Jorgenson 2008). Permafrost in the Coastal Plain is generally between 650 and 1,300 feet thick (USFWS 2015a). Polygonal patterned ground is created when ice wedges form in the upper few feet of the ground surface and is indicative of ice-rich soils. Polygonal ground is a common surface feature in the program area, especially in lowland areas; polygons may be less apparent in drained upland areas, where vegetation can mask these surface features (Rawlinson 1993).

The top layer of the soil surface that typically thaws and refreezes annually is known as the active layer. In the Coastal Plain, the active layer is generally between 1 and 4 feet thick (USFWS 2015a). Active layer thickness can vary from year to year and depends on such factors as ambient air temperature, aspect, gradient, vegetation, drainage, snow cover, water content, and soil type. Long-term permafrost temperature monitoring shows a warming trend over the past 25 years, with the greatest warming near the coast. Soil temperatures increased 3 to 5°F between 1985 and 2004 (USFWS 2015a). At the approximately 4-foot depth at three USGS monitoring stations in the program area, average subsurface temperatures showed warming trends between 2000 and 2014 of 32.9 to almost 35.6°F (Urban and Clow 2017).

Degradation of permafrost can be affected by ice content, soil or vegetation removal, and ground disturbances, with ice-rich and thaw-unstable soils and hillsides being the most sensitive to thawing (ADNR 2018a). Thawing, ice-rich, permafrost soils create thermokarst features that transform the landscape by subsidence, erosion, and changes in drainages, including channelization and ponding (USFWS 2015a).

Changes in the landforms due to erosion and thermokarst, such as slumping and channelization, affects the vegetation and water characteristics of the area (USFWS 2015a).

Changes being experienced to soils and permafrost on the North Slope resulting from a changing climate are fully described in BLM (2018a).

Direct and Indirect Impacts

Issuance of oil and gas leases under the directives of Section 20001(c)(1) of PL 115-97 would have no direct impacts on the environment because by itself a lease does not authorize any on the ground oil and gas activities; however, a lease does grant the lessee certain rights to drill for and extract oil and gas subject to further environmental review and reasonable regulation, including applicable laws, terms, conditions, and stipulations of the lease. The impacts of such future exploration and development activities that may occur because of the issuance of leases are considered potential indirect impacts of leasing. Such post-lease activities could include seismic and drilling exploration, development, and transportation of oil and gas in and from the Coastal Plain. Therefore, the analysis is of potential direct and indirect impacts on soil resources from on-the-ground post-lease activities.

Potential impacts from the development and operation of facilities identified in the hypothetical development scenario (**Appendix B**) are as follows:

- The placement of gravel fills for pads, roads, and airstrips
- Construction of VSMs for pipelines and building foundations
- Construction of ice roads and pads
- Removal of sand and gravel resources for embankment fills
- Impacts from exploratory seismic activities

These future actions, including vehicular travel on snow and ice-covered tundra, change and disturb the insulating surface vegetation layer and increase the active layer thickness, thawing the permafrost, and developing thermokarst structures. Thermokarst changes the surface topography, increasing water accumulation, changing surface water drainage patterns, and increasing the potential for soil erosion and sedimentation (BLM 2018a; Jorgenson et al. 2010).

The effects of climate change described under *Affected Environment* above, could influence the rate or degree of the potential direct and indirect impacts.

Alternative A

Under Alternative A, current management actions would be maintained as described in the Arctic Refuge CCP (USFWS 2015a). The Coastal Plain would remain undeveloped. No direct or indirect impacts on soils or permafrost would occur from post-leasing oil and gas activities.

Impacts Common to All Action Alternatives

Under all action alternatives, approximately 2,000 acres of disturbance due to placement of gravel fills and VSMs for future construction of roads, pads, airstrips, and structures would occur and would result in potential direct impacts on soil quality and permafrost in and next to the gravel fill footprint. Changes to surface drainage due to the placement of fills causes permafrost thawing and subsidence and water accumulation, which would not occur under Alternative A. Placement of fills would cover soils and kill existing vegetation, altering the thermal active layer (USACE 2018). Installation of VSMs for pipelines would displace and disturb soils around the VSM (BLM 2018a). Seismic surveys supporting exploration for resources would be performed during the winter to reduce impacts; however, impacts on vegetation and disturbance of the active layer would result in direct impacts on the soil quality and permafrost where seismic survey activities occur (USFWS 2014; Jorgenson et al. 2010).

By changing drainage patterns of surface water, ponds and channels form and concentrate water that accelerates permafrost thaw. Where drainage patterns are altered, blockages can lead to ponding and sediment deposition. Where drainage patterns redirect surface flow or increase velocities, such as at embankments, erosion of sediments occurs (BLM 2018a).

Potential indirect impacts on soil and permafrost in and next to the gravel fill footprints would be due to dust deposition and snow accumulation. Fugitive dust would be suspended in the air by vehicle and equipment use and would settle onto surrounding vegetation and snow, which would decrease surface albedo.[11] A decrease in surface albedo can increase absorption of solar radiation, accelerate the rate of snowmelt, and lead to permafrost thaw (USACE 2018). Dust accumulation can also affect the pH of the surrounding soils, which leads to changes in the health and growth of vegetation that hold soil in place.

Blowing snow conditions due to changes in topography from the construction of pads and roads and VSMs/infrastructure foundations changes the thermal regime of the soils and permafrost next to the pad and road or VSMs. Snow accumulation insulates the underlying soil during the winter, increasing the overall soil temperatures and leading to permafrost thaw at those locations. Snow accumulation would occur more frequently on the leeward side of embankments (USACE 2018).

Future sand and gravel material extraction and transport would be required to provide materials for embankment construction and would have impacts on the permafrost and soils in the mine site footprint, around its perimeter, and along transportation routes. **Section 3.2.9** discusses the impacts of material extraction in further detail.

Future reclamation of roads and pads would be subject to the permitting process. Removal of gravel would affect the underlying soil and permafrost resources by exposing the underlying soils to increased radiation and leading to continued permafrost degradation (USACE 2018).

Alternative B

Potential impacts on soils and permafrost under Alternative B would be the same as identified above for all action alternatives. Approximately 12,509,000 cubic yards of material is required for constructing the embankment infrastructure, estimated to be up to 310 acres of disturbance to the ground surface and soils at material extraction sites.

Alternative C

Potential impacts on soils and permafrost under Alternative C would be the same as identified above for all action alternatives; however, lease stipulations would limit surface occupancy to the western half of the program area, which consists of greater areal deposits of alluvial sands and gravels, as well as marine deposits along the northern boundary. Approximately 12,722,000 cubic yards of material is required for constructing the embankment infrastructure, estimated to be up to 315 acres of disturbance to the ground surface and soils at material extraction sites.

[11] The light that is reflected from the surface

Alternative D

Potential impacts on soils and permafrost under Alternative D would be the same as identified above for all action alternatives; however, lease stipulations would limit surface occupancy to the western third of the program area, which is primarily composed of fine sand and silt deposits with restricted use of areas next to alluvial plains, which are composed of sands and gravels. Approximately 12,420,000 cubic yards of material is required for constructing the embankment infrastructure, estimated to be up to 308 acres of disturbance to the ground surface and soils at material extraction sites.

Cumulative Impacts

The geographic area relevant for assessing cumulative impacts for soils and permafrost is the program area. Previous seismic survey explorations and an exploratory test well in the program area have disturbed the surface vegetation and affected the thaw of permafrost, changed drainage patterns, and changed vegetation growth for over 25 years after disturbance (USFWS 2014; Jorgenson et al. 2010). Approximately 900 square miles of additional seismic surveys over the program area are required (**Appendix B**); while improvements have been made to avoid impacts on the ground surface, future seismic surveys may have similar impacts.

Each of the hypothetical development scenarios could affect over 2,000 acres of soils and permafrost, as acreage would be regained against the 2,000-acre surface disturbance limit during reclamation (**Appendix B**). The potential impacts are related to future changes to topography and landforms resulting in changes to soil chemical composition, drainage patterns, and erosion of soils. Disturbance to surface vegetation directly leads to changes in the thermal regime of soils due to placement of gravel fills for pads and roads. The effects of climate change described under *Affected Environment* above, could influence the rate or degree of the potential cumulative impacts.

Alternative A would have no cumulative impacts on soils and permafrost from future post-lease oil and gas activities.

3.2.9 Sand and Gravel Resources

Affected Environment

Sand and gravel are most commonly present in the Coastal Plain in the valleys of larger rivers and streams (Bird and Magoon 1987); the valleys of larger streams are underlain by coarse sand and gravel. These include the Canning, Sadlerochit, Hulahula, and Aichilik Rivers, which are heavily braided and have extensive gravel bars generally free of vegetation. Sediments on the Coastal Plain in the western half of the program area are dominated by outwash sediments covered by younger fluvial sands and gravels within approximately 10 miles of the coastline; the outwash sediments are either directly below the fluvium or have been eroded and replaced by the fluvium (Rawlinson 1993). The eastern half of the program area is also composed of fluvial sediments overlying outwash sediments; however, the fluvial and outwash sediments extend farther inland into the Sadlerochit Mountains than the western side of the program area, about 24 miles.

The Canning River valley on the western border of the program area was formed by a large valley glacier. It formed a piedmont lobe along the Canning and Tamayariak Rivers, depositing glaciofluvial soils (Bird and Magoon 1987). These soils are composed of outwash sediments deposited in multiple terraces, formed by glacial outwash washed downstream and are capped by younger alluvial deposits. The outwash deposits near the northern boundaries of the program area are covered by eolian sand and overlain by lacustrine silt and peat, exposed at stream cuts, and bank exposures (Rawlinson 1993).

Sediments in the program area are dominated by outwash sediments covered by younger fluvial sands and gravels. The outwash sediments are either directly below the fluvium or have been eroded and replaced by it (Rawlinson 1993). Sands and gravels are often found in elevated terrain between river valleys and alluvial fans originating from the foothills to the south (Rawlinson 1993). Soils downstream and closer to the coastline become progressively fine grained, transitioning to deltaic and marine deposits (Bird and Magoon 1987).

Existing material sources in the Coastal Plain and west and outside of the program area are in similar geological environments and next to streams. These sites are reportedly excavated to depths of approximately 45 feet below the surface and are in similar glaciofluvial and fluvial deposits. These deposits have been observed to contain ice wedges and thin discontinuous beds of fine-grained material with abundant detrital wood debris (Rawlinson 1993).

Climate Change

Changes in climate may affect access to those sand and gravel resources. Developers of sand and gravel resources in the program area would use ice roads for access to the material sites. Depending on the excavation methods to mine sand and gravel resources, climate change could make the excavation easier, due to thawing permafrost, or more difficult, due to increased water or swampy conditions (BLM 2018a).

Direct and Indirect Impacts

Issuance of oil and gas leases under the directives of Section 20001(c)(1) of PL 115-97 would have no direct impacts on the environment because by itself a lease does not authorize any on the ground oil and gas activities; however, a lease does grant the lessee certain rights to drill for and extract oil and gas subject to further environmental review and reasonable regulation, including applicable laws, terms, conditions, and stipulations of the lease. The impacts of such future exploration and development activities that may occur because of the issuance of leases are considered potential indirect impacts of leasing. Such post-lease activities could include seismic and drilling exploration, development, and transportation of oil and gas in and from the Coastal Plain. Therefore, the analysis is of potential direct and indirect impacts on sand and gravel resources from on-the-ground post-lease activities.

Potential impacts from the future development and operation of facilities identified in the hypothetical development scenarios (**Appendix B**) include the removal of sand and gravel resources for embankment fills. These actions change and disturb the surface vegetation layer and excavate landforms, resulting in changes to surface drainage, erosion of soils, and thawing of permafrost.

The effects of climate change described under *Affected Environment* above, could influence the rate or degree of the potential direct and indirect impacts.

Alternative A

Under Alternative A, current management actions would be maintained as described in the Arctic Refuge CCP (USFWS 2015a). The Coastal Plain would remain undeveloped. No direct or indirect impacts on sand and gravel resources would occur from future post-lease oil and gas activities.

Impacts Common to All Action Alternatives

Sand and gravel resources would be required for future development projects under each of the action alternatives. Sand and gravel resources would need to be extracted for the construction of roads and pads. Sand and gravel would likely be obtained from more than one newly permitted mine site near the proposed development and would be accessed during winter via ice roads. Sand and gravel mining would alter the geomorphic landforms and remove vegetation, leading to permafrost thaw. At mine site closure, and depending on site characteristics and reclamation requirements, the mine sites could be inundated with surface water, forming a pond. By changing the drainage patterns of surface water, ponds and channels form and concentrate water that accelerates permafrost thaw. Where drainage patterns are altered, blockages can lead to ponding and sediment deposition. Where drainage patterns redirect surface flow or increase velocities, such as at embankments, sediments erode. Water impoundment in a flooded pit would likely remain unfrozen near the bottom, creating a thaw bulb around and beneath the pit, which may cause the excavation walls to slough and deposit material into the pit (BLM 2018a).

Removal of gravel in the future from areas near or in streams could change stream configurations, hydraulics, flow patterns, erosion, sedimentation, and ice damming (USACE 2018). These actions would not occur under Alternative A.

Alternative B

Approximately 12,509,000 cubic yards of material would need to be mined for future gravel pads and roads. The area footprint of a 25-foot-deep pit is 310 acres. Multiple material source sites are expected to be used to meet the material demands and reduce haul distances. Based on areas of high potential mineral leasing under this alternative (**Map 3-4** in **Appendix A**), material sources are anticipated to be primarily in the outwash sediments from the Sadlerochit Mountains in the southwestern portion of the program area and in alluvial deposits of larger rivers.

Alternative C

Approximately 12,722,000 cubic yards of material would need to be mined for future gravel pads and roads. The area footprint of a 25-foot-deep pit is 315 acres. Multiple material source sites are expected to be used to meet the material demands and reduce haul distances. Based on areas of high potential mineral leasing under this alternative, material sources are anticipated to be primarily in the outwash sediments from the Sadlerochit Mountains in the southwestern portion of the program area and in alluvial deposits of larger rivers.

Alternative D

Approximately 12,420,000 cubic yards of material would need to be mined for future gravel pads and roads. The area footprint of a 25-foot-deep pit is 308 acres. Multiple material sources sites are expected to be used to meet material demands and limit haul distances. Based on areas of high potential mineral leasing under this alternative, material sources are anticipated to be primarily from fluvial deposits between the Canning and Tamayariak Rivers, and material resources may be limited to streams and topographic high points.

Cumulative Impacts

The geographic area relevant for assessing potential cumulative impacts for sand and gravel resources is the program area. Potential direct impacts would include permanent changes to landforms and vegetation, due to material extraction, which would lead to changes in permafrost. Changes to permafrost would likely be due to thaw and would result in subsidence, formation of thaw bulbs, and changes to drainages in and around the perimeter of the material site. Alternative C would require more cubic yards of material, compared to the other action alternatives. Past and present actions affecting sand and gravel in the program area are expected to continue, including natural riverbank and slope erosion. The effects of climate change described under *Affected Environment* above, could influence the rate or degree of the potential cumulative impacts. Alternative A would have no cumulative impacts on sand and gravel resources from post-leasing oil and gas activities.

3.2.10 Water Resources

Affected Environment

The climate and permafrost of the Arctic Refuge Coastal Plain (ARCP)[12] are the controlling physical forces of the hydrologic cycle and are characterized by low precipitation and below-freezing average temperatures during 8 months of the year (Lyons and Trawicki 1994). A comparison of average monthly temperatures at Barter Island on the coast and farther south in the coastal plain and northern Brooks Range foothills (represented by Kuparuk and Toolik Lake, respectively) are provided in **Table H-1** in **Appendix H**.

Snowfall measurements date back to 1949 on Barter Island, but the monitoring site was taken out of service in 1989, resulting in a discontinuous record of snow climatology. In 2000, three meteorological stations were established (Urban and Clow 2017) as part of the DOI/Global Terrestrial Network for Permafrost Observing System in remote parts of the ARCP. Locations of the three climate monitoring gaging stations can be seen in **Map 3-13**, Essential Fish Habitat, in **Appendix A**. The limited data available from these stations are the only modern continuous record of snow accumulation in this region of Alaska. The available average annual water equivalent of monthly precipitation and snowfall data is provided in **Tables H-2** and **H-3** in **Appendix H**, respectively.

Hydrology

Water resources on the North Slope consist mainly of rivers, shallow discontinuous streams, lakes, and ponds. Hydrology is influenced by climate, topography, and permafrost. Topography of the program area ranges from the steep Brooks Range foothills to relatively flat and poorly drained tundra underlain with continuous permafrost closer to the coast.

Streams on the North Slope typically freeze in September and thaw in June. Due to the climate, the annual hydrologic cycle is dominated by an approximate 3-week period of spring breakup associated with snowmelt and overbank and overland flooding. The open water season is generally limited to June through September. While notable fall events have been recorded, annual peak stage (i.e., water level) and discharge in streams is associated with the spring break up in late May or early June. Runoff from summer rainfall are generally contained in the river channels.

Streams on the North Slope are generally divided into three types, based on the physiographic province of their origin: those that originate in (1) the coastal plain of the North Slope (a broader area than the program area), (2) the Arctic foothills, or (3) the Brooks Range (Gallant et al. 1995). Streams and rivers in the program area share flow characteristics that are typical of the region (Brabets 1996). In the winter, stream flow is generally nonexistent or so low as to not be measurable. During freeze-up, ice becomes anchored to the streambed, and in shallow locations the entire water column freezes. River flow begins during spring break up in late May or early June, and flooding may occur from rapid snowmelt, combined with ice- and snow-filled channels.

Spring breakup can inundate extremely large areas in a matter of days. More than half of the annual discharge for a stream can occur over several days to a few weeks (Sloan 1987). Most streams continue to

[12]Lands in the Arctic Refuge, including the program area, that are part of the larger Arctic Coastal Plain that stretches east into Canada.

flow throughout the summer but at substantially lower discharges. Rainstorms can increase stream flow, but they are seldom sufficient to cause flooding in the Arctic Coastal Plain. Stream flow rapidly declines in most streams shortly after the onset of freeze-up in September and ceases in most rivers by December.

The spring season brings about major shifts in hydrology that recharge aquatic habitats and support fish migration. Snowmelt starts earliest in the foothills and then proceeds to the coastal plain. During this time, sheets of snowmelt water flow over frozen ground, extensive fields of aufeis play an important role, directing river flow paths over land and into new channels; snowmelt and flood waters create ephemeral connections between aquatic habitats and recharge floodplain lakes and wet meadow zones. On the North Slope, up to 40 percent of snowmelt recharges the evaporation deficit from the previous summer; immediately following snowmelt, surface waters are at their maximum extent (Bowling et al. 2003). Within two weeks of snowmelt, overland flow ceases and many hydrologic systems become disconnected (Bowling et al. 2003).

Flooding of North Slope rivers is influenced by the type of physiographic region drained, the size of the drainage area, and the air temperatures during breakup. Snowmelt is the main cause of annual flooding in all North Slope rivers and it may be heavy during rapid temperature rises in late May or may occur to a lesser extent over a prolonged period of weeks. Snowmelt flooding nearly always produces the annual peak discharge on rivers in the study area. On some of the larger rivers, summer precipitation or late summer/fall snowmelt events have been observed to produce floods. **Table H-5** in **Appendix H** provides historic data of measured discharge for several rivers in the program area, and climate monitoring stream-gage locations are provided in **Map 3-13** in **Appendix A**.

Watersheds, Rivers, and Streams

Ten major rivers and numerous smaller streams and rivers flow north from mountain/foothill and tundra watersheds that traverse the program area before flowing into the Arctic Ocean. During winter, some rivers may freeze to the bed while others have small pockets of unfrozen water beneath ice hummocks and along spring-fed reaches or exhibit flow sub-bed in unfrozen gravels. At locations where water is forced to the surface, extensive fields of aufeis (an expansive mass of layered ice formed by successive freezing of emerging groundwater) may be generated and persist and melt during the summer, providing a continued source of flow. During late May to June, snowmelt begins in the foothills and proceeds to the coastal plain, providing as much as 50 percent of the annual flow to rivers (Clough et al. 1987; Sloan 1987). **Table H-4** in **Appendix H** provides a list of the major drainage basins and waterbodies in the program area, their drainage areas, other characteristics, and stream lengths.

Lakes and Wetlands

Most of the program area is considered wetland; however, lakes are very scarce (less than 2 percent of the land surface area), compared with the eastern NPR-A, where lakes cover approximately 20 percent of the land surface area; here, using water from lakes for ice road building is common practice. Lakes are not evenly distributed across the program area but are concentrated near the mouth of the Canning River and in the region of the Sadlerochit and Jago Rivers, with very few lakes occupying the central Katakturuk River region (Trawicki et al. 1991). Lakes vary in surface area, from 1,500 acres to less than an acre and 90 percent are less than 12 acres. A study of 115 of the largest lakes indicated most are shallow and freeze to the bottom during winter (Trawicki et al. 1991). The estimated volume of liquid water in these lakes is 1.1 billion gallons by the end of the winter season. Eighty percent of this volume is concentrated in seven lakes in the Canning River Delta. One of these lakes is known to have salinity concentrations close to that of seawater.

The recharge capacity of many lakes is generally limited to snowmelt and direct precipitation near the lake. Deep lakes also have a larger thermal mass; thus, the deeper lakes may remain covered by ice into early July, much later than the shallow lakes (BLM 2014). Some lakes in the program area have been measured for lake volume (Trawicki et al. 1991), with some characteristics listed in **Table H-6** in **Appendix H**.

During winter, most waterbodies on the ARCP freeze solid as they are typically not as deep as the depth of freeze, reported to be 6 to 7 feet (Trawicki et al. 1991; Lyons and Trawicki 1994). Small pockets of unfrozen water occur in lakes with depths that exceed ice growth. By the end of the winter season, the volume of liquid water in these lakes has been estimated to be reduced by 98 percent (Craig 1989). Up to 40 percent of snowmelt serves to recharge the evaporation deficit from the previous summer (Bowling et al. 2003).

Groundwater Springs and Aufeis

The perennial springs in the ARCP are unique, when compared with the lands to the west beyond the program area, which lacks major spring-fed habitats. Spring-fed reaches maintain relatively stable flows and temperatures year-round, have relatively large productive stands of riparian vegetation, and produce extensive fields of aufeis. Aufeis formations near springs can be 20 feet high and more than 1 mile wide by the end of the winter. Aufeis persists throughout much of the summer season and represents at least a third of the cumulative annual base flow (Yoshikawa et al. 2007); some spring-fed reaches stay ice-free during the winter and provide critical overwintering habitat for high concentrations of macroinvertebrates and Dolly Varden (Craig 1989). The most prolific springs in the program area are the Canning, Hulahula, Sadlerochit, Itkilyariak, and Katakturak Springs.

In general, usable groundwater is limited to distinct and unconnected shallow zones in the thaw bulbs of rivers and lakes, due to the presence of permafrost, which is continuous across the North Slope (Jorgenson et al. 2008). The frozen state of the soils, combined with their fine-grained characteristics and saturated conditions, form a confining layer that prevents percolation and recharge from surface water sources and prohibits the movement of groundwater. Because percolation and recharge are restricted, the formation of usable subsurface water resources is limited to unfrozen material on top of the permafrost or taliks (thawed zones) beneath relatively deep lakes, or zones in thawed sediments below major rivers and streams. In general, while these shallow groundwater zones do exist, they are typically very small and are likely to have similar water quality as the rivers and lakes nearby (BLM 2004, Section 3.2.2.1). Shallow supra-permafrost water also occurs seasonally in the active zone above the impervious permafrost; the thickness of the active layer is typically 1.5 feet but can range from 1 to 4 feet (Gryc 1985).

Nearshore Marine

There is a narrow continental shelf that extends offshore 31 to 62 miles into the Beaufort Sea. Surficial sediments of the shelf consist primarily of mud, with coarser material. The Beaufort shelf is most influenced by river input, but it is also affected by processes offshore in the deep basin, such as currents. During the open water season, surface currents are primarily wind driven close to shore. Ice covers the sea for up to 9 months, generally from September to July.

The nearshore environment in the SBS is a mix of open coast and lagoons bounded by barrier islands. In summer, water along the coast becomes brackish and water temperatures can rise due to flow from the Mackenzie River and other rivers along the eastern Arctic coastline into the oftentimes still ice-covered nearshore environment. (Craig 1984; Hale 1990; Dunton et al. 2006). The lagoons are relatively shallow, the amplitude of the tides is very small (11.5 inches or less), and waters can vary in temperatures (28°F to 57°F) and salinity (0 to >45) throughout the year.

Water Quantity

Water quantity in the program area has been calculated and documented by the USFWS (Lyons and Trawicki 1994). There are 119 lakes with an annual ice-free volume of 55,382 acre-feet, as summarized in **Table H-6** in **Appendix H**. This volume is reduced to 3,366 acre-feet in April, when there is approximately 7 feet of ice. These values do not represent the total available quantity nor indicate suitable uses of the water, such as for ice road construction.

Water Rights

The Alaska Department of Natural Resources (ADNR) water rights records indicate there are two water right permits issued to North Slope Public Works for water supply and over 360 Instream Reservation completed and pending applications under the USFWS. While the Instream Reservations have not been issued as a water rights permit, those applications would have seniority over any new applications received by the ADNR.

Water Quality

Most freshwater systems in the program area are pristine; however, fecal contamination above State of Alaska water quality standards may occur in areas with dense avian, caribou, and lemming populations. Cold water temperatures tend to prolong the viability of fecal coliform. Most freshwater bodies in the program area have low turbidity and dissolved oxygen near saturation. According to the ADEC, no freshwater in the program area has been documented as impaired by pollutants (ADEC 2017a).

Winter freeze and summer recharge cycles cause contrasting effects in water quality. During winter freezing, major ions of calcium, magnesium, sodium, potassium, chloride, sulfate, and nitrate and other impurities are excluded from downward-freezing ice and forced into the underlying sediment. Spring snowmelt and resulting water flowing across the surface of the ice removes the cover from lakes, allowing the wind to mix the water column throughout the summer. Recharge of lakes through sheet flow during spring counteracts the effects of water loss and ion concentration caused by evaporation in the summer. The net result of the input of snowmelt waters and spring sheet flow in deeper lakes is to refresh their existing water chemistry. Lakes in the program area generally have lower pH and alkalinity values that slowly increase in the winter; this reflects the ice exclusion process, which occurs during freeze-up (Trawicki et al. 1991).

Climate Change

Climate variability would affect water resources by increasing the frequency and severity of extreme floods. Snowmelt would occur during a period of lower solar radiation, which could lead to a more protracted melt and less intense runoff. The magnitude and frequency of high flows would decline while low flows would increase, as changes in climate continue. These effects on water resources are described in more detail in the GMT2 Final SEIS (BLM 2018a, Section 3.2.4).

Direct and Indirect Impacts

Issuance of oil and gas leases under the directives of Section 20001(c)(1) of PL 115-97 would have no direct impacts on the environment because by itself a lease does not authorize any on the ground oil and gas activities; however, a lease does grant the lessee certain rights to drill for and extract oil and gas subject to further environmental review and reasonable regulation, including applicable laws, terms, conditions, and stipulations of the lease. The impacts of such future exploration and development activities that may occur because of the issuance of leases are considered potential indirect impacts of leasing. Such post-lease activities could include seismic and drilling exploration, development, and transportation of oil and gas in and from the Coastal Plain. Therefore, the analysis is of potential direct and indirect impacts on water resources from on-the-ground post-lease activities

Hydrology and surface water quality are closely linked, and the discussion regarding potential impacts on water resources is combined in this section. Future development activities that can affect water resources include the following:

- Gravel mining
- Placement of gravel fill for infrastructure, such as roads, pads, and airstrips
- Installation of culverts and bridges
- Construction of pipelines and VSM footers
- Construction of ice roads and pads
- Extraction of water supply from local lakes for ice roads, construction, drilling, and operation
- Wastewater discharge

The following potential future impacts on surface water quality would be similar to those of the NPR-A, as described in BLM 2012, Section 4.5.4.2, and 2004, Section 4F.2.2.2:

- Shoreline disturbance and thermokarst (marshy hollows and small hummocks formed by thawing permafrost)
- Blockage or convergence of natural drainage
- Increased stages and velocities of floodwater
- Increased channel scour
- Increased bank erosion
- Increased sedimentation
- Increased potential for overbank flooding
- Changes in recharge potential from removal or compaction of surface soils and gravel
- Produced-water spills
- Petroleum hydrocarbon spills
- Demand for water supply

The effects of climate change described under *Affected Environment* above, could influence the rate or degree of the potential direct and indirect impacts.

Alternative A

Under Alternative A, no federal minerals in the program area would be offered for future oil and gas lease sales. Current management actions and resource trends would continue, as described in the Arctic Refuge CCP (USFWS 2015a). Changes to water resources would continue to occur along current trends. No direct or indirect impacts on water resources would result from post-lease oil and gas leasing activities under Alternative A.

Impacts Common to All Action Alternatives

Changes in Surface Water Flow

Changes to surface water flow would result from the various aspects of future development and include short-term, long-term, and permanent changes to water resources from exploration, construction, and production. The effects from these activities vary in intensity and involve alterations to stream stage (water level) and velocities, water quality and water volume, and surface runoff processes and drainage networks.

Sand and gravel would be mined for future construction of pads, roads, and air strips (**Appendix B**). Removing gravel from areas near (or in) streams and lakes would change stream or lake configurations, stream hydraulics, lake shoreline flow patterns, erosion, sedimentation, and ice damming (National Research Council 2003). Gravel extraction would cause sedimentation, as discussed in BLM 2012, Section 4.5.4.2, pp. 12 and 13. No specific gravel mining sites have been identified associated with the proposed leasing program; however, estimated volumes of the hypothetical development scenarios are summarized in **Appendix B**.

The water in a flooded gravel pit would likely remain unfrozen near the bottom, altering the thermal regime and creating a thaw bulb around and beneath the pit, potentially resulting in localized thermokarst. The steep side slopes of excavation pits would likely slough as they thaw, becoming more gradual over time and causing some slight infilling. USACE-approved reclamation plans would be required when the pit is decommissioned.

Future exploration and construction, such as the placement and construction of gravel pads, roads, air access facilities, culverts, and bridges, could affect natural drainage patterns (creation of new channels, inundation of dry areas, ground surface subsidence under some seismic trials, and starving wetlands of water on the downstream side of roads), stream stage (water level) and stream flow (volume), stream velocity (which influences erosion and sedimentation rates), groundwater flow, and lake levels. Potential disturbance of the vegetation or water and wind erosion could initiate thawing of the upper ice-rich zones and trigger the development of thaw-lakes.

Modification of the natural surface water drainage patterns could block or redirect flow. Disruption of streambeds and stream banks could remove protective shoreline vegetation and lead to channel erosion and sedimentation, formation of meltwater gullies, plunge pools from perched culverts, and formation of alluvial fans in streams and lakes (BLM 2012, Section 4.4.4.2. p. 377).

An example of future construction that could affect hydrology is the displacement of a lake or pond by fill or placing fill (such as an airstrip or road) transversely across grade, thereby blocking the natural drainage patterns when the snow melts. Placing fill transversely across grade or the predominant wind direction may also change snow accumulation patterns, which, in turn, may change drainage patterns when the snow melts. Impacts on drainage patterns would increase inundation or drying of affected areas. Increased inundation may in turn increase thermokarst action in the affected areas.

Placing gravel fill on tundra would change recharge potential, block natural drainage, and change the existing hydrologic regime; erosion of roads and pads could increase sedimentation onto the tundra or into waterways. During construction, sediments and dust would be disturbed and deposited on snow and ice during the winter or on tundra and open water during the summer. The sediments and dust would be introduced into the water column, increasing turbidity and sedimentation. A road or airstrip aligned perpendicular to stream channels and the direction of sheet flow would have a greater potential to impound sheet flow and shallow groundwater than a road or airstrip aligned parallel to existing drainage patterns. Details related to erosion and sedimentation during the construction phase are provided in BLM 2004, Section F4.2.2.2.

Future mining pads, airstrips, and roads would be designed to account for thermal criteria (minimum thickness to prevent permafrost degradation) and hydrologic criteria to minimize potential impacts on the surrounding area, as discussed in ROPs 23 and 24.

Where gravel fill is placed in wet areas to construct a future road, pad, or airstrip, the receiving waters would temporarily have higher suspended solids concentrations, greater turbidity, and contaminant concentrations (depending on the underlying geology). Fugitive dust that enters surface water bodies would also increase turbidity and sedimentation. Further information regarding turbidity during the construction phase is provided in BLM 2004, Section F4.2.2.2).

Culverts would likely be used extensively under all action alternatives in the future for access road water crossings and to provide cross drainage. The design criteria for all culverts is such that they would avoid restricting fish passage or adversely affecting natural stream flow (ROP 24). Culverts would be installed at regularly spaced intervals to mitigate the risk of sheet flow interruption and thermokarst action. Final design of culverts depends of the spring ice breakup and snow melt characteristics for those drainages that could affect the road.

The potential impacts of increased stream velocities through culverts during floods are addressed in BLM 2004, Section F4.2.2.1. Constricting flows would increase stream velocities and a higher potential for ice jams, scour, and stream bank erosion. Impeding flows would result in a higher potential for bank overflows and floodplain inundation. These potential impacts need to be minimized by incorporating design features to protect the structural integrity of the road- and pipeline-crossing structures to accommodate all but the low probability floods. Once installed, aboveground pipelines would have nearly no effect on stream and water flow characteristics.

The configuration of gravel fills also affects impacts; a linear road running perpendicular to the hydraulic gradient would result in a larger extent of hydrological impacts than a consolidated, square pad of similar acreage. The duration of potential impacts would be long term because the roads and pads would remain during operations.

Future pipeline construction in the program area would have effects on water resources related to ice road construction and associated water withdrawals from local lakes. Narrow drainages are typically crossed using elevated pipelines on suspension spans. Pipelines would be routed to avoid lakes. Once installed, aboveground pipelines would have nearly no impact on water flow characteristics but would affect water resources in the event of an oil spill.

Potential impacts on hydrology associated with construction of gravel pads, roads, and airstrip and ice roads would persist through the life of an individual project, including natural drainage patterns, stream stage and stream flow, stream velocity, groundwater flow, and lake levels, as described previously. The duration of impacts would be long term because the gravel infrastructures would remain during operation. Reclamation has not been proven for gravel removal in the arctic environment once operations have ceased. There is the potential to reclaim the gravel mines into water reservoirs suitable to support fish and wildlife habitats and potential water sources for further water use needs, if the gravel mines are near waterways (BLM 2004).

Ice roads and ice pads would be used extensively in the future for seasonal vehicle access and would require removal, breaching, or slotting stream crossings if fish passage is a concern during spring break up (ROP 13).

Water Withdrawals

Future water withdrawals to support components of the action alternatives would affect the water levels of lakes used as water sources and any connected water body, such as streams or wetlands. Only permitted lakes, rivers, or reservoirs (under ADNR Temporary Use Authorizations and, if required, ADFG Fish Habitat Permits) would serve as water sources. Typical consumptive water use would involve the following:

- Seasonal construction of ice roads and pads
- Drilling, hydraulic fracturing, and waterflooding
- Hydrostatic testing
- Dust abatement on roads, pads, and airstrips during summer
- Potable water
- Fire suppression and maintenance

Surface water withdrawals in the future for construction of ice roads, dust abatement, and operations would affect shallow groundwater levels, surface water levels, and drainage patterns during summer season. Lakes would be the principal supply for freshwater during construction. Ice roads and ice pads would be constructed to support construction under all action alternatives for access during the winter season. Although estimates of water use for oil and gas activities on the North Slope have been made in literature, the actual amount of water used would be project specific and would be based on BMPs, new technology, and the specific needs of the project, such as the width of ice roads, number of camps, number of crew, and ice pad size. Under all action alternatives, no potential long-term impacts on lakes and ponds are anticipated from ice roads, ice pads, or ice bridges, as discussed in BLM 2012, Section 4.5.4.2.

Future ice road construction over lakes that do not freeze to the bottom could affect dissolved oxygen concentrations. An ice road that crosses such an intermediate-depth lake could freeze the entire water column below the road, isolating portions of the lake basin and restricting circulation. With mixing thus reduced, isolated water pools with low oxygen would result. Details related to dissolved oxygen concentrations during ice road construction are provided in BLM 2004.

Changes to Surface Water Quality

Changes to water quality could occur during the exploration, construction, and operation phases of a future oil and gas development project. Increased turbidity of water bodies would result from dust fallout, flooding, erosion, or bank failure. After construction is complete, gravel from roads, pads, and airstrips would be the main dust source; dust fallout from vehicle traffic could increase turbidity in ponds, lakes, creeks, streams and rivers, and wetlands that are next to roads and construction areas.

A potential direct impact from winter road and pipeline construction would be disturbance of tundra soils and vegetation (see **Section 3.2.8** and **Section 3.3.1**). Disturbed and exposed soils are more susceptible to erosion and subsequent sedimentation during spring breakup of ice than undisturbed areas. Fugitive dust from construction could also be deposited on snow and ice during the winter. When melting occurs, this dust can then enter surface water bodies, increasing turbidity and contaminant concentrations, depending on the underlying geology.

Freshwater would be withdrawn from lakes in the program area in the future for several primary uses: construction of ice roads and pads, pipeline maintenance, production drilling, and potable water at camps. Water would also be used for dust control on roads. This water would be recharged in the spring when snow and ice melt increase flow volumes in connected water bodies, assuming that withdrawal rates would not exceed recharge rates, based on BMPs, permitting, and permitting requirements.

There is a potential for wastewater discharge from future oil and gas activities, such as sanitary/domestic, secondary containment, gravel mine dewatering, and hydrostatic test water, and could increase pollutant loads to waterbodies. These discharges would occur under the appropriate Alaska Pollutant Discharge Elimination System (APDES) authorization; however, it is more likely that wastewater would be placed in underground injection control wells. A thorough discussion of the water quality effects resulting from development can be found in BLM 2004, Section 4F.2.2.2.

It is likely that only treated (secondary treatment) domestic wastewater would be discharged to water bodies/wetlands with authorization from the applicable APDES permits; it is not anticipated that there would be an increase in fecal coliform counts over the naturally occurring concentrations outside of authorized mixing zones.

Drinking water resources are unlikely to be affected because they would have to meet State of Alaska Water Quality Standards for drinking water. Permitting, permit authorizations, and BMPs of any oil and gas activities around the drinking water resources would mitigate any potential impacts on the resources.

Oil spills could occur in the future from pipelines, storage tanks, production facilities and infrastructure, drill rigs, and vehicles during the drilling and operation phases. Spills occurring from pipelines or oil leaving pads and roadbeds could enter water sources, reaching tundra ponds, lakes, creeks, or rivers. Spills can occur at any time during the year. The potential impacts associated with oil spills are described in **Section 3.2.11**, Solid and Hazardous Waste.

Changes to Groundwater

During future gravel mining, it is probable that shallow taliks and supra-permafrost water zones would be temporarily eliminated in the immediate vicinity of a gravel mine. The effect of this loss on water resources is localized if the talik network is discontinuous. Supra-permafrost water zones may be reestablished over time if the ground does not refreeze after the mine is decommissioned. The subsurface water-bearing zone would be permanently eliminated in the immediate footprint of the mine and would be replaced by surface water that is connected to the shallow groundwater.

Changes to Marine Waters

There is a potential for impact on marine water from barge docking sites, primarily in the event of an oil spill. The extent of such contamination would be related to the size, nature, and timing of the spill. If a spill were to happen during the open-water or broken-ice seasons, hydrocarbons dispersed in the shallow estuarine water column could exceed acute-toxic criteria during the initial spill period but would be short term and localized. Impacts on marine waters are more thoroughly described in BLM (2018).

Discharges of various pollutant concentrations in the future from an STP would be required to meet standards in the treatment plant's APDES discharge permit and potential mixing zone requirements.

Alternative B

Alternative B includes approximately 1,563,500 million acres available for lease sale. Lease Stipulation 1 provides setbacks (0.5 mile to 1 mile) and prohibits permanent oil and gas facilities and supporting infrastructure in the streambeds of the Canning, Hulahula, Aichilak, Okpilak, Jago, Sadlerochit, Tamayariak, and Okerokovik Rivers.

These actions are designed to minimize the disruption of natural flow patterns and changes to water quality for these specific waterbodies. Additionally, ROPs 3, 4, 9, 10, 12, 13, 17, 20, 24, and 26 would minimize potential impacts on water resources under Alternative B.

Alternative C

Alternative C includes 1,563,500 million acres available for lease sale. The lease stipulations and ROPs would be the same as those discussed under Alternative B, except for the inclusion of additional protections from Lease Stipulation 9. Under Alternative C, this lease stipulation does not allow exploratory well drill pads, production well drill pads, and central processing facilities in coastal waters, lagoons, or barrier islands in the boundaries of the program area or 1 mile inland from the coast.

Alternative D

Alternative D includes 1,037,200 million acres available for lease sale and provides the most protections for water resources. Lease Stipulation 1 increases the setback distances on rivers from Alternative B and adds additional rivers to the list for setbacks. There are also seasonal operational restrictions on coastal water bodies or islands between May 15 and November 1, or when sea ice is on the coast of each season. Lease Stipulation 2 reduces impacts on water quality by prohibiting permanent oil and gas facilities and infrastructure within 0.5 mile of the ordinary high-water mark of any water body in Townships 8 and 9 north of the Canning and Tamyariak watersheds. Lease Stipulation 3 protects water quality associated with these specific features and identifies areas that would not be offered for lease sale or would have NSO stipulations.

Cumulative Impacts

The geographic area relevant for assessing cumulative impacts for water resources is the program area. No other past, present, and reasonably foreseeable future actions that could affect water resources have occurred or would occur in the program area. Alternative A would have no cumulative impacts on water resources from post-leasing oil and gas activities.

3.2.11 Solid and Hazardous Waste

Affected Environment

The Coastal Plain has had limited human or industrial activity that could result in solid or hazardous wastes being introduced into the environment. Kaktovik is the only community in the Coastal Plain; however, it is excluded from the program area boundary under PL 115-97. Solid, human, and hazardous wastes identified in the Coastal Plain are related to industrial activities or community development typically along the coast.

Industrial activity consists of past Department of Defense (DOD) Distant Early Warning (DEW) line facilities and Long-Range Radar Sites (LRRS) at Brownlow Point, Collinson Point, Barter Island, Griffin Point, and Nuvagapak Point. Construction of these facilities began as early as 1947, with the main installations built in 1952 and 1953. Brownlow Point was abandoned in 1958, Collinson Point and Nuvagapak Point were active between 1953 and 1962. Griffin Point was active between 1953 and 1957, and Barter Island White Alice Communications System was deactivated in 1979 and replaced with a minimally attended radar in the mid-1980s.

Most of the DOD's cleanup and building demolition occurred in 1994, 2000, and 2006. Community development is associated with public facilities in Kaktovik. Most facilities and sites are on the coast at Brownlow Point, Collinson Point, Barter Island, Griffin Point, and Nuvagapak Point. See **Section 3.4.1**, Landownership and Use, for a further discussion of Kaktovik facilities and DOD facilities and activities.

Appendix I identifies the facilities near the program area that are required to be registered with the EPA or ADEC for discharges associated with the Clean Air Act or the Clean Water Act; identifies ADEC authorized solid waste facilities closest to the program area; identifies ADEC documented contaminated sites, all of which are shown on **Map 3-9**, Hazardous Waste Sites, in **Appendix A**; and lists of spills near Kaktovik, Alaska.

Direct and Indirect Impacts

Issuance of oil and gas leases under the directives of Section 20001(c)(1) of PL 115-97 would have no direct impacts on the environment because by itself a lease does not authorize any on the ground oil and gas activities; however, a lease does grant the lessee certain rights to drill for and extract oil and gas subject to further environmental review and reasonable regulation, including applicable laws, terms, conditions, and stipulations of the lease. Such post-lease activities could include seismic and drilling exploration, development, and transportation of oil and gas in and from the Coastal Plain. Therefore, the analysis is of potential direct and indirect impacts on solid and hazardous materials from on-the-ground post-lease activities

Potential impacts from the future development and operation of facilities identified in the hypothetical development scenarios (**Appendix B**) include the generation of solid waste, wastewater, produced fluids, drilling muds, and spills of oil, salt water, and hazardous substances. Analysis of these impacts is tiered from information contained in the GMT2 Final SEIS (BLM 2018a), and the NPR-A IAP/EIS (BLM 2012); the updated information from the spills database were used to supplement the analysis below.

Spills can originate from pipelines, storage tanks, production facilities and infrastructure, drilling rigs, and heavy equipment or vehicles. Impacts from spills vary, based on material type, size, and season. For this analysis, the materials that could be spilled associated with post-lease activities are categorized and described as follows:

- Produced fluids are composed of crude oil, natural gas, and brine and formation sand.
- Crude oil is oil separated from the brine, natural gas, formation sand, and other impurities and would be transported in the proposed pipeline.
- Refined oil is Arctic diesel, Jet-A 50, unleaded gasoline, hydraulic fluid, transmission oil, lubricating oil and grease, waste oil, mineral oil, and other products.
- Salt water is treated water from the STP.
- Other hazardous materials are methanol, propylene and ethylene glycol (antifreeze), water soluble chemicals, corrosion inhibitor, scale inhibitor, drag reducing agent, and biocides.

Spill impact quantities are categorized and described as follows (taken from BLM 2004, Section 4.3.2.3):

- Very small spills, less than 10 gallons
- Small spills, 10 to 99.5 gallons
- Medium spills, 100 to 999.5 gallons
- Large spills, 1,000 to 100,000 gallons

- Very large spills, greater than 100,000 gallons

Based on the GMT2 Final SEIS (BLM 2018a), more than half of the North Slope spills were less than 10 gallons and approximately 98 percent of the total volume released resulted from spills larger than 99 gallons (BLM 2014, Section 4.5.2). The probability of a spill over 100,000 gallons is low (BLM 2004, Section 4.3.1)—only three documented spills have been greater than 100,000 gallons (BLM 2014, Section 4.5.2). Upon detection, spills have been contained and cleaned up, as required by federal, state, and NSB regulations (NRC 2003).

Spills as a result of the development and operation of facilities identified in the hypothetical development scenarios (**Appendix B**) would occur on or close to oilfield infrastructure (BLM 2004, Section 4.3.2.3). Most Alaskan North Slope industry spills have been contained on gravel pads and roadbeds (BLM 2012, Section 4.2.2), and most of the spills that reach the tundra have affected fewer than 5 acres (BLM and MMS 1998). Natural or anthropogenic-assisted restoration from these spills has generally occurred within a few months to years (NRC 2003).

The season in which a spill occurs can dramatically influence its behavior, impacts, and the cleanup response actions (BLM 2004, Section 4.3.2.3). The active soil layer in the program area ranges from less than 1 foot to 5 feet and is on average 2 feet thick; it consists of poorly drained, unconsolidated sediments, transected by fluvial deposits of rivers and streams. Dispersal of spilled materials would likely occur at or near the ground surface, as permafrost would likely inhibit infiltration of oil, salt water, or hazardous substances. Permafrost is at least 1,000 feet thick, except in isolated areas of natural thaw near deep lakes, springs, or rivers and areas of thaw exacerbated by climate change and anthropogenic earth-disturbing activities. **Table 3-14** describes potential spill behavior during the four seasons and has been taken from the Alpine Satellite Development Plan EIS (BLM 2004).

The rate of potential oil, salt water, and hazardous substance spills from the hypothetical development scenario (**Appendix B**) is likely to be lower than the history of the past 30 years of oil exploration, development, production, and transportation on the North Slope. The combination of more stringent agency regulations, continually improving industry operating practices, and advancements in best available control technology reduce the probability and size of future spills (BLM 2004, Section 4.3.1).

Alternative A

Under Alternative A, current management actions would be maintained, as described in the Arctic Refuge CCP (USFWS 2015a). There would be no generation of solid waste, wastewater, or spills of oil, salt water, or hazardous substances in the Coastal Plain associated with future post-leasing oil and gas activities under Alternative A.

Impacts Common to All Action Alternatives

The hypothetical development scenario (**Appendix B**) identifies development activities in the program area and the potential timing of these activities that would require the management of solid waste, wastewater, and hazardous waste.

Table 3-14
Spill Characteristics by Seasons

Season	Conditions	Description
Summer (ice-free)	Most rivers and creeks are ice-free or flowing; ponds and lakes are open water; tundra is snow-free; and biological use of tundra and water bodies is high.	Currents, winds, and passive spreading forces would disperse spills that reach the water bodies. Spills to tundra would directly affect the vegetation, although the dispersal of the spilled material is likely to be impeded by the vegetation. Spills to wet tundra may float on the water or be dispersed over a larger area than would spills to dry tundra or to snow-covered tundra. Spills under pressure that spray into the air may be distributed downwind over substantial areas and affect the tundra vegetation and water bodies.
Fall (freeze-up)	Waterbodies are beginning to ice over, but the ice cover might vary, depending on temperature, wind, currents, and river flow velocities. Snow begins to cover tundra, and most of the migratory birds are leaving the North Slope.	Spilled material could be dispersed when it reaches flowing water but slowed or stopped when it reaches snow or surface ice. The spilled material could be contained by the snow or ice but dispersed if the ice breaks up and moves before it refreezes. The spilled material also could flow into ice cracks to the underlying water, where it could collect.
Winter (ice cover)	Waterbodies are covered by mostly unbroken ice, and snow covers the tundra.	Dispersal of material spilled to the tundra generally would be slowed though not necessarily stopped by the snow cover. Depending on the depth of snow cover as well as temperature and volume of spilled material, it may reach the underlying dormant vegetation or tundra ponds and lakes. Similarly, spills to rivers and creeks generally would be restricted in distribution by the snow and ice covering the waterbody, compared to seasons when there is no snow or ice cover. Spills under the ice to creeks, rivers, and tundra ponds and lakes might disperse slowly, as the currents are generally slow to nonexistent in the winter.
Spring (breakup)	Thawing begins in the higher foothills of the Brooks Range and river flows increase substantially and quickly, often to flood stages. This is a short period of the year. These increased flows cause river ice cover to break up and flow downriver. River floodwaters usually flow over sea ice, which hastens the breakup of the sea ice. Snow cover begins to melt off the tundra and many migratory species, especially birds, return to the tundra.	Spills to waterbodies during breakup are likely to be widely dispersed and difficult to contain or clean up. Spills to the tundra might be widely dispersed if the flooding overtops the river and creek banks and entrains the spilled material.

All action alternatives would generate solid waste, consisting of food wastes, sewage sludge, and other nonhazardous burnable and unburnable wastes from future oil and gas exploration, development, and production. Solid wastes would be separated and stored in large trash receptacles or approved containers, as part of the CPF, until they are incinerated or transported to an approved landfill outside the Coastal

Plain, such as the landfill near Prudhoe Bay. Wastes that cannot be incinerated would be transported to approved offsite landfills. Burning waste would temporarily affect air quality.

Use of injection wells (Class I or Class 2) in the future would be used to dispose of wastewater, produced water, spent fluids, and chemicals, as approved by the EPA, the AOGCC, or ADEC. Injection wells would be used to dispose of wastewater generated from the estimated field use of 2 million gallons per day. As a result, injection of wastewater reduces potential impacts on surface waters or the land by injecting wastewater deep underground into zones isolated from drinking water sources.

The potential occurrence of spills does not depend on any alternative chosen, as spills are not a planned activity and are unpredictable in cause, location, size, time, duration, and material type (Mach et al. 2000). **Table 3-15**, taken from the Alpine Satellite Development Plan EIS, describes the relative rate of occurrence for spills from main sources.

Table 3-15
Relative Rate of Occurrence for Spills from Main Sources

Source Pipeline	Spill Size				
	Very Small (<10 Gallons)	Small (10–99.5 Gallons)	Medium (100–999.5 Gallons)	Large (1,000–100,000 gallons)	Very Large (>100,000 Gallons)
Produced fluids	H	H	M	L	VL
Salt water	H	H	M	L	VL
Diesel	H	M	L	VL	0
Sales oil	M	M	M	L	VL
Bulk storage tanks and containers of pads	L	L	L	VL	0
Tank vehicles	H	M	L	VL	0
Vehicle and equipment operation and maintenance	VH	VH	M	VL	0
Other routine operations	VH	VH	H	L	VL
Drilling blowout	VL	VL	VL	VL	VL
Production uncontrolled release	VL	VL	VL	VL	VL

Notes:
VL = Very low rate of occurrence
VH = Very high rate of occurrence
L = Low rate of occurrence
M = Medium rate of occurrence
H = High rate of occurrence
0 = Would not occur

Alternative B

Potential impacts on solid and hazardous waste from post-leasing oil and gas activities under Alternative B would be the same as identified above for all action alternatives.

Alternative C

Impacts on solid and hazardous waste from post-leasing oil and gas activities under Alternative C would be the same as identified above for all action alternatives.

Alternative D

Impacts on solid and hazardous waste from post-leasing oil and gas activities under Alternative D would be the same as identified above for all action alternatives.

Cumulative Impacts

Cumulative impacts include the existing 34 spills of approximately 16,313 gallons of oils, salt water, or hazardous substances and potential spills from the hypothetical development scenario. Over half of documented spills associated with oil and gas operations are less than 10 gallons, and detected spills are promptly contained and cleaned up to federal, state, and borough regulations. Alternative A would have no cumulative impacts on solid and hazardous waste from post-leasing oil and gas activities.

3.3 Biological Resources

3.3.1 Vegetation and Wetlands

Affected Environment

The program area encompasses much of the broad, treeless ARCP, including portions of the northern foothills of the Brooks Range and the Beaufort Sea coast, between the Canning and Staines Rivers to the west and the Aichilik River to the east (**Map 1-1** in **Appendix A**). This area includes portions of two broad ecoregions, the Beaufort coastal plain and the Brooks foothills (Nowacki et al. 2003; Jorgenson and Grunblatt 2013). The Beaufort coastal plain generally is characterized by flat and very gently sloping tundra and the Brooks foothills by increasingly undulating terrain inland toward the Brooks Range. Within these two ecoregions are four subregions or eco-subsections: coastal lagoons, lowland peatlands (wet tundra), well-drained colluvium (upland moist tundra), and broad floodplains (shrub thickets) (Jorgenson and Grunblatt 2013; USFWS 2015a).

Vegetation

The vegetation mapping chosen to quantify the coverage of each vegetation type in the program area (**Map 3-10**, Vegetation, in **Appendix A**) was prepared by the Alaska Center for Conservation Science (ACCS) (ACCS 2016; Boggs et al. 2016); the development of vegetation mapping is discussed further in **Appendix J**. **Table J-1** in **Appendix J** provides estimates of the area covered by each vegetation class, based on the ACCS (2016) land cover mapping reproduced for the program area (see **Map 3-10** in **Appendix A**).

The vegetation type descriptions below were developed using data sources that provide information at the plant community level for the specific vegetation types in the program area (Viereck et al. 1992; USFWS 2015a).

<u>Dwarf Shrub</u>

Dwarf shrub and dwarf shrub-lichen, combined, encompass less than 1 percent of the program area (**Table J-1** in **Appendix J**). Dwarf prostrate shrub communities (heights of less than 8 inches) have a dry to moist moisture regime. Dry sites are characterized by lichens or bare ground, or both, throughout the understory, whereas moist sites tend to support grasses, sedges, and mosses throughout the understory. Dry dwarf shrub typically occupies raised and well-drained topographic features on the Coastal Plain, such as steep riverine banks and alluvial fans where little snow accumulates during winter. Moist sites generally have less topographic relief and a deeper snowpack that protects the vegetation from abrasion and desiccation by winter winds (USFWS 2015a). See **Appendix J** for individual species that characterize this vegetation type.

<u>Low and Tall Shrub</u>

Tall shrub (open-closed) communities are most often associated with riparian zones along rivers and streams and account for less than 1 percent of the program area (**Table J-1** in **Appendix J**). Shrub heights in tall shrub communities are variable, ranging from low shrubs of 8 to 60 inches and tall shrubs from 60 to 118 inches. Shrub density also varies, depending on the frequency of overbank flooding and drainage of the substrate. The low and tall shrubs are primarily deciduous, dominated by willows (*Salix* spp.).

Low shrub communities 8 to 60 inches tall also occur in riparian zones and in the larger expanses of tussock-shrub tundra in upland areas. This community accounts for 15 percent of the program area (**Table J-1** in **Appendix J**). See **Appendix J** for individual species that characterize this vegetation type.

Moist Herbaceous Meadow

Moist herbaceous meadow types are dominated by graminoids[13] and forbs,[14] often growing alongside dwarf shrubs. Moist herbaceous meadow comprises the most common group of vegetation types in the program area. These types grow on reasonably well-drained but low-lying Coastal Plain substrates in flat or gently sloping terrain and undulating terrain in the northern Brooks Range foothills. Surface indicators of permafrost (ice wedges in particular) in the form of polygonized patterned ground are often present in flat or gently sloping areas. In such areas, raised centers of high-centered polygons or raised ridges of low-centered polygons support moist tundra habitats, while the low troughs or polygon basins support wet herbaceous types (see *Wet Herbaceous Meadow* below) (USFWS 2015a).

Moist herbaceous meadow types include herbaceous (mesic) and tussock tundra (low shrub or herbaceous); combined, these types account for 59 percent of the program area (**Table J-1** in **Appendix J**). See **Appendix J** for individual species that characterize this vegetation type.

Wet Herbaceous Meadow

Wet herbaceous vegetation types include freshwater and brackish water aquatic (marsh) vegetation, and saturated and seasonally flooded freshwater wetlands. The herbaceous (wet-marsh) tidal and herbaceous (marsh) types combined account for less than 2 percent of the program area (**Table J-1** in **Appendix J**).

The herbaceous (wet) vegetation type accounts for 17 percent of the program area (**Table J-1** in **Appendix J**). It is primarily found in low-lying drained lake basins, intermingled with moist tundra where the surface is patterned with low-centered polygons; this type has a limited occurrence on headwater stream floodplains (USFWS 2015a). See **Appendix J** for individual species that characterize this vegetation type.

Barrens

The barren type covers approximately 1 percent of the program area (**Table J-1** in **Appendix J**). Vascular plants are scattered or absent, and bare soil is the dominant feature. This land cover type is most commonly found on exposed riverine surfaces or intertidal beaches; it occurs on a limited basis at higher elevations in the Brooks Range foothills.

Waters

The freshwater or saltwater type comprises 9 percent of the program area, primarily consisting of nearshore water in the coastal lagoons between the mainland and the barrier islands (**Table J-1** in **Appendix J**). Freshwater lakes and ponds comprise a smaller proportion of this type, mostly concentrated in the river deltas and in abandoned floodplains, where flooded oxbow lakes are common.

[13]Grass-like plants, including sedges, rushes, and grasses
[14]Herbaceous, broad-leaved, vascular plants

Rare Plants

There are no federally listed, threatened, or endangered plant species known to occur in the program area (USFWS and NMFS 2014). The ACCS maintains a listing of ranked, rare vascular plant species in Alaska, provides updates to a rare plant field guide, and manages a database of rare plant occurrences (ACCS 2018a; 2018b). To obtain a preliminary listing of rare plants, the BLM searched the ACCS rare plant occurrence database for all known records in the program area; this search resulted in 14 vascular plant species with Alaska state rankings, 5 of which are BLM watchlist species and 4 that are BLM sensitive species (**Table J-2** in **Appendix J**).

The BLM monitors a list of 31 vascular plant species that are considered rare on the North Slope, including on the ARCP (Cortés-Burns et al. 2009). Based on the presence of appropriate habitats, there are 19 additional taxa on the BLM list not already documented as occurring in the program area in **Table J-2** in **Appendix J** that could occur in the program area.

Nonnative and Invasive Plants

The spread of nonnative plants is limited on the North Slope of Alaska due to the short growing season, low summer temperatures, and the relative rarity of disturbed areas (Carlson et al. 2015). Historically, the region has been thought of as a low-risk area for invasive plant infestations. Disturbance vectors for transporting propagules[15] to remote locations on the North Slope are still limited but are expected to increase with industrial development in remote areas, such as the program area. Vector pathways for invasive plants are closely tied to human disturbance, primarily at regional airport hubs, along road and highway corridors, and in areas with foot traffic (Carlson et al. 2015; ACCS 2018c). With a warming climate and an increase in commercial activity on the North Slope, damage caused by invasive plants is expected to increase in the coming decades (Carlson and Shephard 2007; Carlson et al. 2015).

A review of Alaska's statewide invasive plant database, the Alaska Exotic Plants Information Clearinghouse (ACCS 2018c), revealed no documented occurrences of nonnative plant species in the program area. The search area was then expanded to the broader ARCP and Brooks Range foothills, where infestations were documented along the Dalton Highway and at Umiat (ACCS 2018c); documented nonnative species in the broader search area were Canada thistle (*Cirsium arvense*), narrowleaf hawksbeard (*Crepis tectorum*), herb Sophia (*Descurainia sophia*), white sweetclover (*Melilotus albus*), common dandelion (*Taraxacum officinale*), and foxtail barley (*Hordeum jubatum*). These infestations were associated primarily with disturbances, such as fill importation, or extraction associated with the construction of gravel roads and pads.

According to the ecological risk analysis conducted by Carlson et al. (2015), none of the documented species listed above are regarded as a significant ecological threat. The species with the greatest ecological risk is thought to be *Hordeum jubatum,* which may be an Alaska native plant. It has been spreading rapidly through the state over recent decades in straw and agricultural seed (Carlson et al. 2015). *Hordeum jubatum* is a salt-tolerant species with extreme cold tolerance and is capable of invading a range of Coastal Plain ecosystems, including coastal-influenced plant communities. It thus has some potential to spread along with development in the program area.

Wetlands

The BLM used coarse-scale National Wetland Inventory (NWI) mapping for the North Slope of Alaska (USFWS 2018) to assess the extent of wetlands and wetland types in the program area. Most of the landscape in the program area is considered to be jurisdictional wetland (USFWS 2018), and NWI data

[15]Any structure that can propagate a new plant, such as a shoot, root mass, or seed.

indicate that at least 96 percent of the program area is classified as wetlands or waters of the US; the 4 percent of the program area that is unmapped is also likely to consist of wetlands or waters (**Table 3-16**; **Map 3-11**, Wetlands, in **Appendix A**). Upland areas that do not meet the three-parameter criteria to be classified as a wetland (Environmental Laboratory 1987; USACE 2007) likely are present, but detailed field observations and fine-scale mapping would be required to assess the extent of uplands in the program area.

Table 3-16
Wetland Types Mapped in the Arctic Refuge Program Area by the National Wetland Inventory Program

Wetland Class	Area (Acres)	Percent of Program Area
Estuarine and Marine Deepwater	71,300	5
Estuarine and Marine Wetland	9,700	1
Freshwater Emergent Wetland	1,258,300	83
Freshwater Forested/Shrub Wetland	98,000	6
Freshwater Pond	5,700	<1
Lake	12,300	1
Riverine	53,500	4
Unmapped	54,700	4
Total area	1,508,800	100

Source: USFWS 2018

Uplands are typically rare on the North Slope and limited to well-drained ridge crests and other exposed areas that are typically blown free of snow in the winter; these areas accumulate little moisture throughout the year (see the descriptions of dry dwarf shrub and bare ground types above).

Elsewhere, the combination of continuous permafrost, which impedes drainage, riverine flooding, tidal influences, and the flat and gently sloping or undulating landscape account for most of the hydrogeomorphic features driving wetland development in the program area. Isolated and possibly non-jurisdictional wetlands may be present in specific geomorphic locations; however, because of the broad extent of interconnected wetlands with subsurface hydrologic connectivity, the likelihood of isolated wetlands occurring is very small. As noted above, regarding quantifying uplands, a detailed field survey and fine-scale wetland map would be required in any area proposed for an oil or gas development project. It is at that stage at which the presence of any small occurrences of non-jurisdictional wetlands can be assessed.

In the NWI mapping, 83 percent of the acreage in the program area is classified as freshwater emergent wetland (**Table 3-16**); this includes the freshwater herbaceous marsh and herbaceous wet meadow types described in the *Vegetation* section above. Marine waters wetland types account for 5 percent of the program area and occur in the lagoons between the mainland and the barrier islands. Freshwater lakes and ponds comprise less than 2 percent of the program area, riverine wetlands cover another 4 percent, and other freshwater wetlands account for 6 percent.

The program area is largely undisturbed, and wetland structure and function are intact. Climate change poses the most significant threat to the stability of wetlands in the program area (BLM 2018a; USFWS 2015a). As described below in the *Climate Change* section, climate change is generating a drying trend on the North Slope for lake, pond, and wetland habitats, and this is predicted to continue in the program area.

Wetland Functions and Values

Most of the land cover types in the program area are likely to be jurisdictional wetlands subject to permitting under Section 404 of the Clean Water Act or Section 10 of the Rivers and Harbors Act. Because wetlands are ubiquitous in the program area, any development project proponent would find it difficult to avoid the loss of wetlands from fill. In such cases, under the mitigation rule of 2008 (33 CFR 320(r)(1)), compensatory mitigation is required for the loss of wetland functions. To quantify the extent of mitigation required, wetland functions may be evaluated, and a value is assigned to each function so that project designers can avoid the most important wetlands and determine a compensation ratio if an in-lieu fee is required.

Wetland functions are the chemical, physical, and biological processes that occur in the ecosystem. Wetland values or ecosystem services are the benefits that a wetland provides to human communities and ecosystems.

Statewide, Alaska has very few formally developed and regionally specific methods to systematically quantify wetland functions. Recently, however, the USACE developed a wetland conditional assessment method for the North Slope (Berkowitz et al. 2017). This method may rely on field data or be conducted remotely using off-site data. It assesses three functional groups: habitat, hydrology, and biogeochemical cycling along a gradient of anthropogenic disturbance. It standardizes the calculation of mitigation compensation metrics. The method is most suitable in areas where development has already occurred and may be useful only in the development phase; however, this is the first method to use a North Slope-specific land cover classification and assess regionally specific wetland conditions.

Previous wetland functional assessment methods evaluated a variety of the most commonly assessed functions for North Slope wetlands, including flood flow regulation, sediment nutrient and toxicant removal, erosion control and shoreline stabilization, organic matter production and export, threatened and endangered species support, avian and mammal habitat suitability, fish habitat suitability, educational-scientific-recreational-subsistence use, and soil thermal regime maintenance. In general, the functions that show the greatest variability among wetland types are the habitat functions supporting wildlife and fish species. This is because the measurable indicators of wetland function—the numbers of species and numbers of individual animals that use specific wetland or habitat types—can be wide ranging.

Relative to wetlands in temperate regions, North Slope wetlands tend to have low function for most of the hydrologic, biogeochemical, or social functions. This is because of the short, cold growing season, harsh winter conditions, remote location, low human population numbers, and the ubiquitous impermeable permafrost layer preventing groundwater flow. The most important functions tend to be related to wildlife habitat value and endangered species support. The most common wetland type (Freshwater Emergent Wetland, 83 percent of the program area) is comprised of multiple fine-scale wetland types, ranging from drier, well-drained saturated wetlands to permanently flooded marshlands. The wetter wetland types in this broad class are equivalent to the Herbaceous (Wet), Herbaceous (Marsh), and Herbaceous (Wet-Marsh) (Tidal) vegetation classes (**Table J-1** in **Appendix J**). These provide nesting, brood-rearing, and migration staging habitat for a variety of avian species, and spawning and rearing habitat for fish where those types are next to fish-bearing waters.

Climate Change

Climate change is expected to alter vegetation and wetlands on the North Slope in the direction of more well-drained and drier habitat types characterized by a greater dominance of shrubs, and dwarf trees in protected areas. In the reasonably foreseeable future, alterations to vegetation and wetlands from climate change would also occur as the activities described above contribute to cumulative impacts. Despite projections for increased precipitation, the longer growing season and increased temperatures due to climate change are predicted to result in greater evapotranspiration rates, which in turn are expected to produce landscape-scale drying; by mid-century, the landscape may be 10–12 percent drier on the Coastal Plain (USFWS 2015a). This drying would alter vegetation and shallow-water systems, such as palustrine wetlands, ponds, and lakes directly, and these wetlands and waterbodies are likely to be reduced in number and extent. These transitions may result in substantial changes in wildlife species assemblages, depending on the extent of habitat change (see **Section 3.3.3**, Birds, and **Section 3.3.4**). Coastal erosion would result in the continued loss of coastal vegetation and wetlands, and gradual reductions in the extent of the barrier island-lagoon system on the North Slope are also likely.

The longer growing season and increased summer temperatures are expected to promote the expansion of shrub vegetation in the program area, as has been found elsewhere on the North Slope (Tape et al. 2006) and throughout Alaska. Warming and a longer growing season is also expected to promote the northward expansion of the ranges of some plant species more typically associated with the boreal forest, such as balsam poplar (*Populus balsamifera*) (USFWS 2015a).

Additionally, increasing soil temperatures could release stored carbon to the atmosphere, thus exacerbating warming (Sturm et al. 2001a) and further promoting the direct and indirect changes to vegetation and wetlands described above. The combined effects of the drying of wetlands and waterbodies and an increase in shrub plant cover would reduce the extent of sedge-dominated wetlands and lacustrine waterbodies that are used for nesting and brood-rearing by many waterbird and shorebird species.

Coastal erosion and the direct loss of coastal vegetation and wetlands on the North Slope also has increased due to climate change. Increasing ocean temperatures, sea level rise, and an increase in wind-driven storm surges has resulted in a substantial increase in coastal erosion rates (Jorgenson and Brown 2005). It is expected that increasing water temperatures, reduced sea ice, sea level rise, permafrost degradation, increased storm surges, and changes in river discharge and sediment transport rates (see drying trend noted above) would continue to alter coastal habitats. A recent analysis of data for the North Slope coastline from the Canadian border to Icy Cape indicates that although some areas show accretion, the mean values across the region and a substantial majority of the shoreline transects analyzed, including barrier islands, have been eroding between the 1940s and 2010s (Gibbs and Richmond 2017). Erosion rates along the Beaufort Sea coast also were substantially greater than along the coast of the Chukchi Sea.

Lastly, the degradation of permafrost and multi-year sea ice could release persistent organic contaminants and mercury to aquatic ecosystems and wetlands (Schiedek et al. 2007).

Direct and Indirect Impacts

Issuance of oil and gas leases under the directives of Section 20001(c)(1) of PL 115-97 would have no direct impacts on the environment because by itself a lease does not authorize any on the ground oil and gas activities; however, a lease does grant the lessee certain rights to drill for and extract oil and gas subject to further environmental review and reasonable regulation, including applicable laws, terms, conditions, and stipulations of the lease. The impacts of such future exploration and development activities that may occur because of the issuance of leases are considered potential indirect impacts of leasing. Such post-lease activities could include seismic and drilling exploration, development, and transportation of oil and gas in and from the Coastal Plain. Therefore, the analysis is of potential direct and indirect impacts on vegetation and wetlands from on-the-ground post-lease activities

Potential impacts on vegetation and wetlands were evaluated for all areas available for development under each alternative, as identified in **Table 2-2** in **Chapter 2**, and for areas of high, medium, and low HCP (**Tables J-3** through **J-8** in **Appendix J**). The quantification of potential impacts on specific vegetation and wetland types using a geographically explicit project footprint (the typical scenario for a proposed development) was not possible for this EIS because no on-the-ground actions have been authorized. Instead, the most vulnerable resources that could be affected were identified by calculating the proportions of each vegetation and wetland type occurring in each lease stipulation category and HCP zone. The hypothetical direct footprint for one anchor development oil field (consisting of a CPF, roads connecting to six satellite drill pads, a STP pad, and a 30-mile access road) was estimated at approximately 750 acres. The anchor development footprint was buffered by 328 feet (comprising another 6,607 acres) to account for the area of indirect effects on vegetation and wetlands.

The effects of climate change described under *Affected Environment* above, could influence the rate or degree of the potential direct and indirect impacts.

Alternative A

Under Alternative A, no federal minerals in the program area would be offered for future oil and gas lease sales. Current management actions would be maintained and resource trends would continue, as described in the Arctic Refuge CCP (USFWS 2015a). There would be no direct or indirect impacts on vegetation or wetlands from post-lease oil and gas activities under Alternative A.

Impacts Common to All Action Alternatives

Exploration

Future seismic exploration is proposed to occur during winter, with direct surface impacts occurring by passage of camp trains on skis pulled by a tracked trailer directly over the snow-covered tundra surface (see **Appendix B**). Potential impacts on vegetation and wetlands typically include changes in plant community structure for altered hydrology or direct damage to aboveground structures, such as tussocks or woody stems and branches. Long-term studies have shown that the overall impact of seismic vehicle traffic on tundra is low, but impacts can still be measured up to 25 years after exploration (Jorgenson et al. 2010). Seismic vibrator lines and camp train trails on the North Slope were found to be generally visible in summer vegetation for about 5 years after disturbance, and the longer-term impacts involved limited ground disturbance and ground subsidence where the trail became a wetter trough (Jorgenson et al. 2003).

Impacts affected drier, well-drained, woody shrub vegetation types to a greater degree than wetter types dominated by sedges. Studies on BMPs for winter off-road vehicle traffic suggest that the impacts described above could be mitigated somewhat by using vehicles fewer less pounds per square inch and performing seismic operations later in the winter when there is more snow cover and soils are frozen deeper (Bader and Guimond 2004; Bader 2005).

According to a long-term study on the effects of ice road construction and operation in the NPR-A, ice roads have a minimal effect on the vegetation, which would recover to pre-construction conditions after approximately 20 years. Similar to seismic train impacts, ice roads disturb the drier, shrub-dominated vegetation types to a greater degree than wetter graminoid-dominated communities. The damage was found to be due to the freezing of plant tissues in ice, in those species not adapted to inundation in water and then ice during winter, as well as the clipping of high microsites, such as raised tussocks that form in tussock tundra or shrub branches in low shrub vegetation types (Guyer and Keating 2005). BMPs include building ice roads along the wettest routes and avoiding the clipping of vegetation above the ice surface.

The most vulnerable wetland types to ice road construction and use are in the broad category of Freshwater Forested/Shrub wetlands.

Construction

The primary impact on vegetation and wetland types from construction is permanent loss of those types due to the placement of fill for the construction of roads, pads, and VSMs for pipeline footings. The removal of surface layers for gravel extraction in material sites also results in permanent loss of vegetation and wetlands. No vegetation or wetland types are more or less vulnerable to gravel fill, but the routing for roads and pads is preferentially located in drier vegetation types such as tussock tundra, herbaceous (mesic) tundra, and low shrub. Ice roads and pads also continue to be used during the construction phase to transport and stockpile materials. The effects of ice roads and pads would be the same as described in the *Exploration* section above.

During construction, vegetation and wetland plant community composition can be altered through the deposition of dust and gravel spray from vehicle traffic, alterations to drainage patterns from drifted snow, impounded drainages, the potential for introduction of invasive or noxious nonnative plants, and oil, water, and drilling mud spills to the tundra surface (see **Section 3.2.11** for a discussion of spills). Dust fallout due to traffic on gravel road surfaces has been shown to occur up to 328 feet from the edge of the footprint (Myers-Smith et al. 2006). Dust particles may reduce plant growth by smothering the vegetation and may reduce wetland function by introducing pollutants.

Gravel roads and pads tend to increase the occurrence of thermokarst next to the footprint edge, with ponded areas extending into the adjacent tundra and altering the vegetation and wetland plant community structure (Raynolds et al. 2014). Ponding also may occur if existing subsurface drainage is impeded at the edges of roads or if changes to patterns of snow drifting increases meltwater.

Invasive species infestations are a growing threat to the relatively pristine vegetation and wetland types on the North Slope and in the program area. Gravel sources and vehicle tracks contaminated with invasive plant propagules have been shown to be the most likely way for invasive plants to be dispersed (Carlson and Shephard 2007).

Operations

Impacts during future project operations typically would include all the effects described for construction, except for the placement of fill and gravel extraction.

Rare and Invasive Plants

Those rare vascular plant species with documented occurrences in the program area occur broadly across all vegetation types, with a few exceptions (see *Affected Environment* above). The available data for rare plants are not sufficient to determine the range of individual taxa across the program area; therefore, impacts on rare plant populations are assumed to be equivalent across all alternatives.

Similarly, potential impacts from the introduction of invasive plants are assumed to be the same for all alternatives. This is because the exploration, construction, and operations activities that can increase the risk of invasive plant introductions are very likely to be the same for all alternatives.

Alternative B

The most common vegetation type across all areas available for lease under Alternative B is herbaceous (mesic) tundra, ranging from 16.4 percent to 39.9 percent of the areas open for leasing (**Table J-3** in

Appendix J). The exception is the NSO areas in the high HCP zone, where herbaceous (wet) tundra is more common than herbaceous (mesic) tundra and accounts for 22.4 percent of the area open for leasing.

The NSO requirements under Alternative B restrict construction of permanent oil and gas facilities, except under circumstances when stream or river crossings are unavoidable; thus, the disturbances mentioned under *Impacts Common to All Action Alternatives* would likely occur throughout the NSO/high HCP areas but to a lesser extent than in the standard terms and conditions or TL areas.

The NSO protections preferentially preserve wetter more vulnerable vegetation types common to riparian areas because impacts are limited to approved crossing areas and because well pads and central processing facilities may not be constructed.

The TL areas and areas with only standard terms and conditions in Alternative B closely match the proportion of vegetation types throughout the entire program area (**Table J-1** in **Appendix J**) and overall may be preferable for construction of gravels roads and pads. This is because they are dominated by drier types, such as tussock tundra and low shrub. The TL area (comprising inland areas of caribou calving and post-calving habitat) in the low HCP zone notably has the highest proportion of low shrub (32.1 percent of the area open for leasing; **Table J-3** in **Appendix J**). The percentage of low shrub in this inland area is higher than the overall proportion in the full program area.

The lease stipulations in the TL areas restrict construction between May 20 and July 20 to reduce disturbance to calving and post-calving caribou. This restriction, however, would not preserve vulnerable vegetation or wetland types because construction would be permitted outside the TL period and would still affect vegetation and wetlands. Because of the higher incidence of low shrub vegetation, potential winter seismic and ice road impacts, as described under *Impacts Common to All Action Alternatives* above, likely would be more pronounced in the TL area under Alternative B.

The predominant wetland type in all areas open for leasing under Alternative B is freshwater emergent (ranging from 42.4 percent to 96.3 percent of the areas available for leasing; **Table J-4** in **Appendix J**). This broad category includes wetlands with a range of hydrologic conditions, from marsh to saturated classes. The wetter types occurring in the broad freshwater emergent class are often higher functioning wetlands but were not delineated separately in the NWI mapping used in this analysis. The NWI mapping provides information on high-value estuarine and marine deepwater wetlands and waters, which typically are high functioning as habitat for a variety of avian species that rely on estuarine wetlands and coastal lagoons during the post-breeding and fall migratory staging periods. The NSO areas in all HCP zones include a relatively high proportion of estuarine and marine habitats (**Table J-4** in **Appendix J**). As described in the *Affected Environment* section above, the estuarine wetlands in the program area tend to be wetter saltmarsh habitats that are high value primarily for geese in the post-breeding and migratory staging periods. The high-value freshwater wetland habitats that are encompassed in the freshwater emergent wetland class (**Table J-5** in **Appendix J**) have moderate protection through the construction restrictions along rivers and streams, but the high-value estuarine wetlands do not have similar protections under Alternative B.

Alternative C

In general, the most common vegetation types in all areas available for lease under Alternative C are herbaceous (mesic), ranging from less than 0.1 percent to 37.4 percent of the areas open for leasing, and tussock tundra, ranging from less than 0.1 percent to 41.1 percent of the areas available for leasing (**Table J-5** in **Appendix J**). The exception is the NSO area in the high HCP zone where herbaceous (wet) tundra

(24.6 percent of the area available for leasing), freshwater or salt water (29.4 percent), and sparse vegetation (12.0 percent) are the dominant broad-scale vegetation types (**Table J-5** in **Appendix J**).

The vulnerable wet tundra types in the NSO riparian areas under Alternative C are protected to a limited extent, depending on the specific design of an anchor oil field development and whether stream crossings are approved. Protections for barrier islands and selected coastal areas from impacts of barge landings and docks primarily apply to the sparse vegetation category, which is most likely comprised of barren gravel/sand beaches and dune geomorphic types.

The relative proportions of wetland types in the areas available for leasing under Alternative C generally are equivalent to the overall proportions occurring in the full program area, with freshwater emergent wetlands accounting for the greatest areal coverage (**Table J-6** in **Appendix J**). The NSO requirements for Alternative C effectively protect high-value estuarine wetlands (see discussion under *Affected Environment* and *Alternative B* above).

Alternative D

Large areas of caribou calving habitat and springs and aufeis areas, especially in the southeastern portions of the program area, are not available for leasing under Alternative D (**Table J-7** in **Appendix J**). Added restrictions for the NSO stipulation include larger setbacks for riparian areas, coastal areas, caribou calving habitat, polar bear denning areas, springs and aufeis areas, the Canning River delta and lakes, and the Mollie Beattie Wilderness boundary on the southern and eastern edges of the program area (see **Table 2-2** in **Chapter 2**). The added NSO restrictions, however, would provide limited protection to common or high-value vegetation types except for the Lease Stipulation 10, which does not allow development within 3 miles of the southern and eastern boundaries of the program area where they are next to designated Wilderness.

The most common vegetation types in all areas open to leasing under Alternative D are herbaceous (mesic), ranging from 4.7 to 60.6 percent of the areas available for leasing, and tussock tundra, ranging from 10.3 to 58.9 percent (**Table J-7** in **Appendix J**). In the NSO/high HCP zone, the most common vegetation types are herbaceous (mesic) at 24.6 percent of the area, freshwater or salt water at 23.7 percent, and herbaceous (wet) at 22.5 percent (**Table J-7** in **Appendix J**). The area identified in Lease Stipulation 10 as NSO is farther inland and is dominated by relatively low-value tussock tundra. Lease Stipulation 8 includes TLs for caribou post-calving habitat but has no effect on the preservation of high-value vegetation types occurring in that area. Similarly, the TLs for Alternative D outside of the CSU has no effect on the preservation of vulnerable vegetation types. Lease Stipulation 10 provides the only full protection for all vegetation types. This is because no development is allowed within the 3-mile setback from the Wilderness boundary (see **Table 2-2** in **Chapter 2**).

Most of the high-value estuarine and marine deepwater wetlands, as described above for Alternative B, occur in the NSO area. Outside of the NSO areas and the Wilderness boundary setback, the other lease stipulations for Alternative D would provide limited protection for the loss of wetlands from post-leasing oil and gas activities.

Cumulative Impacts

Oil and gas development impacts are common on the North Slope, and any development resulting from lease sales in the program area would increase the occurrence and intensity of these common impacts. Such projects are likely in terrestrial environments in the future, as more oil resources are being discovered, especially to the west in the NPR-A, and those projects would affect vegetation and wetlands.

In support of both oil and gas development projects and increased access for North Slope communities, impacts on vegetation and wetlands from surface transportation are anticipated to increase as the road system increases in size and more airstrips are constructed. To the extent that they would involve gravel fill, community development projects on the North Slope, such as airport improvements, roads and ports, telecommunication, and energy projects, also would increase impacts on vegetation and wetlands. The effects of climate change described under *Affected Environment* above, could influence the rate or degree of the potential cumulative impacts.

3.3.2 Fish and Aquatic Species

Affected Environment

Fish Habitat

There are three primary aquatic habitats available to marine, anadromous, and freshwater species in and next to the program area: the lagoon and nearshore brackish waters of the Beaufort Sea; the rivers, streams, and springs emanating from the Brooks Range or Arctic Coastal Plain[16] (ACP) tundra; and lakes or ponds that are concentrated mostly near the Beaufort Sea coast. The quantity and distribution of these habitats throughout the program area are summarized in **Table 3-17**, **Map 3-12**, Fish Habitat and Distribution, and **Map 3-13** in **Appendix A.**

As described in **Section 3.2.10**, freshwater habitat is limited in the program area; this is the case especially during the winter, when aquatic habitat is reduced to approximately 5 percent of that available during summer. This reduction in habitat results in fewer freshwater and anadromous fish species in the program area, relative to other parts of the ACP along the Beaufort and Chukchi Seas (USFWS 2015a) (**Map 3-12** in **Appendix A**).

Table 3-17
Fish Habitat in the Program Area and Surrounding Area

Freshwater Streams	Total Anadromous Fish Habitat by Basin (Miles) [a]	Anadromous Fish Habitat in the Program Area (Miles) [a]	Streams in the Program Area (Miles) [b]
Aichilik River	51	1	–
Akutoktak River	13	13	18
Angun River	8	8	33
Canning River	125[c]	46	41
Carter Creek	13	13	22
Hulahula River	73	27	27
Jago River	35	27	37
Katakturuk River	20	20	22
Kimikpaurauk River	4	4	5
Kogotpak River	12	12	20
Marsh Creek	1	1	20
Nataroarok Creek	11	8	21
Nularvik River	3	3	3
Okpilak River	43	31	33
Sikrelurak River	11	11	21
Siksik River	5	5	7
Staines River	18	18	18

[16]The Arctic Coastal Plain is a physiographic province that includes all of the North Slope of the Brooks Range north of the Foothills province. It extends across all of northern Alaska from the Chukchi Sea to the BS. (Wahrhaftig GIS 1965)

Freshwater Streams	Total Anadromous Fish Habitat by Basin (Miles) [a]	Anadromous Fish Habitat in the Program Area (Miles) [a]	Streams in the Program Area (Miles) [b]
Tamayariak River	26	26	29
West Canning River	15	15	15
Unnamed Stream Total	47	26	–
Total Streams	**587**	**316**	**392**

Other Waters	Miles	Acres
Total Lake Area [b]	–	19,000
Unfrozen Lake Area [d]	–	6,400
Coastline [e]	593	–

Notes:

[a] Johnson and Blossom 2017. Data do not exist to quantify overwintering habitat by stream; the locations of overwintering habitat in the program area are depicted in **Map 3-12** in **Appendix A**.

[b] USGS GIS 2018. Data may conflict with Johnson and Blossom 2017; some streams may show fewer miles of stream than anadromous waters in the stream. These are the best available data for stream miles and anadromous fish habitat miles.

[c] Includes Marsh Fork Canning River

[d] NSSI 2018. Dataset indicates the presence of liquid water, but not depth of water; thus, this data set overestimates potential fish overwintering habitat (unfrozen water may be range from a few inches to over 7 feet), though it is the best available information for this topic. Numbers are surface area of lakes with any portion unfrozen.

[e] NOAA GIS 2018; USFWS 2015a

Lagoons and Nearshore Brackish Waters

Lagoons and shallow, brackish coastal waters are well understood to provide refuge/nursery habitat for juvenile fishes and for providing significant invertebrate prey for juvenile and adult fishes alike (Craig et al. 1984; Dunton et al. 2006). The nearshore brackish and marine waters within the boundary of the Arctic Refuge, included the program area, are composed of a mix of open coastline, bays, and lagoons, bounded on the north by barrier islands. There are 16 bays and lagoons along the program area coastline, representing 593 miles of coastline and nearshore aquatic habitat potentially home to aquatic species (**Map 3-12** in **Appendix A**). During summer, these waters become brackish due to freshwater input from rivers along the ACP (Dunton et al. 2006; USFWS 2015a). Many of the inside barrier island lagoons are shallow and experience reduced currents and a small tidal flux of less than or equal to 1 foot, resulting in waters that are warmer and fresher than those outside the barrier islands.

Summertime mixing of marine waters with freshwaters produces conditions favorable to many marine and anadromous fishes,[17] as well as invertebrates (USFWS 2015a); however, by late fall the lagoons become saline again as freshwater input declines. As ice forms on the lagoons the water below becomes hypersaline and very cold, the result of ion exclusion during ice formation, restricted flow between the lagoons and the open sea beyond, and freezing point depression with greater salinity. These cold, hypersaline lagoon environments become unsuitable habitats for both anadromous and marine fishes during winter (USFWS 2015a).

Rivers, Streams, and Springs

The program area is underlain by continuous permafrost, which limits infiltration of surface water, resulting in a high ratio of stored water at the surface, rather than in the ground (USFWS 2015a). Data on these water resources are limited, with few datasets going back more than 5 years.

[17] Fish species that inhabit the ocean mostly but return to inland waters to spawn

All flowing surface waters in the program area drain to the Beaufort Sea. There are at least 10 major rivers and many smaller streams in the program area, though most flow only during summer, because of snowmelt, rainfall, perennial springs, and, in some cases, glacier melt (McCart 1980; Lyons and Trawicki 1994; Rabus and Echelmeyer 1998; Kane et al. 2013; USFWS 2015a) (**Map 3-12** in **Appendix A**). During winter, stream flow ceases due to freezing. The exception to this rule is in areas with perennial spring flow, which offer the only available overwintering habitat outside of summer (Kane et al. 2013; USFWS 2015a) (**Map 3-12** in **Appendix A**). Though there are 392 miles of streams in the program area, only 5 percent (roughly 20 miles) are habitable in winter (**Table 3-17**).

Lakes

A large portion of the program area is classified as wetlands, but lakes constitute very little of the total surface area of water for the region. Lake density from the Staines and Canning Rivers to the Aichilik River, which mark the western and eastern bounds of the program area, is lower than the ACP west of the Arctic Refuge (White et al. 2008; Arp and Jones 2009; USFWS 2015a). The central portion of the program area in particular has very few lakes. Most program area lakes are near the delta areas of the Canning, Sadlerochit, and Jago Rivers (**Map 3-12** in **Appendix A**) (USFWS 2015a).

These lakes vary in surface area from less than 1 acre to approximately 1,500 acres, though most are less than 12 acres (USFWS 2015a). Most are shallow and freeze solid during winter (Lyons and Trawicki 1994). Only a fraction of the program area lakes have a small volume of unfrozen water in winter because they are shallow (less than 7 feet) and freeze to the substrate (USFWS 2015a). The lakes with remaining liquid water at the end of winter (generally deeper than 7 feet) occur mostly in the Canning River delta; thus, fish overwintering habitat is extremely limited in area lakes. The total lake surface area is 22,100 acres, with only 6,400 acres available as potentially deep, overwintering water (**Table 3-17**; overwintering acres are likely overestimated).

Fish Species

There are approximately 17 to 21 species of fish that use the program area regularly on a seasonal basis (**Table 3-18**); however, only Dolly Varden, round whitefish, burbot, ninespine stickleback, and arctic grayling overwinter in freshwater habitats in the program area (**Table K-1** in **Appendix K**). Some species are described as overwintering in other parts of the Arctic Refuge (USFWS 2015a), but they have not been confirmed in studies in the program area (USFWS 2015a); thus, a range of likely species is presented in this EIS, based on the best available information. It is also likely that additional marine species, which are not listed in **Table 3-18**, may use waters north of the program area (USFWS 2015a; BLM 2012).

Round whitefish and burbot are present in the Canning River at the western boundary but not elsewhere in the program area (Fruge and Palmer 1994; USFWS 2015a). Dolly Varden are present in three resident freshwater populations—a resident dwarf form, a lake and spring form, and residual dwarf males of otherwise anadromous populations that stay in freshwater—and several anadromous populations (McCart and Craig 1973; USFWS 2015a).

Arctic grayling occur in some lakes and in rivers with perennial springs (Fruge and Palmer 1994; USFWS 2015a). Most of the anadromous species described in **Table 3-18** use the nearshore marine area for migration or rearing. Various marine species also use the nearshore marine area, but only four are present in large numbers next to the program area (USFWS 2015a): fourhorn sculpin, arctic flounder, saffron cod, and arctic cod. Additional information on the life history attributes for fish of the program area are provided in **Appendix K**.

Table 3-18
Fish Species that May Use the Program Area

FAMILY	Common Name	Scientific Name	Freshwater	Anadromous	Marine
COTTIDAE: Sculpins	Fourhorn Sculpin	*Myoxocephalus quadricornis*	-	-	+
GADIDAE: Cods	Arctic Cod	*Boreogadus saida*	-	-	+*
	Burbot	*Lota*	+	-	-
	Saffron Cod	*Eleginus gracilis*	-	-	+*
GASTEROSTEIDAE: Sticklebacks	Ninespine Stickleback	*Pungitius*	+	+ brackish	-
OSMERIDAE: Smelts	Rainbow Smelt	*Osmerus mordax*	-	+	-
PLEURONECTIDAE	Arctic Flounder	*Pleuronectes glacialis*	-	-	+
SALMONIDAE: Salmonids	Arctic Char [a]	*Salvelinus alpinus*	+	-	-
	Arctic Cisco [b]	*Coregonus autumnalis*	-	+	-
	Arctic Grayling	*Thymallus arcticus*	+		-
	Broad Whitefish	*Coregonus nasus*	+	+	-
	Chinook Salmon	*Oncorhynchus tshawytscha*	-	+*	-
	Chum Salmon	*O. keta*	-	+*	-
	Dolly Varden	*Salvelinus malma*	+	+	-
	Humpback Whitefish	*Coregonus pidschian*	+	+	-
	Lake Trout [a]	*Salvelinus namaycush*	+	-	-
	Least Cisco	*Coregonus sardinella*	+	+	-
	Pink Salmon	*Oncorhynchus gorbuscha*	-	+*	-
	Round Whitefish	*Prosopium cylindraceum*	+	-	-

Source: BLM 2012; USFWS 2015a
Notes:
- = not applicable
* Species with designated Essential Fish Habitat (EFH) in the program area
[a] Species that may be extremely rare or unconfirmed as present in program area waters.
[b] Some subsistence users have reported harvest take of Bering cisco (*Coregonus laurettae*), though this has not been confirmed, based on taxonomic features, such as gill raker count.

Aquatic Invertebrates

Though data for aquatic invertebrates in the program area are limited, it is well understood that invertebrates provide the bulk of food resources for both fish and bird communities of the ACP (Howard et al. 2000). The most productive waters for invertebrates are in coastal marine environments, where benthic and pelagic organisms are plentiful and diverse. The distribution and density of invertebrates depend on the types and quantities of habitats, including sediment and vegetation types (Dunton and Schonberg 2000). In freshwater habitats, benthic invertebrates and zooplankton are most prevalent, with the former dominating food sources for fish (Howard et al. 2000). Terrestrial insects likely contribute to freshwater invertebrate food resources for fish. For a more complete understanding of aquatic invertebrate communities in the program area and the ACP, refer to *The Natural History of an Arctic Oil Field* (Truett and Johnson 2000).

Essential Fish Habitat

The 1996 Sustainable Fisheries Act enacted additional management measures to protect commercially harvested fish species from overfishing. Measures were added to the Magnuson-Stevens Fishery

Conservation and Management Act Reauthorization (16 USC 1801–1882), including one to describe, identify, and minimize adverse effects on EFH. Pacific salmon EFH in the program area includes both marine water and freshwater. Marine EFH for salmon extends 200 nautical miles from the coast, though recent data indicate that EFH for these species on the ACP could be refined to just freshwater habitats (Echave et al. 2012). Freshwater EFH consists of the lower reaches of some larger rivers (**Map 3-13** in **Appendix A**). Because there is no available spawning habitat for these species, EFH does not extend to the upstream reaches of these rivers. Arctic cod and saffron cod EFHs include the coastal lagoon and marine waters next to the program area, but they may also extend into the lower reaches of larger rivers during summer. Additional relevant information on EFH for the Arctic, including the Beaufort Sea coastline, can be found in the NPR-A IAP/EIS (BLM 2012).

Climate Change

As discussed in BLM 2018a, climate change is affecting many variables that then affect aquatic species and habitats; such variables are precipitation, timing of ice formation, permafrost degradation, and changes to hydrologic functions and water quality, such as temperature and dissolved oxygen. Increasing temperature is expected to change climate patterns and lengthen the ice-free season, degrade permafrost, and increase evaporation, processes that contribute to surface water hydrology and may reduce (Laske et al. 2016) or increase (Stueffer et al. 2017) surface water connectivity. Reductions in connectivity from, for example drying of channels or ponds, may in turn reduce colonization opportunities for fish by limiting dispersal pathways and movement between habitats (Laske et al. 2016). This could change local species assemblages or species richness.

Direct and Indirect Impacts

Issuance of oil and gas leases under the directives of Section 20001(c)(1) of PL 115-97 would have no direct impacts on the environment because by itself a lease does not authorize any on the ground oil and gas activities; however, a lease does grant the lessee certain rights to drill for and extract oil and gas subject to further environmental review and reasonable regulation, including applicable laws, terms, conditions, and stipulations of the lease. The impacts of such future exploration and development activities that may occur because of the issuance of leases are considered potential indirect impacts of leasing. Such post-lease activities could include seismic and drilling exploration, development, and transportation of oil and gas in and from the Coastal Plain. Therefore, the analysis is of potential direct and indirect impacts on fish and aquatic species from on-the-ground post-lease activities

As a proxy for a geographically explicit project footprint, potential impacts on fish and fish habitat are described by types of available fish habitat, scarcity of those habitats in the program area, and importance of those habitats to aquatic species.

The effects of climate change described under *Affected Environment* above, could influence the rate or degree of the direct or indirect impacts.

Alternative A

Alternative A (No Action Alternative) would not establish an oil and gas program for the leasing, development, production, and transportation of oil and gas in and from the Coastal Plain in the Arctic Refuge. Resource trends and management actions would continue as described in the Arctic Refuge CCP (USFWS 2015a). There would be no potential direct or indirect impacts on fish and aquatic species under Alternative A.

Impacts Common to All Action Alternatives

Post-oil and gas leasing activities that could affect fish and fish habitat would occur under all action alternatives, though their locations could vary. Potential effects on aquatic species and habitats are summarized here; locations that would incur more or fewer impacts are described by alternative in the following sections.

Direct Habitat Loss or Alteration

Activities with the potential to affect fish and aquatic species include the construction and operation of new gravel roads, gravel pads, airstrips, pipelines, culverts, bridges and barge landings or docks, and gravel mining.

Fill for infrastructure would directly and permanently remove aquatic habitat within the fill footprint. Gravel fill would likely not be placed in waterbodies due to practicability; however, fill placed near waterbodies could alter aquatic habitats and indirectly affect fish, as described below in *Indirect Habitat Alteration*. Bridge piers could be located in waterbodies or floodplains. A marine barge landing or dock could remove marine habitat. Potential direct aquatic habitat loss would be adverse and long term and would occur in the fill footprint.

Use of culverts could directly alter aquatic habitats by replacing substrates, banks, or both with metal pipe. This would adversely affect the habitat in the long term by removing the capacity of the fill footprint to contribute nutrients or organic matter to the waterbody.

Buried pipelines, such as the STP pipe, would alter marine sediments in the fill footprint due to trenching to bury the pipe. This would adversely affect the habitat in the short term by removing invertebrate food sources and potential algal cover in the trench footprint until the invertebrate and algal resources regenerate.

Because gravel is often most abundant in waterbodies, gravel may be mined in waterbodies and floodplains, which would alter aquatic habitats. Existing habitats would be adversely affected in the long term by the removal of substrate and the capacity of the mining footprint to contribute nutrients or organic matter to the waterbody. Water quality would also be degraded in the short term due to increased turbidity, which could lead to changes in dissolved oxygen or other water quality changes (see **Section 3.2.10**). Water depth would increase in the long term and could create new deep freshwater habitat for fish, as has been observed in other North Slope gravel mines (BLM 2012). Because deep habitats are limited in the program area, this could result in potential beneficial long-term effects for fish by creating new overwintering habitat.

Indirect Habitat Alteration: Dust and Gravel Spray

Activities associated with the post- leasing program that could cause potential dust and gravel spray effects include construction and operation of new gravel roads and gravel pads and vehicle traffic on gravel infrastructure.

Dust and gravel spray would be generated during future gravel placement, gravel compaction, and vehicle traffic on gravel roads and pads. Road dust accumulation is greatest within 35 feet of roads, but deposition may occur over a broader area. Roughly 95 percent of dust settles within 328 feet from the road surface (Myers-Smith et al. 2006; Walker and Everett 1987). Dust could increase turbidity in waterbodies next to roads and construction areas and could increase sediment and gravel inputs to existing substrates. This would have a long-term adverse effect on aquatic habitats and species by decreasing habitat quality, including through mobilization of possible contaminants specific to the underlying geology of gravel pits where sediment is mined. These sequestered chemicals or elements are not necessarily harmful themselves but could be harmful, in combination with other water chemistry attributes, such as pH.

Indirect Habitat Alteration: Flow Alteration and Fish Passage

Post-leasing oil and gas activities that could affect flow alteration and fish passage include construction of ice roads, snow management activities, use of rolligons or other off-road vehicles for seismic surveys, maintenance, and the placement of bridge piers or piles in waterbodies.

Flow alteration can result from obstructions in the natural flow path, either by infrastructure or by compacted ice. Compacted ice over and surrounding waterbodies can delay ice melt and temporarily alter aquatic habitats. Compacted ice can change natural drainage patterns or cause water impoundments during spring break up. Delayed melt of ice roads or pads can also temporarily block fish passage, which can impede Arctic fish attempting to migrate from overwintering areas to feeding habitat during the early part of the open-water season.

As discussed in BLM (2012), many fish move upstream during breakup to access productive feeding habitat or to reach locations only accessible during spring flooding. Energy reserves in spring are typically low for most fish and additional stress or delayed access to feeding habitats could have adverse impacts. A barrier to movement could alter migration patterns to lower quality feeding habitat and increase energetic demands, which could compromise survival. Ice compaction would temporary alter aquatic habitats near ice infrastructure or near where off-road activities would occur. This could have longer-term adverse effects on fish if their migration is annually delayed.

Bridge piers or piles could also alter flow due to ice blockage during spring break up. Effects would be the same as those described above for flow alteration due to ice compaction.

Indirect Habitat Alteration: Water Quantity

Post-lease oil and gas activities that could affect water quantity include water withdrawal from lakes or streams for ice roads, water supply, dust suppression, and other uses.

Water withdrawal from lakes can affect the amount of habitat available to overwintering fish, summer habitat accessibility, and habitat characteristics. Removal or compaction of snow can also increase the depth of freezing on lakes. As a result, the water quantity available in a lake during the winter can be greatly reduced.

Because unfrozen freshwater in winter is scarce in the program area, any future withdrawal from these areas would have the most adverse effects on fish. These springs and deep lakes are sensitive areas, in part because there are so few of them that they limit the distribution of fish in the program area.

Indirect Habitat Alteration: Water Quality

Activities that could affect water quality in the future include the following:

- Water withdrawal from lakes or streams for ice roads, water supply, dust suppression, and other uses
- STP discharge to marine waters
- General construction in or near waterbodies
- Vehicle traffic on gravel infrastructure
- Gravel mining

Future water withdrawal from lakes in the winter could temporarily alter lake water chemistry (until spring breakup and recharge) by depleting oxygen, increasing solutes, and changing pH and conductivity. Reducing water quantity in a lake during the winter can increase the salinity of the water beneath the ice.

Construction or gravel mining that disturbs soils can increase sediment runoff, turbidity, and contaminant concentrations in streams. During future construction or mining, this would have a short-term adverse effect on aquatic habitats and species around or immediately downstream of soil-disturbing activities. Fugitive dust from vehicle traffic could also increase local turbidity in streams around gravel infrastructure. Dust effects on aquatic habitats and species would be long term and adverse.

Discharge of brine to the marine area from a potential STP could further increase salinity, particularly in the winter when freshwater may be frozen. Effects would be particularly pronounced if the discharge was in the brackish lagoon waters that are hypersaline in winter.

<u>Disturbance or Displacement: Noise and Human Activity</u>
Post-lease oil and gas activities that could cause effects related to noise and human activity include seismic surveys (use of vibroseis to image the subsurface), gravel mining (dredging or explosives), and pile driving for bridges or VSMs.

Seismic surveys generate increased sound pressures in waterbodies. The high-intensity acoustic energy produced by seismic surveys can damage auditory sensory hair cells in fish, reducing their ability to hear (McCauley et al. 2003; Popper 2003; Smith et al. 2004). Underwater shock waves can also injure the swim bladder and other organs and tissue, which could injure or kill fish. Increased sound pressures in unfrozen springs in winter could stress fish because they would not have alternate habitats where they could move to avoid effects; thus, seismic surveys could disturb, injure, or kill fish in unfrozen waterbodies (springs) in the winter. Vibroseis rigs operating on the ice overhead can create sound pressures great enough approximately 33 feet from the source to cause avoidance behavior (Greene 2000 and Nyland 2002, as cited in BLM 2012). Effects are further detailed in BLM 2012.

Noise generated by vehicles and machinery in the future could have potential local impacts on fish, such as stress-induced fleeing related to loud noises. The noise would be greatest during construction but would occur to a lesser degree throughout the program area. Because most construction would occur in the winter when waterbodies would have ice cover, noise effects on fish would be reduced during that time.

<u>Injury or Mortality: Noise</u>
Post-lease oil and gas activities that could affect fish and aquatic species from noise include seismic surveys (use of vibroseis to image the subsurface), gravel mining (dredging or explosives), and pile driving for bridges or VSMs.

As described above in *Noise and Human Activity*, noise can disturb fish, and, at higher dB or in greater intensity, it can injure or kill fish. Restricting seismic surveys to winter when waterbodies (except springs) are frozen and avoiding areas around springs would minimize effects on fish.

Pile driving can also create sound levels that affect fish. Assuming that piles would be installed in winter, if the bridge or VSM sites freeze to the bottom, the ice would diminish the sound, and the potential impact on fish in any adjacent overwintering habitats would be negligible.

Entrainment

Post-lease oil and gas activities that could cause effects related to entrainment include gravel mining and water withdrawal from lakes or streams or from marine waters, such as the STP.

Though injury or mortality of fish from entrainment or impingement at water intake could occur, the effect would be minimized by ROPs that ensure that intakes be screened. As is described in BLM 2012, it is unlikely that fish would be entrained in the water intake.

Contaminants

Post-lease oil and gas activities that could cause effects related to contaminants include potential spills from storage, use, and transport of waste and hazardous materials, potential spills from wells, pipelines, or other infrastructure, and mobilization of contaminants into aquatic or terrestrial systems from erosion, fugitive dust, and permafrost degradation. As described in detail in BLM 2012, spills can adversely affect aquatic habitats and species by exposing them to contaminants. Spills can injure or kill fish and effects can be long or short lived depending on the type, size, duration, and season of the spill. See **Section 3.2.11** for more discussion of spills.

Alternative B

Under Alternative B, five streams described in Lease Stipulation 1 would have a 0.5-mile setback and five streams would have a 1-mile setback for surface development, though bridges, roads, and pipelines could still be built in the setbacks. Some streams would have no setbacks, and fish-bearing streams and other fish-bearing waterbodies would have a 500-foot setback. Most of the coastal areas would not have setbacks, but no development would be allowed in the coastal waters, lagoons, and barrier islands under any alternative; thus, effects on unprotected streams and coastal areas and the species that use them would be most pronounced under this alternative, and the types of impacts would be the same as those described under *Impacts Common to All Action Alternatives*. Overwintering habitat (springs) would be unprotected from both surface development beyond the 500-foot setback for fish-bearing waters and from water or ice withdrawal, which could affect the long-term survival and distribution of freshwater fish in the program area. Withdrawal of unfrozen water from lakes may be permitted. Alternative B would also have the most potential adverse effects on EFH since coastal areas and some anadromous streams would not be protected and could be developed.

Alternative C

Under Alternative C, the same select streams as Alternative B would have 0.5- to 1-mile setbacks for surface development, with similar exceptions for roads and pipelines; however, the Canning, Hulahula, and Okpilak River setbacks would be increased to 2 miles from the active floodplain, except where the Canning River floodplain is outside of the Arctic Refuge. Some streams would have no setbacks. As with Alternative B, fish-bearing streams and other fish-bearing waterbodies would have a 500-foot setback. There would be a 1-mile NSO setback from the coast (although exceptions would be allowed for various facilities, including docks and barge landings), and no development would be allowed in the coastal waters, lagoons, and barrier islands. As with Alternative B, no special protections are included in Alternative C for the critical springs in the areas offered for lease. Such springs are vital overwintering habitat for fish beyond the 500-foot setback for fish-bearing waters; they are protected from surface development and from water or ice withdrawal; thus, long-term survival and distribution of freshwater fish in the program area could be affected. These lease stipulations are similar in magnitude of potential impact on fish and aquatic resources as under Alternative B, though greater protections are offered for select rivers and streams under

Alternative C, and streams in the southeastern portion of the program area would be in areas not offered for lease.

Alternative D

Under Alternative D, 17 streams would have setbacks for surface development, although exceptions would be allowed for roads and pipelines. Setbacks for the Canning River east of the Arctic Refuge boundary and for the Aichikik and Okpilak river floodplains would be 3 miles; setbacks for the Hulahula River floodplain would be 4 miles; setbacks for the Sadlerochit and Jago River floodplains would be 1 mile; and the remaining 11 streams would have 0.5-mile setbacks.

Permanent facilities would be prohibited within 0.5 mile of the ordinary high-water line of all waterbodies in the Canning River delta, which would protect most lakes in the program area. Additional 1- to 3-mile setbacks would be provided for four specific springs and aufeis areas, which would reduce potential effects on aquatic species and habitats, as described under *Impacts Common to All Action Alternatives*. There would be a 2-mile NSO setback from the coast, though exceptions would be allowed for barge landings, docks, and pipelines. No development would be allowed in coastal waters, lagoons, and barrier islands, as with all alternatives. Withdrawal of unfrozen water from lakes may be permitted.

Future gravel mining would not occur in the active floodplain or channel of the Canning, Sadlerochit, Hulahula, and Aichilik Rivers. Potential impacts on fish and aquatic species would be reduced under Alternative D, compared with Alternatives B and C, and would occur mostly in the western portion of the program area. Impacts would be predominantly indirect, such as in changes to hydrology associated with infrastructure outside river and lake buffers or where infrastructure crosses river corridors. Protecting spring habitat via TLs and NSOs would reduce the likelihood of disrupting groundwater that supports fish habitat.

Cumulative Impacts

Past and present actions in the program area have been limited and thus have had limited effects on aquatic species and habitats. Infrastructure developed for the community of Kaktovik may have indirectly affected or may be affecting aquatic habitats and species by contributing dust and gravel spray to streams, altering habitat by withdrawing water, and disturbing or displacing fish due to noise. Impacts from areawide seismic activities may change hydrology and water quality, potentially affecting fish habitat, if surface damage results in thermokarst and water channel formation. The effects of climate change described under *Affected Environment* above, could influence the rate or degree of the potential cumulative impacts.

Alternative A would have no cumulative impacts on aquatic species and habitats, but all action alternatives would incrementally contribute to potential cumulative impacts on fish and aquatic resources from post-leasing oil and gas activities.

3.3.3 Birds

Affected Environment

According to the USFWS (USFWS 2015a), 156 bird species have been recorded in the Arctic Refuge on the northern foothills of the Brooks Range, in the ACP (an area inclusive of the program area), and in adjacent marine waters (**Table J-9** in **Appendix J**). Seventy of those species (45 percent) are confirmed breeders or permanent residents, or both; 11 are possible breeders, 40 have been recorded staging or migrating in the area (some also breed there), and 64 are casual, accidental, or rare visitors.

With few exceptions, all birds in the program area are migratory and are present only during the summer breeding season, May to September, depending on species. Winter residents include small numbers of ravens and ptarmigan, dippers near open running water, and occasional gyrfalcons. The migration routes and wintering areas of ARCP birds encompass much of the North American and South American continents and central and southern Pacific islands; some species may winter in southern Africa, Australasia, Japan and China, and coastal Antarctica.

Shorebirds and passerines are the most abundant guilds of nesting birds on the ACP (Liebezeit et al. 2009). Waterfowl, loons, grebes, and cranes also use the ARCP in large numbers (Bart et al. 2013). Other bird groups present in lower numbers are larids (gulls, jaegers, and terns), raptors and owls, and seabirds. Many of the 156 species recorded are uncommon or rare; only 57 species are known to occur regularly in substantial numbers on the ARCP and are classified as fairly common, common, or abundant (Pearce et al. 2018; **Table J-9** in **Appendix J**).

Additional seabirds occur along the marine vessel route to Dutch Harbor, Alaska, including Steller's and spectacled eiders, which are discussed under Special Status Species, below (see **Table J-10** in **Appendix J**).

The ARCP represents a substantial portion of the Beaufort Sea coastline in Alaska. Accordingly, it also supports a large number of birds during the important nesting, rearing, and migration staging periods. For these reasons, the ARCP and adjacent marine waters are recognized as important bird areas by the American Bird Conservancy, Audubon, and Birdlife International. Because the ARCP completely encompasses it, the program area is considered part of the important bird areas. Prior studies (summarized in USFWS 2015a) have demonstrated that at least several hundred thousand breeding and nonbreeding birds use the ARCP and program area during the short arctic summer.

Although there are historical survey data for the ARCP, as described in USFWS and BLM (2018), detailed distribution and abundance data for the program area are lacking for many, and contemporary data are lacking for most bird species. In addition, much of the contemporary data were collected for only 1 or 2 years, cover only a small portion of the program area, or were collected at low survey intensity. The program area contains far fewer water bodies, compared with sites farther west, such as Prudhoe Bay and the NPR-A. Because of this, many waterbirds and shorebirds are patchily distributed, which increases the difficulty in determining accurate abundance levels based on a small number of surveys.

A few bird species have been relatively well studied on the ARCP, such as golden eagles and fall-staging snow geese (summarized in USFWS 2015a), but detailed distribution and abundance data are lacking for many species. Information about the various bird species and species groups found in the program area is summarized below.

Special Status Species

Of the 156 species known to occur in the program area, 10 are recognized as BLM sensitive species (BLM 2018b [in prep.]), 11 are USFWS birds of conservation concern (USFWS 2008a), and 44 are recognized as at-risk species by the ADFG (**Table J-9** in **Appendix J**). Listings by the US Shorebird Conservation Plan Partnership, Partners in Flight, the International Union for Conservation of Nature (2018) Red List of Threatened Species, and Audubon Alaska are also included in **Table J-9**. At-risk species are those with a small population size or range, a declining population, or a population facing documented threats. At-risk rankings also incorporated the conservation concern listings prepared by other agencies and specialist groups focused on the conservation of Alaska birds (ADFG 2015).

Steller's eiders, the smallest of the four eider species, are tundra-nesting sea ducks. Their primary breeding range is in eastern Siberia, where they nest in wet tundra near freshwater ponds with and without emergents[18] (Fredrickson 2001; Safine 2013, 2015; Graff 2016). The Alaska-breeding Steller's eider, belonging to a larger Pacific population, was listed under the ESA as a threatened species in 1997 (62 FR 31748–31757). Critical habitat was designated for Steller's eiders in western Alaska, but no critical habitat was designated on the North Slope. Although the nesting distribution on the North Slope once extended eastward to Demarcation Bay, most Steller's eiders nest in the Utqiaġvik area (Quakenbush et al. 2002). Although Steller's eiders could occur in the program area, it would be unusual. The species is considered to occur only as a rare visitor in the program area (**Table J-9** in **Appendix J**) and is not expected to nest that far east on the ACP.

The spectacled eider is a medium-sized eider, breeding on tundra in arctic and western Alaska and eastern Siberia and spending the rest of the year at sea, after young can fly (Petersen et al. 2000). The spectacled eider was listed as threatened in 1993, after a severe decline of the species on the Yukon-Kuskokwim Delta (58 FR 27474–27480). Critical habitat was designated in 2001 in Ledyard Bay in the Chukchi Sea and in other areas of western Alaska (66 FR 9146–9185). No critical habitat occurs in the program area. The spectacled eider breeds primarily on the Arctic coast from Point Lay and Utqiaġvik to the Sagavanirktok River (USFWS 1996). The spectacled eider is an uncommon breeder in the program area, and nests have been documented only on the Canning River delta (Latty, unpublished data). The program area is in a low-density region for pre-nesting spectacled eiders. ACP aerial surveys from 2012 to 2015 recorded low densities of pre-nesting spectacled eiders in those portions of the program area that were surveyed (0 to 0.07 birds/square kilometer) (**Map 3-14**, Nest Sites, Observations, and Density of Pre-Nesting Spectacled Eider, in **Appendix A**). The distribution of nesting is unknown in the program area because extensive surveys have not been undertaken. Low numbers of spectacled eiders are expected to occur in the program area during the pre-nesting period, where suitable habitat is available.

Waterbirds

As treated in this EIS, waterbirds on the ARCP are waterfowl, loons, grebes, and cranes. Thirty-seven species of waterbirds have been observed on the ARCP. Of these, 23 species are confirmed breeders or migrants (or both), and 14 are casual, accidental, or rare visitors (**Table J-9** in **Appendix J**). The group of 23 breeders/migrants includes 13 species of ducks, 4 geese, 3 loons, 2 swans, and 1 crane. Of these 23 species, 3 are BLM sensitive species (BLM 2018b [in prep.]), 2 are USFWS birds of conservation concern (USFWS 2008a), and 4 are ADFG at-risk species (ADFG 2015) (**Table J-9** in **Appendix J**). Waterbirds, especially ducks and geese, are an important subsistence resource for residents in Kaktovik (summarized in USFWS 2015a).

Seventeen waterbird species are fairly common, common, or abundant in the program area as either breeders or migrants: greater white-fronted goose, snow goose, brant, cackling goose, tundra swan, American wigeon, northern pintail, greater scaup, king eider, common eider, surf scoter, white-winged scoter, long-tailed duck, red-breasted merganser, red-throated loon, Pacific loon, and yellow-billed loon (Pearce et al. 2018). Since 1986, the USFWS has conducted annual aerial surveys of much of the ACP of Alaska to generate indices of breeding waterbird population size and trends over time (Stehn et al. 2013); however, prior to 2018 only about a quarter of the area was included, and it was surveyed at the lowest intensity, making estimates of waterbird abundance and distribution across the program area relatively unreliable.

[18]A water plant whose leaves and flowers appear above the surface

Breeding waterbirds generally arrive on the coastal plain of the North Slope in late May and June and begin nesting from late May through June (Johnson and Herter 1989). In addition to water body shorelines and islands, most waterbirds use a variety of wet and moist tundra habitats for nesting, often next to water (but see *Common Eider* below). After hatching in July and August, most waterbirds occupy lakes and ponds to rear their young, although geese and cranes graze in tundra wetlands. In the late summer, post-breeding and molting (temporarily flightless) waterbirds use coastal lagoons behind the barrier islands. Waterbirds continue to forage in the lagoons in the fall as they stage for the southward migration. Various migration routes and wintering areas are used by different species of waterbirds. Most waterfowl (swans, geese, ducks) migrate through the central continent to wintering areas across the continental US.

Common Eider and King Eider

Common and king eiders are an important subsistence resource for North Slope residents. The USFWS conducts annual aerial surveys to estimate the number, distribution, and population trend of breeding common eiders in coastal habitats on the North Slope, including Arctic Refuge lands (summarized in USFWS 2015a) (**Map 3-15**, Post-Breeding and Fall Staging Common Eider, in **Appendix A**). Common eiders have been increasing in abundance on their barrier island breeding grounds in the Arctic Refuge since 1976, when only 14 nests were found. In a 2015 ground-based survey conducted across most Arctic Refuge barrier islands, over 800 common eider nests were found (Latty, unpublished data). Common eiders winter in coastal areas from the Aleutian Islands south to southern Alaska. Migration routes of common eiders in the Beaufort Sea are generally within 30 miles of shore, and routes are affected by the occurrence of open water leads in spring. Common eiders undertake a spectacular molt migration of several hundred thousand birds from the Beaufort Sea to coastal areas in western Alaska along the Chukchi sea coast.

King eiders are abundant in the Beaufort Sea area, including the program area (Johnson and Herter 1989). They nest primarily in tundra wetlands, and low densities (0.3–0.8 nests/square kilometer) have been documented in the Arctic Refuge (Johnson and Herter 1989) (**Map 3-16**, Post-Breeding and Fall Staging King Eider, in **Appendix A**). Barry (1974) estimated that about a million king eiders migrate into and through the Beaufort Sea area. Most of these birds nest on high arctic islands of Canada. Spring migrating king eiders come close to land only as they pass specific points, including Point Barrow and sites primarily in the Northwest Territories; offshore lead systems in pack ice are the primary determinant of routing and timing. King eiders undertake a spectacular molt migration from nesting areas to molting areas in the Chukchi and Bering Seas. As in spring, much of this migration occurs offshore and is most conspicuous at Point Barrow and Cape Bathurst in the eastern Beaufort Sea, which is much less conspicuous along much of the intervening coast (Johnson and Richardson 1982). King eiders are not abundant during fall surveys of coastal lagoons in the Arctic Refuge (Lysne et al. 2004).

Waterbird Use of Coastal Lagoons

Many waterbirds in the post-breeding period use the coastal lagoons behind the common barrier islands along the program area's coast (**Map 3-15**, **Map 3-17**, Post-Breeding and Molting Surf Scoter, **Map 3-18**, Post-Breeding and Molting Long Tailed Duck, and **Map 3-19**, Post-Breeding and Fall Staging Yellow-Billed Loon, in **Appendix A**). In aerial surveys of nearshore waters and barrier islands conducted during the early post-breeding period (early July 1999–2009), 17 waterbird species were recorded regularly (Dau and Bollinger 2009). The most abundant species recorded was surf scoter (average of 2,173 individuals), followed by long-tailed duck (average of 819 individuals), common eider (average of 593 individuals), and glaucous gull (average of 553 individuals) (from data summary by Pearce et al. 2018). In aerial surveys conducted later in the season (late July and early August 2002 and 2003), thousands more long-tailed ducks were observed, with over 28,000 birds recorded in one year (Lysne et al. 2004). These data suggest that long-tailed ducks from a larger geographic area move to coastal lagoons in the Arctic Refuge in late summer and fall.

During those same aerial surveys conducted in fall 2002 and 2003, up to 20, 28, 29, 33, and 41 percent of the yellow-billed loons, red-throated loons, long-tailed ducks, scaup, and Pacific loons, respectively, counted across the entire North Slope survey area were in the lagoons and nearshore areas along the Arctic Refuge coast. It is likely that many of the birds using lagoons along the Arctic Refuge coast during post-breeding nested to the east, particularly in northern Canada.

Snow Geese

Up to 325,000 snow geese of the Western Arctic Population use the ARCP as a staging area for fall migration (USFWS and BLM 2018) (**Map 3-20**, Frequency of Occurrence of Snow Goose Flocks with >500 Birds observed During Aerial Surveys, 1982-2004, in **Appendix A**). They come primarily from the large nesting colony on Banks Island and from much smaller nesting colonies on the North Slope and in western Canada to graze in upland and coastal tundra habitats (Hupp et al. 2002). The breeding population on Banks Island more than doubled, from 200,000 in the early 1990s to 500,000 in 2013 (Pacific Flyway Council 2013). The population breeding across the entire coastal plain of the North Slope also increased dramatically in that time (Burgess et al. 2017; Hupp et al. 2017). In the last surveys of staging snow geese on the ARCP conducted in 2004, 189,636 individuals were recorded (USFWS 2015a). If trends in staging reflect population trends in breeding areas, the number of geese staging in the program area was likely higher in recent years. Snow geese depend on this staging period to build energy reserves for their southward migration (Brackney and Hupp 1993). Following staging on the ARCP and areas east to the Canada border, snow geese migration takes birds south through Alberta and Manitoba and to wintering areas primarily in central California.

Shorebirds

Thirty-three shorebird species have been recorded on the ARCP, 21 of which are confirmed breeders or migrants or both, and 12 are casual, accidental, or rare visitors (**Table J-9** in **Appendix J**). The group of 21 breeders/migrants includes 16 sandpiper species, three plovers, and two phalaropes. As a group, shorebirds are of increasing conservation concern, as many species have been undergoing population declines over the past several decades. Of the 21 breeding/migrant shorebird species, 4 are BLM sensitive species (BLM 2018b [in prep.]), 4 are USFWS birds of conservation concern (USFWS 2008a), and 9 are ADFG at-risk species (ADFG 2015) (**Table J-9** in **Appendix J**).

Seventeen shorebird species are fairly common, common, or abundant in the program area as either breeders or migrants: black-bellied plover, American golden-plover, semipalmated plover, upland sandpiper, whimbrel, ruddy turnstone, stilt sandpiper, sanderling, dunlin, Baird's sandpiper, buff-breasted sandpiper, pectoral sandpiper, semipalmated sandpiper, western sandpiper, long-billed dowitcher, red-neck phalarope, and red phalarope (Pearce et al. 2018).

Shorebirds arrive on the North Slope in mid-May through June. Most begin nesting in June, though a small number begin laying eggs in late May and into early July (Saalfeld and Lanctot 2015). Shorebirds use a wide range of aquatic, wet, and moist tundra habitats for nesting, often near bodies of water. Brown et al. (2007) conducted surveys of breeding shorebirds in June 2002 and 2004; they recorded 14 shorebird species and estimated that 230,000 shorebirds (95 percent confidence interval (CI) of 104,000 to 363,000) occupied the program area during the breeding season.

Species richness and density typically were highest in coastal wetland and riparian habitats and near river deltas. Among wetland plots, densities were highest near the Canning River delta on the western edge of the program area. In a review of studies conducted across the entire North Slope, Johnson et al. (2007) determined that shorebirds were more abundant near the coast than farther inland and that species richness was highest to the west, in the NPR-A; however, several species were more common in the east, reflecting differences in distribution among individual species across the coastal plain of the North Slope.

After hatching, most shorebirds use open tundra and shorelines to rear their young; as the young become flight capable, they begin to forage on the coast. In late July through September, shorebirds stage on ARCP river deltas for the fall migration to wintering areas in the Americas and Asia. Most of the deltas are used by large numbers of foraging shorebirds, with the Jago River delta being one of the most heavily used areas (summarized in USFWS 2015a and Pearce et al. 2018). Most of the shorebirds foraging in the river deltas in late summer and fall are juveniles hatched earlier in the summer.

The data from birds marked with radio transmitters indicate that individuals that migrate via the Central Flyway use multiple river deltas as they gradually migrate eastward across the ARCP. Shorebirds continue migrating south to Central and South American coasts.

Larids

Larids on the ARCP are gulls, jaegers, and terns. Sixteen larid species have been recorded, 9 of which are confirmed breeders or migrants, or both, and 7 are casual, accidental, or rare visitors (**Table J-9** in **Appendix J**). The 9 breeding/migrant species are pomarine jaeger, parasitic jaeger, long-tailed jaeger, ivory gull, Sabine's gull, Ross's gull, mew gull, glaucous gull, and arctic tern. None of these are BLM sensitive species (BLM 2018b [in prep.]), one is a USFWS bird of conservation concern (USFWS 2008a), and none are ADFG at-risk species (ADFG 2015) (**Table J-9** in **Appendix J**). Three additional larid species (black-legged kittiwake, glaucous-winged gull, and herring gull) occur along the marine vessel route to Dutch Harbor (Audubon Alaska 2017).

Larids arrive on the North Slope roughly at the same time as shorebirds, in mid-May through June (Johnson and Herter 1989). They breed across the ARCP in a range of habitats, including open tundra (primarily jaegers), shores and islands on tundra lakes, and on the barrier islands (primarily gulls and terns). During the breeding season, the smaller gulls and terns generally feed on aquatic invertebrates and small fish, whereas jaegers largely prey on small mammals, birds, and eggs.

The single larger gull species (glaucous gull) is omnivorous and can prey on small birds and eggs. Local residents report that glaucous gull populations on the ARCP have been increasing, and there is some evidence of increases in gull populations in the Arctic generally (National Research Council 2003). These increases could be due to global changes in their populations or increased human development in the area (Weiser and Powell 2010). There are numerous accounts of glaucous gulls foraging in North Slope landfills. Distribution maps from aerial surveys indicate that gulls tend to concentrate in the vicinity of human development on the coastal plain of the North Slope, including Kaktovik on the Arctic Refuge (summarized in USFWS 2015a).

Raptors

As treated in this EIS, raptors on the ARCP are eagles, hawks, falcons, and owls. Thirteen raptor species have been recorded on the ARCP, 6 of which are confirmed breeders or migrants, or both, and 7 are casual, accidental, or rare visitors (**Table J-9** in **Appendix J**). The 6 breeding/migrant species are rough-legged hawk, golden eagle, gyrfalcon, peregrine falcon, snowy owl, and short-eared owl. None of these are

BLM sensitive species or USFWS birds of conservation concern (BLM 2018b [in prep.]; USFWS 2008a), but 4 are ADFG at-risk species (ADFG 2015) (**Table J-9** in **Appendix J**). Northern harriers are an uncommon summer resident and both northern harrier and merlin also may breed in the program area (USFWS 2015a). Golden eagles are protected under the Bald and Golden Eagle Protection Act. The arctic peregrine falcon subspecies, which breeds on the ARCP, was previously listed as endangered under the ESA, but it has been delisted (USFWS and NMFS 2014).

In the Arctic Refuge, nesting of raptors begins from late March to early May (Young et al. 1995). Some snowy owls winter on Arctic breeding grounds, but most arrive on the North Slope during April and May, with most egg laying in mid-May (summarized in Holt et al. 2015). The remaining raptors arrive and begin nesting in May and early June (Johnson and Herter 1989).

Golden eagles nest almost exclusively in cliff habitats and, in the program area, they nest primarily in the Brooks Range foothills, as cliff habitat appropriate for eagles is rare elsewhere on the ARCP. Breeding golden eagles return to Alaska, presumably including the Arctic Refuge, from late February to mid-April, with nonbreeders arriving later (summarized in Kochert et al. 2002). Golden eagles are commonly observed on the ARCP in late June and early July, when calving and post-calving caribou herds are present; these are primarily subadult birds that are preying on or scavenging caribou calves (summarized in USFWS 2015a). In a 1983–1985 study, golden eagles were the main predators of caribou calves on the calving grounds (Whitten et al. 1992; Griffith et al. 2002). It also appears that golden eagles from other regions in the state use northern Alaska, including the Brooks Range and ARCP. Eagles that hatched in the Alaska Range were found in the Arctic Refuge during at least two subsequent summers (summarized in USFWS 2015a).

Surveys on the ARCP were conducted on the Canning, Hulahula, and Kongakut Rivers in the 1990s and early 2000s to monitor cliff-nesting raptors (summarized in USFWS 2015a). Raptors nesting on cliffs along these rivers are golden eagles, peregrine falcons, gyrfalcons, and rough-legged hawks. In the program area, cliff nest habitats occur primarily in river corridors; in the surveyed areas the overall abundance of nesting raptors generally was found to be low.

The two owl species, snowy owl and short-eared owl, that breed on the ARCP are variable in abundance among years. As in other regions on the North Slope, both species are substantially more common as breeders in years of high vole or lemming abundance (Johnson and Herter 1989).

Landbirds

As treated in this EIS, landbirds on the ARCP include a diversity of species that are strongly dominated in abundance by passerines[19] and ptarmigan. Fifty landbird species have been recorded on the ARCP, but 32 of these are casual, accidental, or rare visitors; only 18 are confirmed breeders, permanent residents, or migrants (**Table J-9** in **Appendix J**); this includes 16 passerines and 2 ptarmigan species. None of the 18 breeding/migrant landbird species are BLM sensitive species or USFWS birds of conservation concern (BLM 2018b [in prep.]; USFWS 2008a), and 8 are ADFG at-risk species (ADFG 2015) (**Table J-9** in **Appendix J**).

Most landbirds on the coastal plain of the North Slope are migrant species that arrive in mid-May through June and begin nesting shortly thereafter (Johnson and Herter 1989). The willow ptarmigan, rock ptarmigan, and common raven are year-round residents. By far the most abundant landbird species on the

[19]Perching birds

ARCP is Lapland longspur, which nests throughout the area in wet and moist tundra habitats. Other relatively common species on the ARCP are rock ptarmigan (found throughout the area), willow ptarmigan (more common inland), common raven (found throughout the area), eastern yellow wagtail (most common in riparian areas), common and hoary redpoll (found throughout the area), snow bunting (more common on the coast), savannah sparrow (more common inland), and American tree sparrow and white-crowned sparrow (more common inland) (Pearce et al. 2018).

Seabirds

Seabirds occurring in marine waters next to the ARCP are fulmars, shearwaters, and alcids. Seven seabird species have been recorded in marine waters off the ARCP, but 5 of those species are casual, accidental, or rare visitors. Only the black guillemot occurs as a rare breeder on barrier islands, and the thick-billed murre as a rare migrant (**Table J-9** in **Appendix J**). Of the 2 breeding/migrant seabird species, neither is a BLM sensitive species or USFWS bird of conservation concern (BLM 2018b [in prep.]; USFWS 2008a), and neither is an ADFG at-risk species (ADFG 2015) (**Table J-9** in **Appendix J**).

Thirteen additional seabird species are present along the marine vessel route to Dutch Harbor, including alcids (auklets, murres, and puffins) and cormorants (Audubon Alaska 2017) (**Table J-10** in **Appendix J**). The federally endangered short-tailed albatross may be present in southernmost portion of the route.

Climate Change

The changing climate has varied impacts on bird species, depending on the species considered and how dramatically the vegetation and hydrology are responding to the changes. Some bird species could benefit from longer breeding seasons and expansion of shrub and coastal habitats, while others could lose habitat, food, or prey, and could experience seasonal mismatches in breeding and plant/insect phenology.

Climate change is expected to increase temperatures, increase precipitation, and lengthen the snow-free season (see **Section 3.2.1**). Summer temperatures above freezing could occur for 6 weeks longer by 2099 (SNAP 2011). Warmer temperatures and earlier snowmelt would likely change the timing of seasonal events on the North Slope, but it is unclear how bird populations would respond. For birds, climate change would affect phenology (seasonal timing of events), habitat and forage availability, and range expansion.

It is unclear whether some or all birds would be able to arrive earlier to take full advantage of an earlier and longer breeding season; however, a delay in freeze-up in fall should be advantageous to the slow-growing young of such species as loons and swans, which are not always flight capable by time of freeze-up.

With earlier thaws and snowmelt, insect populations would hatch earlier (McKinnon et al. 2012). Some species of insect-feeders (shorebirds and songbirds) can initiate nests earlier with early snowmelt, whereas others (jaegers, common eiders, and raptors) do not; however, it is unclear if birds relying on insects to feed their young (songbirds and shorebirds) could adapt to hatch at the optimum time as insect hatch continues to advance (Grabowski et al. 2013). Plant biomass is predicted to increase with warmer temperatures, but forage quality is seasonal. Mismatches in insect abundance and forage quality with timing of bird reproduction would likely have adverse effects on growth rates of young of some species (Dickey et al. 2008; McKinnon et al. 2012).

Avian habitat is likely to change slowly with climate change, except for coastal areas subject to erosion and deposition (see below). Waterbodies in the program area may shrink, depending on the balance of precipitation, evapotranspiration, and drainage from thermokarsting and a deeper active layer in soils.

Some shorebirds (particularly phalaropes), waterfowl, and loons could face reduced availability or quality of nesting and brood-rearing habitats (Martin et al. 2009).

Increases in shrubs and trees have been documented (Sturm et al. 2001b; Tape et al. 2006) and are expected to continue with increasing summer temperatures. If available wet sedge and graminoid meadows are reduced by invading shrubs and decreasing moisture, it may result in shifts in the breeding bird community. Shrub- and tree-nesting birds (passerines, such redpolls, sparrows, and thrushes) may become more numerous, and tundra nesting birds (longspurs, savannah sparrows, shorebirds, geese, and eiders) may decline. With a longer breeding season and increases in shrub and tree cover, breeding species more typical of boreal forest areas to the south may extend their ranges northward and possibly compete with current tundra breeders for resources.

Coastal habitats are likely to change quickly with increased water temperature, reduced sea ice, rising sea level, and increasing storm surges and wave action. Erosion of barrier islands and ice-rich coastlines from mechanical process and thawing can happen rapidly; current rates of loss along the Beaufort Sea coastline is 6.5 to 59 feet per year (see Martin et al. 2009 for review).

River deltas may grow from deposition of sediment, while barrier islands, which form the lagoon areas important to post-breeding birds, may be losing area to storm surges, while accreting less material from ice-push events in the future. Erosion of coastal shorelines could increase inundation of tundra by salt water; the resulting salt-killed tundra may be colonized by salt-tolerant species and develop into salt marsh, a rare but important post-breeding habitat for geese (Flint et al. 2003).

Direct and Indirect Impacts

Issuance of oil and gas leases under the directives of Section 20001(c)(1) of PL 115-97 would have no direct impacts on the environment because by itself a lease does not authorize any on the ground oil and gas activities; however, a lease does grant the lessee certain rights to drill for and extract oil and gas subject to further environmental review and reasonable regulation, including applicable laws, terms, conditions, and stipulations of the lease. The impacts of such future exploration and development activities that may occur because of the issuance of leases are considered potential indirect impacts of leasing. Such post-lease activities could include seismic and drilling exploration, development, and transportation of oil and gas in and from the Coastal Plain. Therefore, the analysis is of potential direct and indirect impacts on birds from on-the-ground post-lease activities.

Potential impacts of oil development on birds are four primary categories of effects: habitat loss and alteration, disturbance and displacement (including alteration of behavior), injury and mortality, and attraction of predators and scavengers (including both mammals and birds) to human activity or facilities, with subsequent changes in predator abundance (Eberhardt et al. 1982; Truett et al. 1997; Burgess 2000; Stickney et al. 2014). The season in which activities occur would either moderate or accentuate the effects on birds. Winter activities would affect few species and low numbers of year-round residents. Summer activities would affect breeding birds during the nesting, brood-rearing, molting, and fall migration-staging seasons, when many species are present in high numbers and potential population-level consequences of impacts are greatest.

Although many future activities, such as vehicle traffic, would occur during exploration, construction, drilling, and operations of a development project, the potential intensity of impacts on birds differs among phases. Exploration occurs during winter and would have little direct effect on birds; indirect effects would occur only from ice roads and rolligon traffic on vegetation and terrain surfaces and impacts on habitat quality from water removal. Human-caused disturbance and displacement would peak during the construction phase, which involves the largest number of people, temporary construction camps, and the highest levels of vehicle, machinery, heavy-haul equipment, and aircraft traffic. Habitat loss also would peak during construction, including the building of ice roads to support gravel extraction, gravel hauling, gravel road and pad construction, bridge construction, and pipeline construction.

Future barging and in-field transport of CPF modules would occur early in the construction phase of any development project and would also affect birds through habitat loss and disturbance. The drilling phase of a development project would require less personnel and traffic than during construction, but still higher levels than during operations. Air traffic and vehicle traffic would peak during construction and drilling because personnel numbers peak during construction and materials transport during drilling. Traffic rates would be lower during operations.

Schedules of development projects in the program area are unknown, but foreseeable hypothetical scenarios indicate extensive overlap of exploration, construction, drilling, and operation phases of potentially several different projects with different operators. In terms of impacts on birds, activities and areas affected would increase until the limit of 2,000 acres of surface disturbance is reached in years or perhaps decades after initial project construction. These activities would be dispersed in different parts of the area available for lease over that period.

For most actions, potential impacts can be described only qualitatively, either because resource and impact data are unavailable or because project-specific details are uncertain or unknown at the time of this preliminary analysis; however, for some habitat impacts and for some types of behavioral disturbance, semiquantitative estimates of areas affected are possible, with some assumptions regarding the likely configuration of a development project.

Potential direct effects resulting from future on-the-ground actions on avian habitats would occur in the footprint of gravel fill, whereas indirect effects on habitat would occur at varying distances, depending on the source. Fugitive dust, gravel spray, thermokarsting, and impoundments may affect soils and vegetation up to 328 feet from roads and pads (see **Section 3.3.1**). Disturbance and displacement could occur over a larger area. When estimating the incidental take of spectacled eiders that would be caused by the construction and operation of oilfield infrastructure, the USFWS considers the direct loss of habitat due to gravel fill plus indirect loss in an adjacent zone of influence (estimated to be 656 feet wide), where disturbance could prevent spectacled eiders from nesting. Implicit in this method of estimating impacts is the assumption that displaced pairs would not move and nest successfully elsewhere.

Using the schematic anchor-field footprint,[20] the BLM calculated estimates of the area within 328 feet, for impacts of dust fallout, gravel spray, thermokarsting, and impoundments, and within 656 feet for impacts of disturbance and displacement. Using these standardized footprints and extrapolating to a 2,000-acre maximum gravel footprint, the BLM estimated total acres indirectly affected by habitat alteration and by disturbance and displacement and then compared these areas with areas available for lease under each action alternative. The effects of climate change described under *Affected Environment* above, could influence the rate or degree of the potential direct and indirect impacts.

[20]One CPF and 6 radiating 8-mile access roads to 6 drill pads, including an STP pad and a 30-mile access road, totaling 750 acres

Alternative A

Under this alternative, current management actions would be maintained, and resource trends would continue, as described in the Arctic Refuge CCP (USFWS 2015a). No direct or indirect impacts on birds from post-leasing oil and gas activities would occur under Alternative A.

Impacts Common to All Action Alternatives

The following actions and types of potential effects would be common to all action alternatives, but the avian resources affected (e.g., total area, specific habitats, bird species, and bird densities) would vary based on the location of facilities in each action alternative.

Habitat Loss and Alteration

Habitat would be temporarily altered from future winter ice roads and pads. Ice road alignments are unavailable for calculating areas affected, but proposed use of ice roads is extensive under all action alternatives, including an annual ice road between the program area and the Prudhoe Bay/Deadhorse road system. Ice roads and pads can interfere with natural drainage of spring runoff; additional habitat alteration can occur through vegetation damage, including reduced live and dead cover due to crushed standing plant cover, stem and blade breakage, compaction, freezing, and physical damage (see **Section 3.3.1**). Although recovery of sedges, grasses, and forbs may occur in two to three growing seasons (Pullman et al. 2005), tussocks and woody shrubs often take longer to recover (Yokel et al. 2007).

Vegetation damage is most severe and takes longer to recover in well-drained areas, including moist tundra and shrub habitats, which support higher densities of passerines, ptarmigan, and some shorebirds, like whimbrel and American golden-plover. In contrast, aquatic and wet tundra habitats, which are favored by most waterbird species (Derksen et al. 1981; Johnson et al. 2003, 2005, 2007), generally are damaged less by ice roads and recover more quickly (Guyer and Keating 2005; Pullman et al. 2005). Habitat alterations from ice roads are likely, and their impacts would be short to long term, depending on the types of vegetation affected and whether routes and pad sites are reused in multiple years.

Water source lakes may include those used by a variety of birds. Future drawdowns may change the abundance and distribution of foods on which birds rely. Drawdowns may also affect shorelines, degrading habitat for a variety of waterbirds and shorebirds. For example, lower water levels could eliminate important nesting sites on islands and peninsulas and may reduce fish prey, with particular impacts on breeding Pacific and red-throated loons. Although water withdrawals would be limited to permitted lakes and to permitted percentages of total lake volume to protect resident fish, water withdrawals could cause lower lake levels and exceed natural recharge (see **Section 3.2.10**).

Withdrawing water from under ice could affect water chemistry and turbidity and possibly result in some fish mortality and impacts on aquatic invertebrate communities (see **Section 3.3.2**, Fish and Aquatic Species). Drawdowns may cause fish mortality, and lack of fish would make such lakes unsuitable for breeding loons. The long-term loss of nesting lakes would have potential population consequences for loons, primarily for Pacific and red-throated loons; yellow-billed loons in the Arctic Refuge nest primarily in the northern foothills of the Brooks Range and outside of the program area.

Gravel would be mined in the future during winter at several unidentified material sites and transported over gravel roads or ice roads or both. Reclamation would consider gravel's potential use for enhancing fish and wildlife habitat. Some pits remaining from excavation would be used as water sources during drilling and operations. Avian habitats would be lost to material sites, but rehabilitated sites would likely be used by some species of nonbreeding, breeding, and brood-rearing waterbirds. The potential habitat loss or alteration from gravel excavation would affect up to 320 acres of surface disturbance; the impact on birds would be long term and somewhat ameliorated by reclamation plans (i.e., terrestrial breeding habitats could be replaced by aquatic habitats).

Future construction of gravel pads and roads would result in potential; long-term direct loss of habitat and indirect alteration of habitat. Direct losses from gravel coverage (up to 2,000 acres allowable) would last as long as development projects are active, or until gravel is partially removed from retired roads and pads to restore some habitat features; this is estimated to be 85 years after the first lease sale before all facilities described in the hypothetical development scenarios are abandoned and reclaimed.

Potential indirect habitat modification would result from fugitive dust (i.e., dust shadow) and gravel spray, changes in drainage resulting in impoundments and vegetation desiccation, thermokarsting, and delayed melt of snow in snow drifts or berms created by snow removal. Fugitive dust would generally affect the largest area, extending as much as 328 feet from gravel roads (see **Section 3.3.1**; Walker and Everett 1987).

Using a hypothetical schematic drawing of a standardized anchor field (one CPF and 6 radiating 8-mile access roads to 6 drill pads, one STP pad, and a 30-mile access road, totaling 750 acres), the area within 328 feet for impacts of dust fallout, gravel spray, thermokarsting, and impoundments was estimated to be about 6,607 acres. The actual area potentially affected would depend entirely on the configuration of roads, but these numbers indicate that indirect impacts of gravel roads and pads would affect an additional area about 7 to 8 times larger than the gravel footprint.

Potential effects on waterbirds would be minimized by using the shortest road routes and smallest pads and by placing gravel in uplands and well-drained habitats composed of moist and shrub tundra. Such habitats support higher densities of landbirds and impacts on these species could be greater as a result. Habitat alteration caused by fugitive dust, thermokarsting, and water impoundments intensifies with time. As dust and gravel spray accumulate, vegetation is slowly affected, and thermokarsting deepens or spreads.

Potential loss and alteration of habitat from direct effects of gravel deposition and indirect effects of dust, thermokarsting, and impoundments would be long term and would occur over about 17,000 acres (2,000 acres total gravel footprint plus approximately 15,000 acres within 328 feet), or about 1 percent of the program area (1,563,500 acres). For some species of tundra nesting birds, habitat loss due to gravel placement redistributes individual nesting pairs to adjacent similar habitats (Troy and Carpenter 1990; Johnson et al. 2003).

Future screeding for barge access would result in short-term (one season) habitat modification in the affected lagoon just prior to each barge arrival. Each potential CPF module is expected to be shipped on two barges, CPFs would be built at 10- to 15-year intervals, and up to three could be active at any one time. Screeding would modify the sea floor in shallow water. The area of potential screeding and redistribution would likely be lost in the short term to benthic feeding birds and would create a sediment plume that could disrupt feeding by non-breeding, post-breeding, and staging birds. Although high numbers of birds use the lagoons, they are highly mobile and likely would be able to move to adjacent similar areas if necessary.

Long-tailed ducks made up 80 percent of the birds on surveys during late summer and fall in nearshore waters of the Beaufort Sea (Fischer et al. 2002). Other species included many of those potentially breeding in the program area, plus common eiders and scoters. Potential habitat alteration in the area is expected to be brief, occurring only during screeding and vessel travel. Habitat alteration impacts from screeding are expected to be of short duration and would occur in localized areas.

Disturbance and Displacement

The impact of disturbance refers to behavioral and potential physiological reactions to perceived disturbing stimuli, which may be visual or aural. Displacement occurs when the organism moves to another site or area that is free from the disturbing stimulus. For example, alert postures, concealment postures, and escape all are potential behavioral reactions and may or may not be accompanied by changes in heart rate, endocrine states (including stress), and increased energy expenditure. For nesting birds, displacement is less available as an option than it would be for non-nesting birds that are not attached to a nest site. Many types of human activities in bird habitats would result in either disturbance or displacement of birds.

Future gravel transport and placement and pipeline construction would take place in winter from ice roads and, after initial construction, from existing gravel roads. Traffic and machinery related to winter construction could cause disturbance, behavioral alterations, and displacement to resident wintering birds. In the event that ice road use is permitted into April, some early arriving breeding birds could also be affected, primarily golden eagles and snowy owls. Although winter construction activity would involve more traffic and machinery than other phases, potentially resulting in higher levels of disturbance and displacement, only small numbers of only a few bird species are resident during winter, and none are breeding. Winter construction therefore would potentially affect small numbers of non-breeding birds during the construction phase of a development project.

Future construction activities during summer would occur on gravel roads and pads, which could cause short-term behavioral changes or displacement of breeding birds. Summer construction would involve gravel grading and compacting, module and pipeline hookups, and construction of the camp, operations center, and CPF. Summer construction would have higher levels of machine, heavy equipment, and vehicle traffic and more human activity than during drilling or operations, thus higher rates of disturbance-caused behaviors and displacement of birds. During drilling and operations, similar types of disturbance and displacement would continue, and additional helicopter, boat, and human activity likely would occur associated with pipeline inspection and maintenance, surveying, cleanup, and spill prevention and response activities, such as equipment deployment and maintenance and boom placement on waterways.

Human-caused disturbance could cause behavioral changes in birds, ranging from alert postures to flush or flight behaviors (Murphy and Anderson 1993; Johnson et al. 2003; Livezey et al. 2016). At low levels, disturbance could increase the occurrence of concealment postures, interfere with resting and feeding activities, and increase energetic costs. At higher levels, escape behaviors could affect reproduction through increased absences from nests and nest abandonment, thereby increasing the likelihood of predation leading to nest failure (Uher-Koch et al. 2015; Stien and Ims 2015) or disintegration of broods and chick predation. Although foot traffic on the tundra would be uncommon with most development activities, reduced productivity due to disturbance by foot traffic is the most consistently reported effect of human presence at nesting sites (Meixell and Flint 2017). Human disturbance can lead to displacement of breeding birds (Johnson et al. 2003), which may or may not affect reproduction. Studies of bird responses to human disturbance in oilfields indicate that responses vary among species, by season and breeding status, by type of human disturbance, and by distance to the source of disturbance (Anderson et al. 1992; Murphy and Anderson 1993; Johnson et al. 2003, 2008).

As discussed previously, for assessment of potential effects of disturbance and displacement by future road traffic, the area was calculated within 656 feet of roads, pads, and pipelines as a conservative estimate of the area affected by disturbance and displacement for all species of birds. This overestimates the area of disturbance for nesting shorebirds and passerines, which respond at very close distances (43 to 72 feet; Livezey et al. 2016); however, it likely underestimates the area for more sensitive birds, such as nesting tundra swans (at least 1,640 feet or more; Monda et al. 1994).

Future disturbance and displacement could affect nesting within 0.8 miles of active roads (Johnson et al. 2003). Liebezeit et al. (2009) reported a decrease in nest survival of passerines within 3.1 miles of oilfield facilities. A review of literature on reported distances from various motorized and nonmotorized human activities, at which nesting birds initially respond and take flight, found all species studied reacted and flushed at mean distances of less than or equal to 656 feet, except for falcons, hawks, and eagles; these species reacted at greater distances to some disturbance types (Livezey et al. 2016). Fall migration-staging flocks may also be subject to disturbance and displacement, such as shorebirds in river deltas, molting long-tailed ducks and other birds in lagoons, and snow geese in tundra habitats.

As for estimating potential habitat impacts, above, a drawing of a hypothetical anchor field was used to estimate the area within 656 feet for impacts of disturbance and displacement. The actual area affected would depend entirely on the configuration of roads, but with a standardized footprint of 750 acres, an additional 11,820 acres of tundra within 656 feet was calculated, an additional area about 15 to 16 times larger than the gravel footprint. With a 2,000-acre gravel footprint at peak development, disturbance and displacement of breeding birds in tundra habitats could occur over about 31,000 acres, or about 2 percent of the program area (1,593,500 acres). Potential impacts of disturbance and displacement by summertime construction and operations would be long term and may affect nesting success for some birds near facilities; however, they are unlikely to affect regional or global population sizes or nesting densities of breeding birds.

Future screeding and barging would be required to transport modules to Camden Bay early in the construction period of each development project. This could displace and disturb normal behavior of birds in the nearshore marine environment. Both screeding and barging would involve slow-moving vessels (7 knots for barges) and would produce noise and visual disturbance. Boat operations for other activities may also occur.

Many seabird species use the nearshore and lagoon waters of the Beaufort Sea, which attracts them because of its shallow water for feeding and protection from wind and waves (Flint et al. 2004). Long-tailed ducks make up about 80 percent of the birds in nearshore waters of the Beaufort Sea (Fischer et al. 2002) and are the predominant bird in the lagoon system. The long-tailed duck molt period, when the ducks are flightless, begins in mid-July and ends by early September; this is also the period of highest lagoon use by most other species.

Lysne et al. (2004) recorded over 23,000 long-tailed ducks along the Arctic Refuge coast during a survey in late summer 2003. They also reported a substantial portion of yellow-billed loons, red-throated loons, scaup, and Pacific loons counted during the entire Alaska North Slope survey, which was done along the Arctic Refuge coast during some years. Johnson (1982) reported displacement of long-tailed ducks in response to aircraft, boats, and human disturbance. Schwemmer et al. (2011) reported ship traffic affected flight reactions in sea ducks and the distribution of loons. Flint et al. (2004) reported that molting long-tailed ducks using lagoons in the Beaufort Sea had low but variable fidelity to sites inside barrier islands, averaging 39 percent. Sites were occupied consistently, but turnover of individuals was high as flightless ducks moved among sites. Site fidelity was not clearly affected by seismic surveys and little evidence was found for disturbance-related displacement of individuals (Flint et al. 2004); aerial surveys did not find a difference in density of long-tailed ducks between industrial and control sites (Fischer et al. 2002).

Potential displacement and disturbance of birds from future screeding and barging would be short term and would occur in a relatively small area; other boating activities may also be short term but may occur over a broad area and for the duration of a development project. Additional low levels of disturbance and displacement of seabirds could occur along the marine vessel route between the ARCP and Dutch Harbor, Alaska.

All types of air traffic could disturb and displace both breeding and non-breeding birds. Air traffic supporting any future development project in the program area would include aircraft carrying passengers and supplies to the airport in Deadhorse and helicopter support primarily during summer. Use of the Deadhorse airport, which is the primary hub for the North Slope oil industry, would increase both for passenger and freight flights. It is expected that the additional use of the Deadhorse airport would add to disturbance levels there, although traffic levels already are high. Potential impacts on birds would be long term but would be restricted to the area of the airport in Deadhorse; however, birds in this area already experience high levels of disturbance due to current aircraft traffic and airport activities.

Under all action alternatives, helicopters would be used in the future to support ice road layout, survey, and summer cleanup and possibly for spill-response equipment deployment and maintenance. These activities usually take place in July or early August and last approximately 4 weeks, with daily helicopter traffic during that time, involving departures from the helipad and landings at various tundra locations. Helicopter flights during July and August would occur during nesting, brood-rearing and molting, and fall migration-staging periods for most of the species in the program area. Helicopter landings on tundra could cause displacement from nests and separation of broods, which could allow predators to take eggs or chicks and thus reduce reproductive output. As young grow and become more mobile or even flight capable, helicopter landings and low-level flights would cause escape movements or flight behavior and interfere with feeding and resting; however, such effects are usually very short term. The intensity of impacts of helicopter flights would vary, depending on number of landings on tundra, landing locations, and seasonal timing. Impacts would occur during all development phases and would be extensive in geographic scope.

Air traffic could disturb and displace staging snow geese that visit the eastern coastal plain of the North Slope in large numbers in late August and September of most years. As many as 325,760 snow geese have been documented using the ARCP, including the program area and east to the Canada border, for several weeks, foraging for cottongrass and equisetum in both coastal and upland habitats and building energy reserves needed for fall migration (Kendall 2006). They are easily disturbed by aircraft and other human intrusions during staging, making them vulnerable to displacement and potentially significant impacts. Davis and Wisely (1974) documented flushing distances of staging snow geese on the North Slope up to 8 miles from overflying aircraft. Mean distances of flushing for various types of overflights ranged between 1.2 and 2.5 miles and durations averaged between 5 and 6 minutes, depending on overflight category, such as aircraft and altitude. Boothroyd (1985) found similar results and that staging snow geese were the waterfowl species in their area most sensitive to aircraft overflights.

Mortality and Injury

Vehicle and aircraft traffic and tall structures, including communication towers and drill rigs, pose collision hazards that could kill or injure birds. Little information is available on rates of mortality or injury from collisions in the North Slope oilfields. Collisions with vehicles and aircraft would probably be correlated to bird densities and traffic rates. Collisions might increase during breeding, when birds are less focused on hazards, and during brood-rearing, when flightless birds would be crossing roads. Reduced speed limits and driver awareness of seasonal bird vulnerability could reduce collision risk from vehicles.

Collisions with tall structures increase with tower height, bright lighting, and the presence of guy wires (Manville 2005; Gehring et al. 2011). Weather conditions, such as fog, rain, and low light, increase collision mortality of common eiders at towers and transmission lines (MacKinnon and Kennedy 2011). On the North Slope, birds often migrate at low altitudes and in foggy conditions; migrating eiders averaged 40 feet aboveground level at Point Barrow (Day et al. 2002). BMPs of eliminating guy wires, reducing tower heights, and shielding lighting would reduce the risk of collisions with facilities in the program area.

Collisions with vehicles, aircraft, or structures in the future would likely injure or kill birds. Although the risk of collisions is low, the consequences are high, resulting in serious injury or death. Collisions would be expected to occur annually in small numbers, but mortalities could be serious if flocks of birds of conservation concern are involved. The potential impacts of collisions are short term, infrequent, and seasonal in but would occur throughout the life of any development project and would be restricted to roads and facilities.

Oil spills and other releases of contaminants pose risks of injury or death to birds. During future exploration and construction, the primary potential for release would be accidental spills from vehicles, storage tanks, marine barges and docks, aircraft, and equipment during transport or fueling and during pipeline hydrotesting (see **Section 3.2.11**). Most potential spills would involve refined oils, antifreeze, or salt water used in hydro-testing. Crude oil spills would not be a risk during construction. During drilling and operation, there may be risks of larger spills, due to well blowout or pipeline failure.

Small spills are likely, medium-sized spills are possible, and large and very large spills are unlikely. Most spills would be fewer than 100 gallons and would be restricted to ice or gravel roads and pads, never reaching the tundra. Oil spills on tundra or in water are extremely rare, as are large spills of greater than 10,000 gallons. Spill containment at strategic points on waterways would likely keep oil from flowing downstream into lagoons. Nonetheless, if oil escaped, many species would be vulnerable.

Potential salt-water spills would not be toxic to birds but would likely kill vegetation in the spill zone and thus alter habitat. Somewhat larger spills, such as tanker truck spills of fewer than 10,000 gallons could reach tundra and contaminate a few birds, nests, and eggs or their habitat and forage, or they could reach streams or lakes, which would spread the effect farther and affect more birds and bird habitats. Potential marine spills would likely be very small to small, fewer than 100 gallons, would be localized to docking facilities, and would have a very low to low frequency of occurrence. Medium to very large spills in the ocean would be possible but very unlikely, requiring a vessel to run aground or somehow have containment compartments breached. This could occur in the shipping lanes leading to the docking or STP pads.

Small spills would be short term and of several acres or fewer on land. This is because they are usually contained on gravel pads and roads. Marine spills would have similar probabilities for similar volumes, but they would occur only during screeding and barging of CPF and STP modules. Large spills would be more extensive, with cleanup activities lasting days to weeks, and could pose contamination risk to large numbers of molting, feeding, or migrating birds.

Attraction to Human Activities and Facilities

Future oil development projects in the program area would likely increase the numbers of scavengers and predators in the area, beginning in the construction phase and continuing through operations. Effective food and garbage control, wildlife interaction plans, and personnel training should minimize the attraction of predators to oilfield facilities; however, the potential for development to attract scavengers and predators is a concern in part because increased predator abundance can decrease productivity and increase mortality of nesting birds (Truett et al. 1997; Johnson et al. 2010). Liebezeit et al. (2009) detected reduced nest survival among Lapland longspurs from predation up to 3.1 miles from oilfield infrastructure.

Both birds and mammals may be attracted to human activities. Two avian predators, glaucous gulls and common ravens, are attracted to human food (Day 1998; National Research Council 2003), and populations of these species have increased on the coastal plain of the North Slope (Stehn et al. 2013). On the North Slope, ravens and, to a lesser degree, peregrine falcons, gyrfalcons, and rough-legged hawks nest on human-made structures, including buildings, elevated pipelines, bridges, towers, drill rigs, and wellheads (Ritchie 1991; Frost et al. 2007; Powell and Backensto 2009; Sanzone et al. 2010). Some species of songbirds (e.g., snow buntings, common redpolls) also are attracted to human structures for nest sites. The potential impact of attracting birds to facilities would vary, depending on the species attracted and their predatory effect on species of concern (for example, threatened species) and the duration extending longer than 5 years. This would affect most of the program area, as predators are far-ranging.

Foxes and bears also prey on birds and their eggs and are attracted to areas of human activity, where they readily feed on garbage and handouts (Eberhardt et al. 1982; Follmann and Hechtel 1990; Savory et al. 2014). Arctic foxes in oil-development areas occur at higher densities and experience reduced population fluctuations, compared to foxes in undeveloped regions, increasing potential levels of predation of nesting birds and their eggs (Eberhardt et al. 1983; Burgess 2000). Foxes also use human structures (gravel berms and empty pipes) for denning and shelter (Eberhardt et al. 1983; Burgess et al. 1993). Future development projects would attract foxes throughout the year and grizzly bears in summer and fall.

Alternative B

In Alternative B, the entire program area is available to lease. Alternative B includes 359,400 acres designated NSO to protect nearshore marine, lagoon, and barrier islands and to protect rivers and streams, although barge landings, docks, pipelines, and road crossings would be allowed. These restrictions offer some protection to birds in riparian areas by limiting potential habitat loss and alteration and disturbance and displacement. Important waterbird habitats in the Canning River delta and adjacent lakes district are included in this NSO.

In addition, Alternative B includes 721,200 acres of caribou calving habitat in which construction activity using heavy equipment would be halted between May 20 and June 20. In the same area, road and air traffic restrictions would be applied when caribou are present. These areas also would offer negligible protection to birds from limiting future disturbance and displacement by stopping traffic, but only when caribou are present.

The most abundant vegetation types in the program area are herbaceous (mesic) (31 percent total cover), tussock tundra (26 percent), herbaceous (wet) (16 percent), and low shrub (15 percent). Freshwater or salt water (primarily salt water, as all lagoons are included) comprises 9 percent, and no other vegetation type comprises more than 2 percent of the program area. Breeding birds use all these vegetation types, but the greatest abundance and species richness of nesting birds, and potentially greater direct and indirect habitat and disturbance-related impacts, would occur in wetter habitats and in more coastal and delta habitats.

Areas available for lease under Alternative B are 427,900 acres in the area of high HCP, 658,200 in moderate HCP, and 477,100 in low HCP. Areas of high, medium, and low HCP have similar cover by vegetation types overall, although areas of medium and low HCP include greater proportions of inland habitats. This is reflected in an increase in occurrence of more well-drained tussock tundra and low shrub and decreasing occurrence of herbaceous (mesic) and freshwater or salt water (again almost entirely salt water) (see **Section 3.3.1**). Also, two relatively high-quality bird habitats, herbaceous (marsh) and herbaceous (wet-marsh) (tidal) occur primarily in areas of high HCP in the program area.

Assuming a maximum of 2,000 acres of facility footprints (excludes material sites), potential long-term loss and alteration of habitat from direct effects of gravel deposition and indirect effects of dust, thermokarsting, and impoundments under Alternative B would occur over 1 percent of the entire program area. Potential disturbance and displacement of breeding birds in tundra habitats could occur over about 2 percent of the area available for leasing.

Alternative C

In Alternative C, the entire program area is open to lease, but 932,500 acres are subject to NSO to protect rivers and streams, nearshore marine lagoon and barrier islands, coastal areas (within 1 mile of the coast), and caribou calving habitat. Exceptions would be made for roads, pipelines, barge landings, and docks, but not in 606,200 acres of caribou calving habitat, where no surface occupancy would be allowed.

Alternative C includes some larger setbacks than Alternative B for riparian areas and is, therefore, somewhat more protective of avian habitats in riparian areas. The area closed to surface occupancy to protect caribou calving habitat comprises entirely inland habitats and nearly all in the area of Low HCP. Although protective of birds, this closure affects mainly drier and inland habitats that are more important for landbirds, including passerines, ptarmigan, and some shorebirds, like whimbrel and American golden-plover. Fall staging snow geese are an important exception, as the area closed to leasing overlaps extensively with areas historically used by the largest numbers of fall staging snow geese in the program area.

The coastal and riparian setbacks in Alternative C would protect important bird habitat, although as described above, future roads and pipelines would be allowed, including docking pads and the STP in the coastal setback. Alternative C also includes an additional 317,100 acres subject to TLs, including 115,000 acres of caribou calving habitat (restrictions May 20 to June 20) and 985,500 acres of caribou post-calving habitat (restrictions 15 June to 20 July) in which traffic controls would be implemented when caribou are present. NSOs and TLs to protect caribou habitat would offer negligible protection to breeding birds, again primarily in inland and drier habitats; however, lower levels of aircraft traffic in NSO areas would result in much lower potential for disturbance and displacement of staging snow geese, by comparison with Alternative B.

With Alternative C, potential long-term loss and alteration of habitat from direct and indirect effects of gravel deposition would be similar to Alternative B (the entire area is available for leasing) and would occur over approximately 1 percent of the area available for leasing; disturbance and displacement could occur over about 2 percent of the area available for leasing.

Alternative D

In Alternative D, 476,600 acres are closed to leasing to protect caribou calving habitat, and an additional 49,900 acres are closed to leasing to protect springs and aufeis locations. An additional 910,600 acres would be subject to NSO to protect rivers and streams: the Canning River delta and adjacent lakes; springs and aufeis; nearshore marine, lagoon, and barrier islands; polar bear denning habitat; caribou calving habitat' the coastal zone (within 2 miles of the coast); and the wilderness boundary (3 miles from wilderness boundary). Exceptions would be made for roads, pipelines, barge landings, and docks; however, there would be no exceptions in 526,300 acres not offered for lease (calving habitat and springs/aufeis) or in an additional 244,600 acres of calving habitat subject to NSO.

An additional 264,300 acres of caribou post-calving habitat would be subject to CSU, meaning no CPFs allowed with other infrastructure (roads, pads, airstrips, and pipelines) not to exceed 100 acres per township or 510 acres total. Alternative D includes some larger setbacks than Alternatives B or C for riparian areas and is, therefore, somewhat more protective of avian habitats in riparian areas.

All these no lease areas, NSO areas, and CSU areas would potentially reduce impacts on birds. As with Alternative C, nearly all of the area closed to leasing are in the area of low HCP and in inland and drier habitats that are important to landbirds and some shorebirds and are used extensively by fall staging snow geese; however, the various NSO areas with Alternative D would be protective to many important avian habitats, including riparian and stream habitats, Canning River delta water bodies and wetlands, lagoon and barrier island habitats, and coastal habitats. Setbacks for springs and aufeis with Alternative D would provide some protection to several specific sites that are important providers of surface water during summer and thus very important to tundra birds.

Alternative D also includes TLs on activities in some areas, some of which would be potentially beneficial to birds. These TLs to protect caribou would provide negligible protection to birds, primarily in inland habitats that are important for landbirds, including passerines and ptarmigan, and some shorebirds.

Although protective of all birds, areas closed to leasing and adjacent areas with NSO or CSU restrictions that are intended to protect caribou habitat under Alternative D also overlap extensively with areas known to be used intensively by fall-staging snow geese. Lower levels of future aircraft traffic in these areas would result in reduced disturbance and displacement of staging snow geese. As mentioned above, air traffic and other disturbances would likely be low in areas used by the largest numbers of staging snow geese in the southeast portion of the program area, which is closed to leasing with Alternative D; however, potential disturbance and displacement of staging snow geese also would occur during fall in areas north and west of protected calving habitat. These areas are used by large numbers of staging snow geese in fall, and the TLs to protect caribou would not be protective. Fall-staging snow geese occur throughout these areas and air traffic and other activities there likely would result in potential disturbance and displacement.

Under Alternative D, potential long-term loss and alteration of habitat from direct and indirect effects of gravel deposition would occur over approximately 1.6 percent of the area available for leasing (1,037,200 acres). Disturbance and displacement could occur over about 3 percent of the area available for leasing.

Cumulative Impacts

Past, present, and reasonably foreseeable oil and gas development impacts would be common to the impacts described for developments pursuant to the program area lease sales. They would increase the occurrence and intensity of these common impacts. Such projects are likely in both terrestrial and marine environments and would affect birds in both.

The National Research Council (NRC 2003) identified higher predator densities and increased predation on nests as the most apparent effect of oil development on birds. Transportation activities are anticipated to increase in support of both oil and gas development projects and of coastal villages, along with increases in research and recreational transportation. Increased transportation would include overland movement as the road system increases in size, barge and boat traffic, and passenger and cargo air traffic. Future surface, boat, and air traffic would result in increasing levels of disturbance of birds. Subsistence activities involving bird hunting and egg harvesting would continue with similar types of activities and areas used.

If residents of adjacent villages are allowed access to roads, harvest of birds may increase. Future subsistence activities and scientific research are unlikely to negatively affect bird populations. Recreation and tourism could negatively affect birds, depending on locations and seasons, intensity, and types of transport. Air-based sightseeing could cause widespread disturbance, as could adventure cruise ships. Community development projects, such as airport improvements, roads and ports, telecommunication, and energy projects, all would affect local birds in the vicinity of such communities but would result in small increases in impacts on bird populations. The effects of climate change described under *Affected Environment* above, could influence the rate or degree of the potential cumulative impacts. Alternative A would have no cumulative impacts on birds from post-leasing oil and gas activities.

3.3.4 Terrestrial Mammals

Affected Environment

Thirty-nine species of terrestrial mammals are known or expected to occur in the Arctic Refuge, 18 of which occur regularly on the Coastal Plain physiographic province in the Arctic Refuge (MacDonald and Cook 2009; USFWS 2015a; **Table J-11** in **Appendix J**). The occurrence and distribution of terrestrial mammals in the program area have been described in detail previously (Clough et al. 1987; Douglas et al. 2002; USFWS 2015a; Pearce et al. 2018); those discussions are incorporated here by reference, and relevant information is summarized below, supplemented with updates from more recent research.

Special Status Species

None of the terrestrial mammals in the program area are listed under the federal ESA. (Polar bears do occur on land in the program area, but they are discussed in **Section 3.3.5**). In 2010, the BLM (2010) added to its list of sensitive species the Alaska tiny shrew (*Sorex yukonicus*, which has since been reclassified as the Holarctic least shrew, *S. minutissimus*; Hope et al. 2010; Bradley et al. 2014).

To date, one specimen of the Holarctic least shrew has been captured in the mountains of the Arctic Refuge, south of the program area, at the confluence of the Canning and Marsh Fork Rivers.[21] A previous report of this species from the Canning River delta in 2004 (MacDonald and Cook 2009; USFWS 2015a) was based on a misidentified specimen (University of Alaska Museum of the North, number 85499). It was subsequently identified correctly as a barren ground shrew (*S. ugyunak*).[22]

Caribou

Caribou are the most abundant large mammals in the program area and are an important subsistence resource for Iñupiaq and Gwich'in hunters. They also are important for harvest by other hunters who do

[21]A. G. Hope, Kansas State University, personal communication
[22]A. G. Hope, Kansas State University, personal communication

not live in the refuge and for nonconsumptive uses, such as tourism and wildlife viewing. Because caribou exhibit high fidelity to calving grounds, the ADFG defines herds based on their use of calving grounds.

Four herds of barren-ground caribou occur in Arctic Alaska: (proceeding from west to east) the Western Arctic herd, the Teshekpuk herd, the CAH, and the PCH. These four herds differ in their use of seasonal ranges, especially during the calving, insect-relief, and winter seasons (Russell et al. 1993; Murphy and Lawhead 2000). The program area is primarily used by the PCH and the CAH and is far to the east of the Western Arctic herd range (Dau 2015; Joly and Cameron 2017). The program area is outside the primary range of the Teshekpuk herd, although an estimated 5,000–10,000 caribou of the Teshekpuk herd moved into the northern portion of the Arctic Refuge in the fall of 2003 (Person et al. 2007; USFWS 2015a); that unprecedented movement was highly unusual and has not been repeated.

Caribou in the PCH give birth in the program area during most years and use the Coastal Plain and ridges in the adjacent foothills and mountains for relief from insect harassment during summer, a period when some CAH caribou also use the program area. For these reasons, this discussion focuses on the PCH and CAH.

<u>Herd Sizes and Trends</u>

The PCH was estimated to number about 100,000 animals in 1972 and increased to 178,000 in 1989, before declining to 123,000 animals in 2001 (Caikoski 2015). Due to unsuitable conditions of weather and herd distribution, another census could not be conducted until 2010, when the herd was estimated at 169,000 animals. It increased to 197,000 animals by 2013 and reached a herd size of 218,000 animals in July 2017 (**Figure 3-5**, Population Size of Three Caribou Herds in Arctic Alaska, 1977-2017, in **Appendix A**; Caikoski 2015; ADFG 2018a). Although population dynamics are complex, population growth of the PCH has been correlated with phases of the arctic oscillation (an index of oceanic temperature and sea-level pressure over the Arctic Ocean), which may affect snowfall and summer growing conditions (Joly et al. 2011).

The CAH was estimated at approximately 5,000 animals when it was first described as a separate herd in the mid-1970s. The herd grew to its estimated peak of 68,000 animals by July 2010, then declined steeply to 23,000 by July 2016; the most recent estimate was 28,000 individuals in 2017 (**Figure 3-5** in **Appendix A**; Lenart 2015a, 2018; ADFG 2017). The herd decline between 2010 and 2016 was thought to be due to high adult mortality and to the emigration of some CAH caribou to the PCH and Teshekpuk herd (ADFG 2017).

<u>Life History and Habitat Use</u>

Caribou behavior and habitat use in northern Alaska vary substantially on a seasonal basis (Russell et al. 1993; Murphy and Lawhead 2000). This is because caribou efficiently travel long distances (Fancy and White 1987) to maximize access to areas of accessible, nutritious forage plants, to minimize the risk of predation, and to limit their exposure to insect harassment.

Caribou of the PCH and CAH generally spend the winter in or south of the Brooks Range (Griffith et al. 2002; Lenart 2015a; Nicholson et al. 2016), where the winter ranges of the two herds often overlap substantially, although some CAH caribou winter north of the Brooks Range in some years (Lenart 2015a; Nicholson et al. 2016). Many PCH animals migrate to winter range in the Yukon. During winter, the availability of lichens and other winter forage is influenced strongly by snow depth, snow hardness, and ice (Collins and Smith 1991). Winter snow depth is negatively related to population growth (Aanes et al.

2000), calf birth mass (Adams 2005), and birth rate (Ferguson and Mahoney 1991). Deep winter snow may delay the timing of births and reduce birth rates for a year (Adams and Dale 1998a, 1998b).

In spring, pregnant females migrate northward to calving grounds ahead of non-pregnant females, with males arriving later, after most calving is complete (Russell et al. 1993; Murphy and Lawhead 2000). Spring migration tends to coincide with snowmelt, and caribou often calve farther south when snowmelt is delayed (Carroll et al. 2005) or, in the case of the PCH, farther east (Griffith et al. 2002). In northern Alaska, most adult females older than 2 years of age give birth to a single calf in late May or early June. Caribou calving grounds in Arctic Alaska are in areas with few predators and with abundant, early emerging forage plants (especially tussock cotton grass, *Eriophorum vaginatum*), which are high in protein and are highly digestible (Kuropat 1984; Griffith et al. 2002; Johnstone et al. 2002). Use of the Coastal Plain during summer appears to extend the period when caribou can find forage with adequate digestible nitrogen (Barboza et al. 2018).

The calving grounds of the PCH and CAH are near coastal mosquito-relief habitat, requiring relatively short movements once mosquitoes become active (Walsh et al. 1992; Murphy and Lawhead 2000; Nicholson et al. 2016). During the summer insect season (late June to mid-August), caribou are harassed heavily by mosquitos (*Aedes* spp.) and parasitic oestrid flies (warble fly, *Hypoderma tarandi*; nose-bot fly, *Cephenemyia trompe*). The longest distances traveled per day throughout the entire year typically occur in July, when mosquito harassment peaks (Fancy et al. 1989; Prichard et al. 2014; Dau 2015). In response to severe mosquito harassment, caribou form large groups and move to relief habitat near the coast or to remnant snowfields, patches of aufeis, and mountain ridges farther inland, where temperatures are lower and wind speeds are higher (Downes et al. 1986; Walsh et al. 1992; Murphy and Lawhead 2000; Yokel et al. 2011; Wilson et al. 2012).

Oestrid flies emerge in July and exert strong effects on caribou behavior and body condition (Murphy and Lawhead 2000; Hughes et al. 2009). In response to fly harassment, large caribou herds break up and disperse widely in small groups, seeking relief in unvegetated habitats, such as river bars, dunes, drained-lake basins, pingos,[23] and ridgetops. In areas of northern Alaska with industrial development, caribou often use elevated sites on gravel roads and pads and in shaded areas under buildings and pipelines when flies are active (White et al. 1975; Pollard et al. 1996; Murphy and Lawhead 2000). Hot summers with severe insect harassment can substantially decrease caribou conditions in fall, causing them to enter the winter in poor condition (Helle and Tarvainen 1984; Colman et al. 2003; Weladji et al. 2003; Couturier et al. 2009) and potentially leading to lower productivity (Cameron and Ver Hoef 1994).

During late summer and fall, caribou feed heavily to restore body reserves before the onset of winter (Haskell and Ballard 2004; Gustine et al. 2017). The birth rate for female caribou in spring is strongly related to body mass in the previous autumn (Cameron and Ver Hoef 1994; Cameron et al. 2000). On the range of the CAH, the length of the growing season has increased by 15 to 21 days as the climate warmed between 1970 and 2013 (Gustine et al. 2017); despite a 9- to 10-day increase in the fall growing season during that period, no significant change in seasonal forage quality was evident. Caribou migration to winter ranges in the fall coincides with the breeding season (rut) in October, a period when male caribou experience high energy demands. In one study, adult males lost 23 percent of body protein and 78 percent of body fat during the rut (Barboza et al. 2004).

[23]A dome-shaped hill formed in a permafrost area when the pressure of freezing groundwater pushes up a layer of frozen ground

Compared with the conditions experienced by other arctic migratory herds, the range of the PCH has warm spring conditions and cool moist summers, which likely result in longer periods of high plant quality and lower mosquito harassment (Russell and Gunn 2017). The winter range has relatively high snow depths, but diverse terrain provides a wide range of wintering locations. PCH animals accumulate less back fat and get pregnant at higher fall body weights (indicating lower productivity) than other herds, but pregnancy rates change less dramatically with changing fall body weights (indicating lower vulnerability). The PCH has had a more stable population size than other herds in recent decades (Russell and Gunn 2017; Fauchald et al. 2017).

PCH Use of the Program Area

Caribou use of the program area varies greatly throughout the year. The principal use by the PCH occurs in the spring and summer, during spring migration and the calving, post-calving, and insect seasons (**Map 3-21**, Seasonal Distribution of the Porcupine Caribou Herd, in **Appendix A**). The PCH give birth from the northern portion of the Arctic Refuge into northern Yukon, and the extent of use of those areas varies substantially among years (Map 4-9 in USFWS 2015a; **Map 3-21** in **Appendix A**).

Four terms are used to describe the use of calving grounds by caribou, as follows (Russell et al. 2002):

- Annual calving ground—the calving ground for a particular year
- Extent of calving—the outer perimeter of all known annual calving grounds
- Annual concentrated calving area—the area of relatively high use in an annual calving ground
- Extent of concentrated calving—the outer perimeter of all known annual concentrated calving areas

Between 1983 and 2001, the annual percentage of PCH females calving in the ANILCA 1002 Area (essentially the program area) averaged 42.7 percent. It was highest in years with early spring conditions (as measured by the Normalized Difference Vegetation Index [NDVI] calculated from satellite imagery during calving; Griffith et al. 2002). In 8 of the 12 years from 2000 to 2011, the annual concentrated calving areas occurred in the Yukon or near the Yukon-Alaska border, largely outside the program area (USFWS 2015a). The PCH calved predominantly in the Yukon in 2012/2013 (Caikoski 2013, 2015) but predominantly in Alaska between 2014 and 2017, and calving was widely dispersed in 2018 (Caikoski 2015).[24] In 2017, much of the PCH concentrated calving area was west of the Sadlerochit River.[25]

The annual calving grounds were in areas with higher rates of increase in NDVI, which is thought to indicate higher quality forage. The annual concentrated calving areas in those annual calving grounds were characterized by higher forage biomass, as measured by NDVI (Griffith et al. 2002). PCH caribou feed primarily on immature flowers of tussock cottongrass early in June, in wet sedge meadows, herbaceous tussock tundra, and riparian vegetation types; then later in June they forage primarily on willows and herbaceous plants (Griffith et al. 2002; Johnstone et al. 2002).

Between 1983 and 1985, PCH calf mortality during June averaged 29 percent, and 61 percent of that mortality was due to predation, primarily by golden eagles, grizzly bears, and wolves. Predation rates and predator densities were higher in the foothills south of the program area (Whitten et al. 1992; Young and

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[24]Caikoski, Jason. Personal communication. Phone call from Jason Caikoski, ADFG to Alex Prichard, ABR Inc on September 11, 2018 regarding annual calving distribution of the Porcupine Caribou Herd.

[25]Caikoski, Jason. Personal communication. Phone call from Jason Caikoski, ADFG to Alex Prichard, ABR Inc on September 11, 2018 regarding annual calving distribution of the Porcupine Caribou Herd.

McCabe 1997), and calf survival was lower for calves born in the foothills (Griffith et al. 2002). Mean annual calf survival was higher when the forage biomass at peak lactation (estimated by NDVI on June 21) was higher (Griffith et al. 2002); hence, calving grounds for the PCH varied annually, at least in part due to spring weather and vegetation growing conditions; calving location and vegetation growing conditions appear to affect calf survival. The USFWS (2015a) concluded that, due to the annual variability in the calving area, the PCH needs a large region from which to select the best conditions for calving in a given year.

During the post-calving season (last week of June and first week of July), most locations of PCH caribou were in the program area, and PCH caribou moved west toward the program area, even if they calved outside of it (Griffith et al. 2002).

PCH caribou may use both coastal areas and inland ridgetops for insect relief (Walsh et al. 1992; USFWS 2015a). During the summer insect season (July 7–August 14) in the years before 2000, caribou spread out across the Coastal Plain and in the Brooks Range in Alaska and Yukon, with few remaining in the program area (**Map 3-21** in **Appendix A**; Griffith et al. 2002). After 2000, PCH caribou generally left the Coastal Plain by the end of June (USFWS 2015a). Most PCH caribou move out of the program area by mid to late summer.

CAH Use of the Program Area

Females in the CAH calve in two areas west of the Arctic Refuge: one south and southwest of the Kuparuk oilfield, between the Colville and Kuparuk Rivers, and the other between the Sagavanirktok and Canning Rivers in an area with little development (**Map 3-22**, Seasonal Distribution of the Central Arctic Herd, in **Appendix A**). Since construction of the Alaska North Slope oilfields, the CAH has been exposed to some level of development for about 40 years (Cameron et al. 2005). During most years since 2004, a portion of the CAH has moved through the program area during the summer insect season (**Map 3-22** in **Appendix A**; Lenart 2015a; Nicholson et al. 2016; Prichard et al. 2017).

Coastal movements by large groups of caribou occur during periods of mosquito harassment, with caribou typically moving into the wind (which tends to be easterly); however, those groups tend to break up and disperse when oestrid flies become the dominant insect pests (Murphy and Lawhead 2000).

The number of CAH animals using the program area varies annually, likely in response to weather conditions and the resulting levels of insect harassment and longer time scale shifts in CAH summer movement patterns.

Muskox

This native species became extinct in Alaska in the nineteenth century; the history, distribution, and habitat preferences of muskoxen were described previously (BLM 2012, Section 3.3.6.2, page 293; USFWS 2015a). The current population in northeastern Alaska was reestablished by translocation when 64 animals from Greenland stock were released at Barter Island and the Kavik River in 1969 and 1970 (USFWS 2015a). As their numbers increased, they expanded westward on the ACP to the Colville River drainage and eastward across the international border to the Babbage River in northern Yukon.

The population in northeastern Alaska and northwestern Canada was estimated at 700–800 animals in the mid-1990s, but it subsequently declined to approximately 300 animals from 2007 to 2014; about 200 were located west of the Arctic Refuge and 100 were located east of it in northern Yukon (Lenart 2015b; Arthur and Del Vecchio 2017). The decline was especially steep in the Arctic Refuge, where only one muskox was observed in 2006. A group of fewer than 20 animals, which moved back and forth across the Canning River, was the only group using any part of the Arctic Refuge from 2009 to 2015 (Lenart 2015b). Predation by grizzly bears accounted for 58 percent of calf mortality and 62 percent of adult mortality from 2007 to 2011 (Arthur and Del Vecchio 2017).

Moose

The program area is near the northern extent of moose range, but moose are found in low numbers on the ACP where suitable forage plants occur, primarily in riverine habitats dominated by willow shrubs (Lenart 2014; USFWS 2015a). Late-winter aerial surveys in 2014 found only 22 moose in a series of drainages that included the program area, a sharp decrease from the fairly stable number of 47–61 moose found in the same survey area from 2002 to 2010 (Lenart 2014). Moose exhibit large fluctuations in population size on the North Slope but appear to be expanding their range farther onto the North Slope in response to climate warming and corresponding northward expansion of tall shrubs (Tape et al. 2016).

Carnivores

Three large- to medium-sized terrestrial carnivores—grizzly bear, wolf, and wolverine—inhabit the Arctic Refuge, occurring in lower densities on the coastal plain of the North Slope than father inland in the foothills and mountains (Young et al. 2002). The USFWS (2015a) summarized information on these species.

Grizzly bears and wolves are important predators of caribou and other ungulates. Grizzly bears occupy dens during winter dormancy, whereas wolves and wolverines remain active year-round. Grizzly bear density in Game Management Unit (GMU) 26C, which covers much of the program area, was estimated to be 3.8 bears per 100 square miles in 1993 (Lenart 2015c). Due to the distribution of suitable landforms and substrates, wolf den sites are more common in the foothills and mountains than on the coastal plain of the North Slope (Young et al. 2002; USFWS 2015a). Wolf density in GMU 26C was estimated to be 5.7–8.3 per 1,000 square miles in the 1980s (Garner and Reynolds 1986; Caikoski 2012).

Two species of foxes and two species of weasels inhabit the program area, all which feed on small mammals year-round and on birds and their eggs when available during summer. Arctic foxes inhabit the Coastal Plain during the summer denning season to rear pups but move long distances to forage extensively on sea ice during winter (Pamperin et al. 2008), although arctic foxes may have a significantly reduced winter range and higher survival rates in areas with access to anthropogenic food sources near development (Pamperin et al. 2008; Lehner 2012). Red foxes are not known to inhabit sea ice and are increasing in numbers on the ACP, in concert with climate warming and increased availability of human food sources in industrial areas (Savory et al. 2014; Elmhagen et al. 2017). Red foxes are aggressive toward arctic foxes and would kill or otherwise displace them from den sites (Pamperin et al. 2006; Stickney et al. 2014).

All species of terrestrial carnivores can be attracted to areas of human activity if food or rotting waste are improperly handled or disposed of. This can lead to habituation and food-conditioning, thus increasing the risk of injury or mortality to humans or the carnivores themselves (Burgess 2000; Shideler and Hechtel 2000). Increasing predator populations, with the associated higher predation rates on prey populations (especially migrant birds), has been a perennial concern around the North Slope oilfields (Day 1998).

Small Mammals

Small mammals provide important prey resources for predatory mammals and birds in the region, and arctic ground squirrels are especially important prey for grizzly bears and foxes (Babcock 1986). Arctic ground squirrels hibernate during winter, whereas lemmings, voles, and shrews remain active under the snow cover. Most species of small mammals exhibit cyclical population fluctuations, which have pronounced effects on local ecological systems (USFWS 2015a). Similar to moose, snowshoe hares appear to be expanding their range farther onto the ACP in response to climate warming and corresponding northward expansion of tall shrubs (Tape et al. 2015). Beavers also are expanding their range into parts of Arctic Alaska and the northern Yukon (Tape et al. 2018).

Climate Change

Caribou body condition and population fluctuations have been found to be influenced by large-scale climate oscillations, such as the Arctic Oscillation (Griffith et al. 2002; Joly et al. 2011; Mallory et al. 2018). Climate change is expected to increase temperatures, increase precipitation, and lengthen the snow-free season (see **Section 3.2.1**). Summer temperatures above freezing could occur for 6 weeks longer by 2099 (SNAP 2011). Climate change in the Arctic is predicted to have multiple, sometimes counteracting, effects on barren-ground caribou (Martin et al. 2009; Albon et al. 2016; Mallory and Boyce 2017). Vegetative biomass in the arctic has generally increased since 1984, although the increase in Alaska has been lower than the increase in eastern Canada (Ju and Masek 2016). An increase in shrub cover and a decline in lichens growing on soil has been documented in the western Canadian Arctic (Fraser et al. 2014).

A longer snow-free season can increase access to forage (Cebrian et al. 2008; Tveraa et al. 2013), but warmer summers could increase insect harassment (Weladji et al. 2003), increase the incidence of parasites, and speed the annual decline in forage quality (Gustine et al. 2017). Changes in vegetation composition could result in increased abundance of shrubs and deterioration of forage quality (Fauchald et al. 2017). Increased moose densities could increase predator densities and alter predator distributions.

Changes in winter precipitation could change access to forage and energetic demands for cratering through snow. Increases in rain-on-snow events could greatly decrease access to winter forage (Hansen et al. 2011; Albon et al. 2016; Loe et al. 2016). Changes in timing of snowmelt and vegetation growth could create a phenological mismatch[26] between timing of calving and the emergence of highly nutritious forage (Post and Forchhammer 2008). Gustine et al. (2017) found no evidence of a spring nourishment mismatch for caribou in Alaska but suggested that one may occur in fall with increased warming. If mosquitos emerge closer to calving, it could result in a higher rate of separation of calves, poorer body quality of maternal caribou, and higher calf mortality. Earlier melting of ice and snow and earlier river breakup could alter the timing or difficulty of caribou migrations (Sharma et al. 2009; Leblond et al. 2016).

Climate change is also likely to result in a northward expansion of some mammal species, such as moose, beaver, and snowshoe hare; a potential increase in red foxes due to warming could cause a decline in arctic foxes. Some species with low reproductive output in the Arctic, such as grizzly bears, may benefit from increased productivity and a more diverse prey base.

Because climate change could involve both adverse and beneficial effects on caribou, it is not possible to predict the impacts on the PCH and CAH; however, climate change could affect caribou demographics as well as habitat use and introduce additional uncertainty into projections of impacts due to development.

[26]The phenomenon of food and habitat being available at different times than those to which the species was formerly cued.

The PCH calving distribution varies with the onset of spring seasonal changes and is typically farther west during warmer springs (Griffith et al. 2002); hence, climate warming could result in more frequent calving in the program area or a western shift in concentrated calving areas. Development alternatives that limit development to a smaller portion of previously used PCH calving grounds would allow caribou greater flexibility to adapt to changing conditions. Infrastructure to support development in the program area may facilitate additional development west of the program area, potentially altering the behavior and movements of CAH caribou. It could also result in demographic impacts, although at much higher levels of interaction than currently observed (Murphy et al. 2000).

Direct and Indirect Impacts

Issuance of oil and gas leases under the directives of Section 20001(c)(1) of PL 115-97 would have no direct impacts on the environment because by itself a lease does not authorize any on the ground oil and gas activities; however, a lease does grant the lessee certain rights to drill for and extract oil and gas subject to further environmental review and reasonable regulation, including applicable laws, terms, conditions, and stipulations of the lease. The impacts of such future exploration and development activities that may occur because of the issuance of leases are considered potential indirect impacts of leasing. Such post-lease activities could include seismic and drilling exploration, development, and transportation of oil and gas in and from the Coastal Plain. Therefore, the analysis is of potential direct and indirect impacts on terrestrial mammals from on-the-ground post-lease activities.

Post-lease activities in the program area have the potential to affect terrestrial mammals through habitat loss and alteration, behavioral disturbance and displacement, and injury or mortality as a result of oil and gas exploration and development (**Table 3-19**). The impacts of oil and gas development on caribou have been summarized in various reviews, along with appropriate mitigation measures (Shideler 1986; Cronin et al. 1994; Murphy and Lawhead 2000; Lawhead et al. 2006), which are incorporated here by reference and are summarized below. Because specific project plans are not available for analysis, the areas available for leasing with and without restriction under each alternative were summarized in relation to the available data on terrestrial mammal distribution and in relation to predicted oil potential. The effects of climate change described under *Affected Environment* above, could influence the rate or degree of the potential direct and indirect impacts.

Alternative A

Under this alternative, current management actions would be maintained, and resource trends would continue, as described in the Arctic Refuge CCP (USFWS 2015a). There would be no direct or indirect impacts on terrestrial mammals from post-lease oil and gas activities under Alternative A.

Impacts Common to All Action Alternatives

Seismic Exploration

Future seismic exploration is expected to occur in all portions of the program area that are open to lease sales. It has the potential to affect terrestrial mammals by eliminating below snow habitat for small mammals, reducing forage availability during winter through compaction of snow and underlying vegetation, and disturbing denning grizzly bears and muskoxen. Occupied dens of grizzly bears detected during den surveys would be avoided by at least one half-mile, although complete detection of dens is unlikely (Amstrup et al. 2004a). The program area is used very little by caribou during winter (Clough et al. 1987; Porcupine Caribou Technical Committee 1993; Ryder et al. 2007), so direct impacts on that species

Table 3-19
Summary of the Type, Context, and Duration of Potential Effects of Oil and Gas Exploration, Construction, and Drilling and Operations on Terrestrial Mammals

Project Component	Potential Effect	Type	Context	Duration
Seismic exploration	Elimination of under-snow habitat for small mammals	Adverse	Site-specific	Short-term
	Disturbance of active or denning mammals during winter	Adverse	Local	Short-term
	Change in phenology or damage to forage plants	Adverse/ beneficial	Site-specific	Short-term/ long-term
Gravel and pipeline infrastructure	Habitat loss from gravel fill placement	Adverse	Site-specific	Long-term
	Habitat alteration due to drifted snow, gravel spray, and dust deposition adjacent to gravel infrastructure	Adverse	Local	Long-term
	Early snowmelt due to dust deposition	Beneficial	Local	Long-term
	Displacement of caribou from infrastructure during calving	Adverse	Planning area-wide	Long-term
	Attraction of caribou to roads and gravel pads during oestrid fly harassment	Beneficial	Local	Long-term
	Disturbance and altered behavior due to noise and activities associated with construction and drilling and operation	Adverse	Local	Long-term
	Alteration of normal movement patterns and fragmentation of habitat due to roads and pipelines	Adverse	Local	Long-term
	Injury or mortality of large mammals due to vehicle strikes on gravel roads	Adverse	Site-specific	Long-term
	Injury or mortality of small mammals due to vehicle strikes on gravel roads	Adverse	Site-specific	Long-term
	Contamination of roadside forage due to dust	Adverse	Local	Long-term
	Injury or mortality of small mammals in subterranean burrows	Adverse	Site-specific	Long-term
Ice roads and pads	Habitat alteration due to drifted snow, delayed ice melt, vegetation compression, and hydrologic alteration from ice roads	Adverse	Local	Short-term
	Displacement from ice roads and ice pads due to noise and activity	Adverse	Local	Short-term
	Injury or mortality due to vehicle strikes on ice roads	Adverse	Site-specific	Short-term
	Injury and mortality of small mammals in under-snow habitats	Adverse	Site-specific	Short-term
Gravel Mine	Habitat loss due to gravel mining	Adverse	Site-specific	Long-term
	Habitat alteration from dust, water displacement, and hydrologic alteration at gravel mine	Adverse	Local	Long-term
	Displacement from gravel mine due to noise and activity	Adverse	Local	Long-term

during that time frame would be negligible. Potential localized disturbance of the small number of muskoxen along the western boundary of the program area could result from seismic exploration activities in areas of High HCP.

Potential indirect effects of seismic exploration would include short-term compaction of snow cover in foraging habitats for herbivores. The timing of snowmelt during the spring following seismic exploration would change as a result of snow compaction and changes in snow drifting. Delayed snowmelt in the spring could decrease forage available to caribou and other herbivores, but could also extend the time when highly nutritious, early growth forage is available after snowmelt. Some potential habitat alterations and long-term damage to forage plants for herbivores, such as riparian willow shrub is also likely to occur, as described in the **Section 3.3.1**.

Construction

All action alternatives could result in up to 2,000 acres of direct surface impact from future placement of gravel infrastructure on leased land, in addition to gravel mines and associated development on adjacent land owned by Alaska Native corporations in the program area, but not subject to PL 115-97. The amount of future construction activity is expected to be similar across action alternatives, although the spatial distribution and extent of the activities would differ, as described separately for each alternative later in this section.

Using the hypothetical schematic anchor-field footprint (one CPF and 6 radiating 8-mile access roads to 6 drill pads, including an STP pad and a 30-mile access road, totaling 750 acres), the BLM calculated estimates of the area within 2.49 miles for potential displacement of calving caribou. Using these schematic footprints and extrapolating to a 2,000-acre maximum gravel footprint, it estimated the total acres of potential disturbance and displacement is 633,000 acres; however, this number would vary with different road and pad scenarios, and some portion of this area could be overlapping the buffer from other development, outside of the program area, or in the ocean. This potential displacement area is compared with areas available for lease under each alternative.

During winter, future construction activities would affect mammals that are active all year or are denning in the area. Future summer construction activities could potentially disturb all mammal species using the area in that season. Increased disturbance could result in increased energetic costs, decreased time spent foraging, or displacement from preferred habitat.

Future construction activities would result in potential loss and alteration of terrestrial mammal habitats due to gravel placement for roads, pads, and airstrips, as well as from gravel extraction from mine sites. Habitat loss would reduce forage availability for herbivorous terrestrial mammals. For most terrestrial mammals, foraging habitat is abundant across the program area. Habitat loss also would eliminate denning and burrowing habitat for some species of small mammals, but the availability of denning habitat does not appear to be a limiting factor for those species. Gravel fill occasionally may be used for artificial den sites by small numbers of bears and foxes.

Injury and mortality of terrestrial mammals is possible as a result of potential vehicle strikes on gravel roads and ice roads during construction. Caribou and other mammals attracted by early vegetation greening along gravel roads during spring snow melt would be at increased risk of injury or mortality. Caribou move unpredictably during the oestrid fly season and often use gravel roads and pads as travel routes and as relief habitat, substantially increasing the risk of vehicle-related injury and mortality during that period. Small mammals in under-snow burrows may be killed because of gravel placement, gravel mining, and ice road construction during winter, or they may be killed by vehicles while crossing roads. Humans may haze bears and foxes attracted to infrastructure or, in extremely rare situations, may kill them in defense of life or property.

Potential indirect impacts on terrestrial mammals would include habitat alteration, fragmentation, and loss of use because of disturbance and displacement. Habitat near gravel infrastructure is likely to be affected by physical alteration caused by dust deposition, gravel spray, thermokarst, flow alteration, and impoundments. The magnitude of these impacts varies, depending on species, habitat type, volume of ground ice, and hydrologic regime (Brown and Grave 1979; Walker et al. 1987). Habitat alteration would reduce local forage availability for herbivorous mammals, such as caribou, muskox, moose, and some small mammals. Snowdrifts along roads would reduce the availability of winter forage locally for herbivores and delay its availability in the spring. Deposition of fugitive dust on snow, caused by vehicle traffic on gravel roads, would lead to early snowmelt and green-up in affected areas, attracting some caribou in spring before calving and increasing access to early emerging forage.

Few data are available on the effects of noise and light on caribou. Tyler et al. (2018) suggested that caribou may avoid power lines in winter due to their ability to detect light in the ultraviolet range. Noise and light associated with vehicles, aircraft, and other human activity is likely to increase the level of disturbance associated with those activities, which could result in negative effects on terrestrial mammals, due to increased disturbance, altered behavior, and displacement.

Vegetation damage from future ice-road construction could reduce the abundance and quality of forage for terrestrial mammals, particularly caribou. The compaction of vegetation could reduce concealing cover for small mammals. Although some habitat damage would result from the use of ice roads and pads because the ice road is temporary, the long-term impacts would be considerably less than those associated with gravel roads and pads. Tussock tundra and sedge/grass meadow are preferred cover classes for caribou. Moose generally prefer tall shrub and riverine landcover types. Drier habitat classes are preferred by arctic ground squirrels and denning foxes. Many other terrestrial mammals in the program area are opportunistic and do not have restrictive habitat preferences (**Table J-1** in **Appendix J**).

Disturbance by future vehicle traffic, structures, and construction activities, including blasting associated with gravel mining, causes a variety of potential impacts on the behavior and movements of terrestrial mammals. Some species, particularly bears and foxes, may be attracted to areas of human activity in the program area due to the availability of food or shelter. An increase in red foxes due to human food sources could result in a decline in arctic fox densities. Construction may disturb grizzly bears in dens that are not found by preconstruction denning surveys.

Potential behavioral effects of disturbance on caribou include displacement of maternal caribou during calving and early lactation (late May to late June), deflection and delays in caribou movements across roads and pipelines during the summer insect season (late June to mid-August), and potentially during spring and fall migrations for the smaller numbers of caribou present in those seasons. Potential disturbance could result in behavioral responses, such as reduced foraging rates, increased movements, and energetically costly flight responses, potentially displacing animals from suitable habitat (Shideler 1986; Cronin et al. 1994; Murphy and Lawhead 2000; Murphy et al. 2000).

Under all alternatives, terrestrial mammals are more prone to displacement from areas with consistently high levels of activity, such as near CPFs, airstrips, and busy sections of trunk roads. The most common disturbing stimulus associated with roads is vehicle traffic; 15 vehicles per hour or more has been shown to deflect caribou movements and delay road crossings, even in the absence of pipelines (Curatolo and Murphy 1986; Cronin et al. 1994). Studies of CAH caribou have demonstrated that behavioral reactions are most common when caribou are within 656 feet of roads, but the strongest reactions, as measured in displacement distance, occur in response to humans on foot (Curatolo and Murphy 1986; Lawhead et al. 1993; Cronin et al. 1994).

Experience in existing northern Alaska oil fields indicates that caribou and other terrestrial mammals may habituate to low-level constant noise and oilfield activities on roads and pads (maternal caribou with young calves, being a notable exception). PCH caribou have had much less exposure to human development and activities than have CAH caribou, however, so they would be expected to have stronger reactions to infrastructure than CAH caribou for some years. Some indication of habituation to infrastructure by PCH caribou during winter has been reported (Johnson and Russell 2014).

Research in the Kuparuk and Milne Point oilfields on the central North Slope has demonstrated that, during and immediately after calving, maternal caribou with young calves tend to avoid areas within at least 1,640–3,281 feet of active roads and pads (Johnson and Lawhead 1989; Cronin et al. 1994), and as far as 1.25 to 2.5 miles (Dau and Cameron 1986; Lawhead 1988; Cameron et al. 1992; Cronin et al. 1994; Nellemann and Cameron 1996; Lawhead et al. 2004).

Studies of open-pit mines have recorded more extensive displacement of Bathurst caribou with a zone of influence extending 6.8–8.7 miles (Boulanger et al. 2012). A level of displacement of up to 2.49 miles observed at existing North Slope oil fields would be expected in the program area with similar development and mitigation design. Displacement lasts from calving (late May to mid-June) up to when calves are approximately 3 weeks of age (Lawhead et al. 2004; Haskell et al. 2006), corresponding to the calving and post-calving periods for the PCH (**Map 3-21** in **Appendix A**).

Of the 1,563,500 acres in the program area, 728,300 acres (49.0 percent) are in areas used for annual calving grounds of the PCH at least 40 percent of years; 882,500 acres (59.4 percent) are in areas used for annual calving grounds of the PCH at least 30 percent of years; and 1,031,400 acres (69.4 percent) are in areas used for annual calving grounds of the PCH at least 20 percent of years (**Table J-15** in **Appendix J**). All of the area in the annual calving grounds of the PCH (at least 30 percent of years) is thought to have low or medium HCP (**Map 3-21** in **Appendix A**).

Although several potential demographic impacts of development on CAH caribou have been reported (Cameron et al. 2005; Arthur and Del Vecchio 2009), the CAH increased in size between 1978 and 2010 before declining in size between 2010 and 2016 (Lenart 2015a). The patterns of CAH demography following development should be applied to the PCH with caution for several reasons: movements and demography of the PCH are different from the CAH, concentrated calving density of the PCH is much higher than the CAH, and areas next to the PCH calving grounds contain less high-quality forage and higher predator densities and exhibit more topographic relief than do the current PCH calving grounds (Clough et al. 1987; Griffith et al. 2002).

If future development causes large-scale displacement of the PCH from the calving grounds in the program area, the calving distribution would most likely shift to the east or southeast (Griffith et al. 2002) and displacement would be most likely to occur in years of early snowmelt when the PCH is more likely to calve in the program area in the absence of development (Griffith et al. 2002). Comparison of mean annual survival rates of PCH calves during June 1985 and between 1987 and 2001 showed that calf survival was lower in years when higher proportions of calves were born off the coastal plain and when less vegetative biomass (based on NDVI) occurred on the annual calving ground at the time of peak lactation (June 21; Griffith et al. 2002). Using this model and previous hypothetical development scenarios (Scenarios 2–5 from Tussing and Haley 1999) and assuming that the calving distribution would be displaced 2.49 miles from development, Griffith et al. (2002) predicted that calf survival would decline linearly with the distance that the annual calving ground was displaced and predicted an 8 percent decline in annual calf survival if there were full development of the ANICLA defined 1002 Area, essentially the current program area. This predicted decline in mean annual calf survival during June would have been large enough to halt herd growth, based on random population simulations of the PCH (Walsh et al. 1995). This analysis assumed no change in the shape of the calving distribution. It was developed from annual comparisons of mean calf survival but has not been tested for a spatial shift in calving in a given year. An eastward shift in the calving distribution would move the calving distribution into areas with higher predator densities (Young et al. 2002), into areas with lower quantity and quality of common caribou forage species, and into lower proportions of the preferred tussock tundra and moist sedge-willow tundra vegetation types (Jorgenson et al. 2002).

Large aggregations of PCH and CAH moving in midsummer through the program area during periods of mosquito harassment would have to navigate any infrastructure they encounter. Caribou may expend more energy, take more time, or exhibit reduced crossing success where traffic rates exceed 15 vehicles per hour and pipelines are within 300 feet of roads (Curatolo and Murphy 1986; Cronin et al. 1994; Murphy and Curatolo 1987; Johnson and Lawhead 1989; Lawhead et al. 1993); however, the 7-foot minimum height at VSMs and placement of elevated pipelines at least 500 feet from adjacent roads have been found to be adequate to maintain caribou passage in the oilfields west of Prudhoe Bay (Cronin et al. 1994; Lawhead et al. 2006). During the oestrid fly season (mid-July to mid-August) elevated gravel roads and pads and shaded areas under buildings and pipelines may provide relief from insect harassment (Curatolo and Murphy 1986; Cronin et al. 1994; Noel et al. 1998).

The presence of roads and pipelines in the program area could also delay and deflect movements during spring and fall. Research has found varied responses of caribou to roads during such migrations. Approximately 30 percent of collared female caribou (8 of 24 individuals) encountering the Red Dog Mine road in northwestern Alaska during fall migration experienced long delays in crossing the road corridor, with the delays of these "slow crossers" averaging 11 times longer than those of "normal crossers" (33.3 days vs. 3.1 days; Wilson et al. 2016). Wild reindeer (the same species as caribou) in Norway were delayed approximately 5 days during spring migration at a highway corridor experiencing high levels of human activity, but when human activity was low during fall migration, the road did not appear to pose an obstruction (Panzacchi et al. 2013). Similar delays have not been observed in caribou in the existing North Slope oil fields, where most movements occur during the summer insect season when movement rates and motivation to cross are much higher (Cronin et al. 1994; Murphy and Lawhead 2000). Caribou crossing success in the program area would vary by season, behavioral motivation, level of habituation, and human activity levels. Alteration of the timing of fall migration could affect some subsistence hunters by delaying access until caribou bulls are in rut and are no longer selected by subsistence hunters.

Aircraft noise during take-offs and landings could result in the inability of nearby terrestrial mammals to hear biologically important sounds, such as predators, prey, or interspecific communication (Barber et al. 2010) and could lead to increased stress levels near the airstrip. Low-level aircraft may cause flight responses or temporary changes in caribou behavior (Maier et al. 1998; Reimers and Colman 2006), which could temporarily deflect or alter caribou behavior, potentially affecting hunting activities and hunting success for subsistence hunters (as described in **Section 3.4.3**, Subsistence Uses and Resources).

Most program-related aircraft operators would maintain minimum flight altitudes to reduce disturbance of wildlife and subsistence hunters. In addition, habituation appears to lower the response of caribou to aircraft activity (Valkenberg and Davis 1985). Some of the limited research on aircraft disturbance on caribou involved military jets. Military jets are louder than the typical aircraft likely to use the program area, but they are also faster, potentially resulting in more intense disturbance for a shorter duration. Although the effects of military aircraft on caribou behavior may differ somewhat from the effects of more typical aircraft using the program area, these studies provide useful information on the range of caribou behavior likely to be encountered. Maier et al. (1998) found that caribou responses to low-level military jet overflights were low in late winter, moderate in midsummer, and strongest during post-calving, with females accompanied by young showing the strongest responses. During the post-calving season, caribou subjected to direct overflights at low altitudes by military jets moved farther and were more active than animals that were not overflown. Lawler et al. (2005) found that responses to military overflights during calving were variable but generally mild, and overflights did not result in higher calf mortality or increased movements of cow/calf pairs.

All alternatives would be subject to ROP 23 and portions of ROP 34. ROP 23 incorporates oilfield design specifications that have been found to minimize disruptions to caribou movements in existing oilfields (Shideler 1986; Cronin et al. 1994; Murphy and Lawhead 2000; Lawhead et al. 2006). These include requirements relating to pipeline height, pipeline road separation distance, road and pipeline orientation, caribou crossing ramps, and pipeline coating, and would require a vehicle management plan to be developed. ROP 34 requires an aircraft use plan and would place limits on aircraft altitude and landings near known subsistence hunting camps and cabins and in the PCH calving area (all action alternatives) and the PCH post-calving area (Alternative D only).

<u>Development Drilling and Operations</u>

Given the 2,000-acre limit on gravel placement, the amount of activity during future development drilling and operations is expected to be similar among alternatives, although the spatial distribution and extent of the activity would differ among the alternatives, as described separately below.

Many of the same impacts that occur during construction would persist throughout future drilling and operation, although some activities, such as gravel hauling, gravel fill placement, pipeline construction, would end and others, such as vehicle and air traffic volume, would continue at a lower frequency. Drill rigs and associated activity would introduce additional noise disturbance. Because of the relative levels of activity associated with each phase, the potential impacts during development drilling would be greater than during operations after drilling ceases.

The potential effects of habitat loss are long term and would continue throughout drilling and operations. Additional habitat alterations from the impacts of snowdrifts, dust, thermokarst, and ponding would continue during operations. Accidental oil discharges in the program area may affect terrestrial mammals, depending on the location and size of the spills (see **Section 3.2.11**). During exploration and construction, the primary releases would be accidental spills from vehicles, storage tanks, marine barges and docks, aircraft, and equipment during transport or fueling and during pipeline hydrotesting; however, the frequency of spills would be limited by BMPs.

Most potential spills would be fewer than 100 gallons and restricted to ice or gravel roads and pads, never reaching the tundra, but larger tundra spills are possible. Disturbance from human activities and traffic on roads, pads, and airstrips would continue through drilling and operations; however, the frequency of disturbance would decline during operations, in comparison with construction and development drilling.

Throughout future drilling and operations, the assumption is that maternal female caribou with young calves would continue to avoid active infrastructure by up to 2.49 miles and that caribou moving through the program area during the post-calving and insect seasons could experience delays and deflections when encountering roads and pipelines.

Vehicles are likely to strike small numbers of mammals throughout future drilling and operations, although a vehicle management plan (ROP 23) would be required and may lower the incidence of vehicle strikes. Dust generated during future creation of and travel on gravel roads may add toxic metals to roadside vegetation that mammals forage (Walker and Everett 1987; Shotyk et al. 2016; Knight et al. 2017).

Alternative B

<u>Seismic Exploration</u>

Alternative B would open the entire program area to lease sales, and seismic activity could occur throughout the program area. Approximately 500 line miles of seismic data are expected to be collected, with receiver lines spaced 330 to 1,320 feet apart. Seismic activity could have potential impacts on terrestrial mammals, such as destruction of under-snow small-mammal habitat, disturbance of denning mammals, crushing of forage species, alteration of snowmelt timing.

<u>Construction</u>

Under this alternative, surface occupancy would be excluded from areas within 0.5 and 1 mile of selected river corridors (Lease Stipulation 1); this would limit disturbance on some potentially important PCH calving areas. Although they did not test specifically for selection of riverine areas, Young and McCabe (1998) found that the mean distance from rivers was closer than expected for calving PCH caribou but not for grizzly bears in their 1002 study area. Wilson et al. (2012) found that female Teshekpuk Herd caribou avoided riverine habitats at both the landscape and patch scale of selection during calving. Jakimchuk et al. (1987) found that female CAH caribou avoided riverine habitat during calving, while males selected riverine habitats during that period, although use of riparian areas was partially confounded with industrial development in one river corridor.

Future development along coastal areas could hinder coastal movements of CAH and PCH animals during midsummer periods of mosquito harassment. Alternative B requires an impact and avoidance and monitoring plan to mitigate effects on wildlife along coastal areas (Lease Stipulation 9) but does not limit infrastructure in coastal areas.

Under Alternative B, 289,600 acres would be closed to surface occupancy. The 633,000 acres of potential PCH calving displacement area (based on a displacement of 2.49 miles) would affect up to 52.9 percent of the remaining area, although some of this buffer area would likely fall into the locations with NSO or out of the program area (**Map 3-23**, Porcupine Caribou Herd, Alternatives B, C, D1, and D2, in **Appendix A**).

Alternative B would suspend major construction activities and place limits on vehicle traffic and vehicle speeds in the PCH primary calving habitat area (Lease Stipulation 7 and ROP 23) during the calving period (May 20 to June 20).

Density of infrastructure as well as such activity as vehicle traffic, aircraft, and human foot traffic affects caribou use of calving areas (Curatolo and Murphy 1986; Nellemann and Cameron 1998; Cameron et al. 2005). Some level of displacement of calving caribou has been shown to occur even with low levels of traffic (Dau and Cameron 1986; Lawhead 1988, Lawhead et al. 2004), while caribou avoidance of roads in other seasons appears to be positively related to the intensity of the disturbance (Leblond et al. 2013). As a result, the limitations on vehicle and aircraft use and construction activity outlined in the Lease Stipulation 7, ROP 23, and ROP 34 would lower the frequency and intensity of caribou disturbance. Future infrastructure development, even with low levels of human activity in the area of concentrated calving for the PCH, could lead to displacement of calving caribou and decreased calf survival or a decline in caribou body condition, as described above.

The PCH calving habitat area would not be subject to specific lease stipulations after June 20, although the area is used extensively by the PCH during the post-calving period (PCTC 1993); it would still be subject to the limitations in ROP 23 and ROP 34. As a result, some potential impacts on caribou distribution and movements may occur in this area during the post-calving period, although caribou exhibit less displacement from properly designed infrastructure during the post-calving period, compared with the calving period.

A total of 9.4 percent of the preferred Tussock Tundra land-cover type in the program area would be off limits to lease sales or surface occupancy (**Table J-3** in **Appendix J**). Of the high use PCH calving area (used in greater than 40 percent of years), Alternative B would place 135,500 acres (18.6 percent) off limits to lease sales or surface occupancy, place TLs on 564,900 acres (77.6 percent) and leave 27,900 acres (3.8 percent) subject only to standard terms and conditions (**Table J-12** in **Appendix J**).

Of the high use PCH post-calving area (used in greater than 40 percent of years), Alternative B would place 113,700 acres (20.4 percent) off limits to lease sales or surface occupancy. It would place TLs on 371,300 acres (66.5 percent) and leave 73,500 acres (13.2 percent) subject only to standard terms and conditions (**Table J-13** in **Appendix J**).

Alternative B would place an area predicted to contain 0.27–1.65 percent of the CAH during different seasons off limits to lease sales or surface occupancy, place TLs on an area predicted to contain 0.05–0.78 percent of the CAH during different seasons and use only standard terms and conditions in an area predicted to contain 0.76–4.45 percent of the CAH during different seasons (**Table J-14** in **Appendix J**). Because these percentages represent seasonal averages, the percentage of the CAH moving through these areas during a season may be substantially higher; hence, much of the seasonally important areas for the PCH in the program area are open to surface occupancy but subject to TLs under Alternative B; the potential impacts of this alternative on caribou would depend, in large part, on how well these TLs avoid displacement of calving caribou and impediments to caribou movements during other times of year when caribou are present.

Drilling and Development Operations

Potential impacts under Alternative B during the drilling and operations phase would be similar to the construction phases. Many of the same impacts that occur during construction would persist throughout drilling and operation, although some activities, such as gravel hauling, gravel fill placement, and pipeline construction, would end and others, such as vehicle and air traffic volume, would continue at a lower frequency. These potential impacts would be long term, lasting for at least the period of development and range in extent from the area of the gravel footprint to within 2.49 miles of infrastructure, as described above.

Alternative C

Seismic Exploration

Alternative C would not allow surface occupancy on 606,200 acres of the PCH primary calving habitat area (Lease Stipulation 7); however, seismic activity could occur over the entire program area with potential impacts on terrestrial mammals, as described above, such as destruction of under-snow small mammal habitat, disturbance of denning mammals, crushing of forage species, alteration of snowmelt timing.

Construction

Under Alternative C, 858,000 acres (57.7 percent of the program area) would not allow surface occupancy. The potential 633,000 acres of PCH calving displacement (based on a displacement of 2.49 miles) would affect up to 100 percent of the remaining area, although some of this buffer area would likely fall into the locations with NSO or out of the program area. Because there would be no change from Alternative A, no potential impacts are expected in these areas under Alternative C.

Alternative C would close the areas within 0.5 to 2 miles of selected rivers (Lease Stipulation 1) and 606,200 acres of PCH calving habitat to surface occupancy (Lease Stipulation 7). This could limit potential impacts on caribou in potentially important calving areas. as described above.

Alternative C would suspend major construction activities and place limits on vehicle traffic and vehicle speeds in the remaining 115,000 acres of the PCH primary calving habitat area (Lease Stipulation 7) from May 20 to June 20 and would require sections of road to be evacuated whenever large caribou crossings appear to be imminent in the PCH post-calving habitat area (Lease Stipulation 8) between June 15 and July 20. The limitations on vehicle and aircraft use and construction activity outlined in Lease Stipulation 7, Lease Stipulation 8, ROP 23, and ROP 34 would lower the frequency and intensity of caribou disturbance in this area; however, some level of displacement of calving caribou has been shown to occur even with low levels of traffic (Dau and Cameron 1986; Lawhead 1988, Lawhead et al. 2004).

Alternative C would not allow wells or CPFs within 1 mile of the coast (Lease Stipulation 9). PCH and CAH form large, fast-moving aggregations along the coast in response to mosquito harassment. This lease stipulation would lower the potential for infrastructure to hinder these movements. Pipelines and roads could still be allowed by the BLM Authorized Officer, but with proper design, caribou are generally able to navigate these structures, especially following habituation and with low levels of vehicle traffic (Cronin et al. 1994; Murphy and Lawhead 2000, Lawhead et al. 2006).

Forty-two percent of the Tussock Tundra land cover type in the program area would be off limits to lease sales or surface occupancy (**Table J-5** in **Appendix J**). Of the high use PCH calving area (area used in greater than 40 percent of years), Alternative C would place 631,100 acres (86.7 percent) off limits to surface occupancy, would place TLs on 83,400 acres (11.5 percent), and would leave 13,700 acres (1.9 percent) subject to only standard terms and conditions (**Table J-12** in **Appendix J**).

Of the high use PCH post-calving area (used in greater than 40 percent of years), Alternative C would place 450,400 acres (80.6 percent) off limits to surface occupancy, would place TLs on 108,000 acres (19.3 percent), and would leave 108,000 acres (0.02 percent) subject to only standard terms and conditions (**Table J-13** in **Appendix J**).

Alternative C would place an area predicted to contain 0.4–2.54 percent of the CAH during different seasons off limits to surface occupancy, would place TLs on an area predicted to contain 0.21–1.36 percent of the CAH during different seasons, and would use standard terms and conditions in an area predicted to contain 0.39–2.68 percent of the CAH during different seasons (**Table J-14** in **Appendix J**). Because these percentages represent seasonal averages, the percentage of CAH animals moving through these areas during a season may be substantially higher.

Much of the seasonally important areas for the PCH in the program area is closed to surface occupancy under Alternative C; however, a smaller percentage of the area and some concentrated calving areas used in less than 40 percent of years are subject to TLs or to only standard terms and conditions, except those that apply to all alternatives (ROP 23 and ROP 34). The potential impacts of this alternative on caribou would depend on how well the area off limits to surface occupancy captures the preferred calving area for the PCH, how well these TLs and ROPs avoid displacing calving caribou in areas with surface occupancy, and how well it minimizes impediments to caribou movements during other times of the year.

Drilling and Development Operations

Additional potential impacts under Alternative C during the drilling and operations phase would be similar to the construction phases. Many of the same impacts that occur during construction would persist throughout drilling and operation, although some activities, such as gravel hauling, gravel fill placement, and pipeline construction, would end and others, such as vehicle and air traffic volume, would continue at a lower frequency. These potential impacts would be long term, lasting for at least the period of development and range in extent, from the area of the gravel footprint to within 2.49 miles of infrastructure, as described above; however, the areas of NSO would have no additional impact relative to Alternative A.

Alternative D

Seismic Exploration

Alternative D would close 476,600 acres of the PCH primary calving habitat area to lease sales; however, seismic activity could occur over the entire program area, with potential impacts on terrestrial mammals, as described above, such as destruction of under-snow small mammal habitat, disturbance of denning mammals, crushing of forage species, alteration of snowmelt timing. This alternative would prohibit winter activity within 1 mile of polar bear denning habitat (Lease Stipulation 5), an area that would likely also include some grizzly bear dens, due to similar habitat preferences.

Construction

Alternative D would close to lease sales or to surface occupancy those areas within 0.5 to 4 miles of selected rivers (Lease Stipulation 1), areas of the Canning River delta (Lease Stipulation 2), areas within 1 to 4 miles of selected springs and aufeis, the area within 3 miles of the east bank of the Canning River (Lease Stipulation 3), all 721,200 acres of the PCH primary calving habitat area (Lease Stipulation 7), and areas within 3 miles of the wilderness border (Lease Stipulation 10). Because there would be no change from Alternative A, no impacts are expected in these areas for Alternative D. The limits on surface occupancy near rivers and on the Canning River delta would ensure that development would not hinder caribou movements in these areas. The Canning River delta is used by large numbers of CAH caribou during midsummer in some years (**Table J-14** in **Appendix J**), and one muskox group has often used it in recent years; limiting infrastructure in this area would limit alterations to the movements of this group.

Alternative D would not allow CPFs in the PCH post-calving habitat area and would limit total infrastructure density in this area (Lease Stipulation 8). Sections of road would also be evacuated whenever large crossings of caribou appear to be imminent in this area (Lease Stipulation 8). The density of infrastructure affects caribou use of an area during calving and creates additional barriers for caribou movements during summer (Nellemann and Cameron 1998; Cameron et al. 2005); hence, limits on the density of development should improve caribou movement through the area.

Under Alternative D1,158,700 acres (77.9 percent of the program area) would be closed to lease sales or have NSO restrictions. The potential 633,000 acres of PCH calving displacement (based on a displacement of 2.49 miles) is larger than the 328,600 acres of the program area remaining open to surface occupancy.

Alternative D2 would limit major construction (Lease Stipulation 6) from May 20 to July 20. Sections of road would also be evacuated whenever large crossings of caribou appear to be imminent in the post-calving area (Lease Stipulation 8). These limits would lower the probability of displacement of caribou during calving and lower the frequency of delays in caribou movements or caribou disturbance during summer. Traffic volumes of 15 vehicles per hour or more have been shown to deflect caribou movements and delay road crossings, even in the absence of adjacent pipelines (Curatolo and Murphy 1986; Cronin et al. 1994).

Alternative D would not allow wells or CPFs and would restrict vessel activity within 2 miles of the coast (Lease Stipulation 1). PCH and CAH caribou form large, fast-moving aggregations along the coast in response to mosquito harassment; hence, this lease stipulation would lower the potential for infrastructure to hinder these movements. Pipelines and roads could still be allowed by the BLM Authorized Officer; however, with proper structure design, caribou are generally able to navigate them, especially following habituation and with low levels of vehicle traffic (Cronin et al. 1994; Murphy and Lawhead 2000, Lawhead et al. 2006).

A total of 66.5 percent of the Tussock Tundra land cover type in the program area would be off limits to lease sales or surface occupancy (**Table J-7** in **Appendix J**). Of the high use PCH calving area (used in greater than 40 percent of years), Alternative D1 would place 714,000 acres (98.0 percent) off limits to lease sales or surface occupancy, would control surface use in 5,400 acres (0.1 percent), and would use only standard terms and conditions on the remaining 8,900 acres (1.2 percent; **Table J-12** in **Appendix J**). Alternative D2 would place 714,000 acres (98.0 percent) off limits to lease sales or surface occupancy, would control surface use in 5,400 (0.7 percent), and would place TLs on 8,900 acres (1.2 percent; **Table J-12** in **Appendix J**).

Of the high use PCH post-calving area (used in greater than 40 percent of years), Alternative D1 would place 501,500 acres (89.8 percent) off limits to lease sales or surface occupancy and would control surface use in or use only standard terms and conditions on the remaining 56,800 acres (10.2 percent; **Table J-13** in **Appendix J**). Alternative D2 would place 501,500 acres (89.8 percent) off limits to lease sales or surface occupancy and would control surface use or place TLs in the remaining 56,800 (10.2 percent) (**Table J-14** in **Appendix J**).

Alternative D would place an area predicted to contain 0.64–3.84 percent of the CAH during different seasons off limits to lease sales or surface occupancy, would control use in an area predicted to contain 0.13–0.81 percent of the CAH during different seasons, and would use standard terms and conditions (Alternative D1) or TLs (Alternative D2) on an area predicted to contain 0.27–1.92 percent of the CAH during different seasons (**Table J-14** in **Appendix J**). Because these percentages represent seasonal averages, the percentage of CAH animals moving through these areas during a season may be substantially higher.

Based on the previously recorded calving distribution, most of the seasonally important areas for the PCH in the program area are closed to surface occupancy under Alternative D, but some concentrated calving areas used in less than 40 percent of years would be subject to only standard terms and conditions (Alternative D1) or TLs (Alternative D2); hence, in the absence of large shifts in calving distribution, little displacement of calving PCH caribou is expected during most years. Additional areas closed to surface occupancy would provide additional options for calving caribou to select areas away from infrastructure.

Drilling and Development Operations

Additional potential impacts under Alternative D during the drilling and operations phase would be similar to the construction phases. Many of the same impacts that occur during construction would persist throughout drilling and operation, although some activities, such as gravel hauling, gravel fill placement, and pipeline construction) would end and others, such as vehicle and air traffic volume, would continue at a lower frequency. These potential impacts would last for at least the period of development and would range in extent from the area of the gravel footprint to within 2.49 miles of infrastructure, as described above; however, the areas of NSO would have no additional impact relative to Alternative A.

Cumulative Impacts

Subsistence hunting of caribou has probably occurred in the program area for millennia (USFWS 2015a). Most terrestrial mammals in the program area currently have little interaction with infrastructure. There is permanent development associated with the community of Kaktovik as well as use of the area by subsistence hunters, hunters from outside the NSB, scientists, and recreationists. Far-ranging species such as caribou may encounter the Dempster Highway and other development in the Yukon (Johnson and Russell 2014), communities south of the program area, or oil and gas development west of the program area. Caribou of the CAH have had some interaction with oil and gas development for approximately 40 years.

The use of roads by local hunters to achieve summer and winter access to subsistence hunting areas may alter the distribution of hunting in the area and could further displace caribou and other mammals away from gravel roads, potentially delaying habituation; however, hunting is allowed along most roads in Alaska, including some roads that bisect caribou herd ranges (Boertje et al. 2012). To a lesser extent, roads may also be used by non-subsistence hunters and recreationists in summer and winter. The effects of climate change described under *Affected Environment* above, could influence the rate or degree of the potential cumulative impacts.

3.3.5 Marine Mammals

Affected Environment

All marine mammals found in US waters are protected under the MMPA, as amended (16 USC 1631 et seq.). Some species receive additional protection under the ESA (16 USC 1531 et seq.). Whales, seals, and porpoises are managed by the NMFS, whereas polar bears and walruses are managed by the USFWS. The NMFS and USFWS stock assessment reports (SARs) contain detailed information on the status, seasonal distribution, abundance, and life history of marine mammals in the Beaufort Sea. NMFS publishes current SARs for whales, seals, and sea lions (Muto et al. 2018; www.nmfs.noaa.gov/pr/sars) and the USFWS publishes current SARs for Pacific walrus and polar bear (www.fws.gov/alaska/fisheries/mmm/stock). Additional information on polar bears and Pacific walrus can be found in the Beaufort Sea ITR Final Rule (81 FR 52276). Further, the Final EIS on Effects of Oil and Gas Activities in the Arctic (NMFS 2016a) provides detailed descriptions of marine mammal population status and trends, distribution, seasonal migration and movements, habitat use, reproduction and growth, survival, and mortality. These documents are incorporated into this EIS by reference.

Nine species of marine mammals have been recorded in marine waters within 5 nautical miles of the program area (**Table 3-20**). The bowhead whale is listed as endangered under the ESA, and the polar bear and bearded and ringed seals are listed as threatened.

Table 3-20
Marine Mammal Species Occurring within 5 NM of the Arctic Refuge Coastline and Their Status in the Program Area

Common Name	Scientific Name	Status	Occurrence[3]
Bowhead whale	*Balaena mysticetus*	Endangered[1]	Common
Beluga	*Delphinapterus leucas*	Depleted[2]	Common
Gray whale	*Eschrichtius robustus*	Depleted[2]	Casual
Harbor porpoise	*Phocoena*	Protected[2]	Casual
Bearded seal	*Erignathus barbatus*	Threatened[1]	Fairly common
Ringed seal	*Phoca (Pusa) hispida*	Threatened[1]	Common
Spotted seal	*P. largha*	Protected[4]	Fairly common
Pacific walrus	*Odobenus rosmarus*	Protected[2]	Casual
Polar bear	*Ursus maritimus*	Threatened[1]	Common

Source: ASAMM 2017; Muto et al. 2018
[1]Under the ESA (ESA-listed species are considered depleted under the MMPA).
[2]Under the MMPA.
[3]Common = recorded in every year; fairly common = recorded in most years; uncommon = recorded once every 3–5 years; rare = in its normal range but recorded less than every 5 years; casual = beyond its normal range, further observations unlikely. Occurrence is based primarily on data from the Aerial Surveys of Arctic Marine Mammals Program funded by BOEM and National Oceanic and Atmospheric Administration (NOAA).
[4]The Bering distinct population segment (DPS) uses the program area and is not listed under the ESA (the Southern DPS is listed as threatened but does not occur in the program area).

Table 3-21 lists additional species of marine mammals that may be encountered in the Bering and Chukchi Seas by post-lease oil and gas activity vessel traffic from Dutch Harbor to the program area (**Figure 3-6**, Marine Barge Route—Dutch Harbor to Program Area, in **Appendix A**). Species currently listed as threatened or endangered under the ESA are fin, humpback, and right whales, Steller sea lions, and sea otters. The discussion below focuses on the ESA-listed species and the beluga whale, which occurs commonly nearshore and is of interest for subsistence harvest. Narwhals (*Monodon monoceros*) and hooded seals (*Cystophora cristata*) are considered extralimital to the program area and are not discussed in this EIS.

Polar Bear

<u>Distribution</u>

Polar bears have a circumpolar distribution in the Northern Hemisphere. In Alaska, they occur most commonly within 200 miles of the coast of the Arctic Ocean (Amstrup and DeMaster 1988). Nineteen subpopulations (stocks) of polar bears have been identified throughout their range, ranging from several hundred to several thousand animals each and, in the latest estimate, totaling approximately 26,000 individuals range wide (95 percent CI = 22,000–31,000; Wiig et al. 2015; Durner et al. 2018).

Table 3-21
Additional Marine Mammal Species Occurring Along Vessel Transit Routes in the Bering and Chukchi Seas

Common Name	Scientific Name	Status
Steller's sea lion (Western DPS)	*Eumetopias jubatus*	Endangered[2]
Ribbon seal	*Histriophoca fasciata*	Protected[1]
Northern sea otter (Southwest Alaska DPS)	*Enhydra lutris*	Threatened[2]
North Pacific right whale	*Eubalaena japonica*	Endangered[2]
Minke whale	*Balaenoptera acutorostrata*	Protected[1]
Blue whale	*B. musculus*	Endangered[2]
Fin whale	*B. physalus*	Endangered[2]
Humpback whale (Western North Pacific DPS)	*Megaptera novaeangliae*	Endangered[2]
Gray whale (Western North Pacific DPS)	*Eschrichtius robustus*	Endangered[2]
Pacific white-sided dolphin	*Lagenorhynchus obliquidens*	Protected[1]
Killer whale	*Orcinus orca*	Protected[1]
Harbor porpoise	*Phocoena*	Protected[1]
Dall's porpoise	*Phocoenoides dalli*	Protected[1]
Sperm whale	*Physeter catodon*	Endangered[2]
Baird's beaked whale	*Berardius bairdii*	Protected[1]
Stejneger's beaked whale	*Mesoplodon stejnegeri*	Protected[1]
Cuvier's beaked whale	*Ziphius cavirostris*	Protected[1]

Source: NOAA 2018; Muto et al. 2018
[1]Under the MMPA
[2]Under the ESA; listed species are considered depleted under the MMPA

Bears from three stocks occur in US waters off Alaska: the Northern Beaufort Sea stock, the SBS stock, and the Chukchi Sea stock (Bethke et al. 1996; Amstrup 2003a; Amstrup et al. 2004a; Schliebe et al. 2006; Obbard et al. 2010; Durner et al. 2018). The SBS stock is the subpopulation most likely to occur in the program area, so the analyses below focus on this stock. Based on the distribution and characteristics of sea ice and corresponding population movements (Amstrup et al. 2007), SBS bears either move with the retreating ice or abandon it to spend the summer on land (Durner et al. 2009).

The SBS stock ranges over an expansive area, extending from Icy Cape and Point Hope on the Chukchi Sea coast of Alaska eastward to Cape Bathurst in the Northwest Territories of Canada, and seaward at least 185 miles from the coast (Amstrup 2000, 2002; Bethke et al. 1996; Brower et al. 2002; Schliebe et al. 2006). The core activity area of the SBS stock encompasses a considerably smaller region from Herschel Island, Yukon, to Point Barrow, Alaska, and seaward about 85 miles (Amstrup 2000); thus, the program area is in the core activity area of the SBS.

<u>Species Status</u>

The USFWS listed the polar bear as a threatened species under the ESA in May 2008 (73 FR 28212). The ESA listing decision was based on the rapidly diminishing sea-ice cover and thickness in the Arctic Ocean due to climate change, primarily during summer (73 FR 28212; Durner et al. 2009).

The continuing loss of sea ice was judged to put polar bears at risk of becoming endangered throughout their range in the foreseeable future. Subsequent modeling analyses predict that declining sea ice cover risks significant declines in polar bear populations within three generations (35–41 years; Regehr et al. 2016). Considerable research has focused on changes in population status and survival because of diminishing sea ice habitat. Regehr et al. (2010) documented decreases in vital rates of the SBS stock, including survival and breeding rates, corresponding to increases in the number of ice-free days per year in waters over the Beaufort Sea continental shelf (including waters adjoining the program area).

The best available analyses suggest that the SBS stock is declining (Obbard et al. 2010; Bromaghin et al. 2015; USFWS 2017). The estimated population size of the SBS stock was approximately 900 bears in 2010 (90 percent CI = 606–1,212; Bromaghin et al. 2015). The authors noted, however, that suspected biases may have affected the abundance estimate, which represents a significant reduction from previous estimates of approximately 1,800 in 1986 (Amstrup et al. 1986) and 1,526 in 2006 (Regehr et al. 2006). Furthermore, analyses of over 20 years of data on the size and body condition of bears in the SBS stock demonstrated declines for most sex and age classes and significant negative relationships between annual sea ice availability and body condition (Rode et al. 2010). The estimate of 900 bears is currently used for management purposes by the USFWS (USFWS 2017).

Human activities that can affect polar bears are regulated by the USFWS under both the MMPA and ESA, with the former law taking precedence in the permitting process regarding incidental take. The principal mechanism for regulating human activities in regard to polar bears are incidental take authorizations, generally in the form of ITRs. These regulations allow industry operators to unintentionally take small numbers of polar bears provided that it results in negligible impacts on the species and does not have an unmitigable adverse impact on the availability of the species for subsistence use by Alaska Natives.

ITRs also include measures to avoid and minimize bear conflict with humans. Upon issuance of a LOA by the USFWS, trained personnel are allowed to haze or otherwise take polar bears under specific circumstances involving the protection of human life. The USFWS has voluntary deterrence guidelines (75 FR 61631) to deter polar bears without causing injury or death, focusing on passive measures intended to prevent bears from gaining access to property or people, such as fencing, gates, skirting, exclusion cages, and bear-proof garbage containers, as well as on preventive measures to discourage bears from interacting with property or people, such as acoustic devices for auditory disturbance and vehicle or boat deterrence. Oil and gas activities in the Alaska Beaufort Sea currently are subject to ITRs until August 2, 2021 (81 FR 52276); however, the program area is not included in the geographic region of the current ITRs.

Polar bear harvesting is legal for Alaska Natives under the MMPA. Polar bear harvests in the southern Beaufort Sea are managed through the Iñupiat–Iñuvialuit Agreement, a voluntary Native-to-Native agreement between the US and Canada (Nageak et al. 1991). For the 10-year period from 2006 through 2015, an average of 19 bears per year were removed from the US portion of the SBS stock, averaging 50 percent males, 27 percent females, and 22 percent unreported sex (USFWS 2017).

<u>Population Movements</u>

Polar bears of the SBS stock range over large areas, with annual activity areas of collared individuals ranging from 2,805 to 230,426 square miles (Amstrup et al. 2000). They are transient throughout the nearshore areas of the Beaufort Sea coast, including the program area. The largest monthly movements occur during early winter and the smallest in early spring; females with cubs move less and cover smaller areas than do males and other age classes. Movements are increasing as sea-ice cover diminishes. From 1979 to 2006, collared female polar bears moving from the pack ice to denning areas onshore experienced an average increase in travel distance of 3.7 miles per year (Bergen et al. 2007).

Polar bears typically use land only during late summer, autumn, and the maternal denning season in winter; besides denning females, adult females with and without cubs, subadults, and adult males all come ashore. Polar bears begin to appear on the mainland and barrier islands in July and August, during the open-water period (Miller et al. 2006; Schliebe et al. 2008). As seasonal and pack ice cover spreads southward in the late fall and winter, polar bears move with it, appearing along the Beaufort Sea coast (Amstrup et al. 2000), although some may remain on pack ice all year, if there is continuous access to prey (Stirling 2009).

The number of bears observed on coastal surveys in the fall was significantly related to the distance of pack ice from shore (Schliebe et al. 2008; Wilson et al. 2017). Except for pregnant females that remain to den, bears using land begin to leave when sea ice develops, usually by late October (Schliebe et al. 2001; Kalxdorff et al. 2002). Rapid environmental changes from lengthening of the ice-melt season and diminished sea ice cover has increased the bears' use of terrestrial habitats: the percentage of collared female SBS bears coming ashore tripled over 15 years since the late 1990s, with bears arriving onshore earlier, staying longer, and departing later (Atwood et al. 2016). The mean duration of the open-water period increased by 36 days in that period, and the mean length of stay increased by 31 days.

It has been known for a long time, as stated by several Alaska Native informants (in USFWS 1995), that polar bears become increasingly abundant on the mainland and barrier islands during the open-water season in late summer and the fall subsistence whaling season. USFWS biologists flew 53 aerial surveys along the entire Beaufort Sea coast between Point Barrow and the Canada border in fall 2000 to 2014, averaging 64 bears per survey and recording a maximum of 156 bears on a single survey in August 2012 (Wilson et al. 2017). On average, 4 to 8 percent of the bears in the SBS stock were observed on land per survey (Schliebe et al. 2008). Most sightings on those coastal surveys (82 percent) were recorded on barrier islands, with 11 percent on the mainland and 6 percent on landfast ice (74 FR 56068).

Peak numbers of polar bears observed on land generally occurred in late September and early October (USFWS 1995; Schliebe et al. 2001, 2008; Kalxdorff et al. 2002). Bear numbers onshore have increased in autumn in certain locations, with the greatest concentrations occurring at Barter Island, Cross Island, and Point Barrow, where bears feed on bone piles of butchered bowhead whales taken during the autumn subsistence hunt (Miller et al. 2006; Schliebe et al. 2008; Atwood et al. 2016; Lillie 2018). Genetic analysis of hair-snare samples estimated that as many as 146 individuals (standard error = 21), representing approximately 16 percent of the most recent SBS stock estimate, visited the whalebone pile in Kaktovik in 2012 (Lillie 2018). The number of polar bears onshore is related to sea ice dynamics, although the distribution of bears onshore was most strongly influenced by the availability of food from subsistence whaling (Wilson et al. 2017).

<u>Life History</u>

Polar bears are large, long-lived (29–32 years), opportunistic hunters that feed primarily on ringed and bearded seals but also on beached carcasses of marine mammals (whales and walrus) (Smith 1980; Amstrup 2003a; Schliebe et al. 2006; Miller et al. 2006). Adult males and non-pregnant females are active all year. Mating occurs from March to late May. Pregnant females construct and enter snowdrift natal dens in October or November (Amstrup and Gardner 1994) and give birth in late December or early January. Mothers and cubs emerge from natal dens in late March or April, when the cubs are 3 to 4 months old (Lentfer and Hensel 1980; Amstrup and Gardner 1994; Smith et al. 2007). The cubs remain near the dens for up to 2 weeks (Smith et al. 2007) as they adapt to outside temperatures. Cubs usually stay with their mothers until they are 1.5 to 2.5 years old (Stirling et al. 1975). Females breed again at about the same time they separate from their young, resulting in a breeding interval of females that successfully wean cubs of 3 years or longer.

Critical Habitat

The USFWS designated critical habitat for polar bears in Alaska in 2011 (75 FR 76086). Three units of critical habitat (all of which occur in the program area; **Map 3-24**, Polar Bear Habitat, in **Appendix A**) were designated, corresponding to the following primary constituent elements of critical habitat described in the final rule:

- Sea-ice habitat, used for feeding, breeding, denning, and movements, in US territorial waters
- Terrestrial denning habitat, on land along the northern coast of Alaska, with characteristics suitable for capturing and retaining snow drifts of sufficient depth to sustain maternal dens through winter, occurring within 20 miles of the coast between the US-Canada border on the east and the Shaviovik and Kavik Rivers on the west (including the program area), and within 5 miles of the coast from the Shaviovik and Kavik Rivers west to Point Barrow
- Barrier island habitat, used for denning, refuge from human disturbance, and movements along the coast for access to denning and feeding habitats, comprising barrier islands and associated mainland spits, along with the water, ice, and terrestrial habitat within 1 mile of those features, designated as a no-disturbance zone

Critical habitat excludes human-made structures and the land on which they are located, as well as seven specific areas consisting of the communities of Utqiaġvik and Kaktovik and five US Air Force radar sites (Point Barrow, Point Lonely, Oliktok Point, Bullen Point, and Barter Island).

Habitat Use

Polar bears are strong swimmers but rely principally on the availability of sea ice habitats to roam, hunt, breed, den, and rest. Up to 37 percent of adult females have been estimated to use land in the summer but spending an average of 56 days onshore (Atwood et al. 2016). Given that adult males and subadult bears of both sexes cannot be collared to track their movements, it is not clear what proportion of those bears use land; however, it is clear that they also use land in the summer and autumn (Miller et al. 2015).

Preferred habitats are in the active seasonal ice zone that overlies the continental shelf and associated islands and in areas of heavy offshore pack ice (Stirling 1988; Durner et al. 2004, 2009). Adult males usually remain there, rarely coming ashore (Amstrup and DeMaster 1988). Habitat use changes seasonally with the formation, advance, movement, retreat, and melt of sea ice (Amstrup et al. 2000; Ferguson et al. 2000; Durner et al. 2004, 2009; Schliebe et al. 2008). During winter and spring, 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 (Stirling et al. 1975, 1981; Schliebe et al. 2006); the greatest densities occur in the latter two categories, presumably because those habitats provide greater access to seals. Use of shallow water is greatest in winter, in areas of active ice with shear zones and leads (Durner et al. 2004). Use of landfast ice increases in spring during the pupping season of ringed seals. Multiyear ice is selected in late summer and early autumn as the pack ice retreats to its minimal extent (Ferguson et al. 2000; Durner et al. 2004).

Maternal Denning

The southern Beaufort Sea is an area of widespread, low-density denning by maternal polar bears (Amstrup 2003b; Schliebe et al. 2006). The total number of maternal dens occupied annually by females of the SBS stock has been estimated at 140 to 240 (Amstrup and Gardner 1994; 75 FR 76099).

Notable shifts in the distribution of maternal dens in northern Alaska were documented by comparing 124 den locations used by 85 collared SBS bears between 1985 and 1994 and between 1997 and 2004, documenting a landward and eastward shift in maternal denning along the Beaufort Sea coast (Fischbach et al. 2007). The proportion of dens on drifting sea ice decreased from 62 percent in the early period to 37 percent in the later period, and proportionately fewer dens occurred on pack ice in the western Beaufort Sea in the later period. Although female polar bears do not show fidelity to specific den locations, they tend to den on the same substrate (sea ice or land) from year to year and may return to the same general area to den (Amstrup and Gardner 1994; Amstrup 2003b; Schliebe et al. 2006; Fischbach et al. 2007). Fischbach et al. (2007) noted that more females shifted from sea ice to land during both periods studied and that females in the later period showed greater fidelity to land for denning.

This increasing trend of more bears denning on land has continued (Olson et al. 2017). The use of denning substrate (sea ice or land) is significantly related to where bears occur in autumn. Pregnant polar bears in the SBS stock that spent 25 days or more on land in autumn all subsequently denned on land (Olson et al. 2017). Between 1985 and 2013, the percentage of SBS females denning on land increased from 34 to 55 percent, linked to sea ice declines. Terrestrial Denning Critical Habitat overlaps 77 percent of the program area of the Arctic Refuge (USFWS 2010), and 38 percent more potential maternal denning habitat is available in the program area than in the region immediately west of it (Durner et al. 2006).

Polar bears have been shown to den in the program area with greater frequency than expected, based on available habitat (Amstrup 1993). From 2000 to 2010, 22 percent of the known maternal dens of the SBS stock occurred in the program area (Durner et al. 2010); thus, the program area has been shown to be an important area for maternal denning and would likely increase in importance as the percentage of bears denning on land increases with continuing sea-ice loss (Olson et al. 2017).

Because of bears' greater proximity to settlements, industrial sites, and other coastal areas of human activity, dens on land and landfast ice are more vulnerable to disturbance by human activity than are dens on sea ice. A few records of female polar bears denning successfully in snow drifts near oil infrastructure have been recorded since development began in the oilfields along the central Beaufort Sea coast.

Pregnant polar bears denning in terrestrial habitats excavate maternal dens in compacted snow drifts next to coastal banks of barrier islands and mainland bluffs, river, stream, and lake banks, and other areas with suitable topographic relief (Amstrup and DeMaster 1988; Durner et al. 2001, 2003, 2006). In the program area, 46 maternal dens have been documented in terrestrial habitats, 18 of which were located between the Katakturuk and Sadlerochit River drainages in the central portion of the program area; 12 other dens were found on sea ice within 5 miles of the program area and in the Arctic Refuge south of the program area (**Map 3-24** in **Appendix A**).

The dens in this sample were found using a variety of methods; most were found by radio-tracking bears collared with very high frequency radio collars or satellite transmitters from 1989 to 2010, whereas others were found through opportunistic encounters or dedicated searches from as early as 1913 to as recently as 2010 (Durner et al. 2010). Based on the estimated population of the SBS stock, the proportion of adult females in the population, the breeding probability of adult females, the proportion of dens on land, and the proportion of historical dens in the program area, approximately 19 female bears may den in the program area annually.[27]

[27]Wilson, Ryan. Personal communication. Phone conversation, BLM to USFWS on October 19, 2018 regarding polar bear denning activity in the Coastal Plain.

The most important characteristic of maternal denning habitat is the presence of topographic features of sufficient height and slope to catch blowing snow and form persistent drifts in early winter, with at least 4.3 feet of vertical topographic relief and steep slopes (mean 40°, range 15.5–50°) (Amstrup and DeMaster 1988; Durner et al. 2001, 2003, 2006). Biologists characterized and mapped landscape features (bank-habitat segments) considered to provide suitable maternal denning habitat along the Alaska Beaufort Sea coast, from the NPR-A to the Canada border (Durner et al. 2001, 2003, 2006, 2013; **Map 3-24** in **Appendix A**). Aerial imagery showed that approximately 1,815 miles of bank habitats were delineated by Durner et al. (2006) in the program area. Since then, synthetic aperture radar also has been used to detect suitable denning habitat, producing similar results (Durner and Atwood 2018).

Other researchers recently developed a three-dimensional spatial model, integrating snow physics, weather data, and a high-resolution digital elevation model, to predict the occurrence of potential denning habitat along the Beaufort Sea coast (Liston et al. 2015). All of these techniques provide fine-scale results to focus aerial surveys of denning habitat using thermal imaging equipment (forward-looking infrared radiometry [FLIR]). This method is the most suitable for searching large areas for maternal dens in advance of seismic exploration or other potentially disturbing activities (York et al. 2004; Owyhee Air Research 2018).

Bowhead Whale

Bowhead whales transit past the program area during spring (April–June) and fall (September and October) migration, traveling along the shelf break and coming close to shore to feed (Quakenbush et al. 2010; Citta et al. 2015; **Map 3-25**, Bowhead and Beluga Whale Sightings, in **Appendix A**). They may occur in the program area throughout the open-water season. Bowhead whales were listed as endangered under the predecessor of the ESA in 1973, but no critical habitat has been designated. The decline in extent and duration of sea ice over the past 40 years has coincided with an increase in harvest by residents of Kaktovik, who harvested 1–2 whales per year from 1973 to 1994 and 2–4 whales per year from 1995 to 2016 (Koski et al. 2005; Suydam and George 2018). The Western Arctic population of bowhead whales increased at a rate of 3.2–3.7 percent from 1978 to 2011 (Schweder et al. 2009; Givens et al. 2013), and the current population estimate is 16,820 individuals (95 percent CI: 15,176–18,643; Givens et al. 2016)

Beluga Whale

Beluga whales in Arctic Alaska belong to the Beaufort Sea (BS) and the Eastern Chukchi Sea (ECS) stocks (Muto et al. 2018). They use waters in the eastern Beaufort Sea but stay farther offshore than bowhead whales, typically beyond the shelf break (Hauser et al. 2014). Spring migration eastward through the Beaufort Sea is stock-specific, with BS stock migrating in spring and ECS stock migrating in summer. The main fall migration corridor of belugas is over 54 NM north of the coast; however, they do occasionally approach shallow water in coastal areas, such as lagoons and river deltas, to molt or feed (Suydam 2009).

Belugas have been recorded within 5 NM of the program area in the lagoons (**Map 3-25** in **Appendix A**) and are sometimes harvested by Kaktovik residents. The population estimate for the ECS stock is approximately 20,000 belugas (Lowry et al. 2017). Although the BS stock was estimated to be approximately 39,000 whales, based on 1996 information, there is currently no recent reliable population estimate available for the BS stock (Muto et al. 2018); however, trend data suggest that the stock is at least stable (Harwood and Kingsley 2013).

Other Whales

Whale species that may be encountered by vessels in transit from Dutch Harbor to the Beaufort Sea are described in the EIS for the Liberty development project (BOEM 2018b), incorporated here by reference. In addition to the species listed above, sub-arctic whales that could be encountered during vessel transit are blue, fin, humpback, minke, North Pacific right, sperm, and killer whales. Blue whales are present in Alaska waters only during their non-breeding season and would be found in the open waters near the Aleutian Islands and the Bering Sea. Fin whales are present in both the Bering and Chukchi Seas in the summer, with greater numbers in the Bering than the Chukchi Sea (Muto et al. 2018). Individual humpback whales from the Western North Pacific Stock could occur in the Bering Sea and possibly in parts of the Chukchi and Beaufort seas (Muto et al. 2018), although sightings are rare. Minke whales are believed to be migratory summer residents of the Chukchi and Bering Seas, and move south of the Bering Sea to overwinter. North Pacific right whales are considered the rarest of all large whale species and among the rarest of all marine mammal species. Critical habitat was designated for the eastern North Pacific right whale in 2008 (73 FR 19000) in the Bering Sea, based on geographic coordinates where they have been consistently sighted in spring and summer.

Ringed Seal

Ringed seals are year-round residents in the Beaufort Sea (Muto et al. 2018). They use sea ice as a platform for pupping in the winter and early spring, molting in early summer, and resting throughout the year (Kelly 1988). Ringed seals can be found in the nearshore areas during the summer and winter (Williams et al. 2002). Optimal wintering areas for ringed seals in the Beaufort Sea are generally in waters 32–115 feet deep; however, under-snow seal structures have been found in waters depths of 5–10 feet in the central Beaufort Sea (Williams et al. 2006), indicating that a small number of seals could use portions of the program area.

The decline in extent and duration of sea ice cover is the primary conservation concern leading to their listing as threatened under the ESA in 2012. During the summer, ringed seals forage along ice edges offshore and in productive open water (Harwood et al. 2015), including waters within 5 NM of the program area (**Map 3-26**, Seal Sightings, in **Appendix A**). The population trends and status of this stock are currently unknown (Muto et al. 2018), but there are indications that ocean conditions have been favorable for ringed seals recently: ringed seals near Kaktovik are growing and maturing faster and at a younger age now than 30 years ago (Quakenbush et al. 2011).

Bearded Seal

Bearded seals are associated with offshore pack ice throughout the year, remaining close to the ice edge for as long as the ice is available. They use ice as a platform for breeding, pupping, molting, and resting. In summer, bearded seals may use nearshore areas of the Beaufort Sea (**Map 3-26** in **Appendix A**), and occasionally haul out on land (Muto et al. 2018). The primary conservation concern for this species is the ongoing and projected loss of sea ice cover (Cameron et al. 2010), which led to their listing as threatened under the ESA in 2012.

No reliable population estimate and no reliable data on trends of population abundance are available for the entire Alaska stock of bearded seals (Muto et al. 2018). The most recent abundance estimate for bearded seals in US waters (299,174 individuals; 95 percent CI: 245,476–360,544) applies only to the Bering Sea (Conn et al. 2014). Residents of Kaktovik hunt bearded seals as part of their subsistence activities, but seals are not considered a primary food source (Clough et al. 1987). Bearded seals are expected to occur within 5 NM of the program area.

Other Marine Mammals

Pinniped species that may be encountered by vessels in transit from Dutch Harbor to the Beaufort Sea are described in the EIS for the Liberty development project (BOEM 2018b), incorporated here by reference. Steller sea lions typically occur in coastal areas of the North Pacific and Bering Sea, and are commonly encountered by vessels traveling in and out of Dutch Harbor and near the Pribilof Islands where large breeding rookeries occur. Spotted seals are widely distributed on the continental shelf of the Bering, Chukchi, and Beaufort seas, with pupping and breeding occurring primarily south of Bering Strait (Boveng et al. 2009). While extralimital near the program area, Pacific walruses are common in the Bering and Chukchi seas and occasionally range into the Beaufort Sea (Fay 1982; Garlich-Miller et al. 2011). The Southwest Stock of northern sea otters may be encountered by barges near Dutch Harbor, but probably not in offshore areas.

Climate Change

Climate change is a global issue affecting marine mammals in the program area (see **Section 3.2.1**). Climate warming is expected to be most dramatic in the Arctic, with rates of warming nearly twice that experienced globally (ACIA 2005; Wendler et al. 2014). The effects of these global trends are complicated; yet the forecast models—based on current trends—that have been constructed to examine the likely effects on marine mammal habitats point to dramatic declines in the extent and thickness of arctic sea-ice cover. This has serious implications for the future of such species as polar bears and ice seals (Durner et al. 2009; Cameron et al. 2010; Kelly et al. 2010; Regehr et al. 2016).

Climate change in the Arctic is a rapidly growing concern, especially for the marine environment. Increased air and sea temperatures, longer periods of open water with an earlier onset of melting and later onset of freeze-up, increased rain-on-snow events, warm water intrusion, and changing atmospheric wind patterns are contributing to overall reduction and changes in sea ice (Kovacs et al. 2011; Chapin et al. 2014). The greatest concern for marine mammals in the reasonably foreseeable future is the continued Arctic warming trend and the resulting deterioration of sea ice conditions that are necessary for ice-dependent species and their prey.

Arctic sea ice is changing in the extent of geographic coverage, thickness, age, and timing of melt and is one of the most pronounced changes currently occurring, at rates higher than previously predicted. Analysis of long-term data sets show substantial decreases in both extent (area of ocean covered by ice) and thickness of sea ice cover during the past 30 years (Post et al. 2013; Wendler et al. 2014). These trends are projected to continue, possibly resulting in loss of summer sea ice by mid-century (Chapin et al. 2014) and suggesting that all ice-dependent species may experience conditions that could result in declines of food availability and foraging and breeding habitat.

The ongoing declines in the extent and duration of sea-ice cover present the greatest source for possible population-level impacts on marine mammals over the next 20 years, although the impacts are not entirely clear. Bowhead whales appear to be in better body condition in years of light ice cover (George et al. 2015) and the Western Arctic stock is so far adapting to change in ice cover, as demonstrated by their consistent population increase (Givens et al. 2013; Muto et al. 2018); the long-term effect of reductions of sea ice on bowhead populations is not known (George et al. 2015).

The broad distribution, diverse diet, and ability to haul out on land or ice suggest that ringed seals may be resilient to changes in sea ice availability (NMFS 2013). Bearded seals are more strongly associated with sea ice available over shallow benthic habitat that is suitable for feeding, suggesting they may be less resilient to reduced sea-ice cover (NMFS 2013).

Recent shifts in distribution and habitat use by polar bears in the Beaufort and Chukchi Seas are likely attributable to loss of sea ice habitat. The greatest declines in optimal polar bear habitat are expected to occur in those areas where reduced habitat would likely reduce polar bear populations (Durner et al. 2009; Regehr et al. 2016).

The increasing difficulty for polar bears dealing with ecological changes, resulting from declining sea ice cover related to climate change has led to behavioral changes, as follows:

- Increased frequency of long-distance swimming by collared bears (Durner et al. 2011)
- Observations of swimming bears and dead bears in open water (Monnett and Gleason 2006; Schliebe et al. 2006)
- Polar bear predation and cannibalism (Amstrup et al. 2006a)
- Unusual predation behavior (Derocher et al. 2000; Brook and Richardson 2002; Stirling et al. 2008)
- Increased time spent onshore (Atwood et al. 2016; Wilson et al. 2017)

Polar bears of the SBS stock experienced twice as many days of reduced sea ice from 2008 to 2011 than did those of the Chukchi Sea stock. Despite similar diets, SBS bears were smaller and in poorer condition and exhibited lower reproduction, and twice as many were fasting in spring (Rode et al. 2014). Consuming terrestrial foods is judged to be insufficient to offset the loss of ice-based hunting.

Given the high metabolic demands and increased movements of polar bears, cascading negative effects on polar bear populations are predicted as sea ice declines and the availability of high-energy prey decreases (Rode et al. 2015; Pagano et al. 2018). The increased frequency of female SBS polar bears denning on land now rather than on pack ice was attributed to reductions in stable old ice, increases in unconsolidated ice, and lengthening of the melt season (Fischbach et al. 2007; Olson et al. 2017).

Another result of climate change is increasing delays in formation of sea ice in the fall, forcing more bears to spend more time on land where they have difficulty catching prey and spend longer periods fasting and increasing the chance of interactions with humans, which increases the risk of bears being killed in defense of life or property (Amstrup 2000; Whiteman et al. 2015).

The warming temperatures and increased precipitation year-round and longer growing seasons that are predicted to occur in the future may have negative implications for the stable conditions required for maternal denning by polar bears, especially if warm temperatures prevent snow cover of sufficient depth from accumulating early in the denning season. Population-level effects of sea-ice loss have been observed in polar bears at the southern edge of their range in western Hudson Bay, and models predict decreased survival (including breeding rates and cub litter survival) of polar bears in the SBS population with reduced sea-ice coverage (Regehr et al. 2010; Hunter et al. 2010). Reduced body size and cub recruitment in polar bears have been documented in years when sea ice availability was reduced (Rode et al. 2010).

Range expansion of subarctic and temperate species into the Beaufort and Chukchi Seas has been observed in recent years and is likely to continue with changing arctic conditions. Increased observations of gray whales, humpback whales, and fin whales in the northeastern Chukchi Sea and gray and humpback whales in the western Beaufort Sea is a relatively recent phenomenon (Clarke et al. 2015). Thus far, potential range expansion into the Beaufort Sea has been limited, but sightings appear to be increasing slowly. Range expansion by more temperate species raise the possibility of resource competition with arctic species (ACIA 2005). Other risks to arctic marine mammals induced by climate change include increased risk of infection and disease with improved growing conditions for disease vectors and from contact with nonnative species, increased pollution through increased precipitation transporting river borne pollution northward and increased human activity through shipping and offshore development (ACIA 2005; Huntington 2009; Hauser et al. 2018).

Direct and Indirect Impacts

Issuance of oil and gas leases under the directives of Section 20001(c)(1) of PL 115-97 would have no direct impacts on the environment because by itself a lease does not authorize any on the ground oil and gas activities; however, a lease does grant the lessee certain rights to drill for and extract oil and gas subject to further environmental review and reasonable regulation, including applicable laws, terms, conditions, and stipulations of the lease. The impacts of such future exploration and development activities that may occur because of the issuance of leases are considered potential indirect impacts of leasing. Such post-lease activities could include seismic and drilling exploration, development, and transportation of oil and gas in and from the Coastal Plain. Therefore, the analysis is of potential direct and indirect impacts on marine mammals from on-the-ground post-lease activities.

The Final EIS on Effects of Oil and Gas Activities in the Arctic (NMFS 2016a) provides detailed descriptions of potential impacts of petroleum-related industrial activities on marine mammal populations, including seismic exploration and drilling activities. That analysis is incorporated here by reference. The effects of climate change described under *Affected Environment* above, could influence the rate or degree of the potential direct and indirect impacts.

Alternative A

Under this alternative, current management actions would be maintained, and resource trends would continue, as described in the Arctic Refuge CCP (USFWS 2015a). There would be no direct or indirect impacts on marine mammals under Alternative A from post-lease oil and gas leasing activities.

Impacts Common to All Action Alternatives

The following potential actions and environmental consequences would be common to all action alternatives, although the extent of activities allowed and the areas affected would differ somewhat under each alternative, as described later in this section. All the action alternatives would affect large areas of the designated terrestrial-denning unit of critical habitat for polar bears; any facilities constructed within 20 miles of the coast would be located in that critical habitat unit.

<u>Habitat Loss and Alteration</u>

POLAR BEAR

For polar bears, direct loss or alteration of maternal denning habitat would potentially result from gravel mining, gravel and ice road construction, changes in natural drainage patterns (impoundment), and off-pad snow disposal. The permanent, direct loss of polar bear habitat as a result of oil and gas leasing-related activities would primarily involve the terrestrial-denning unit of critical habitat (**Map 3-24** in **Appendix A**) and constituting 77 percent (1,222,300 acres) of the program area. At 4.8 percent (76,600 acres) and 0.1 percent (1,400 acres), respectively, the areas of the sea ice and barrier island critical habitat units potentially affected by program-related activities would be much smaller. Even though the overall proportion of Barrier Island Critical Habitat in the program area is not large, it receives a disproportionately high level of use by polar bears (Wilson et al. 2017); thus, program-related activities affecting that habitat could have a larger impact on polar bears than is indicated on the basis of proportional representation.

It is important to note that not all portions of the terrestrial-denning unit of critical habitat represent suitable maternal denning habitat, however, because of local topography and the distribution of suitable habitat characteristics across the landscape. Specifically, potential maternal denning habitat (Durner et al. 2001, 2006; **Map 3-24** in **Appendix A**) covers an estimated total of 1,769 miles and 4,700 acres (assuming an average segment width of 21 feet; Durner et al. 2001) among the three zones of estimated HCP, constituting the high-priority area that would need to be searched in den surveys before exploration or development activities occur (**Table 3-22**). To date, the occurrence of maternal dens has been disproportionately high in the high-potential zone, where 54 percent of known dens occurred in 30 percent of the potential habitat mapped. In contrast, the occurrence of dens in the low-potential zone has been disproportionately low, with only 4 percent of known dens occurring in 24 percent of the potential habitat. The occurrence of dens in the medium-potential zone has been proportional to the amount of potential habitat.

Table 3-22
Number of Documented Dens and Extent of Potential Terrestrial Denning Habitat for Maternal Polar Bears within the Three Zones of Estimated HCP in the Program Area

Hydrocarbon Zone	Number of Dens	Habitat Metrics	
		Total Length of Bank-Habitat Segments (miles)	Estimated Area of Bank-Habitat Segments (acres)
High	25 (54%)	527 (30%)	1,400 (30%)
Medium	19 (41%)	799 (45%)	2,100 (46%)
Low	2 (4%)	442 (25%)	1,100 (24%)
Total	**46**	**1,769**	**4,600**

Notes:
Bank-habitat segments mapped by USGS (Durner et al. 2006); see **Map 3-24** in **Appendix A.**
Acreage estimates assume an average width of 21 feet per mapped segment of bank habitat (Durner et al. 2001) and are rounded to the nearest 100 acres.

Temporary loss or alteration of polar bear denning habitat would potentially result primarily from the construction of ice roads and pads, which persist for one winter season. The effects of ice placement in potential denning habitat would be temporary until the ice road or pad thawed during spring melt, although annual reconstruction in the same location would result in perennial loss of use of the specific bank-habitat segment affected. Because ice placement would not affect the topographic characteristics that create the favorable denning conditions, no long-term effects on habitat suitability would be expected to occur. The effects of construction of ice and gravel roads and pads and pipelines would create the potential for temporary loss of use of suitable denning habitat through behavioral disturbance (described further in the next section below). The ITR/LOA process requires that surveys of potential denning habitat be conducted within a 1-mile buffer zone surrounding the proposed locations of roads and pads. The use of FLIR sensors has proven to be an effective means of locating dens in such surveys, as has the use of specially trained dogs (Amstrup et al. 2004b; York et al. 2004; Perham 2005; Shideler 2015). Even so, those survey methods do not provide perfect detection and occupied maternal dens are sometimes missed in preconstruction surveys.

Future water withdrawal from lakes for the construction of ice roads and pads would not be likely to cause adverse effects on polar bear habitat, provided that no occupied maternal dens occur within 1 mile of the withdrawal sites or ice roads used for access. Similarly, the presence of snow dumps and drifts in the vicinity of oil and gas facilities probably would have negligible effects on polar bear habitat, inasmuch as they are unlikely to be located on or near bluff habitats.

Most polar bears moving through areas near industrial facilities would likely be disturbed by activities on, or be hazed away from, drill-site pads. Disturbance from traffic on access roads would likely alter the use of habitats by bears nearby, although those effects would diminish for facilities located farther inland because they would be less likely to be used by bears than other areas near the coastline. Overall, the effects of reduced use of habitats near oil and gas facilities likely would be minimal, although they would be long-term in duration.

In summary, the potential effects of temporary habitat loss and alteration on polar bears are expected to be reduced if mitigation measures, similar to the ITRs in the Alaska Beaufort Sea currently in place west of the Coastal Plain, were implemented. After the placement of gravel pads and roads during the construction phase, the attractiveness of some potential maternal denning habitat in the vicinity of infrastructure likely would be diminished for some bears because of the presence of the facilities and associated human activity.

Seals

For ringed and bearded seals, potential alteration of benthic foraging habitat could result from modification of the seafloor profile caused by dredging or screeding operations at a barge landing site. The size of the affected area would be similar among the action alternatives, regardless of which possible landing site is used (one on Camden Bay near the mouth of Marsh Creek and the other farther east, between Griffin and Humphrey points; Clough et al. 1987). The exact amount of habitat to be altered would depend on the local bathymetry and the placement of the barge landing site.

A small number of ringed seals could over-winter and produce pups in the nearshore program area. One potential impact on ringed seals from the action alternatives could result from threats to lair integrity, such as lair collapse caused by tracked vehicles transiting sea ice during seismic activity. This impact could result in injury or mortality of pups and females. Noise from seismic activities could also disturb and displace individual seals. Overall, potential impacts of on-ice seismic activity could be lethal to a small number of seals, although the probability of this occurring is low. Most impacts would be temporary behavioral changes on the ringed seal population.

Whales

No whale habitat is expected to be lost or altered under any of the action alternative.

<u>Disturbance and Displacement</u>

All three action alternatives would result in a similar level of potential disturbance and displacement of marine mammals in the marine environment. Because vessel transit routes and the number of barge landing locations of hypothetical development scenarios do not differ among the action alternatives, neither would the potential effects of the activities associated with marine transport and STP development and operation (facility noise, dredging or screeding, and transportation) on marine mammals. Polar bears and seals would experience direct behavioral effects and indirect habitat loss from disturbance caused by human activities and noise associated with ice road and barge transportation (vehicle passage and noise), dredging or screeding for marine barge docks, human activities at camps, and oil spill response planning and drills. During the seasons of open-water barge transport, large vessel traffic transiting from Dutch

Harbor to the program area would have the potential to disturb or displace whales, seals, and possibly polar bears by the temporary disturbance of water and by creating strong low-frequency underwater sounds (Richardson et al. 1995). Terrestrial activities and facilities are not expected to have an effect on the behavior of whales because they do not generally approach within 1 NM of the coast.

Polar Bear

Noise and visual disturbance from human activity and operation of equipment, especially aircraft and vehicle traffic, have the potential to disturb polar bears nearby (Blix and Lentfer 1992; MacGillivray et al. 2003; Perham 2005; Schliebe et al. 2006; USFWS 2006, 2008b, 2009; Andersen and Aars 2008). The greatest concern is disturbance of maternal females during the winter denning period, which could result in den abandonment and reduced survival of cubs (Amstrup 1993; Linnell et al. 2000; Lunn et al. 2004; Durner et al. 2006). Polar bear dens are known to occur onshore in relatively high numbers in the program area (**Map 3-24** in **Appendix A**) and the incidence of terrestrial denning by the SBS population is increasing (Fischbach et al. 2007; Olson et al. 2017), so the potential for disturbance of dens during the drilling, construction, and operational phases of development projects is of concern.

Various studies have evaluated the impacts of anthropogenic disturbance on polar bears. Amstrup (1993) reported that 10 of 12 denning polar bears tolerated exposure to a variety of disturbance stimuli near dens with no apparent change in productivity (survival of cubs). Two females denned successfully (produced young) on the south shore of a barrier island within 1.7 miles of an active oil processing facility and others denned successfully after a variety of human disturbances near their dens. Similarly, during winter 2000–2001, two females denned successfully within 1,312 feet and 2,625 feet of remediation activities being conducted on Flaxman Island (MacGillivray et al. 2003), located just northwest of the Arctic Refuge boundary. In contrast, Amstrup (1993) found that several females responded to disturbance early in the denning period by moving to other sites, suggesting that females may be more likely to abandon dens in response to disturbance early in the denning period than later. Hence, the initiation of intensive human activities during the period when females seek den sites (October–November) would give them the opportunity to choose sites in less-disturbed locations (Amstrup 1993). Abandonment later in the denning period exerts greater effects on productivity: survival was poor for cubs that left dens prematurely in response to the movement of sea ice (Amstrup and Gardner 1994) and females that remained in dens through the end of the denning period had much higher cub survival than did females that emerged from dens early (Rode et al. 2018).

Experimental studies of noise and vibration in artificial (human-made) "dens" have been used to estimate the distances at which disturbance may occur. Blix and Lentfer (1992) reported that snow cover greatly diminished sounds and concluded that activities associated with oil and gas exploration and development, such as seismic surveys and helicopter overflights, would not be likely to disturb denning bears at distances greater than 328 feet from dens. In a more rigorous study, however, MacGillivray et al. (2003) compared noise levels inside and outside of artificial dens at sites on Flaxman Island during a variety of industrial remediation activities, including passage by different vehicles and overflights by helicopters at various distances. Snow cover provided an effective buffer, reducing low-frequency noise by as much as 25 dB and high-frequency noise by as much as 40 dB for activities conducted near the artificial dens. The noise levels produced by various stimuli were detectable above background levels at ranges from 0.3 miles to 1.24 miles, however, depending on the stimulus. Low-frequency vibrations and noises were detected at the greatest distances. The most audible disturbance stimuli measured from inside the dens was an underground blast, detectable in artificial dens up to 0.8 miles from the source, and airborne helicopters directly overhead. Helicopters were detectable above background levels as far away as 0.6 miles, but the authors noted that noises just above background are not likely to cause biologically significant responses (MacGillivray et al. 2003). The authors noted that high variability in the tolerance of different bears to noise and disturbance, including hazing with acoustic deterrents, was an important factor in evaluating human disturbance.

Den surveys using FLIR sensors or trained dogs would be conducted annually before seismic exploration and construction of roads and pads commenced in the program area, as stipulated by the LOAs and polar bear interaction plans that would be required. If dens are detected within a 1-mile buffer zone around the proposed locations of roads and pads, then the facility locations would be moved outside of that radius to avoid dens, as required by ITRs, to reduce the effects on occupied dens to a negligible level. If dens are located after ice roads and pads are built, then traffic restrictions and emergency closures would be instituted. Such discoveries typically trigger emergency road restrictions and 24-hour monitoring until the bears depart the dens, as prescribed in typical polar bear interaction plans.

Blasting at gravel mines and pile-driving of bridge abutments during future winter construction would be sources of noise in polar bear denning habitat. Pile-driving would occur at bridge crossings over rivers. Pile driving in or near water is known to produce strong underwater noise levels (e.g., Greene and Moore 1995; Blackwell et al. 2004) and, along with gravel blasting, would be one of the noisiest activities resulting from construction. The level of received sound at any specific distance from pile-driving depends on the water (or ice) depth in which the piles are driven, the density or resistance of the substrate, bottom topography and composition (e.g., mud, sand, rock), the physical properties and dimensions of the pile being driven, and the type of pile-driver that is used (Richardson et al. 1995; Blackwell et al. 2004). Winter blasting and pile-driving are likely to disturb some polar bears. Possible impacts on polar bears exposed to noise potentially include disruption of normal activities, displacement from foraging and denning habitats, and displacement of maternal females and young cubs from dens. USFWS-approved mitigation measures for avoidance and minimization of disturbance of dens, as required under MMPA ITRs, would reduce the potential impacts of blasting and pile-driving on polar bears, however.

Displacement of nondenning bears from preferred coastal habitats would be another potential impact. In one study female bears with young cubs reacted to direct approaches by snowmachines nearly 1 mile away (mean distance 5,032 feet; Andersen and Aars 2008). Medium-sized single bears (subadults) in that study also reacted at fairly long distances (mean distance 3,806 feet) and adult males and females without cubs were the least reactive (mean distances 1,070 and 538 feet, respectively). Besides reacting at longer distances, maternal females and subadults showed stronger responses than did adults without cubs.

Polar bears passing near infrastructure in the program area would be exposed to a wide variety of potentially disturbing stimuli resulting from exploration, drilling, pipeline and pad construction and other human activity on the pads, vehicles on pads and interconnecting access roads, barge traffic in the lagoon system and associated offloading operations at marine docks, and spill-response drills. A wide variety of behavioral responses by polar bears is likely to occur, ranging from avoidance by maternal females with young cubs in spring to approach by curious bears or those attracted by sights, sounds, and odors. The USFWS (2006, 2008b, 2009; 81 FR 52276) has concluded that the types of activities typical of oil and gas exploration, development, and production projects in northern Alaska were not likely to have population-level effects on polar bear populations at the levels analyzed in developed areas. This is because the behavioral responses of individual bears were short term and localized.

Disturbance and localized displacement could occur during seasonal movements by polar bears in the program area. The net direction of movement by maternal females leaving terrestrial denning areas with young cubs is northward, potentially requiring them to cross roads and pipelines, although the number of such encounters likely would be small. The greatest likelihood for bears to encounter program-related infrastructure and activities is along the coast during the open-water season (mainly July–October), as bears move eastward along the coast and gather near the Kaktovik whalebone pile in advance of the formation of seasonal ice. Early detection of bears by trained bear monitors and detection systems would allow industrial activities to be modified to minimize disturbance of bears moving through the vicinity. The completion of barging in summer would reduce the potential for those activities to disturb bears moving along the shoreline, although some encounters are likely to occur in July and early August. Barge traffic operating in open water may cause some short-term disturbance of bears swimming in the ocean, but the likelihood of such encounters is low.

Polar bears moving along the coast through established oilfields (Kuparuk, Greater Prudhoe Bay, and Point Thomson) routinely encounter human-made obstructions and are able to cross or move past them without difficulty, resulting in short-term disturbance at most (USFWS 2008b, 2009; 81 FR 52276). Short-term behavioral responses are not likely to have population-level effects and thus are considered less problematic than are den disturbance and abandonment (USFWS 2008b, 2009; 81 FR 52276).

The potential effects of short-term behavioral disturbance are likely to be negligible on the SBS population, although the magnitude may increase in the future with increasing terrestrial presence of bears in late summer and autumn. Polar bears spending more time on land and fasting more as sea-ice cover diminishes are likely to experience an increase in negative effects on energy budgets as a result of reduced access to fat-rich prey (Molnár et al. 2010; Wilson et al. 2017; Pagano et al. 2018).

Another source of potential disturbance of polar bears during all phases of exploration and potential development would be noise and light generated by industrial facilities, such as CPFs. Noise from production facilities would be relatively constant, with wind direction affecting the perception of sounds by polar bears. Depending on the individual bear, however, such stimuli could also be attractants.

Behavioral disturbance on the productivity of polar bears in the program area is likely to be low. This assumes that all mitigative measures are implemented, as required under ITRs and specified in typical wildlife interaction plans for industrial activity in Arctic Alaska, and that preconstruction den surveys detect most maternal dens in the affected areas.

The number of bears potentially affected is likely to increase during the operational life of program-related development as summer sea-ice cover continues to diminish in the future. This could result in more bears being present onshore during the open-water period, traveling the coastline more in summer and fall, and denning onshore. Such an increase is expected as a result of the current trends for increasing use of coastal habitats and terrestrial denning habitats (Fischbach et al. 2007; Schliebe et al. 2008; USFWS 2006, 2008b, 2009; Olson et al. 2017; Wilson et al. 2017). It is likely that maternal denning would continue to increase in terrestrial habitats in the future, although the presence of operating facilities would probably discourage female bears from denning in suitable habitat nearby; instead, they would be more likely to seek suitable den sites in less-disturbed areas.

Seals

Potential noise and disturbance from program-related facilities and activities are likely to affect ringed, spotted, and bearded seals annually while they are in the program area. A primary source of potential disturbance to seals would be anthropogenic noise. This could be generated by vessel traffic and coastal facilities, such as the STP during the open-water season. Noise also could be generated by activities in the nearshore coastal or lagoon areas, such as seismic programs, during the ice-covered season; this could affect individual seals by exposing them to noise and lair disturbance. In-air noise would be relatively constant, with wind direction affecting the perception of sounds at haul-out locations and in lairs within a radius of 2.5–3.7 miles from facilities. Additional noise could be generated by dredging or screeding and vessel traffic during barging operations in summer, mobilization of modular units in winter, and oil-spill drills year-round.

Although marine mammals show overt reactions to noise from industrial activities, individuals or groups may become habituated if the noise does not result in physical injury, discomfort, or social stress (NRC 2003). Based on habituation reported for ringed seals at the Northstar Island facility (Blackwell et al. 2004), it is likely that at least some ringed seals may habituate to the noise and continue to use haul-outs and lairs for pupping near a STP location, but that cannot be predicted with confidence. The effects of disturbance on seals are predicted to be less than 5 years, with no demographic effects expected.

Future vessel traffic is not expected to significantly disrupt normal pinniped behavioral patterns (breeding, feeding, sheltering, resting, and migrating). This is because most pinniped/vessel interactions documented during arctic oil and gas exploration operations show little to no observable behavioral reactions due to vessels (NMFS 2018). Pinnipeds typically show limited responses to vessel noise, such as increased alertness, diving, moving from the vessel's path by up to several hundred feet, or by ignoring the vessel. If hauled out, seals and walruses typically enter the water when approached by vessels. Seals are quick and agile in the water, making them unlikely to be injured by large, slow-moving vessels. The vessel noise and presence would be temporary and limited to affecting a few individuals by eliciting small, behavioral responses. Impacts at the population level for all pinnipeds are not expected.

Whales

Baleen whales, considered a low-frequency hearing group, have a hearing range of 7–35 (kilohertz (kHz) (NMFS 2016b). Toothed whales are a mid-frequency group with a hearing range of 150–160 kHz. The primary underwater noise associated with vessel operations is the continuous cavitation noise produced by the propellers on the oceanic tugboats, especially when pushing or towing a loaded barge (NMFS 2018). Oceanic tugboats have a source level of approximately 170 dB at 3.3 feet that is anticipated to decline to 120 dB re 1μPa rms within 1.15 mile of the source (Richardson et al. 1995). Generally, vessels do not produce sound source levels capable of injuring whales (Richardson et al. 1995; NMFS 2016a).

Whales often show tolerance to vessel activity; however, they may react at long distances if they are confined by ice or shallow water or were previously harassed by vessel operators (Richardson et al. 1995). Whale reactions to vessels may include behavioral responses, such as altered headings or avoidance (Blane and Jaakson 1994; Erbe and Farmer 2000); fast swimming; changes in vocalizations (Lesage et al. 1999; Scheifele et al. 2005); and changes in dive, surfacing, and respiration patterns. Beluga whale reactions to vessels depend on whale activities and experience, habitat, boat type, and boat behavior (Richardson et al. 1995).

Future vessel traffic associated with the program area activities would produce temporary avoidance of vessels, as well as changes in vocalizations, diving, swimming, and respiration patterns. None of these potential effects would be chronic or sufficient to produce meaningful energetic losses to individual whales or to their populations. Because of the slow vessel speeds and the presence of PSOs onboard operating vessels, as specified under ROP 46, no vessel strikes are expected to occur from any of the action alternatives. With this mitigation, whales would be expected to have temporary behavioral responses.

Injury and Mortality

Small numbers of accidental injury or mortality of marine mammals may occur under all of the action alternatives. Polar bears could be susceptible to vehicle strikes and other marine mammals to vessel/equipment strikes during barging and in-water work. Additional injury or mortality of marine mammals may occur due to accidental spills or contamination. For polar bears, program-related actions are most likely to result in injury or mortality due to human-bear interactions.

The BLM qualitatively evaluated the potential injury or mortality of marine mammals due to collisions. The assessment was based on documented species behavior, sensitivity to the activity, mobility, and distribution relative to the frequency and seasonality of vehicle and vessel traffic.

POLAR BEAR

When the polar bear was listed as a threatened species in 2008 (73 FR 28212), the USFWS noted that the factors contributing to the primary threat identified in the listing analysis—rapidly diminishing sea-ice habitat—cannot realistically be regulated under their management purview; therefore, in lieu of influencing the causes underlying climate change, such as GHG, the USFWS has focused on factors more amenable to regulation, such as habitat protection and the prevention and reduction of lethal take. The result of this approach is that even greater emphasis has been devoted to mitigation through interaction planning to avoid and minimize injury and mortality of polar bears (USFWS 2016).

Under all action alternatives, future oil and gas activities would increase the level of human-polar bear interactions, creating the possibility for increased bear injuries or deaths. As sea-ice cover continues to diminish, the number of encounters between humans and nutritionally stressed bears is expected to increase (DeBruyn et al. 2010). Sightings of polar bears at industrial sites in the Beaufort Sea region of Alaska have increased in recent years, consistent with increasing use of coastal habitats as summer sea-ice cover has diminished (Schliebe et al. 2008; USFWS 2008b; 76 FR 47010; 81 FR 52276); however, the incidence of human-bear encounters and harassment by deterrence (hazing) remains low. From 2010 through 2014, 14 percent of the polar bears observed in the North Slope oilfields (260 of 1,911 individuals) were intentionally deterred (81 FR 522760); that percentage decreased over time from a high of 39 percent of bears observed in 2005. The USFWS attributes the decrease in deterrence events to increased polar bear safety and awareness training of industry personnel, as well as ongoing deterrence education, training, and monitoring programs (76 FR 47010; 81 FR 522760).

Despite increased interactions in the existing oilfields in recent years, lethal take associated with oil and gas activities is rare. Three polar bears have been killed at oil and gas industrial sites in Alaska since the late 1960s: one in winter 1969, another in 1990 at the Stinson exploration site in western Camden Bay, north of the program area (Perham 2005; USFWS 2006), and one bear in 2011 (killed accidentally during hazing) since the Chukchi Sea and Beaufort Sea ITRs went into effect in 1991 and 1993, respectively (USFWS 2008b, 2009; 81 FR 52276).

Several other mortalities have been associated with military and industrial activity. A polar bear was killed at the Oliktok Point Long-range Radar Site in 1993 (USFWS 2010) after attacking a worker who provoked it. In 1988, a polar bear died on Leavitt Island, 5 miles northwest of Oliktok Point, after ingesting a mixture that included ethylene glycol and Rhodamine B dye (Amstrup et al. 1989). In 2012, two polar bears that had been exposed to Rhodamine B (and possibly other chemicals) were found dead on Narwhal Island, northwest of Endicott; although the deaths were human caused, the source of the chemicals could not be identified (FR 81 52276). In contrast, 33 polar bears were killed at industrial sites in the Northwest

Territories from 1976 to 1986 (Stenhouse et al. 1988). Dyck (2006) reported that 618 polar bears (averaging 20 per year) were killed from 1970 to 2000 in the Northwest Territories and Nunavut in northern Canada, 25 (4 percent) of which occurred at industrial sites.

In addition to attraction to areas of human activity and direct interaction with humans, a second potential source of injury or mortality is premature den abandonment, which is a possible outcome of den disturbance and has been documented as an adverse effect on cub survival (Amstrup and Gardner 1994; USFWS 2008b, 2009; 76 FR 47010; 81 FR 52276). The precautions against den disturbance in the interaction plan, required under ITRs, and the denning surveys conducted before seismic exploration and construction of roads and pads would minimize the likelihood of this potential risk.

A third potential source of injury or mortality is traffic on ice and gravel roads that intersect the movement paths taken by females with young moving from terrestrial denning habitat to hunting areas offshore in late winter (March–April). This poses a risk of vehicle strikes and disturbance-related distributional shifts. No vehicle strikes of polar bears along ice roads in the North Slope oilfields have been reported in agency documents evaluating impacts on polar bears, indicating the impact is negligible.

A fourth potential source of injury or mortality is accidental spills, leaks, and other sources of contamination. Polar bears are susceptible to thermal stress after fouling their fur by direct contact with spilled petroleum products. This reduces body temperature and increases metabolic rate; oil is absorbed through skin contact, through the gastrointestinal tract, and by inhalation (Engelhardt 1983). Contact and ingestion can lead to severe blood and kidney problems. The direct and indirect effects of spills depend primarily on the seasonal timing and location of the spills and on the volume of material released into the environment. Terrestrial spills during winter would have substantially less impact on polar bears than would marine spills during the open-water period in summer and fall.

The only substantial potential program-related activity occurring in the marine environment would be barging of modules in several years during the open-water period, which would pose a low risk of spilled fuel if a vessel carrying fuel were to run aground. The number of bears potentially affected by such an accident would be smaller than the numbers that would be affected by modeled, hypothetical, large marine spills (Amstrup et al. 2006b; BOEM 2018b; Wilson et al. 2018). This is because the spill volume and the area affected would be substantially smaller. To date, large oil spills in the marine environment from industry activities in the Beaufort Sea and coastal regions that would affect polar bears have not occurred, although the interest in, and the development of, offshore hydrocarbon reservoirs has increased the potential for such spills.

Spills associated with development projects on the mainland are of much less concern for polar bears than are marine spills. Although the risk of a large spill during the drilling, construction, and operational phases of the proposed program is low, several large terrestrial oil spills have occurred in the Prudhoe Bay area without any known impacts on polar bears. The volume of material released and the area affected would likely be small due to the volumes of material being used and the terrestrial base of activities.

Small releases of contaminants also can have effects. As described above, three polar bears have died near industrial sites from chemical ingestion as a result of human activity (Amstrup et al. 1989; 81 FR 52275). Effective control of potentially toxic substances and careful attention to preventing spills of any size are the key to preventing such injuries. Overall, potential impacts on polar bears and their habitat in the program area from oil spills, leaks, and contaminant releases would be lessened through the safeguards specified in the required spill prevention and contingency plan, the relatively small amounts of material likely to be released under most scenarios, and the responsible party's ability to detect and clean up spills quickly on land, where most program-related activities would occur.

Any injury or mortality from oil and gas development-related human-bear conflicts would pose a problem because of the declining status of the SBS population. The attraction of polar bears to facilities and the attendant problems from such attraction may increase through the operational life of the proposed program, as more bears use onshore areas during the open-water season due to declining sea ice, leading to increased use of coastal travel routes past oil and gas facilities.

In summary, although the potential for injury or mortality could be high when developing new oil and gas projects in polar bear habitat, the risks are well understood. Also, effective mitigation is available and has been implemented in the established North Slope oilfields west of the program area. With mitigation in place, the net effects of program-related activities are likely to be negligible in terms of injury and mortality at the population level. Given the current and predicted continuing decline of the SBS stock of polar bears, emphasis would be placed on avoiding injury or mortality, and current mitigation measures appear to be effective at reducing such risks.

Whales and Seals

Any vessels operating in or along transportation corridors to the program area would follow specified procedures for changing vessel speed and direction to avoid collisions with marine mammals. TLs on barging activity would avoid adverse effects on newborn ringed seals, particularly when nursing and molting (NMFS 2016a), because program-related vessel traffic would occur late in the open-water season when pups would be larger.

The number and speed of ships is related directly to the severity of collisions between vessels and whales (Jensen and Silber 2004). In contrast, seals are less likely than whales to be struck due to their smaller size and higher maneuverability. BOEM estimated that 67 vessels per year could transit the Beaufort Sea associated with oil and gas leasing and exploration (NMFS 2013). Collisions with whales are rare for slow-moving vessels traveling at less than 10 knots (Laist et al. 2001; Vanderlaan et al. 2008). Barge convoys would move slowly, but the vessels would be unable to change direction or speed quickly. Although it is possible that a marine mammal could be struck by a vessel engaged in the barging operation, such incidents are highly unlikely due to the slow vessel speed and low frequency of barge deliveries (assumed to be two landings per year).

The low incidence of propeller scars found on bowhead whales landed by Alaska Native whalers indicates that vessel strikes of bowhead whales are rare (Laist et al. 2001, George et al. 2017). There is no indication that vessel strikes would be a major source of mortality for whales during marine transport to the program area (NMFS 2013). Data recorded by PSOs aboard sound-source and monitoring vessels indicate that ringed and bearded seals in the Beaufort Sea avoid oncoming vessels (NMFS 2016a), and there is no indication that vessel strikes would become an important source of injury or mortality (NMFS 2013).

The absence of collisions involving industry vessels and marine mammals in the Bering, Chukchi, and Beaufort seas, despite decades of spatial and temporal overlap, suggests that collision probabilities are low along the transit route from Dutch Harbor to the program area (NMFS 2013). More specifically, it is unlikely that vessels would strike subarctic whales because: (1) Few blue and sperm whales could be encountered, as they are found in deeper waters than those in which the transit route would occur, and are rare; (2) approximately 30 North Pacific right whales are known to exist; (3) Few western North Pacific gray whales have been documented outside their feeding areas in waters around Sakhalin Island, Russia; and (4) Vessel mitigation measures, such as reducing speed, are typically required by NMFS and reduce the likelihood of vessel strikes. Thus, potential ship strikes of marine mammals would be highly unlikely and are not expected to occur.

The presence and movement of ships may cause some ringed and bearded seals to abandon preferred feeding and resting habitat in areas of high traffic. Interactions with whales and seals would be reduced somewhat by the seasonal timing of barge transport in mid to late summer, a time when ringed and bearded seals also tend to occur farther offshore and when most bowhead and beluga whales are foraging father east or northeast of the analysis area. Exposure to vessels during the open-water period may affect individual seals and whales, but evidence of habituation to activity and evasion of vessels indicates that activities associated with marine transport to the program area are not likely to affect the reproductive success or survival of seals and whales.

Another potential source of injury or mortality is accidental spills, leaks, and other sources of contamination. All of the exploration and development would occur on land, with oil being transported in terrestrial pipelines to TAPS. The potential effects of accidental releases of hazardous materials (including oil spills) that reach the distributary channels of rivers and streams and adjacent marine waters would be negligible due to the safeguards in place to avoid and minimize oil spills. In the unlikely event of a large oil spill reaching open water during summer or fall, small numbers of bearded, ringed, and spotted seals and beluga whales could be negatively affected. The probability, volume, and potential spread of different types of spills are discussed in **Section 3.2.11**. Assuming that no large oils spills reach the open water environment, potential impacts of terrestrial oil spills on marine mammals are expected to be negligible.

Small, accidental fuel spills could occur with refueling at sea. This potential impact would be common to all marine mammals. In previous analyses, the BOEM assumed a vessel transfer spill during offshore refueling to have an estimated volume range from <1 to 13 barrels (blue barrel [bbl]). The 13 bbl maximum spill volume represents a spill where spill prevention measures fail, fuel lines rupture, and no oil remains on the vessel. A spill of less than 1 bbl could persist for up to 30 hours in open water, while a 13 bbl spill could persist for up to 2 days (BOEM 2015). Exposure of marine mammals to this type of spill would be highly unlikely and is not expected to occur.

Attraction to Human Activity and Facilities

Other than polar bears, marine mammals are not likely to be attracted to program-related activities or facilities. Polar bears are curious and opportunistic hunters, frequently approaching and investigating locations where human activity occurs (Stirling 1988; Truett 1993). Proximity to humans poses risks of injury and mortality for both bears and humans and may necessitate nonlethal take through deterrence and hazing or, on rare occasions, lethal take to defend human life (Stenhouse et al. 1988; Truett 1993, Perham 2005).

Stirling (1988) reported that curious polar bears commonly approach offshore drilling rigs in the Canadian Beaufort Sea whenever sea ice moved into the area but did not remain nearby for long, unless seals were present in the leads created by the rigs. Similar behavior has been observed at Northstar Island, north of Prudhoe Bay. Sightings of polar bears at industrial sites in the Beaufort Sea region of Alaska have increased in recent years, consistent with increasing use of coastal habitats, as summer sea-ice cover has diminished (Schliebe et al. 2008; USFWS 2008b; 81 FR 52276), and this trend is likely to continue.

Encounters between polar bears and humans in the program area are most likely to occur on and near the coastline, as bears move through in late summer and fall (August–October) and as maternal females search for den locations in autumn and early winter (October–November) and depart from dens with dependent cubs in late winter (March–April); however, the latter animals are the least likely to be attracted to industrial facilities, due to their greater sensitivity to disturbance.

The current ITR/LOA process has proven to be effective at addressing and mitigating the risks of polar bear encounters with humans. Besides denning surveys, the interaction plan required by the ITRs stipulates monitoring and reporting of bear sightings and encounters using trained observers, as well as training of personnel in nonlethal means of protection (deterrence and hazing).

Although camps and other activity areas have the potential to attract polar bears, experience demonstrates that these risks can be mitigated effectively by following the interaction plan; for example, with Detection systems using bear monitors, motion/infrared sensors, and adequate lighting; Safety gates, fences, and cages for workers, as well as skirting of elevated buildings; Careful waste handling and snow management; Chain-of-command procedures to coordinate responses to sightings; and Employee education and training programs (Truett 1993; Perham 2005; USFWS 2006, 2008b, 2009). All program-related activities must be conducted to minimize the attractiveness of work and facility sites to polar bears and to prevent their access to food, garbage, rotting waste, and other potentially edible or harmful materials, as required by ROPs 1–3 and 5. Trained bear monitors would be on-site, and all polar bear sightings would be reported immediately to safety personnel.

Alternative B

The types of future program-related activities and facilities would be similar among the action alternatives, but the location and extent of infrastructure and associated activity would differ among alternatives, in accordance with lease stipulations and ROPs. Differences that would alter effects on marine mammals among alternatives primarily are those in the distribution and acreage of potential denning habitat for maternal polar bears, as well as the extent to which activities and facilities would be permitted in coastal habitats used as travel routes by polar bears.

The potential impacts among action alternatives cannot be quantified accurately without knowing the future locations of program-related activities and facilities, so this evaluation assesses impacts by comparing the number of historical dens, amount of potential maternal denning habitat mapped, and likelihood of use by polar bears of the areas subject to various lease types and stipulations.

Because the entire program area is available to lease for oil and gas activity, Alternative B presents the greatest difference from Alternative A by enabling program activities and facilities in nearly all potential terrestrial maternal denning habitat for polar bears in the program area. Despite the lack of specific protection of denning habitat under this alternative, however, Lease Stipulation 1 would protect some potential maternal denning habitat by prohibiting permanent facilities within 0.5 to 1 mile of the 10 rivers and streams listed under that stipulation. The NSO area under Lease Stipulation 1 includes 48 percent of the known historical polar bear dens (**Table 3-23**) and 29 percent of the potential maternal denning habitat mapped in the program area (**Table 3-24**).

Except for those river buffers, all program activities and facilities would be allowed throughout the areas of greatest proportional occurrence of dens (high and medium HCP zones), relying on adherence to mitigation measures described in ITRs, and requiring surveys to detect occupied dens before beginning winter activities. Under Alternative B, Lease Stipulations 2, 3, 4, and 5 contain no specific requirements

Table 3-23
Number and Percentage of Documented Polar Bear Dens by Alternative, Hydrocarbon Potential, and Lease Type

Lease Type	Alternative B				Alternative C				Alternative D (Identical for D1 and D2)			
Hydrocarbon Potential	**High**	**Medium**	**Low**	**Total**	**High**	**Medium**	**Low**	**Total**	**High**	**Medium**	**Low**	**Total**
Not offered for lease sale	-	-	-	-	-	-	-	-	-	2	2	4
	-	-	-	-	-	-	-	-	-	11%	100%	9%
Subject to NSO	17	4	1	22	18	9	2	29	23	15	-	38
	68%	21%	50%	48%	72%	47%	100%	63%	92%	79%	-	83%
Subject to CSU	-	-	-	-	-	-	-	-	-	1	-	1
	-	-	-	-	-	-	-	-	-	5%	-	2%
Subject to TLs	-	3	1	4	3	7	-	10	-	-	-	-
	-	16%	50%	9%	12%	35%	-	21%	-	-	-	-
Subject to only standard terms and conditions	8	12	-	20	4	5	-	9	2	1	-	3
	32%	63%	-	43%	16%	25%	-	19%	8%	5%	-	7%
Total	**25**	**19**	**2**	**46**	**25**	**19**	**2**	**46**	**25**	**19**	**2**	**46**

Source: BLM GIS 2018
- = not applicable

Table 3-24
Estimated Acreage and Percentage of Potential Maternal Denning Habitat by Alternative, Hydrocarbon Potential, and Lease Type

Lease Type	Alternative B				Alternative C				Alternative D (identical for D1 and D2)			
Hydrocarbon Potential	**High**	**Medium**	**Low**	**Total**	**High**	**Medium**	**Low**	**Total**	**High**	**Medium**	**Low**	**Total**
Not offered for lease sale	-	-	-	-	-	-	-	-	-	300	1,000	1,300
	-	-	-	-	-	-	-	-	-	15%	77%	28%
Subject to NSO	400	600	400	1,400	600	1,100	1,100	2,800	800	1,400	300	2,500
	31%	29%	29%	29%	43%	52%	79%	57%	62%	70%	23%	54%
Subject to CSU	-	-	-	-	-	-	-	-	100	200	-	300
	-	-	-	-	-	-	-	-	8%	10%	-	7%
Subject to TLs	-	600	800	1,400	300	600	300	1,200	-	-	-	-
	-	29%	57%	29%	21%	29%	21%	24%	-	-	-	-
Subject to only standard terms and conditions	900	900	200	2,000	500	400	-	900	400	100	-	500
	69%	43%	14%	42%	36%	19%	-	18%	31%	5%	-	11%
Total	**1,300**	**2,100**	**1,400**	**4,800**	**1,400**	**2,100**	**1,400**	**4,900**	**1,300**	**2,000**	**1,300**	**4,600**

Source: BLM GIS 2018
- = not applicable

relevant to polar bears or their habitat (other than complying with the ESA and MMPA), resulting in greater potential long-term disturbance effects than under Alternative A and the greatest among the action alternatives because of the larger area open to leasing under this alternative.

The coastline survey required under Lease Stipulation 9 for this alternative would provide some specific information for planning purposes but would not specifically restrict activities that could disturb polar bears using coastal habitats. This would leave the regulatory requirements of ITRs as the sole mitigation measures in effect in the coastal area. They would reduce disturbance of bears moving along and denning near the sea coast, including the barrier islands unit of designated critical habitat and its attendant 1-mile no-disturbance zone.

ROPs 1 and 2, and adherence to ITR requirements would reduce the potential for attraction to improperly handled garbage and other rotting waste, greatly diminishing the safety risks that could result from habituation and food-conditioning of polar bears. ROP 4 would reduce the safety risks for both humans and bears by ensuring that measures are in place to address the risks of, and solutions for, bear-related problems and to follow accepted practices for deterring bears around facilities, when necessary. The highest number of documented historical polar bear dens and the greatest area of potential maternal denning habitat occur in the high- and medium-potential hydrocarbon zones, where the least restrictive development activities would be most likely to occur. Because of this, the potential impacts of waste handling and bear-human interactions under this alternative would be the most different from Alternative A and would be greater than those under the other two action alternatives.

Under ROP 10, the pre-activity surveys required to locate dens, plus the 0.5-mile and 1-mile buffers for seismic and heavy equipment operation around occupied dens of grizzly and polar bears, respectively, would help to reduce the impacts of behavioral disturbance on denning bears (as well as birth lairs of ringed seals on landfast ice along the coast) throughout the entire program area. Even so, complete detection of occupied bear dens is unlikely to be achieved, so an unknown (though probably small) number of denning bears could be exposed to disturbance until discovered by such operations every winter during exploration, construction, and development drilling phases. This would reach the highest levels under this alternative, in comparison with Alternative A. As part of the ITR/LOA process, however, the USFWS implements protective mitigation measures around a maternal polar bear den once it is discovered, which can include applying a 1-mile no-disturbance buffer around the den site and 24-hour monitoring of the den site.

The requirement to obtain permits before installing fences to capture snow under ROP 15 (identical under all action alternatives) could alleviate potential conflicts with denning bears. Pregnant polar bears could be attracted early in the denning season to the drifts in the lee of snow fences, which could create suitable denning habitat if the drifts become deep enough.

Alternative C

Most of the historical dens that have been documented in the program area occur in the zones of high and medium HCP, which would be open to development subject to only standard terms and conditions or under NSO stipulations. The NSO area under Lease Stipulations 1 and 9 would include 63 percent of the known maternal dens and 57 percent of potential denning habitat (**Table 3-23** and **Table 3-24**). The expanded NSO setback (2 miles rather than 1 mile) around the Canning, Hulahula, and Okpilak Rivers under Lease Stipulation 1 would provide additional protection of potential denning habitat along those drainages. The NSO buffer within 1 mile of the coastline, barrier islands, and lagoons under Lease Stipulation 9 would reduce potential disturbance of polar bears moving through those habitats during all seasons and denning there in winter; thus, it would be consistent with the 1-mile no-disturbance zone that is required around the barrier islands unit of critical habitat designated for the species. Lease Stipulations 2, 3, 4, and 5 contain no specific requirements relevant to polar bears or their habitat (other than complying with the ESA and MMPA), resulting in greater long-term disturbance effects on the species than under Alternative A and similar effects as under Alternative B in the areas covered by those lease stipulations.

The area subject to TLs under Alternative C would include an additional 17 percent of known dens and 24 percent of potential denning habitat (**Table 3-23** and **Table 3-24**), but those TLs are intended primarily as mitigation for caribou post-calving habitat during summer and thus would not benefit maternal polar bears during winter; therefore, potential long-term disturbance impacts likely would be greater than those under Alternative A and similar to those under Alternative B.

The requirements of ROPs 1, 2, and 4 under this alternative would be identical to those under Alternative B, but the potential impacts would be less under this alternative because the NSO area would be larger than under Alternative B. The requirement of ROP 10 would be identical to Alternative B, so the potential impacts would be similar.

Alternative D

Alternatives D1 and D2 would be identical with regard to potential impacts on polar bears, so they are discussed together here. By affording the highest degree of protective measures for polar bears, this alternative would be the most similar to Alternative A in terms of potential impacts than would the other two action alternatives. The areas not offered for lease and NSO areas—0.5- to 4-mile buffers around 17 rivers and streams, the Canning River delta and lakes, and three springs—would encompass 92 percent of known historical dens and 82 percent of potential denning habitat, affording the highest level of protection for polar bear denning among the action alternatives. The 34 percent of the program area not available for lease contains 28 percent of the potential maternal denning habitat but only 9 percent of historical maternal dens (**Table 3-23** and **Table 3-24**). In contrast, the various NSO areas under this alternative contain 54 percent of the potential denning habitat and 83 percent of the known dens (**Table 3-23** and **Table 3-24**). This reduces the potential for impacts from program-related habitat loss and disturbance to the lowest degree among the action alternatives.

Under Lease Stipulation 5, the "coastal polar bear denning river habitat" zone (see **Map 2-6** and **Map 2-8** in **Appendix A**) subject to NSO and TLs totals 105,400 acres. This constitutes 6.7 percent of the program area and 8.8 percent of the terrestrial denning unit of designated critical habitat in the program area. Despite being such a small percentage of that unit of critical habitat, the stipulated area within 5 miles of the coast and 1 mile of the Sadlerochit, Niguanak, and Katakturuk Rivers and Marsh and Carter Creeks encompasses 37 percent of the historical maternal dens documented in the program area.

In addition to the specific protection of maternal denning habitat in that zone under Lease Stipulation 5, Lease Stipulations 1 and 2 would also protect denning habitat by prohibiting permanent facilities in NSO buffers within 0.5 to 4 miles of the 17 rivers and streams and 0.5 mile of the other waterbodies listed under those two stipulations. Lease Stipulation 3 would protect additional denning habitat by excluding leasing and instituting 3- to 4-mile NSO buffers around Sadlerochit Spring, Fish Hole 1 on the Hulahula River, Tamayariak Spring, Okerokavik Spring, and along the east bank of the Canning River.

The various stipulations restricting facilities and activities in coastal habitats would reduce potential behavioral disturbance of polar bears moving along the coastline throughout most of the year. Under Lease Stipulation 5, TLs would reduce disturbance of polar bears by prohibiting program-related activities within 1 mile and up to 5 miles inland between October 30 and April 15. In addition, the TLs under Lease Stipulations 4 and 9 would reduce disturbance between May 15 and November 1, or whenever sea ice comes within 10 miles of shore. They would do this by restricting program-related activities within a 2-mile coastal buffer, extending protections 1 mile farther inland than under Alternative C.

As with the other two action alternatives, ROPs 1 and 2 would reduce the potential for attraction to waste and would greatly diminish the safety risks that could result from habituation and food-conditioning of polar bears, and ROP 4 would further reduce the safety risks for both humans and bears. ROP 10 would reduce the impacts of behavioral disturbance on denning bears (and birth lairs of ringed seals on landfast ice) to the greatest degree among the action alternatives, most similar to Alternative A.

Cumulative Impacts

Most existing industrial development along the Beaufort Sea coast has occurred in terrestrial habitats, which typically receive much less use by polar bears throughout the year than do marine habitats offshore; however, over time, development began to expand into marine areas, starting with the construction of West Dock in the Prudhoe Bay field. It was followed by the Endicott Project, which was the first offshore production facility in the region, and the Northstar Project, located on artificial islands offshore from Prudhoe Bay.

Offshore production facilities (Endicott, Northstar, Oooguruk, and Nikaitchuq islands) have recorded the highest incidences of polar bear sightings and nonlethal hazing incidents in the established oilfields in recent years, accounting for 47 percent of polar bear observations (182 of 390 sightings) from 2005 to 2008 (76 FR 47010; 81 FR 52276). Analysis of the cumulative effects of oil and gas leasing, exploration, development, and production by the National Research Council (NRC 2003, pg. 105) showed that “industrial activity in the marine waters of the Beaufort Sea has been limited and sporadic and likely has not caused serious cumulative effects on ringed seals or polar bears.” Nevertheless, expansion of oil and gas development along the arctic coast on both land and sea may reach a level at which such effects become problematic for polar bears in the future (Amstrup 2003a; USFWS 2009).

Existing oil and gas development, commercial transportation, subsistence harvest and changes in the activities of local communities, and management and research actions by federal and state agencies are the principal activities contributing to cumulative effects on polar bears and other marine mammals in Arctic Alaska. Tourism is growing in Kaktovik, with commercial enterprises offering viewing opportunities of polar bears and recreational travel in the Arctic Refuge.

Marine mammals are exposed to potentially toxic chemical compounds in the water and the food web that have been transported to the Arctic from around the world through the atmosphere, water currents, and migrating animals (AMAP 2010). As a top predator, polar bears tend to have higher levels of potentially toxic compounds that bioaccumulate in the food chain, such as organochlorines and mercury (Braune et al. 2005; AMAP 2010). At the time of listing under the ESA, however, contaminant levels in Alaska polar bears were considered relatively low compared to other stocks (USFWS 2017). Alaska stocks, including the SBS stock, continue to have some of the lowest concentrations of polychlorinated biphenyls, chlorinated pesticides, and flame retardants among all polar bear stocks (McKinney et al. 2011).

Onshore oil and gas production, such as that proposed in the program area, typically requires large sea lifts using barges to transport facility modules, equipment, and material from southern ports to docks on the Beaufort Sea coast. Onshore infrastructure also can affect marine mammals through the need for sea ice roads that cross ringed seal habitat in landfast ice, and ice and gravel infrastructure can affect polar bear habitat and maternal polar bear denning, as described above. These impacts of onshore production would likely affect polar bears through disturbance in coastal barrier-island and denning habitats, especially during construction, but would be mitigated through the ITRs and LOAs issued by the USFWS. The combined effects of likely future actions, particularly those located in the arctic marine environment, may contribute to adverse effects on polar bear, seal, and whale populations in the future, primarily through expansion of coastal and offshore development and the increased risk of a major marine oil spill.

Considering all past, present, and reasonably foreseeable future actions, human-bear interactions have the greatest potential to affect polar bears. Furthermore, the effects of human-bear interactions would interact both spatially and temporally with those of the proposed leasing program. Considering the effects of post-lease oil and gas activities in conjunction with human-bear interactions, and other reasonably foreseeable future actions, the effects post-lease oil and gas activities would have additive cumulative effects on polar bears, possibly resulting in additional impacts on the SBS stock of polar bears. The effects of climate change described under *Affected Environment* above, could influence the rate or degree of the potential cumulative impacts.

3.4 Social Systems

3.4.1 Landownership and Use

Affected Environment

The affected environment for landownership and use is similar to Section 4.1.2, Land Status, in the Arctic Refuge CCP (USFWS 2015a); however, because the Coastal Plain program area does not include the entire Arctic Refuge, a revised description of the program area is included here. Lands administered by the USFWS, including submerged lands, account for greater than 99.9 percent (1,562,600 acres) of the 1,563,500-acre program area. The remaining 900 acres of lands are Alaska Native Allotments. Patented and allotment lands are mostly located along the Beaufort Sea between the Hulahula and Jago Rivers. There also are smaller, isolated allotments along the coast. Descriptions of Alaska Native Lands and Allotments are incorporated here by reference from the USFWS CCP (USFWS 2015a).

There are no BLM-administered surface lands in the program area; however, the BLM manages all of the subsurface mineral estate there (see **Sections 3.2.5** and **3.2.6**). Although none currently exist, the BLM would manage federal oil and gas leases, permits, and ROWs associated with fluid mineral development. The BLM would verify subsurface mineral estate ownership at a site-specific level prior to a lease sale.

With the exception of Barter Island, there are no roads, power lines, pipelines, or other permanent facilities or structures in the program area. On Barter Island is a single runway airport and the city of Kaktovik, a community of approximately 250 people.

Direct and Indirect Impacts

Issuance of oil and gas leases under the directives of Section 20001(c)(1) of PL 115-97 would have no direct impacts on the environment because by itself a lease does not authorize any on the ground oil and gas activities; however, a lease does grant the lessee certain rights to drill for and extract oil and gas subject to further environmental review and reasonable regulation, including applicable laws, terms, conditions, and stipulations of the lease. The impacts of such future exploration and development activities that may occur because of the issuance of leases are considered potential indirect impacts of leasing. Such post-lease activities could include seismic and drilling exploration, development, and transportation of oil and gas in and from the Coastal Plain. Therefore, the analysis is of potential direct and indirect impacts on landownership and use from on-the-ground post-lease activities.

Potential impacts on landownership and uses are the result of decisions that change landownership or from lease stipulations that allow or restrict certain land uses. Landownership decisions, such as conveyance or transfers, can increase or decrease the amount of federal land and the type of management available for those lands. Use restrictions, such as those intended to protect resources or to reduce conflicts with other uses, can preclude the placement of new infrastructure or require special conditions for development. In areas subject to NSO, new land uses would be precluded. Any new uses would be required to locate in areas outside of the NSO area. Depending on the use, developing the use outside of the NSO area may not be physically or commercially viable. In areas subject to CSU or TLs, additional requirements, such as long-term monitoring, special design features, and special siting requirements, could restrict a future project's location or viability of projects.

Alternative A

Under Alternative A, there would be no federal minerals offered for future oil and gas lease sales in the program area and therefore no direct or indirect impacts on uses. There would be no change in landownership.

Impacts Common to All Action Alternatives

Under all action alternatives, areas would be made available for lease sales consistent with PL 115-97. Demand for petroleum resources would result in the subsequent development of oil and gas exploration and production well pads, CPFs, roads, pipelines, barge dock, a STP, and other ancillary uses to support oil and gas development. While the location of these uses would vary under the action alternatives, as discussed below, the size, type, and amount would be nearly the same.

New oil and gas development in the program area would indirectly affect land uses in and surrounding the community of Kaktovik. As one of the North Slope's larger communities and the main point of arrival and departure for air travel to the program area, new or expanded residential, commercial, industrial, and civic land uses would be expected, especially over the long term. Areas south of Kaktovik's current development footprint more likely to experience the most notable growth (NSB 2015a).

There would be no change in landownership under any of the action alternatives.

Alternative B

The nature and types of impacts on land uses under Alternative B would be the same as those described under *Impacts Common to All Action Alternatives*. Making the entire program area available for lease sale and applying NSO stipulations to only 23 percent of the lands available for leasing would allow land uses to be developed in most areas. Areas subject to NSO where uses would be precluded would largely be along river corridors.

Alternative C

Under Alternative C, the nature and types of impacts on land uses would be as described under *Impacts Common to All Action Alternatives*. Making 932,500 acres subject to NSO would limit the locations where new uses could be developed to 631,000 acres (40 percent) of the program area. These areas would be subject to TL or CSU lease stipulations, which would influence the future design, location, and extent of seasonal use associated with the use.

Alternative D

Under both subalternatives of Alternative D, the nature and types of impacts on land uses would be the same as those described under *Impacts Common to All Action Alternatives* and would be similar to Alternative

C. Making 526,300 acres unavailable for lease sales and an additional 708,600 acres subject to NSO would limit the locations where new uses could be developed to the remaining 328,600 acres (21 percent) of the program area.

Cumulative Impacts

Cumulative impacts on landownership and uses would be the result of a change in the demand for lands to be transferred out of federal ownership to support a public use or demand for land uses associated with energy or mineral development. Past, present, and reasonably foreseeable future actions, described in **Appendix F**, that would cumulatively affect landownership and uses include future oil and gas exploration and production and associated demand for infrastructure, and community expansion, particularly near Kaktovik, with associated demand for land uses and potential land tenure actions.

Under all action alternatives, new oil and gas exploration and development would increase the number and density of uses in the program area. Applications for uses would be processed on a case-by-case basis, subject to lease stipulations and other protective measures. NSO stipulations, particularly under Alternatives C and D could result in the concentration of new uses in smaller areas. As new oil and gas uses are developed in an area, the availability of those public lands for other oil and gas infrastructure would decline. Collocation or use of shared facilities would alleviate this potential impact.

Expanding interest in the program area would influence uses in nearby Kaktovik. Combined with past, present, and future actions, which include plans to expand community infrastructure and transportation facilities in the city, new oil and gas development could increase demand for new residential, commercial, civic, and industrial lands uses in the city. Because Kaktovik's urban footprint is confined by the Beaufort Sea to the north, by public lands to the east and west, and by private lands to the south, there may be future interest in conveying lands out of federal ownership to accommodate new community development.

3.4.2 Cultural Resources

Affected Environment

This section incorporates information from the following sources: ADNR, Office of History and Archaeology (ADNR OHA 2018) Alaska Heritage Resources Survey (AHRS);[28] NSB's Iñupiat History, Language, and Cultural (IHLC) Division's repository of Traditional Land Use Inventory (TLUI) sites (IHLC 2018); ADNR, Division of Mining, Land and Water (ADNR MLW 2018) Revised Statute (RS) 2477 trail database (e.g., historic public ROWs; the NOAA Office of Coast Survey (NOAA OCS 2016) wrecks and obstruction database; and previous literature and EIS documents near the program area, including the Point Thomson EIS (USACE 2012) and Arctic Refuge CCP (USFWS 2015a). The BLM also reviewed scoping comments for this EIS for information on cultural resources in the program area.

The relevant regulations for evaluating the effects on cultural resources are NEPA and Section 106 of the NHPA and its implementing regulations in 36 CFR 800.[29] Federal agencies are encouraged to coordinate compliance with Section 106 with any steps taken to meet the requirements of NEPA and should consider their Section 106 responsibilities as early as possible in the NEPA process (36 CFR 800.8a). Other relevant legislation or EOs that apply to the management of cultural resources include the Antiquities Act of 1906 (16 USC 431 et seq.); the Archaeological Resources Protection Act of 1979 (16 USC 470 et seq.); the Abandoned Shipwreck Act of 1987 (PL 100-298); the American Indian Religious Freedom Act; Section 4(f)

[28]AHRS data reviewed for this EIS in June of 2018

[29]Section 106 of the NHPA requires the BLM to evaluate effects on historic properties, which are a type of cultural resource.

of the DOT Act (49 USC 303); the Archaeological and Historic Preservation Act of 1974 (the Moss-Bennett Act); EO 13007 (Indian Sacred Sites); and the Native American Graves Protection and Repatriation Act (25 USC 3001-3013).

Cultural and Historic Context

The Arctic Refuge Revised CCP (USFWS 2015a) and Point Thomson EIS (USACE 2012) describe the cultural themes and periods of the Arctic Refuge, including the program area. **Table 3-25**, below, provides a summary of the cultural context of the Arctic Refuge as presented in the CCP (USFWS 2015a) and based on information provided in USACE (2012). **Section 3.4.4**, Sociocultural Systems, also provides a cultural overview of the Iñupiat and Gwich'in people that is relevant to this section.

Table 3-25
Cultural Themes and Periods of the Arctic Refuge Area

Theme	Period
Paleoindian	13,700 to 9,800 years ago
American Paleo-Arctic	11,800 to 8,000 years ago
Northern Archaic	8,000 to 3,000 years ago
Arctic Small Tool Tradition	5,000 to 2,400 years ago
Athabascan	2,000 years ago, to present
Birnirk Culture	1,600 to 1,000 years ago
Thule	1,000 to 400 years ago
Iñupiat	400 years ago, to present
Euro-American exploration	1820s to 1880s
Early ethnographic research	1900s to 1920s
Trading posts and reindeer herding	1920s to 1940s
Military presence/DEW Line sites	1950s to 1980s
Land conservation	1950s to present
Oil development	1970s to present

Cultural Resources in the Program Area

<u>Previous Archaeological and Historic Resources Surveys</u>

In general, previous survey efforts focused on identifying archaeological and historic resources in the program area have been concentrated primarily along the coastal region, with fewer investigations along the river systems and little research in the overland areas. A review of the previous surveys module of the AHRS database, using section-level[30] spatial coverage for the program area 10 literature reviews, 12 reconnaissance surveys, and one intensive survey. A similar review of the document repository module of the AHRS returned 30 records for reports associated with those sections.

Past surveys have largely been concentrated in and around the village of Kaktovik, along the coast and barrier islands of the Beaufort Sea, and along several of the major rivers in the area. Of special note is one wide-area survey of the program area conducted by Edwin Hall (1982) over approximately 20 days, using aerial overflights and limited pedestrian investigation of the coastal area and select river systems. This survey represents the only attempt at systematic coverage of the program area guided by targeted surveys at high potential landforms and topographic settings. Overall, vast inland areas of the program area have received little to no systematic investigation for cultural resources; while the coastal region has been the

[30]The finest resolution of the AHRS database for wide-area queries is the section level, which may result in non-program area lands being included in the search.

subject of a greater number of survey efforts, dynamic coastal erosion processes are affecting those resources.

Previously Documented Sites

For the Arctic Refuge, the USFWS (2015a) identified several categories of site types that could be found. These types are as follows for the five categories most likely to be found in the program area, which correspond to the specific sites identified in the program area:

- Coastal settlements, consisting of semi-subterranean driftwood or whalebone houses, in some cases associated with cemeteries or additional structures; post-contact and pre-contact houses are present along the coast of the Beaufort Sea
- Inland settlements, consisting of semi-subterranean driftwood or whalebone houses, also in some cases associated with cemeteries or additional structures; this is the least known type of site on the Arctic Refuge
- Tent ring complexes, consisting of arrangements of stones used to secure skin tents to the ground, often with associated hearths in and outside the ring; these features are found along river corridors on elevated terraces and likely relate to seasonal caribou hunting by coastal people; in some cases, these complexes are near or next to caribou drive lines or fences
- Lithic scatters, consisting of surface and subsurface collections of artifacts and debris resulting from the procurement, preparation, and manufacture of stone tools; in many cases, lithic typological and technological comparisons are the only way of assigning an age to a site
- Historic structures, including sod houses and cabins, built by indigenous peoples, early explorers, and trappers that offer insights into the early contact period

As identified in the AHRS database, there are 89 AHRS sites recorded in the program area, including sites of both prehistoric and historic origin (**Appendix L**). Approximately one-third of the sites have prehistoric components, including such features as sod houses, lithic scatters, tent rings, and various artifact scatters. Historic sites comprise the remaining two-thirds of sites and include military sites associated with the DEW Line and several historic Iñupiaq structures, such as sod houses, cellars, tent frames, and other buildings. The NSB's TLUI database documents place names, landmarks, traditional land use sites, travel routes, and important locations remembered by the Iñupiat. According to the TLUI database, there are 34 recorded TLUI sites in the program area (**Appendix L**). These sites primarily consist of house ruins (both collapsed sod and cabin structures), graves, and important hunting, fishing, camping, and lookout areas. Except for five TLUI sites inland, the remaining 29 sites are located along coastal areas of the program area.

Other repositories of cultural resources are the RS 2477 database, and the NOAA Wrecks and Obstruction database. The RS 2477 trail database identifies three RS trails (914, 1043, and 1649) in the program area. RS 914 is the Poker (Pokok) Lagoon Southeast Trail, a 5.5-mile winter trail near Pokok Lagoon; RS 1043 is the Bullen-Staines River Trail, a 22-mile tractor trail; and RS 1649 is the Tamayariak River-Simpson Cove Trail, a 20-mile tractor trail.[31] The NOAA database identifies two shipwrecks in the program area, one just off the northeast shoreline of Barter Island and a second in Camden Bay next to the POW-DEW Line site.

[31]The RS 2477 trails have been identified and asserted by the State of Alaska, but the validity of all RS 2477 trails must be determined either via a determination of perfection prior to the Federal Land Policy and Management Act or through appropriate judicial proceedings

Locations of Previously Documented Sites

Due to the confidential and sensitive nature of cultural resource sites, no map is provided in this EIS; however, there are two main locations where cultural resources have been documented in the program area: on barrier islands and protected coasts of the Beaufort Sea and inland on elevated dry ground landforms, such as pingos, river terraces, and bluffs. While these are the types of landforms on which inland sites have been found, one reason for this is because these were the types of landforms focused on by Hall (1982) when he surveyed in the interior. Sites of greatest antiquity are found inland, as these landforms appear to have long periods of relative stability. Documented coastal sites are mainly historic, as the dynamic coastal environment appears to cause rapid displacement of sediments and soils through erosion, underlying permafrost thawing, elevated sea levels, and the likely destroying ancient shoreline sites (CCRS and NLUR 2010). These areas correspond to locations having the highest potential for human activity and where previous surveys have focused. Other undocumented sites are likely present in unsurveyed portions of the program area.

Ethnographic Cultural Resources

Cultural aspects of the environment are not limited only to discrete locations where physical remains of past human activities are preserved, but they may also include culturally valued places, cultural use of the biophysical environment, such as religious and subsistence uses, and sociocultural attributes, such as social cohesion, social institutions, lifeways, religious practices, and other cultural institutions (National Preservation Institute 2018). These ethnographic resources are cultural or natural features of a region, where traditionally associated cultures have formed significant connections. They are closely linked with their own sense of purpose, existence as a community, development as ethnically distinctive peoples, and survival of their lifeways.

Ethnographic resources are held as traditionally meaningful and may be sites, landscapes, structures, objects, or natural resources, such plants, animals, minerals, and bodies of water, that are assigned traditional legendary, religious, subsistence, or other significance in the cultural system of a group. The significance that cultures assigned to ethnographic resources may encompass both the tangible and the intangible aspects of these special places. These types of sites provide knowledge regarding places important to identity, spirituality, and, in the case of ethnographic landscapes, a broader more holistic way of viewing cultural resources in the natural resources that surround them.

Many terms are used by different groups to describe these ethnographic resources. Although not an exhaustive list, commonly used terms to describe the various types of ethnographic resources include the following:

- Traditional cultural properties (TCPs)
- Ethnographic landscapes
- Native American sacred sites
- Intangible cultural resources (e.g., oral traditions, indigenous knowledge, traditional skills)

Traditional knowledge provided through oral histories and scoping testimonies is one avenue of identifying ethnographic resources. Such knowledge can be derived from oral histories and public testimony and can provide traditional knowledge that is both general, such as testimony on long-standing use of the arctic environment, or very specific, such as testimony about use of a specific family subsistence camp.

During the scoping process, commenters, particularly the Gwich'in people in Arctic Village and Venetie, expressed the importance of investigating TCPs in the program area. They commented that there should be an emphasis on consultation with local tribal governments and organizations, nongovernmental agencies, and other interested parties. Broadly speaking, it is evident that the program area is held as sacred among the Gwich'in people, particularly for those residing in Arctic Village and Venetie. They hold it sacred because it is where life begins and for its association with caribou calving and bird nesting grounds (see **Section 3.4.4**, Sociocultural Systems).

Besides the NSB's TLUI program, surveys and research to identify and document potential sacred sites, TCPs, ethnographic landscapes, or intangible resources have not been completed to date in the program area. Kaktovik commenters stressed the importance of residents being able to maintain, if not increase, their access to and management of traditional areas in the program area and broader Arctic Refuge. Further efforts to describe the process for consulting, identifying, and documenting these types of ethnographic cultural resources that the Iñupiat and Gwich'in people hold as culturally important would be addressed in accordance with the Section 106 process.

Climate Change

As identified in the GMT2 Final SEIS (BLM 2018a), cultural resources on the North Slope are susceptible to climate change effects of erosion, mass wasting, and cryoturbation[32], which results in increased thawing and lack of preservation of frozen artifacts and loss of spatial relationships between cultural levels.

Direct and Indirect Impacts

Issuance of oil and gas leases under the directives of Section 20001(c)(1) of PL 115-97 would have no direct impacts on the environment because by itself a lease does not authorize any on the ground oil and gas activities; however, a lease does grant the lessee certain rights to drill for and extract oil and gas subject to further environmental review and reasonable regulation, including applicable laws, terms, conditions, and stipulations of the lease. The impacts of such future exploration and development activities that may occur because of the issuance of leases are considered potential indirect impacts of leasing. Such post-lease activities could include seismic and drilling exploration, development, and transportation of oil and gas in and from the Coastal Plain. Therefore, the analysis is of potential direct and indirect impacts on cultural resources from on-the-ground post-lease activities. The effects of climate change described under *Affected Environment* above, could influence the rate or degree of the potential direct and indirect impacts.

Alternative A

Alternative A would not result in potential direct or indirect impacts on cultural resources because no leasing activity that could affect cultural resources would occur in the program area. Existing activities that could affect cultural resources would include people using Arctic Refuge lands and waters that could lead to purposeful or inadvertent damage to cultural resources. Additionally, natural processes, such as erosion, would continue to affect cultural resource sites under this alternative.

Impacts Common to All Action Alternatives

Potential impacts associated with the development of a lease, including the exploration, construction, and operation phases of any permitted development, could include physical destruction of or damage to all or part of a cultural resource, removal of the resource from its original location, change in the character of the resource's use, or change of the physical features in the resource's setting (e.g., vibration, noise, visual,

[32]Refers to the mixing of materials from various horizons of the soil down to the bedrock due to freezing and thawing. Occurs to varying degrees in permafrost soils.

or olfactory) that contribute to the importance of the resource, or change in access to traditional use sites by traditional users.

In areas where avoidance does not occur, examples of ground-disturbing activities that could potentially cause direct impacts are excavation of material sites; construction and maintenance of gravel roads, pads, airstrips, bridges and culverts; construction of ice roads and pads; construction of VSMs for power lines and pipelines; and any other disturbance of the ground surface in the proximity of development project components.

Other activities and events that could potentially cause direct impacts on cultural resources include seismic and other exploratory activities, damage caused by equipment during the construction, drilling, and operation phases of development projects, and unanticipated accidents, such as blowouts, spills, or fires, and subsequent cleanup activities. Certain future impacts, such as oil spills, can contaminate site artifacts and organic materials to make them undatable. Section 4.3.12.2 in BLM 2012 provides additional discussion of potential direct impacts on cultural resources associated with oil and gas exploration and development.

Potential indirect impacts on cultural resources could also occur at distances greater than the development project footprints. Indirect impacts on cultural resources could occur throughout the construction and operation phases of a development project and during closure and reclamation. Examples of indirect impacts on cultural resources could include increased access and potential removal, trampling, or dislocation of cultural resources and culturally sensitive areas by personnel and visitors; complete or partial destruction of a site from erosion, thawing permafrost, and thermokarsting; the loss of traditional meaning, identity, association, or importance of a resource; effects on beliefs and traditional religious practices; or neglect of a resource that causes its deterioration.

While potential impacts on specific cultural resource sites would differ by alternative (see discussion below), broader cultural impacts on belief systems/religious practices would be common across all alternatives. Particularly for the Gwich'in people, who hold the program area as sacred ground to their culture and as *Iizhik Gwats'an Gwandaii Goodlit*, "The Sacred Place Where Life Begins" (Gwich'in Steering Committee 2004), the presence of development in the program area would constitute a cultural impact on the Gwich'in people. This is because they believe that development in the program area would harm the caribou and other migratory resources (such as waterfowl) that migrate to the Coastal Plain to give birth. This sacred pattern of migration and birth maintains the value of, and gives essence to, the Coastal Plain as the place where life began. This sacred belief is based on the intergenerational traditional knowledge of the Gwich'in people that is built on millennia of residence in the region (see Irving 1958 and Kofinas et al. 2002 for examples of this knowledge). Similar to the cultural value that Iñupiat place on bowhead whales in their culture, caribou are held in the highest regard by the Gwich'in people and are the backbone of their cultural identity (Slobodin 1981). Any potential impacts on the resource would constitute a cultural effect. These effects, including those on belief systems, are also discussed in **Section 3.4.4**.

Both the Iñupiat and the Gwich'in people have cultural and ethnographic ties to the program area, as evidenced by cultural sites, traditional and contemporary uses, oral histories, and current beliefs and values. When these are viewed as a whole, these ties to land and place are often documented and identified in the cultural resource regulatory framework as TCPs or cultural landscapes.

These types of cultural resources have not been documented to date in the program area under the existing regulatory frameworks, although the wide array of individual TLUI and AHRS sites in the program area demonstrate the potential for these ethnographic resources, such as TCPs, cultural landscapes, and sacred sites, to be documented. While the available data (see *Affected Environment* section above) have not documented these types of cultural resources for Iñupiat or the Gwich'in people in the program area, the absence of these cultural resources can be attributed to the lack of past research to document these types of resources rather than the fact that they do not exist.

The Gwich'in people in Arctic Village have stated that documented and undocumented TCPs do exist for them that they believe could be affected by oil and gas leasing in the program area and that the Section 106 consultation process needs to fully consider these cultural resources. Other scoping testimony identified the Coastal Plain of the Arctic Refuge as a cultural landscape that provides for indigenous communities and that the area should be explicitly analyzed as a traditional cultural landscape of the Gwich'in Nation.

In summary, given the information currently available and the undetermined location and nature of development in the program area, potential impacts on traditional belief systems/religious practices and other ethnographic cultural resources, such as TCPs and cultural landscapes, particularly for the Gwich'in people, would be adverse, regional, and long term. Consultation with the tribes during the NEPA and Section 106 processes will occur to explore options for minimization and mitigation measures related to ethnographic cultural resources. For cultural resource sites in the program area that could not be avoided or that would experience indirect effects, the impacts would be adverse, local, and long term.

No potential adverse effects on documented specific cultural resource sites would be expected in areas where adequate investigation, such as surveys, consultation, and interviews, has occurred prior to development and where appropriate avoidance, minimization, or mitigation measures are implemented. The Section 106 process for addressing effects on historic properties is occurring concurrently with the NEPA process and will include the development of a programmatic agreement to address the process for identifying historic properties and resolving potential adverse effects through avoidance, minimization, or mitigation. Lease stipulations already proposed include conducting cultural surveys prior to ground-disturbing activities, a plan for unanticipated discovery stoppage, and cultural awareness training and orientation.

Alternative B

Under Alternative B, the types of potential impacts on cultural resources would be the same as those described above (*Impacts Common to All Action Alternatives*). Alternative B would make available the largest number of acres for potential leasing and development; therefore, in terms of direct and indirect impacts on cultural resource sites (e.g., TLUI, AHRS, RS 2477[33] trails), Alternative B could affect the greatest number of documented sites (**Table 3-26**). Thirty-six AHRS and 25 TLUI sites are in areas that are open with standard terms and conditions or TLs and could experience ground-disturbing activities. RS 2477 trails #1649 and #914 also occur in these areas. An additional 57 AHRS and 9 TLUI sites are in areas of NSO and would have less potential to be affected, due to the reduced levels of ground-disturbing activities in the NSO areas. RS 2477 trails #1649, #1043, and #914 and the two shipwrecks occur in the NSO area.

[33]RS 2477 is found in Section 8 of the Mining Law of 1866 and states, "The ROW for the construction of highways over public lands, not reserved for public uses, is hereby granted." This statute granted states and territories ROWs over federal lands that had no existing reservations or private entries. In Alaska, this law effectively ended in 1969, but due to the time frame in which these ROWs were established (1866–1969), these highways, trails, and other ROWs are considered historical resources and are taken into consideration in this EIS (ADNR MLW 2013).

Table 3-26
Cultural Resource Sites by Action Alternative

Alternative	STC/TL	CSU	NSO	Not Offered for Lease Sale
B	36 AHRS 25 TLUI 2 RS 2477	n/a	57 AHRS 9 TLUI 3 RS 2477 2 shipwrecks	n/a
C	6 AHRS 1 RS 2477	n/a	85 AHRS 34 TLUI 3 RS 2477 2 shipwrecks	n/a
D1 and D2	1 AHRS	0	74 AHRS 30 TLUI 3 RS 2477 2 shipwrecks	15 AHRS 4 TLUI

Source: BLM GIS 2018

Notes: Some larger sites may overlap multiple lease areas. This table does not include ethnographic resources, which are addressed under *Impacts Common to All Action Alternatives*.
STC = Subject only to standard terms and conditions
TL = Timing limitations
CSU = Controlled surface use
NSO = No surface occupancy

Because Alternative B has the smallest setbacks from areas of highest potential for containing undocumented cultural resources, such as rivers and coastline, this alternative would have the highest likelihood for affecting undocumented resources. Potential impacts on cultural resource sites under Alternative B would be adverse, local (up to 2,000 acres of disturbance and general vicinity), and long term for sites that could not be avoided or would experience indirect effects.

Alternative C

Alternative C would have the same number of acres available for potential leasing and development compared to Alternative B, but a larger number of acres would be subject to NSO stipulations, which have less potential to impact cultural resource sites; therefore, in terms of direct and indirect impacts on documented cultural resource sites (e.g., TLUI, AHRS, RS 2477 trails), Alternative C would have fewer sites affected in areas subject only to standard terms and conditions or TL stipulations than Alternative B.

Six AHRS are in standard terms and conditions/TL areas that are open to leasing and could experience ground-disturbing activities (**Table 3-26**). RS 2477 trail #1649 occurs in these areas. An additional 85 AHRS and 34 TLUI sites are in the NSO area and would have less potential to be affected due to the reduced levels of ground-disturbing activities. RS 2477 trails #914, #1043, and #1649 occur in the NSO area as do the two shipwrecks.

Because Alternative C has a 1-mile pad and CPF exclusion area near the coast, it has a slightly lower likelihood than Alternative B for affecting undocumented cultural resources. Potential impacts on cultural resource sites under Alternative C would be of lower intensity than Alternative B and would be adverse, local (up to 2,000 acres of disturbance and general vicinity), and long term for sites that could not be avoided or would experience indirect effects.

Alternative D

Alternative D would make available the fewest number of acres for potential leasing and development and therefore, in terms of potential direct and indirect impacts on documented cultural resource sites (e.g., TLUI, AHRS, and RS 2477 trails), Alternative D would affect the fewest number of sites. Only one AHRS site is in the areas subject to only standard terms and conditions or TLs that are open to leasing and could experience ground-disturbing activities (**Table 3-26**). An additional 74 AHRS and 30 TLUI sites are in the NSO area and would have less potential to be affected, due to the reduced levels of ground-disturbing activities. All three RS 2477 trails occur in the NSO area, as do the two shipwrecks. Lastly, 15 AHRS sites and 4 TLUI sites are in areas not offered for lease sale and would not experience impacts.

Because Alternative D has the largest setbacks from areas of highest potential for containing undocumented cultural resources, such as rivers and coastline, this alternative would have the lowest likelihood for affecting undocumented resources. Potential impacts on cultural resource sites under Alternative D would be of lower intensity than under Alternative B and would be adverse, local (up to 2,000 acres of disturbance and general vicinity), and long term for sites that could not be avoided or would experience indirect effects.

Cumulative Impacts

Past, present, and reasonably foreseeable future activities, in combination with oil and gas development in the program area, would increase the potential for cultural resource impacts, both directly on specific cultural resource sites and other ethnographic resources such as TCPs and cultural landscapes. Past and present actions that have affected cultural resources are oil and gas development, onshore and offshore transportation and infrastructure projects, increased recreation and tourism, and community development. The proposed oil and gas leasing program, in addition to future activities, could lead to additional oil and gas development and other development and infrastructure projects, in addition to increasing access to otherwise remote areas inside the program area and increasing the risk of damage or unauthorized collection.

Cumulative impacts would have the greatest effect on ethnographic resources, such as TCPs and cultural landscapes, which are less easy to avoid than specific sites, and would mitigate impacts because their significance is tied to historic and present cultural identity. These could be affected by the presence of development. This cultural identity relates to the cultural importance of the land and its surrounding natural resources, such as the Gwich'in and *Iizhik Gwats'an Gwandaii Goodlit*, "The Sacred Place Where Life Begins". The effects of climate change described under *Affected Environment* above, could influence the rate or degree of the potential cumulative impacts.

Alternatives that allow the greatest amount of land to be developed are likely to have the greatest cumulative effect on cultural resources. This is because they could affect a greater number of documented and undocumented cultural resources; thus, Alternative B would have the largest contribution to cumulative effects on cultural resources, while Alternative D would have the smallest contribution to cumulative effects on cultural resources.

3.4.3 Subsistence Uses and Resources

Affected Environment

This section summarizes the relevant subsistence activities of communities that use the program area or the resources that migrate through the program area and are harvested elsewhere. For the purposes of this analysis, there are four primary subsistence study communities: Kaktovik, Nuiqsut, Arctic Village, and

Venetie. They are the closest to the program area and have subsistence uses in or near the program area or rely heavily on resources that use the program area. In addition, because of the importance of the program area to caribou—particularly the PCH and CAH—this section also includes relevant data on subsistence uses of caribou by 22 Alaskan communities, including the four subsistence study communities listed below, in GMU subunits in the PCH and CAH herd ranges, which have Federal Subsistence Board customary and traditional[34] use determinations for caribou (**Map 3-27**, Coastal Plain EIS Subsistence Study Communities, in **Appendix A**). In this EIS, these communities are referred to as the caribou study communities. Many of these communities, such as Fort Yukon, Chalkyitsik, Wiseman, Beaver, Circle, Birch Creek, and Stevens Village, have reported geographic, historic/prehistoric, or cultural ties to the Arctic Refuge as a whole (USFWS 2015a).

Additionally, Gwich'in people, Inuvialuit, and other user groups in Canada have cultural, historical, and subsistence ties to the Arctic Refuge or the PCH or both. According to the Agreement Between the Government of Canada and the Government of the United States of America on the Conservation of the Porcupine Caribou Herd, "when evaluating the environmental consequences of a proposed activity, the Parties will consider and analyze potential impacts, including cumulative impacts, to the Porcupine Caribou Herd, its habitat and affected users of Porcupine Caribou" (Section 3(g)). Canadian uses of the PCH are addressed under the section below, *Subsistence Uses of the CAH and PCH*.

Additional associated information relevant to subsistence is in **Section 3.4.4**, which addresses cultural history, social and political organization, mixed cash/subsistence economy, and belief systems; **Section 3.4.2**, Cultural Resources, addresses prehistory/history, archaeological sites, and traditional land use sites.

Subsistence Definition and Relevant Legislation

Subsistence is a central aspect of rural life and culture and is the cornerstone of the traditional relationship of the indigenous people with their environment. Residents of the study communities rely on subsistence harvests of plant and animal resources both for nutrition and for their cultural, economic, and social well-being. Activities associated with subsistence—processing, sharing, redistribution networks, cooperative and individual hunting, fishing, and gathering, and ceremonial activities—strengthen community and family social ties, reinforce community and individual cultural identity, and provide a link between contemporary Natives and their ancestors. These activities are guided by traditional knowledge, based on a long-standing relationship with the environment. More than just food, subsistence includes economic, social, cultural/traditional, and nutritional elements.

The program area is almost entirely on federal lands managed by the USFWS; Alaska Native allotments comprise about 900 surface acres. In Alaska, subsistence hunting and fishing are regulated under a dual management system by the State of Alaska and the federal government. Subsistence activities on all lands in Alaska, including private lands, are subject to state or federal subsistence regulations. Fish and wildlife harvesting on corporation-owned land being managed by the State. See USFWS (2015a) for a more in-depth discussion of subsistence management in the Arctic Refuge.

[34]Customary and traditional use, based on federal definitions (36 CFR 242.4), means a long-established, consistent pattern of use, incorporating beliefs and customs that have been transmitted from generation to generation. This use plays an important role in the economy of the community. Where the Federal Subsistence Board has made a customary and traditional use determination regarding subsistence use of a specific fish stock or wildlife population (36 CFR 242.24), only those Alaskans who are residents of rural areas or communities designated by the board are eligible for taking of that population or stock on public lands for subsistence uses.

Overview of Subsistence Uses

The following sections provide a brief overview of subsistence uses for the four study communities, in addition to *Subsistence Uses of the PCH and CAH*, below. Additional subsistence data tables are provided in **Appendix M**, and maps are provided in **Appendix A**. Other sources provide additional descriptions of subsistence or contain data that are relevant to subsistence but are not directly comparable to the information in this section, such as reported versus estimated harvests and Native households versus all households. These sources include the USFWS (2015a), which provides a detailed description of subsistence uses in the Arctic Refuge, and the NSB census reports and community plans (e.g., NSB 2015a, 2015b), which includes subsistence data that focus on Native households and selected resources.

Kaktovik

Kaktovik residents are the primary subsistence users of the program area, which crossed much of the community's traditional and contemporary area of subsistence use (**Map 3-28**, Kaktovik Subsistence Use Areas, in **Appendix A**). Kaktovik use areas from the two previous comprehensive all resources mapping studies show overlap with the program area; for the most recent period (1996 to 2006), the data show the greatest amount of overlapping use areas in the program area occurring along the coast, between Beaufort Lagoon and Brownlow Point, and inland around the Sadlerochit, Hulahula, and Jago Rivers. In addition, high levels of overlapping subsistence use areas occur offshore from the program area in the Beaufort Sea. All respondents (38 active harvesters) (SRB&A 2010) reported 1996 to 2006 subsistence uses in the program area.

Kaktovik use areas overlap with the program area for the following resources: terrestrial mammals (including caribou, moose, grizzly bear, and Dall sheep), furbearers and small land mammals, fish, birds (including geese and eiders), vegetation, and marine mammals (including bowhead whale, beluga whale, seal, walrus, and polar bear) (**Map 3-29**, Kaktovik Caribou Subsistence Use Areas in Coastal Plain, through **Map 3-39**, Kaktovik Polar Bear Subsistence Use Areas in Coastal Plain, in **Appendix A**). The primary inland subsistence uses for Kaktovik in the program area are caribou, furbearer, and grizzly bear hunting, in addition to limited moose hunting, vegetation gathering, and fishing in select locations along rivers. The primary coastal subsistence uses that overlap the program area are fishing, harvesting vegetation, and hunting for caribou, geese, eider, and bearded and ringed seals in nearshore areas. Offshore areas are used primarily for hunting bowhead whales, with more limited walrus hunting.

The timing of subsistence activities in Kaktovik is depicted in **Table M-4** in **Appendix M**. Subsistence activity, in terms of the number of resources targeted, is highest during the late summer/fall, when residents hunt bowhead whales in addition to targeting caribou, moose, fish, waterfowl, and plants and berries. April is another busy time, when geese arrive in the area and are harvested along the coast and inland. The fewest resources are targeted from December through February, although some residents pursue inland resources, such as furbearers, moose, caribou, and freshwater fish during this time.

Kaktovik residents access much of their subsistence use along the coast using boats, while inland travel is limited exclusively to four-wheel vehicles along coastal locations in the summer/fall and large overland areas by snowmachine in the winter (**Table M-5** in **Appendix M;** SRB&A 2010). Inland travel during the snow-free months is limited due to restrictions on motorized access in the Arctic Refuge. Residents also walk or use vehicles to access subsistence use areas on Barter Island. The program area, which includes coastal, nearshore, and inland subsistence use areas, is accessed using boats and snowmachines, with some inland travel from the coast by four-wheel vehicles.

As shown in **Table 3-27**, based on years with available data, Kaktovik residents harvest an annual average of 588 pounds of subsistence resources per capita. Marine mammals are the primary resource harvested in terms of edible weight, contributing over 60 percent toward the community's subsistence diet. Large land mammals are the second-most harvested resource by edible weight, followed by fish other than salmon and migratory birds. During most years, the primary subsistence species harvested by Kaktovik residents (**Table M-3** in **Appendix M**) is bowhead whale, caribou, Dolly Varden, Arctic cisco, beluga whale (during some years), bearded and ringed seal, Dall sheep, and moose.

Table 3-27
Selected Kaktovik Harvest and Participation Data, Average Across Available Study Years

Resource Category	Estimated Pounds Per Capita	Percent of Total Harvest	Percentage of Households			
			Using	Attempting to Harvest	Giving	Receiving
All resources	588	100.0	99	92	83	98
Salmon	1	<1	16	5	6	12
Non-salmon fish	57	10.1	87	70	53	72
Large land mammals	176	24.7	97	68	60	93
Small land mammals	1	<1	45	41	21	22
Marine mammals	318	62.7	93	72	61	91
Marine invertebrates	<1	<1	1	1	0	1
Migratory birds	12	1.9	80	63	45	65
Upland game birds	3	<1	80	60	42	47
Bird eggs	<1	<1	9	6	5	6
Vegetation	1	<1	49	38	15	36

Sources: 1985, 1986 (ADFG 2018c); 1992 (Fuller and George 1999); 1992 (Pedersen 1995a); 1994-95 (Brower et al. 2000); 2000-01, 2001-02 (Pedersen and Linn 2005); 2002-03 Bacon et al. 2009); 2007-2012 (Harcharek et al. 2018); 2010-11 (Kofinas et al.2016)

Note: See **Tables M-1, M-2,** and **M-3** in **Appendix M** for data by study year.

Over 90 percent of Kaktovik households participate in one or more subsistence resource harvesting activities, with over two-thirds of households participating in marine mammal hunting, fishing, and large land mammal hunting. Sharing is a central aspect of Kaktovik subsistence. A recent BOEM-funded study on sharing networks documented Kaktovik households giving an average of 3.1 and receiving 4.5 core species (identified by Kofinas et al. [2016] as being harvested in the greatest quantity, having the most cultural importance, and being representative of a range of resources). The study found that during a single year, 176,577 pounds of subsistence foods flowed between Kaktovik households. In addition to food, sharing was in the form of labor, money/equipment, and other contributions. Sharing networks extend across nearly all regions of Alaska and to other states (Kofinas et al. 2016). Sharing not only serves to distribute food throughout a community, but "social relations in the form of cooperation and sharing persist and may act as sources of resilience for community households" (Kofinas et al. 2016); thus, sharing is a crucial part of social structure, social ties, and resiliency in Alaska Native communities.

An analysis of resource importance, based on material (percentage of total harvest) and cultural (percentage of households harvesting and percentage of households receiving), is provided in **Table M-6** in **Appendix M** (see USACE [2012] for a description of the method used). Based on this analysis, resources of major importance in Kaktovik are bearded seal, Bering cisco, bowhead whale, caribou, Dall sheep, Dolly Varden/Arctic char, ptarmigan, and wood.

Nuiqsut

Nuiqsut is west of the program area, where there are limited subsistence uses; however, Nuiqsut residents harvest resources that migrate through the area (**Map 3-40**, Nuiqsut Subsistence Use Areas, in **Appendix A**). For the most part, Nuiqsut subsistence users utilize lands west of the Prudhoe Bay area, although many of the lands in the area were traditionally used by Nuiqsut people. In addition, the community's whaling grounds are based out of Cross Island and whaling sometimes extends offshore of the program area. As shown in **Map 3-41**, Nuiqsut Whales Subsistence Use Areas in Coastal Plain, **Map 3-42**, Nuiqsut Seal Subsistence Use Areas in Coastal Plain, and **Map 3-43**, Nuiqsut Wolf and Wolverine Subsistence Use Areas in Coastal Plain, in **Appendix A**, Nuiqsut use areas overlap the program area for marine mammals (bowhead whale and ringed/bearded seal; three mapping studies) and furbearers (wolf and wolverine; one mapping study).

For the most recent period for which information is available (1995 to 2006), bowhead whale and seal use areas overlap the program area in nearshore areas east of Flaxman Island. Cross Island whaling crews travel this far east during certain years, depending on ice conditions and resource availability. During certain years, whaling crews have reported disturbances in their hunting area from vessel traffic and seismic activity. A wolf and wolverine hunting area, likely reported by a single hunter, was documented extending overland from Nuiqsut's core hunting area and crossing the Sadlerochit, Hulahula, and Jago Rivers. Use areas overlapping the program area were reported by four Nuiqsut respondents (12 percent; SRB&A 2010). Nuiqsut residents harvest caribou primarily from the Teshekpuk Herd and the CAH, which sometimes passes through the program area before heading west toward the Colville River delta.

Data on the timing of Nuiqsut subsistence activities are depicted in **Table M-9** in **Appendix M**. August and September are the peak of hunting and harvesting in Nuiqsut, when residents station whaling crews at Cross Island, hunt moose and caribou, and harvest fish. October/November is a crucial time for subsistence in the community, when residents set nets for Arctic cisco (*qaaktak*) as they run upriver. These *qaaktak* are the same that originate in the Mackenzie River delta and migrate west along the coast, passing by the program area, before arriving at their destination in the Colville River delta.

Winter activities are limited primarily to furbearer and caribou hunting, with some fishing through the ice. Residents travel by snowmachine and boat during the spring to hunt waterfowl and then travel offshore and inland during the summer by boat to hunt seals and caribou, set nets for broad whitefish, fish for grayling and Dolly Varden, and harvest berries. Boats are the most commonly used method of transportation for Nuiqsut subsistence activities, although snowmachines are necessary for inland pursuits, such as wolf and wolverine hunting and geese hunting (**Table M-10** in **Appendix M**). In recent years, all-terrain vehicles and trucks have become more commonly used during the summer and fall, when residents hunt caribou to the west of the community (SRB&A 2017).

As shown in **Table 3-28**, based on years with available data, Nuiqsut residents harvest an annual average of 679 pounds of subsistence resources per capita. Marine mammals, large land mammals, and fish other than salmon contribute nearly equal amounts toward the subsistence harvest, although bowhead whaling success often determines the relative contribution of other resources (**Table 3-28**, and **Table M-7** in **Appendix M**). During most years, the primary subsistence species harvested by Nuiqsut residents (**Table M-8** in **Appendix M**) are bowhead whale, caribou, Arctic cisco, broad whitefish, bearded and ringed seal, white-fronted geese, and moose.

Table 3-28
Selected Nuiqsut Harvest and Participation Data, Average Across Available Study Years

Resource Category	Estimated Pounds per Capita	Percent of Total Harvest	Percentage of Households			
			Using	Attempting to Harvest	Giving	Receiving
All resources	679	100.0	100	95	93	98
Salmon	5	<1	65	43	31	35
Fish other than salmon	209	30.6	97	81	81	79
Large land mammals	224	32.6	96	77	77	78
Small land mammals	<1	<1	45	41	17	12
Marine mammals	226	33.8	97	54	60	97
Migratory birds	13	2.3	85	78	58	52
Upland game birds	2	<1	54	48	36	15
Bird eggs	<1	<1	24	16	8	11
Vegetation	1	<1	61	52	19	33

Sources: 1985 (ADFG 2018c); 1992 (Fuller and George 1999); 1993 (Pedersen 1995b); 1994-95 (Brower and Hepa 1998); 1995-96, 2000-01 (Bacon et al. 2009); 2014 (Brown et al. 2016)

Note: See **Tables M-7** and **M-8** in **Appendix M** for data by study year.

One hundred percent of Nuiqsut households report using subsistence resources, and 95 percent participate in one or more subsistence resource harvesting activities, with over two-thirds of households participating in harvests of fish other than salmon, large land mammals, and migratory birds. Household participation in bowhead whale hunting is relatively limited, due to the substantial distance of the whaling site (Cross Island) from the community and the required absence from the community. Nuiqsut residents consider sharing to be central to their identity; the bowhead whale hunt, in particular, centers on sharing, as evidenced by the 97 percent of households who receive bowhead whale meat annually.

An analysis of resource importance, based on indices of harvest (percentage of total harvest), harvest effort (percentage of households attempting harvests), and sharing (percentage of households receiving), is provided in **Table M-11** in **Appendix M**. Based on this analysis, resources of major importance in Nuiqsut are Arctic cisco, Arctic grayling, bearded seal, bowhead whale, broad whitefish, burbot, caribou, cloudberry, white-fronted geese, and drift wood.

<u>Arctic Village</u>
Arctic Village is south of the program area, on the south side of the Brooks Range, along the East Fork Chandalar River. As shown in **Map 3-44**, Arctic Village and Venetie Subsistence Use Areas, in **Appendix A**, Arctic Village subsistence use areas do not overlap the program area; however, Arctic Village is on the Arctic Refuge boundary, so most subsistence activities do extend into the refuge. Resource uses farthest north toward the program area are sheep and caribou hunting and furbearer harvesting.

Arctic Village and other northern Gwich'in people consider caribou their most important food source and refer to themselves as the caribou people (see **Section 3.4.4**). Caribou from the PCH calve in the program area, and for this reason, it is considered sacred ground to the Gwich'in people (USFWS 2015a). Subsistence harvesting by Arctic Village residents generally occurs on their lands or in the Arctic Refuge south of the program area. Key harvesting locations are Old John Lake, the Chandalar, Sheenjek, Junjik, and Wind rivers, and Red Sheep Creek (USFWS 2015a).

Data on the timing of Arctic Village subsistence activities are depicted in **Table M-14** in **Appendix M**. In terms of the number of resources targeted, the fall and winter are the most active times for subsistence harvesters in Arctic Village. From August through October, residents target a variety of large land mammals, including caribou, moose, and Dall sheep, in addition to fishing and harvesting wood for the upcoming winter. The fall is particularly important for caribou hunting, as residents wait for caribou from the PCH to migrate through their traditional hunting grounds after the PCH has spent the spring and summer on the North Slope, including in the program area (USFWS 2015a). Caribou hunting continues through the winter as caribou are available, and residents also set traps during this time. The spring and summer are primarily dedicated to the harvest of waterfowl and fish.

Data that estimate harvest for the entire community are limited to less complex studies documenting harvests of migratory birds and fish. As shown in **Table 3-29**, based on 3 years of limited data, Arctic Village residents harvested an average of 51 pounds of non-salmon fish per capita, and 6 pounds of migratory birds per capita. Scoters were the most commonly harvested migratory bird, followed by scaup, long-tailed ducks, mallards, and white-fronted geese. Whitefish, particularly humpback whitefish and broad whitefish, contributed the greatest amount to the non-salmon fish harvest, with Arctic grayling and northern pike also contributing substantial amounts (**Table M-13** in **Appendix M**). An average of 70 percent of households use non-salmon fish (**Table 3-29**), and half of Arctic Village households report harvesting fish other than salmon. Forty-six percent reported harvesting migratory birds during the 2000 study year and 87 percent used migratory birds (**Table M-12** in **Appendix M**).

Table 3-29
Selected Arctic Village Harvest and Participation Data, Average Across Available Study Years

Resource Category	Estimated Pounds Per Capita	Percent of Total Harvest	Percentage of Households			
			Using	Attempting to Harvest	Giving	Receiving
Non-salmon fish	51	—	71	—	23	35
Migratory birds	6	—	—	—	—	—

Sources: 2000 (Andersen and Jennings 2001); 2001, 2002 (ADFG 2018c)

Note: See **Tables M-12 and M-13 in Appendix M** for data by study year.

The USFWS (2015a) states that, based on reported harvests alone and not community-wide estimates, moose and caribou comprised more than 90 percent of the harvest by weight during harvest years in the 1990s and early 2000s. These data (e.g., Council of Athabascan Tribal Governments 2002, 2003, 2005) are not estimated for the entire community or have low response rates. Because of this, they are not comparable to the more comprehensive surveys, which report estimated harvests for the community as a whole. These data are not described here;[35] however, the reported percentages demonstrate that moose and caribou are highly important to the subsistence harvest of Arctic Village.

Data to calculate resources of importance for Arctic Village are not available, as there have been no comprehensive household harvest surveys in that community; however, based on existing literature reviews and statements from community members during public scoping and elsewhere, the assumption is that caribou are a resource of primary subsistence, economic, cultural, and spiritual importance for the community of Arctic Village.

[35]ADFG, the primary repository for subsistence harvest data in Alaska, removed these data from their Community Subsistence Information System due to data quality issues.

Venetie

Venetie is south of Arctic Village on the Chandalar River. As shown on **Map 3-44** in **Appendix A**, Venetie subsistence use areas do not overlap the program area. As with Arctic Village and other Gwich'in people, Venetie residents consider caribou to be a primary food source and central to their cultural identity (see **Section 3.4.4**). Subsistence harvesting by Venetie residents generally occurs on tribal lands surrounding their community and surrounding the Chandalar (including the East and Middle Forks), Yukon, Christian, and Hadweenzic Rivers (Caulfield 1983; Van Lanen et al. 2012). Caribou are primarily available to Venetie and Arctic Village residents along the upper Chandalar River drainage and the foothills of the Brooks Range (Van Lanen et al. 2012).

Data on the timing of Venetie subsistence activities are listed in **Table M-18** in **Appendix M**. In terms of the number of resources targeted, the spring and fall are the most active times for subsistence harvesters in Venetie. Fishing and hunting of waterfowl, black and brown bears, and small land mammals (muskrats and ground squirrels) are common activities during April and May; these activities continue through the summer and into the fall. Berries are harvested also during summer and early fall. As with Arctic Village, caribou hunting begins in the fall (generally August), when caribou from the PCH begin their annual migration through northern Gwich'in people's hunting grounds. Residents also hunt moose during the fall and continue to hunt both moose and caribou through the winter, along with trapping furbearers.

Data on subsistence harvests for Venetie are provided in **Tables M-15** through **M-17** in **Appendix M** and in **Table 3-30**, below. Venetie data are limited to one comprehensive study of all subsistence resources for the 2009 study year, in addition to several years of data for migratory birds and land mammals. As shown in **Table 3-30**, based on years with available data, Venetie residents harvest an annual average of 274 pounds of subsistence resources per capita. Large land mammals constitute approximately half of the subsistence harvest in terms of edible pounds. Also important are harvests of salmon, fish other than salmon, and migratory birds (Kofinas et al. 2016).

Table 3-30
Selected Venetie Harvest and Participation Data, Average Across Available Study Years

Resource Category	Estimated Pounds Per Capita	Percent of Total Harvest	Percentage of Households			
			Using	Attempting to Harvest	Giving	Receiving
All Resources	274	100.0	99	86	—	—
Salmon	76	27.8	76	37	—	—
Non-Salmon Fish	25	9.0	81	67	—	—
Large Land Mammals	95	49.6	94	63	—	—
Small Land Mammals	12	4.2	56	44	—	—
Marine Mammals	0	0.0	18	0	—	—
Migratory Birds	27	7.4	79	57	—	—
Upland Game Birds	<1	<1	20	31	—	—
Bird Eggs	—	—	—	—	—	—
Vegetation	5	1.8	67	46	—	—

Sources: 2000 (Andersen and Jennings 2001); 2009 (Kofinas et al. 2016); 2008-09, 2009-10 (Van Lanen et al. 2012), 2010-11 (Stevens and Maracle n.d.)

Note: See **Tables M-15, M-16, M-17** in **Appendix M** for data by study year.

The primary subsistence species for Venetie residents are moose, caribou, chum and chinook salmon, grayling, geese, and whitefish. Ninety-nine percent of Venetie households report using subsistence resources, and 86 percent participate in subsistence activities. Over half of the households participate in harvests of large land mammals, fish other than salmon, and migratory birds. A recent BOEM-funded study documented Venetie sharing networks extending throughout the state, but with a focus on nearby interior communities, such as Arctic Village, Fort Yukon, Eagle, Chalkyitsik, Stevens Village, Beaver, and Birch Creek. Venetie residents also have sharing networks with multiple North Slope communities, including Utqiaġvik, Nuiqsut, and Anaktuvuk Pass (Kofinas et al. 2016). The study notes the importance of the close kinship ties between Venetie and Arctic Village as a source of resiliency, as caribou harvested in Arctic Village are often shared with Venetie, sometimes in exchange for resources, such as salmon, which are less available in Arctic Village (Kofinas et al. 2016). The importance of caribou in Venetie sharing networks is evidenced by the 22,445 pounds of caribou that flowed between households (nearly half of all subsistence food flows).

An analysis of resource importance, based on harvest (percentage of total harvest), harvest effort (percentage of households attempting harvests), and sharing (percentage of households receiving), is provided in **Table M-19** in **Appendix M**. Based on this analysis, resources of major importance in Venetie are Arctic grayling, caribou, chinook salmon, chum salmon, and moose.

Subsistence Uses of the PCH and CAH

Harvest and sharing patterns of 22 Alaskan communities and seven Canadian user groups are relevant if post-lease oil and gas activities changes caribou resource availability or abundance for those users. **Map 3-27** in **Appendix A** shows the location of the 22 caribou study communities and communities associated with the seven Canadian user groups. **Table M-20** in **Appendix M** provides caribou use and harvest data for all of the 22 Alaskan caribou study communities, along with data averages for each study community across all available study years. The 22 Alaskan communities have documented customary and traditional uses for caribou in GMU subunits that are in the ranges of the CAH and PCH. **Table M-21** in **Appendix M** provides caribou harvest data for the following seven Canadian user groups of the PCH: Inuvialuit (Aklavik, Inuvik, and Tuktoyaktuk), Northwest Territory (NWT) Gwich'in people (Aklavik, Inuvik, Fort McPherson [*Tetlit Zheh*], and Tsiigehtchic), Vuntut Gwich'in people (Old Crow), Tr'ondek Hwech'in (Dawson City), Nacho Nyak Dun (Mayo), and other residents living in the Yukon Territory and the NWT.

With few exceptions, use of caribou among the 22 Alaskan study communities is high; over 50 percent of households in Bettles, Eagle, Evansville, Allakaket, Venetie, Coldfoot, Wiseman, Alatna, Utqiaġvik. Anaktuvuk Pass, Point Lay, Kaktovik, Atqasuk, Nuiqsut, and Wainwright use caribou. Less than 5 percent of households in Stevens Village, Beaver, and Chalkyitsik have reported using caribou during years when data are available. The contribution of caribou toward the total subsistence harvest is highest in the communities of Anaktuvuk Pass (84 percent) and Coldfoot (85.3 percent) and lowest in the communities of Fort Yukon (2.5 percent) and Evansville (4.9 percent). Four communities reported zero harvests of caribou during available study years: Birch Creek, Stevens Village, Beaver, and Chalkyitsik. Caribou sharing ranges widely, with 0 percent receiving caribou in Beaver and Chalkyitsik during reported study years; between 8 and 28 percent of households receiving caribou in Stevens Village, Wiseman, Birch Creek, and Fort Yukon; and at least 30 percent of households receiving caribou in the remaining study communities.

According to recent data on PCH harvests by Canadian user groups (**Table M-21** in **Appendix M**), the NWT Gwich'in people, the Vuntut Gwich'in people, and the Invialuit are the primary users of the PCH in terms of number of caribou harvested. These data primarily represent a minimum count of actual harvest (whereas the data for Alaska communities are estimated for the community as a whole). Furthermore, variability in herd distribution affects the harvest, and harvests in the 2010s have not been as high as they were in the 2000s due to migratory variability.[36] The most recent data that compare PCH harvests between the US and Canada from 1992 to 1994 (the last time that harvest data were compiled for PCH user groups in Alaska and Canada) indicate that Canadian users accounted for 85 percent of the harvest, and Alaska users were 15 percent of the harvest (**Figure 3-7**, Average Portion of Harvest of Porcupine Caribou Herd Between the US and Canada (1992-1994), in **Appendix A**). The NWT Gwich'in people accounted for 45 percent of all PCH harvests, followed by Inuvialuit (20 percent), Yukon Territory First Nations (13 percent), Alaska Native (12 percent), and the remaining 10 percent split among Yukon Territory and Alaska residents/non-residents (**Figure 3-7** in **Appendix A**); thus, most of the PCH harvest occurs in Canada.

Climate Change

The changing climate within the program area could affect the availability of subsistence resources and user access to harvesting areas. Changes in the predictability of weather conditions, such as the timing of freeze-up and breakup, snowfall, storms and winds, and ice conditions, can prevent individuals from traveling to subsistence use areas. This would be the case when resources are present in those areas or when there are greater risks to safety when travel conditions are not ideal. Additionally, changes in resource abundance resulting from climate change could contribute to changes in resource availability caused by development in and around the program area, thus further reducing their availability to subsistence users.

Direct and Indirect Impacts

Issuance of oil and gas leases under the directives of Section 20001(c)(1) of PL 115-97 would have no direct impacts on the environment because by itself a lease does not authorize any on the ground oil and gas activities; however, a lease does grant the lessee certain rights to drill for and extract oil and gas subject to further environmental review and reasonable regulation, including applicable laws, terms, conditions, and stipulations of the lease. The impacts of such future exploration and development activities that may occur because of the issuance of leases are considered potential indirect impacts of leasing. Such post-lease activities could include seismic and drilling exploration, development, and transportation of oil and gas in and from the Coastal Plain. Therefore, the analysis is of potential direct and indirect impacts on subsistence uses and resources from on-the-ground post-lease activities.

Included in the discussion below are potential impacts on user access (resulting from legal or physical barriers), resource availability (resulting from resource migration, distribution, or health), and resource abundance (resulting from overall population changes), which, following BLM Alaska guidance (Instruction Memorandum No. AK-2011-008), are the three impact categories that must be addressed to inform the ANILCA Section 810 preliminary evaluation (see **Appendix E**). Common types of direct and indirect effects associated with oil and gas development in the program area include changes in subsistence use areas, harvest success, harvest amounts, participation, costs and time, competition, culture, and access (both physical and legal barriers and user avoidance). The hypothetical development scenario is used to inform the analysis of impacts for each alternative, but future analyses would occur with site-specific proposals. The effects of climate change described under *Affected Environment* above, could influence the rate or degree of the potential direct and indirect impacts.

[36]Suitor, Mike. Personal communication. Email from Mike Suitor, Regional Biologist, Environment Yukon to Paul Lawrence, SRB&A on September 27, 2018 regarding Porcupine Caribou Herd harvests in Canada.

Alternative A

Under Alternative A, no oil and gas leasing would take place in the program area, so subsistence uses among the Iñupiaq and Gwich'in peoples would be unaffected by oil and gas development in the Coastal Plain. Existing impacts on subsistence would continue, including oil and gas development to the west of the program area, increased vessel traffic in the Beaufort Sea, infrastructure and transportation projects, environmental and biological changes affecting subsistence resources, changes in land status, and hunting and fishing regulations.

Impacts Common to All Action Alternatives

This section discusses potential impacts on the subsistence uses and resources from post-lease activities that are common to all alternatives. The primary factors which may result in impacts on subsistence resources and uses include: 1) noise, traffic, and human activity, 2) infrastructure (including physical barriers), 3) contamination, 4) legal or regulatory barriers, and 5) increased employment or income/revenue. These factors could affect resource availability, resource abundance, and user access for residents of the study communities. Short-term, or lasting less than 5 years, does not necessarily reflect the level of impact on subsistence uses; an impact lasting 4 years, for example, could have a large effect on subsistence uses.

In all cases, future development would affect subsistence uses of resources of major importance for the subsistence study communities (see **Tables M-6, M-11,** and **M-19** in **Appendix M**). As described in *Affected Environment* above, Kaktovik is the primary user of the program area and would therefore be most likely to experience direct impacts associated with development. Nuiqsut could experience potential direct and indirect impacts on harvesting marine mammals, such as bowhead whale, and indirect impacts associated with the harvests of caribou, waterfowl, and fish. Arctic Village, Venetie, and other communities that use the PCH and CAH herds, have the potential to experience indirect impacts associated with caribou and, to a lesser extent, waterfowl.

In the case of the 22 Alaskan caribou study communities and seven Canadian user groups (**Table M-20** and **M-21** in **Appendix M**), those with a greater reliance on caribou would be more likely to experience potential indirect impacts related to caribou abundance or availability. Alaskan communities with the greatest reliance, that is those where caribou accounts for greater than 10 percent of the annual subsistence harvest, on average, and over 50 percent of households use the resource, are Alatna, Anaktuvuk Pass, Utqiaġvik, Bettles, Coldfoot, Eagle, Kaktovik, Nuiqsut, Point Lay, Venetie, Wainwright, and Wiseman. In Allakaket, Atqasuk, and Evansville, caribou accounts for less than 10 percent (or data are not available), but over 50 percent of households use caribou (**Table M-20** in **Appendix M**). In addition, as noted under *Subsistence Uses of the CAH and PCH*, above, approximately 85 percent of the PCH harvest occurs in Canada; the NWT Gwich'in people, Vuntut Gwich'in people, and Inuvialuit are the primary Canadian users in terms of number harvested (**Figure 3-7** in **Appendix A**).

Potential impacts, particularly those relating to changes in calving distribution and calf survival, are expected to be more intense for the PCH because of their lack of previous exposure to oil field development (see **Section 3.3.4**). Among Alaskan communities, Kaktovik, Venetie, and Eagle are in GMU subunits overlapping the PCH herd and have a high reliance on caribou; however, a portion of Eagle harvests likely come from the Fortymile Caribou Herd; therefore, caribou study communities most likely to experience impacts from the leasing program include the communities of Kaktovik and Venetie (ADFG 2018b). In addition, Arctic Village, although lacking harvest data, would also be most likely to experience impacts due to their proximity and reported reliance on the PCH. Compared with these three Alaskan communities, uses of PCH caribou (in terms of number harvested) by the NWT Gwich'in people, Vuntut Gwich'in people, and Inuvialuit user groups are comparable or higher, and communities associated with these user groups—Old Crow, Aklavik, and Fort McPherson—are in the PCH range (**Map 3-27** in **Appendix A**); thus, these Canadian communities would be among the most likely to experience potential indirect impacts due to their proximity to and reliance on the PCH.

Noise, Traffic, and Human Activity

Noise, traffic, and human activity associated with post-leasing oil and gas activities would result from construction, gravel mining, air, vessel, and ground traffic, seismic activity, drilling, and human presence. Noise, traffic (both ground and air), and human activity can cause both direct and indirect impacts on subsistence users. Impacts related to noise and traffic have been a primary concern reported by subsistence harvesters on the North Slope and elsewhere. Noise and traffic associated with the leasing program could potentially affect the availability of resources, such as caribou, marine mammals, furbearers, and small land mammals, fish, and migratory birds. While most impacts related to noise and traffic would be local, occurring in areas where Kaktovik subsistence use areas overlap with action areas, certain impacts, particularly those related to caribou migration, could extend outside the program area and would be regional.

According to traditional knowledge of North Slope Iñupiat, furbearers, caribou, and marine mammals are particularly sensitive to noise and human activity (SRB&A 2017, 2009a). Potential impacts on caribou availability include displacement of caribou from areas of heavy oil and gas activity, diversion of caribou from their usual migratory routes, and skittish behavior, which results in reduced harvest opportunities (SRB&A 2017).

Air traffic—particularly helicopter traffic—has been the most commonly reported impact on caribou hunting by Nuiqsut harvesters since the Nuiqsut Caribou Subsistence Monitoring Project began in 2009. Residents note that air traffic can cause skittish behavior in caribou, either causing them to stay inland from riversides or diverting them from their usual migration and crossing routes (see **Section 3.3.4**); such potential impacts could occur for Kaktovik harvesters as they travel along the coast by boat or inland by snowmachine looking for caribou. Ground traffic has also been observed diverting or delaying caribou movement across roads, and biological research have shown caribou, especially cows with calves, avoiding roads and other areas of human activity (see **Section 3.3.4**).

These responses may be more likely for PCH caribou, as they have had less exposure to development than the CAH. If development causes large-scale displacement from PCH calving grounds, then the herd could experience a decline in calf survival and stagnant herd growth. In addition to large land mammals, furbearers, such as wolf and wolverine, may avoid areas of heavy traffic, drilling noise, seismic testing, and other activity. ROPs 36, 37, and 39, associated with subsistence consultation for permitted activities, would require consultation with potentially affected communities regarding the timing, siting, and methods of development, including seismic activities. ROP 34 places restrictions on the timing, location, and altitude of aircraft, in addition to requiring consultation with subsistence users, which would help reduce air traffic-related impacts.

Impacts on marine mammals from noise and traffic have also been reported by whaling crews and marine mammal hunters in Kaktovik and Nuiqsut (SRB&A 2009a); biological science also shows that marine mammals are sensitive to such disturbance. As noted in the *Affected Environment* discussion, Kaktovik whaling crews hunt offshore from the program area, and Nuiqsut whaling crews hunt to the west of the program area from Cross Island, sometimes hunting in areas offshore from the program area.

Whaling crews have reported skittish behavior in bowhead whales and other marine mammals during times of heavy air and vessel traffic and seismic exploration. Such activity can divert bowhead whales farther from shore or cause unpredictable behaviors, resulting in greater risks to hunter safety (SRB&A 2009a; Galginaitis 2014). If CAAs between industry and the Alaska Eskimo Whaling Commission continue in relation to the proposed oil and gas leasing program, then impacts on whaling from the leasing program are unlikely; however, not all vessel traffic, such as that from barging not associated with oil and gas development, is subject to CAAs, so impacts from shipping and other activity could occur even with a CAA in place. CAAs are generally considered an effective measure by whaling crews, industry, and agencies (SRB&A 2013). ROP 46 provides a number of restrictions to marine vessel traffic and associated activities when in the vicinity of whales, walruses, polar bears, and seals in addition to restrictions near important habitat areas. It also would help reduce potential conflicts with subsistence users, resources, and offshore activities. Because seismic exploration would be limited to the winter, impacts on marine mammal harvesting from seismic testing would be unlikely.

Noise and traffic associated with future oil and gas development would also potentially disturb subsistence resources, such as birds and fish, and could cause temporary reductions in harvesting success for Kaktovik harvesters; however, most displacement would be temporary and would not change the overall population levels (**Section 3.3.2** and **Section 3.3.3**). Potential impacts of noise on fish would be relatively limited, as most impact sources, such as seismic activity and pile driving, would occur during the winter. Disturbances to birds and fish have been reported by Nuiqsut harvesters as a result of the Alpine Satellite Development Plan and other developments; however, such disturbances have not resulted in overall reductions in harvests of these resources over time (SRB&A 2009a) (see **Section M.2** in **Appendix M**). ROPs 14 and 16 would address some disturbances to fish habitat from seismic activity and exploratory drilling.

The above impacts on resource availability may be considered localized from a biological standpoint; however, small localized changes can have larger impacts on subsistence harvesters when resources are not present in traditional hunting areas at the expected times and in adequate abundance. Residents may experience reduced harvest success, increased costs and time, and increased safety risks if resources are less available.

While potential impacts on resource availability related to noise and traffic are most likely to be local in extent, such as for Kaktovik or Nuiqsut residents who use the program area, more widespread changes in migration or abundance resulting from noise and traffic and infrastructure (see discussion below) could cause regional impacts extending outside the program area to other communities, such as the Gwich'in peoples communities of Arctic Village and Venetie and the Gwich'in and Inuvialuit user groups in Canada. Residents of these communities harvest from the PCH and CAH (see **Table M-20** in **Appendix M**). In addition, reduced harvests by Kaktovik residents could disrupt existing sharing networks to other communities and regions if residents are unable to share as widely or frequently as they are accustomed to.

In addition to affecting resource availability, future noise, traffic, and human activity may also affect user access by deterring subsistence users from their usual harvesting areas. Avoidance of subsistence use areas due to development has been documented in Nuiqsut (SRB&A 2017) and would likely occur for some Kaktovik harvesters if development occurs in their harvesting area. Residents may experience discomfort hunting in the presence of outsiders; may avoid hunting near areas of high air or ground traffic because of a perceived or actual reduction in the availability of subsistence resources; may avoid hunting near human activity due to safety concerns; or may consider noise pollution and increased human activity to degrade the subsistence experience.

Infrastructure

Infrastructure associated with the leasing program could include future gravel and ice roads, pipelines, gravel pads, bridges, gravel mines, and runways. While most potential impacts related to infrastructure would be site-specific or local, occurring in and around action areas, certain impacts—particularly those related to caribou migration and abundance—could extend outside the program area and would be regional.

Infrastructure could cause loss of subsistence use areas due to direct overlap (**Map 3-45**, Kaktovik Subsistence Use Areas and Areas of Hydrocarbon Potential, in **Appendix A**). Much of the coastline in the area of high HCP shows high overlapping use by the community of Kaktovik for subsistence purposes, particularly for caribou, fish, and waterfowl (**Map 3-29**, **Map 3-33**, Kaktovik Fish Subsistence Use Areas in Coastal Plain, and **Map 3-34**, Kaktovik Bird Subsistence Use Areas in Coastal Plain, in **Appendix A**).

While actual infrastructure would be limited to a smaller proportion of the overall development area, areas excluded from subsistence use would likely be greater than the actual footprint, either due to avoidance or security and firearm restrictions. Up to 50 percent of harvesters may avoid development activities or infrastructure at one time or another over the period of development (SRB&A 2017). If future development extends into areas of medium and low potential for oil and gas development, as is expected, associated infrastructure could extend throughout areas of high overlapping use for the community of Kaktovik and could present a barrier (either perceived or actual) between the community and more highly used inland hunting areas for caribou, wolf/wolverine, moose, Dall sheep, and fish (**Map 3-29** through **Map 3-33** in **Appendix A**).

Infrastructure would pose physical obstructions to subsistence users if roads and pipelines are not designed to account for overland hunter travel, or if bridges and causeways obstruct travel along rivers or coastlines. Some residents in Nuiqsut have reported difficulty safely crossing certain gravel roads with snowmachines or four-wheel vehicles due to the steep side slopes (SRB&A 2017).

Kaktovik hunters frequently travel by boat to the west and east of the community, searching for caribou as they congregate along the coast during the insect relief season. Pipelines in coastal areas could cause physical obstructions for these individuals; residents may be unable to shoot inland or may have to expend extra effort accessing suitable use areas if pipelines are situated too close to the coast. As noted in USACE 2012, such impacts would be particularly likely if pipelines are within 1 or 2 miles of the coast. Increased use of roads or changes in travel routes due to the presence of infrastructure could increase the likelihood of injuries and accidents for Kaktovik harvesters (see **Section 3.4.11**, Public Health). ROPs 18, 20, 21 and 23 would minimize potential direct obstructions to subsistence uses from infrastructure; however, impacts on access may still occur due to some harvesters avoiding industry.

If Kaktovik residents have easy access to roads associated with the oil and gas leasing program, it is likely that some would use the roads to access subsistence harvesting areas, when overland snowmachine travel is difficult and for residents who do not have access to overland modes of travel, such as snowmachines and four-wheel vehicles. Use of these roads would be less likely or frequent if the roads are not connected to the community of Kaktovik or are connected only seasonally via ice roads.

The use of future program roads for subsistence activities can introduce effects on subsistence users; examples are facilitating access to areas at times when access is difficult, providing access for community residents who do not own snowmachines, four-wheelers, or boats, and allowing residents to access resources when they are unavailable closer to the community. Impacts include increased competition between community residents along newly introduced hunting corridors and the deflection of caribou from areas closer to the community because of traffic and hunting along the road (SRB&A 2017). If roads, such as the Dalton Highway, connect to the road system and facilitate access by non-local hunters, then residents could experience increased competition from outsiders hunting in traditional subsistence use areas. ROP 38 would prohibit hunting and trapping by lessees, operators, and contractors when persons are on work status; however, this would not apply once workers' shifts end and they return to a public airport or community, such as Kaktovik or Deadhorse.

Similar to noise, traffic, and human activity, infrastructure could also affect the availability of certain resources through changes in resource abundance, migration/distribution, and behavior. Infrastructure would be most likely to affect migratory terrestrial resources, particularly caribou, but could also affect furbearers, waterfowl, and fish. Infrastructure could divert or impede caribou movement, displace waterfowl from nesting and other habitat, and displace fish from nearshore or riverine habitats, at least temporarily.

Studies on the North Slope show that caribou distribution, especially cows with calves, changes around transportation corridors, and that a percentage of caribou (approximately 30 percent) are influenced in their movement by the presence of roads (NRC 2003; Wilson et al. 2016). Future development in the areas of high, medium, and low oil and gas potential could present obstacles to caribou migrating from inland areas to the coast, where many Kaktovik residents hunt them. While infrastructure is not expected to divert caribou migration altogether, linear features occurring perpendicular to migratory routes could slow caribou movement through the area, resulting in changes in the herd/group sizes and timing of their availability along the coast (NRC 2003; Wilson et al. 2016) (see **Section 3.3.4**). Road avoidance is particularly likely during times of high human activity, including ground vehicle use.

Future oil and gas infrastructure in the program area is expected to result in long-term loss and alteration of bird habitat; however, these changes are not expected to cause overall changes in bird populations (**Section 3.3.3**). Infrastructure could affect fish habitat by causing habitat loss, increased turbidity from dust and gravel spray, reduced fish passage, and reduced water quantity (**Section 3.3.2**).

According to **Section 3.3.4**, future oil and gas infrastructure in the program area, particularly in the PCH calving grounds, could cause a shift in calving distribution during some years, which would likely reduce calf survival and halt herd growth. To the extent that calving grounds are disturbed by oil and gas development, PCH calf survival and herd numbers could be reduced. An overall reduction in the PCH could also affect harvest success among Iñupiaq, the Gwich'in people, and Inuvialuit caribou hunters.

According to the Gwich'in people's knowledge, any development in the program area would have devastating effects on the population of the PCH and other resources, such as migratory birds, that have key habitat in the coastal plain. In addition, there are those among the Iñupiat who report similar knowledge regarding the effects of ACP development (BLM 2018c, 2018d, 2018e, 2018f). These concerns are based on Alaska Native observations of the sensitivity of resources to development and change, in addition to traditional knowledge that has been passed on through generations.

Contamination

Real or perceived contamination, including contamination from oil spills and air pollution, could affect resource availability and user access. If an oil spill causes reduced abundance or reduced health of certain resources, then they could become less available to the subsistence users.

Potential impacts on resources from oil spills would occur for marine and riverine resources such as fish, seals, and bowhead whales, in addition to bird and terrestrial resources that frequent riverine and marine areas. Small spills in the program area or air contamination (either real or perceived) could also cause subsistence users to avoid harvesting certain resources, particularly near development areas. This could have potential indirect effects on human health through reduced consumption of nutritional foods (**Section 3.4.11**).

Potential impacts from contamination are most likely to occur for Kaktovik residents and would be local; however, in the event of a large-scale oil spill or other contamination event, subsistence users who harvest resources that use or pass through the development area—such as those from Nuiqsut, Arctic Village, and Venetie—may also experience reduced resource availability. This would be due to physical contamination or avoidance of resources from the perception that resources are contaminated; thus, impacts related to contamination would be of local to regional context. Monitoring air quality and contaminants in subsistence foods (ROPs 6 and 7) and comprehensive waste management plans (ROP 2) would help address subsistence user concerns related to contaminants and would help to identify potential human health issues.

Legal or Regulatory Barriers

Legal or regulatory barriers—including restrictions on access and firearm discharge near oil and gas facilities—would reduce user access and resource availability in traditional use areas. Hunters would likely be subject to certain restrictions regarding discharging firearms near pipelines, roads, and other facilities. Depending on the parameters of such restrictions, such as the distance at which a firearm can be discharged, subsistence users may potentially have difficulty hunting in certain areas, particularly where pipelines or roads parallel the coast.

Miscommunication surrounding rules and restrictions around future oil and gas facilities, as has been documented in the case of Nuiqsut (SRB&A 2017), may dissuade residents from accessing development areas. Impacts related to legal or regulatory barriers are most likely to occur for Kaktovik and would be of local extent; however, whaling crews from Nuiqsut could experience impacts when hunting offshore of the program area. Lease Stipulation 11 would require consultation with the community of Kaktovik to develop a subsistence access plan.

Employment and Revenue

Increased employment and revenue related to future oil and gas development could have potential positive and negative impacts on subsistence uses in affected communities. Increased income from employment and corporation dividends would likely be put to use in supporting subsistence activities through the purchase of faster and more efficient equipment and technologies and through supporting super-harvester households[37] in the community. Data on Kaktovik and Venetie show that community engagement in subsistence activities has remained strong, alongside significant social and economic changes over the past several decades, such as higher household incomes (Kofinas et al. 2016).

[37]Households with an abundance of able-bodied labor who are able to become the centers of subsistence production and distribution for a community.

Despite the relative persistence of subsistence harvesting, data also show a relatively high percentage of households that report low food security (40 percent in Kaktovik and 34 percent in Venetie), which showed no correlation with household income or harvest levels. In terms of harvest and income levels, there is a great diversity among village households, from high income/high harvest to low income/low harvest. These households show different levels of social connections, such as sharing ties, depending on harvest and income levels; thus, certain households may be less able to adapt to changing conditions and may be more vulnerable than others (Kofinas et al. 2016). Social connections are an important mitigation in the absence of household assets, such as income and harvest equipment, through sharing and cooperation; disruption of social connections could thus increase vulnerability in communities.

A potential increase in employment could cause a shift in subsistence roles in the community, as employed individuals may have less time to engage in subsistence activities (see **Section 3.4.4**). These potential impacts would be most likely to occur for Kaktovik (see **Section 3.4.10**, Economy), which is most likely among North Slope villages to see an increase in employment and income from the proposed oil and gas leasing program; however, increased income resulting from ASRC and village corporation dividends could extend throughout the North Slope and would therefore be of regional context.

<u>General Development and Culture</u>

Overall, future development in the program area could have lasting effects on cultural practices, values, and beliefs through its impacts on subsistence. The potential impacts of development could result in reduced harvests, changes in uses of traditional lands, and decreased community participation in subsistence harvesting, processing, sharing, and associated rituals and feasts. Because of this, communities could experience a loss of cultural and individual identity associated with subsistence, a loss of traditional knowledge about the land, damaged social and kinship ties, and effects on spirituality associated with degradation of the Alaska coastal plain. These are key concerns that were reported by the Iñupiaq and Gwich'in people during public scoping meetings associated with the oil and gas leasing program (BLM 2018c, 2018d, 2018e, 2018f).

The various impacts on subsistence from development can weaken social cohesion over time through reduced participation in subsistence activities, including hunting, processing, and sharing. See **Section 3.4.4** for a discussion of potential effects related to social cohesion. ROP 40 would require cultural training for oil and gas personnel on environmental, social, traditional, and cultural concerns. Proper education may reduce the potential for conflicts between subsistence users and visiting workers.

Alternative B

Under Alternative B, the types of potential impacts on subsistence uses and resources would be the same as those described under *Impacts Common to All Action Alternatives*, above. The duration of all types of impacts would be long term, although certain specific impacts, such as those from seismic activity and construction noise, would occur only during the exploration and construction phases of individual development plans.

Potential direct impacts on resource availability, resource abundance, and user access from noise, traffic, and human activity, infrastructure, contamination, and legal or regulatory barriers would occur primarily for Kaktovik residents who use the program area. Potential indirect impacts on resource availability and resource abundance resulting from noise, traffic, and human activity, infrastructure, and contamination could extend outside the program area to other communities, such as Nuiqsut, Arctic Village, Venetie, and other Alaskan and Canadian communities that harvest from the PCH and CAH (**Table M-20** in

Appendix M). Changes in user access related to an increase in employment rates or income, including decreased time to engage in subsistence activities and increased income with which to support subsistence activities, are most likely for the community of Kaktovik; however, these changes could extend to other communities on the North Slope.

Because of its proximity to the program area and the high potential for development in areas of high overlapping use, the community of Kaktovik would experience the greatest intensity of potential effects associated with the proposed oil and gas leasing program. Impacts on subsistence resources and uses may also occur for other communities if oil and gas development in the program area results in changes to resource abundance or availability, particularly caribou, which is a resource of major importance to the communities of Kaktovik, Nuiqsut, Arctic Village, and Venetie (see **Tables M-6, M-11, and M-19** in **Appendix M**). Under Alternative B, 721,200 acres of calving habitat would be available for leasing, which would result in the greatest potential impact on calf survival and overall herd numbers. In addition, Alternative B would include 0.5- to 1-mile setbacks, with no permanent oil and gas infrastructure, including roads and pipelines, allowed, for 10 major rivers. Many of these rivers, such as the Hulahula, Okpilak, and Jago, are key drainages used for subsistence activities. Alternative B may include roadless developments for some of the CPFs and construction of associated airstrips, which would likely result in higher levels of air traffic, compared with roaded developments. Some timing and other restrictions on oil and gas activity (see Lease Stipulation 7 and ROP 23 and 34) would be in place for calving and post-calving habitats of the PCH, which could reduce impacts on resource abundance and availability. Coastal waters, lagoons, and barrier islands would be subject to NSO, which would minimize potential impacts on coastal hunters.

Alternative C

The types of potential impacts under Alternative C would be the same as those described under Alternative B but of lower intensity. Under Alternative C, fewer acres overlapping PCH calving grounds would be available for lease, most (606,200) acres of PCH primary calving habitat would be subject to NSO, 985,500 acres of post-calving habitat would be subject to TLs restricting road traffic, and pads and CPFs would not be allowed within 1 mile of the coast, although essential pipelines and roads may still occur. Alternative C would include greater setbacks (2 miles) along the Canning, Hulahula, and Okpilak Rivers. In addition, Alternative C would impose greater TLs on human activity in the PCH post-calving habitat area than Alternative B. Demographics impacts on the PCH would be less likely than Alternative B; therefore, the intensity of potential subsistence impacts under Alternative C would be less than under Alternative B.

Alternative D

The types of potential impacts under Alternative D would be the same as those described under Alternative B; however, the intensity of subsistence impacts would be substantially less under Alternative D. Less than half of the calving ground acres offered for sale under Alternative B would be offered for sale under Alternative D, and more lands would be subject to NSO lease stipulations or not made available for lease. As a result, Alternative D would be the least likely to affect calf survival and overall herd numbers of all action alternatives.

Alternative D also includes greater setbacks from key subsistence drainages, compared with Alternative B, including 4 miles for the Hulahula River and 3 miles for the Okpilak River, which would greatly reduce impacts on subsistence in those areas, particularly during the winter. Under Alternative D, no pads or CPFs would be allowed within 2 miles of the coast, reducing potential impacts on coastal subsistence hunters and fishers. Any development in coastal areas would be subject to NSO and various TLs and consultation requirements (Lease Stipulation 4). In addition, reclamation of infrastructure would be on ongoing process for each development area, thus lessening the duration of impacts for individual developments related to infrastructure.

Alternative D would require greater design features meant to address impacts on subsistence resources and users and greater consultation with tribal governments on design features, timing, development methods, and access. Alternative D2 would be somewhat less likely to affect subsistence uses and resources, when compared with Alternative D1, because of increased TLs in caribou summer habitat under Alternative D2 (Lease Stipulation 6).

Cumulative Impacts

Past and present actions that have affected subsistence uses and resources include oil and gas development, transportation and infrastructure projects, scientific research, recreation and tourism, government hunting and harvesting regulations, and improved technologies and modernization. Oil and gas development in the program area, in combination with past, present, and reasonably foreseeable activities, would lead to additional impacts on subsistence resources and uses, including impacts on user access, resource availability, and resource abundance. This would ultimately lead to reduced harvesting opportunities and reduced participation in subsistence activities.

Increased infrastructure and activity in and around the program area and in offshore areas could contribute to a feeling of being boxed in by development, particularly for Kaktovik. Concerns to this effect have been reported as early as the 1980s, when some Kaktovik hunters indicated they no longer approach or cross the Canning River because of oil and gas activity to the west of it (Impact Assessment Inc. 1990a). The overall area available for subsistence use would likely shrink over time due to the increasing presence of infrastructure and human activity in traditional use areas. While Kaktovik hunters would adapt, to varying extents, to the changes occurring around them and may continue to harvest resources at adequate levels, their connection to certain traditional areas may decrease over time.

Increased development around Nuiqsut, including development in the program area, could also contribute to existing concerns about being surrounded by development and losing connections to traditional harvesting areas (SRB&A 2017, 2009a). The shifting of subsistence use areas away from oil and gas development would likely continue and result in long-term changes in subsistence use patterns. In addition, the increased existence of road corridors in traditional use areas could shift how residents access subsistence harvesting areas, such as via roads, but could also affect resource availability, particularly for those who choose not to use roads. Such changes have been documented elsewhere in Alaska (SRB&A 2007, 2009b).

Future development of the program area would lead to further expansion of the developed area on the North Slope, increasing the area accessible by outsiders, including non-local hunters, who could increase competition for locals, and resulting in higher levels of oil and gas activity; examples are vessel, ground, and air traffic, seismic activity, gravel mining and blasting, and drilling. Other similar activities, including shipping activity not subject to CAAs and research-related air traffic, would also continue and be additive to oil and gas related disturbances. Harvesters may adapt to such changes by increasing the amount of effort and time spent on the land, investing in more efficient means of travel, and shifting to new subsistence areas in an effort to increase harvest success rates. Increased income, primarily expected to occur for Iñupiaq residents, could help offset some of these impacts by providing cash with which to purchase fuel, equipment, and supplies for subsistence pursuits.

Nuiqsut residents have shown adaptability to the changes around them and continue to harvest subsistence resources at rates similar to before; however, despite continued harvests, residents stress that the frequent disturbances to subsistence activities, loss of connection to traditional use areas resulting from oil and gas infrastructure, and increased time and effort spent by harvesters continue to affect their overall subsistence way of life (SRB&A 2017). If changes in resource availability occur on a larger scale, such as changes in migration or overall abundance of the PCH, then communities farther away, particularly those not experiencing increased economic activity and revenues from the increased development, such as Arctic Village, Venetie, and Canadian user groups, could experience greater net impacts on subsistence. As noted in Kofinas et al. (2016) a total loss of caribou harvests would represent a 31 percent decline in subsistence foods for Venetie and a 32 percent decline for Kaktovik. Such a scenario would cause a severe disruption in social ties and cohesion for the study communities.

Cumulative impacts on subsistence could alter subsistence use areas, user access, and resource availability for Iñupiaq, Gwich'in people, and Inuvialuit subsistence users. Over time, changes in how residents access and use the land and reduced opportunities for participation in subsistence harvesting, processing, distribution, and celebrations resulting from decreased harvests, could have potential negative effects on culture by weakening social ties and knowledge of cultural traditions.

Thus far, communities on the North Slope have adapted to the changes occurring around them and maintained a strong subsistence identity. The continued maintenance of subsistence traditions would depend on the continued availability of subsistence resources and the continued ability of subsistence users to access resources, particularly if there are changes in resource abundance, distribution, or migration.

Alternatives that allow the greatest amount of land to be developed and which have fewer timing and other restrictions would provide the greatest potential contribution to cumulative effects on subsistence uses and resources. This is because they would have a greater effect on resource availability, resource abundance, and user access; thus, Alternative B would have the largest potential contribution to cumulative effects on subsistence uses and resources, while Alternative D2 would have the smallest potential contribution to cumulative effects on subsistence uses and resources.

The effects of climate change described under *Affected Environment* above, could influence the rate or degree of the potential cumulative impacts.

3.4.4 Sociocultural Systems

Affected Environment

This section describes the affected environment for sociocultural systems potentially affected by the leasing program. In particular, the program could affect sociocultural systems among the Iñupiaq and Gwich'in peoples who use the program area, who have cultural ties to the program area, who use resources that cross through the program area, or who could experience social or economic changes associated with the leasing program.

This section provides a brief overview of sociocultural systems among the Iñupiat and Gwich'in peoples, including history, social/political organization, the mixed cash/subsistence economy, and belief systems. There is an emphasis on the communities closest to the program area: Kaktovik, Nuiqsut, Arctic Village, and Venetie. Additional associated information relevant to sociocultural systems is given in **Sections 3.4.2**, **3.4.3**, **3.4.10**, Economy, and **3.4.11**.

History

Iñupiaq

Prehistory and history associated with the program area is described in USFWS (2015a). Kaktovik and Nuiqsut are the two Iñupiaq communities closest to the program area. The Iñupiat are an Alaska Native people whose territory ranges throughout Northwest and Northern Alaska. Archaeological research indicates that humans have occupied northern Alaska for roughly 14,000 years (Kunz and Reanier 1996). The earliest people entering the North American Arctic were the bearers of the Paleoindian and Paleoarctic traditions. Over thousands of years different cultures came to occupy Arctic Alaska and various parts of the program area, subsisting on resources available to them and developing various tools for survival. The Thule people, whose culture emerged about 1,000 years ago, are the direct ancestors of the Iñupiat living on the North Slope today and are the forebearers of modern whaling technologies and culture.

At the time of Euro-American contact, the North Slope was inhabited by two indigenous Iñupiaq populations, the Tagiugmiut and the Nunamiut. The Tagiugmiut ("people of the sea") inhabited coastal areas of the ACP and the Nunamiut ("people of the land") inhabited the Brooks Range and Arctic Foothills areas (Burch 1976). While these labels are useful in providing a general idea of the Iñupiaq inhabitants of the North Slope at the time of contact, the distinction between the Nunamiut and Tagiugmiut is not a definitive one, and more often Iñupiaq groups and territories were defined based on kinship ties and place in which they lived (Spencer 1984).

Residents of Kaktovik and Nuiqsut primarily descend from the Tagiugmiut (Burch 1976). The Tagiugmiut settlement pattern was characterized by permanent villages along the coast with outlying minor permanent and temporary settlements (Spencer 1959). One reason for the Tagiugmiut villages' permanence was due to the marine mammal resource base—particularly bowhead whales—on which community members subsisted. On the North Slope, there is evidence for coastal Iñupiaq settlements from Point Hope (Tikigaq) in the west to as far as Demarcation Point near Canada in the east. The Nuiqsut and Kaktovik areas were known as places where Iñupiat and Athabascan people gathered to trade and fish, maintaining connections between the inland areas and the coast for millennia (Maguire 1988; Brown 1979; Impact Assessment Inc. 1990b).

Initial contact between the Iñupiat of the North Slope and non-Iñupiaq people occurred in the early nineteenth century with the arrival of Euro-American explorers. The first major outside influence on Iñupiaq settlement patterns on the North Slope came with the introduction of commercial whaling in the second half of the nineteenth century. Not only were coastal Iñupiaq settlements and demographics affected, but commercial whaling also affected the inland inhabitants as well. Employment in the whaling industry as well as access to trade goods served to concentrate people along the coast, reducing interior populations.

Following a decline in populations of caribou and marine mammals, caused in part by demand for these resources to support whalers during the commercial bowhead whaling period (SRB&A and ISER 1993), many Iñupiat had moved to Utqiaġvik (formerly Barrow) or Herschel Island (in Canada) where food and medical care were available. By the early to mid-1900s, many residents who had lived along the Arctic Coast had relocated to Utqiaġvik.

Local mission schools and trading posts, established during the late 1800s and early 1900s, also had a profound effect on Iñupiaq settlement patterns through centralization of Iñupiat into permanent communities. Compulsory education in local coastal settlements forced many of the interior people to abandon their more semi-nomadic lifestyle and relocate to coast communities. Trading posts also affected settlement patterns during the early 1900s.

Kaktovik, which had been an important trading center for centuries, was permanently settled by Euro-Americans following the establishment of a trading post by Tom Gordon in 1923 (Wentworth 1979). The trading post was closed in 1942; however, Iñupiat were drawn back to Kaktovik for jobs when preparations for the DEW Line site at Barter Island began in the mid-1940s.

In 1951, a Bureau of Indian Affairs school was built in the thrice-moved village, which—along with the draw for wage labor—led to permanent settlement and the establishment of the modern community of Kaktovik (Impact Assessment Inc. 1990a; Mikow 2010). In 1968, the largest oil discovery in North America was made by Arco at Prudhoe Bay, resulting in a rush to develop the physical and legal infrastructure of Alaska so that production could begin (Coates 1991). Oil development and production at Prudhoe Bay became the nucleus for expanding networks of oil and gas production wells at neighboring fields (Impact Assessment Inc. 1990b, a). In 1973, after the 1971 passage of the ANCSA, 27 families from Utqiaġvik permanently resettled in Nuiqsut to live in a more traditional manner (Brown 1979). Many of those who moved there had family connections to the area (Impact Assessment Inc. 1990b). The families selected the present location of Nuiqsut for its centrality to subsistence resources and ease of access to harvest locations inland, along the river and delta, and in the ocean (Brown 1979).

Gwich'in People

Prehistory and history associated with the program area is described in USFWS (2015a). The Gwich'in people are an Athabascan cultural group who traditionally occupied a massive territory that incorporated long sections of the Yukon, Porcupine, Peel, Chandalar, Itkillik, and Sagavanirktok Rivers and into present-day Canada to the Mackenzie Flats and River Delta (Burch 1998; Raboff 2001, 1999; Slobodin 1981). Archaeological data suggest a Paleoarctic human occupation in the Yukon River region, which includes the contemporary Gwich'in communities of Arctic Village and Venetie, beginning at least 12,000 years ago (Griffin and Chesmore 1988). Ancestral to the Gwich'in Athabascans, the Kavik culture occupied areas of the North Slope and Brooks Range as early as 600 years ago and as late as the early to mid-nineteenth century.

In the north, interactions between the Gwich'in people or Koyukon and the Kukpigmiut Iñupiat of the Colville River were marked by territorial tensions and hostility, culminating in a series of violent incidents that forced the Athabascans south of the mountains (Raboff 2001). Continuing battles with the Iñupiat and other Athabascans in the 1840s pushed the Gwich'in people from the Koyukuk River east to Chandalar Lake and beyond. The Gwich'in people were among the most nomadic of the Athabascan groups in their settlement patterns and continued to travel north to trade with the Iñupiat at Barter Island into the 1920s (Jacobson and Wentworth 1982). Similar to the Nunamiut farther north, the Gwich'in people relied heavily on the harvest of large land mammals—particularly caribou, but also moose and Dall sheep—for their livelihood.

Some of the first contact with the Gwich'in people by Europeans likely took place with the Hudson's Bay Company trading post at Fort Yukon in 1847, some of the latest in terms of first contact in Alaska. It continued with little contact through the end of the nineteenth century (Hadleigh-West 1963). Still, the indirect contact that occurred with other groups trading with the Gwich'in people in the 1850s resulted in an epidemic that devastated their population, especially in the western extent of their territory near the Kanuti River. By 1870, most Gwich'in groups had moved into the Yukon Flats or east of Chandalar River.

This constitutes the known modern territorial range of the Gwich'in people today (Burch and Mishler 1995).

Continuous Euro-American presence in Gwich'in people territory came later than for some other indigenous groups in Alaska. As such, the traditional subsistence lifestyle, including a continued reliance on hunting and fishing as a primary source of food and as a primary basis for Gwich'in people's belief systems, was substantially maintained until World War II (Caulfield 1983).

A severe decline in caribou populations in the Yukon Flats area in the late 1930s and 1940s may have precipitated the need for the Gwich'in people to adapt to a more cash-based economy (Caulfield 1983). The US established several Native reservations in Alaska following the inclusion of Alaska in the Indian Reorganization Act of 1936. The Venetie Indian Reservation included the Gwich'in people of Arctic Village, Venetie, Christian Village, and Robert's Fish Camp. It was during this period that the Gwich'in people made a final transition to permanent settlements (Inoue 2004). The early 1960s saw the creation of the Arctic Refuge, which included lands traditionally used by the Gwich'in people.

Social and Political Organization

<u>Iñupiaq</u>

Iñupiaq social organization traditionally revolved around the family and extended kin, in addition to trading partnerships and friendships (Hall 1984). The social and political organization of Iñupiaq societies revolved around the family; however, one role in particular—the *umialik*—exerted the most political influence. In coastal communities, an umialik would be responsible for organizing hunts for marine mammals, such as whales, and also managed a crew that he enlisted during these hunts (Chance 1990; Burch 1980).

Following Euro-American contact in the second half of the nineteenth century, the social and political organization of the Iñupiat changed. These changes were a result of various factors, including compulsory education. This led to the following (Chance 1990):

- Centralization of people into permanent villages
- Introduction of modern technologies, which altered residents' methods for harvesting and processing subsistence foods
- Introduction of a cash economy
- Introduction of Christianity
- Incorporation of the Iñupiat into new systems of laws and governing systems

Alaska Natives began forming village councils, which were reorganized under the IRA. The ANCSA was passed in 1971 and resulted in the formation of regional and village corporations; the NSB formed in 1972.

Despite the changes in social and political organization over time, the core of Iñupiaq social organization is similar on the North Slope today, in that it encompasses not only households and families, but also wider networks of kinship and friends and individual family groups that depend on the extended family for support. The sharing and exchange of subsistence resources strengthen these kinship ties. The Iñupiat continue to uphold certain traditional social roles, such as those of the whaling captains, whaling crew members, and whaling captains' wives. Similar to the traditional role of the umialiks, today's whaling captains play a key role in Iñupiaq society and political life. Six North Slope communities, including Kaktovik and Nuiqsut, are members of the Alaska Eskimo Whaling Commission and have local whaling captains' associations.

The program area is in the NSB, which has permit authority relevant to the leasing program. Other federal and state agencies, including the USFWS, which is the land manager for all nonnative land in the program area, also have permit authority related to the program (see **Appendix D**). Many residents of the eight permanent North Slope communities are members of the regional federally recognized Iñupiat Community of the Arctic Slope and are shareholders in the ASRC.

The NSB and ASRC not only provide employment but also revenue and economic opportunities throughout the region. The NSB has taxing authority on all lands throughout the North Slope, while the ASRC and other village corporations generate revenue through leasing their lands and providing oilfield services. As oil and gas development has moved closer to Nuiqsut, the community's Kuukpik Corporation has generated revenue, provided employment opportunities, and become a key player in advocating for environmentally and socially responsible development on the North Slope; thus, North Slope communities have shared in the financial gains associated with petroleum development since the 1970s.

Community institutions in Kaktovik include the City of Kaktovik, the Native Village of Kaktovik (a federally recognized tribe), and the KIC. In addition, several subsistence-related organizations are in Nuiqsut, including the Kuukpik Subsistence Oversight Panel, Inc., which was established in 1996 in response to development of the Alpine oilfield.

<u>Gwich'in People</u>

The Gwich'in people are one of several Athabascan cultural groups in Alaska and Canada. Traditional social and political organization of the Gwich'in involved people who lived in small autonomous bands composed of closely related kinsmen. Kinship affiliations were extensive, reaching beyond the immediate group or band and providing people with a network of relationships from which to seek assistance in time of need.

The Gwich'in people had a kinship system based on matrilineal[38] clans organized into moieties[39] (McKennan 1959; Guédon 1974; Haynes and Simeone 2007). Political organization was decentralized and informal, with most decisions affecting the group reached by consensus. In some cases, a leader attained a particular status that enabled him to attract a following (De Laguna and McClellan 1981; Clark 1981). Today, Gwich'in people continue to recognize certain highly respected individuals with the title of chief.

Beginning in the mid- to late 1800s, the fur trade, mineral development, church, and government all worked to undermine traditional kinship patterns by emphasizing the individual over the group. Europeans and Americans also brought new social values, laws, and economic models that undermined and even banned the traditional practices that supported the existing social structure and hierarchy. The Episcopal Church, for example, attempted to stop the ceremonial potlatch,[40] because missionaries believed it was wasteful (Dinero 2016, 2005; Simeone 1992). In doing so, the church failed to understand the importance of Gwich'in people's reciprocity by sharing wealth and maintaining physical and social well-being. The church's attempted ban threatened Gwich'in people's social and political organization and their survival. Despite the impacts of the Episcopal Church on social and political organization, the Gwich'in people in many ways embraced the religion and viewed it as a positive force in their lives, while maintaining a connection to traditional belief systems that emphasized a spiritual connection between the human and animal worlds (Dinero 2016).

[38]Ancestral lineage traced through female relatives
[39]Social organization divided into two parts
[40]A ceremonial feast, where participants part with or destroy possessions, in a display of wealth or prestige.

Despite the various changes to social and political organization over time, much of the traditional Gwich'in people's social and political structure remains intact. Subsistence remains central to their identity. The people of Arctic Village and Venetie are primarily descendants of the Neets'aii band of the Gwich'in and, along with other Gwich'in, identify as the "caribou people" in reference to their main source of food and cultural and spiritual identity (Kofinas 1998). They view their primary cultural tradition as living with the caribou, with an emphasis on the reciprocal nature of their relationship with this important resource.

Many traditional roles and practices related to hunting, fishing, and gathering remain in place today, and residents still observe traditional rituals and feasts, including the potlatch. Similar to the Iñupiat, sharing is central to maintaining social and kinship ties among the Gwich'in people. Modern Gwich'in leadership also mirrors traditional leadership models, with village councils providing both moral and legal guidance to tribal members (Dinero 2005).

After passage of ANCSA, residents of the formerly established Venetie Indian Reservation, including those from Arctic Village and Venetie, elected a provision in ANCSA that allowed villages to forgo payments in exchange for free and simple title to former reservation land, in the case of Venetie and Arctic Village, approximately 1.8 million acres (Venetie Village Council 2013; Inoue 2004). An additional 3.4 million acres north and west of the original reservation were later added, based on earlier petitions. Venetie and Arctic Village thus established the Venetie Indian Reserve, which is managed jointly under the Native Village of Venetie Tribal Government. Unlike many Alaska Native communities, Arctic Village and Venetie are not enrolled in a regional Native corporation and do not have ANSCA village corporations. As such, those communities do not receive any increased economic activity associated with resource development or shares therein by ANCSA corporations.

Since interest in developing the Arctic Refuge began in the 1980s, the Gwich'in people—particularly the Gwich'in of Arctic Village and Venetie—have taken various legal and political actions to prevent such development. Based primarily on concerns about impacts on caribou who calve in the Coastal Plain and subsequent impacts on Gwich'in cultural survival, their opposition has led to many residents advocating for caribou and the Gwich'in way of life. Many of their people wish to protect their traditional lifestyle centered on the PCH.

In 1988, the first of many Gwich'in gatherings was held in Arctic Village to discuss the potential for development in the Arctic Refuge. Out of this meeting the Gwich'in Steering Committee was established, whose stated goal was to "establish Gwich'in cultural survival as a major issue in the debate over oil development in the Arctic Refuge" (Inoue 2004). Meeting attendees included over 500 Gwich'in people from both Alaska and Canada.

Community institutions in Arctic Village include the Arctic Village Council; community institutions in Venetie include the Venetie Village Council. Both Arctic Village and Venetie are members of the Native Village of Venetie Tribal Government, the Council of Athabascan Tribal Governments, and the Tanana Chiefs Conference (ADCCED 2018c). Both communities are, among other Gwich'in communities, members of the Gwich'in Steering Committee.

Mixed Cash/Subsistence Economy

<u>Iñupiaq</u>

The Iñupiat traditionally participated in an economy that relied on subsistence resources and used trade to acquire goods not readily available in their immediate area. The concept of wealth was based on the number or amount of accumulated foods and goods; those with the most material possessions were the wealthiest. Among the Tagiugmiut Iñupiat, the umialik was often held by the wealthiest person, who needed to have a surplus of food and property to outfit a whaling crew.

Both the Tagiugmiut and Nunamiut Iñupiat participated in extended trade networks that included both formalized and less formal modes of trading (Spencer 1959). Their trade was not limited to other Iñupiat, and they also traded with Athabascan peoples farther south, often through established trade fairs, such as those at Nigliq and on Barter Island.

The economy of the North Slope underwent major changes beginning in the mid-nineteenth century. This is when commercial whaling introduced a new type of economy to the Iñupiat, followed by other economic developments, such as reindeer herding and fur trapping. The development of petroleum reserves began in the 1940s and is still the driving force of the economy on the North Slope.

Today, the Iñupiat of the North Slope continue to rely on subsistence resources, while participating in the cash economy. Like other communities on the North Slope, Kaktovik and Nuiqsut have a mixed, subsistence-market economy (Walker and Wolfe 1987), where families invest money into small-scale, efficient technologies to harvest wild foods. Native corporation dividends rely heavily on oil and gas development, and many residents use their dividends as investments into their subsistence way of life. These investments can include gill nets, motorized skiffs, and snowmachines used to conduct subsistence activities. They are not oriented toward sales or profits but are focused on meeting the self-limiting needs of families and small communities.

The trade networks that characterized the traditional subsistence economy of the Tagiugmiut and Nunamiut continue today, exchanging subsistence marine mammal products for terrestrial resource products. In fact, sharing subsistence foods with other communities and regions is a major component of the mixed economy, and it has been facilitated by advancements in rural transportation and technology.

Gwich'in People

Before Euro-American contact, the Gwich'in people were seminomadic hunters and gatherers who moved seasonally throughout the year in reasonably well-defined territories to harvest fish, wildlife, and a variety of plants. The pre-contact Gwich'in economy revolved around subsistence resources, and they traded to acquire goods not readily available in their immediate area. The subsistence economy was focused primarily on harvesting not only caribou but also fish, such as whitefish, and other resources.

First contact between Europeans and the Neets'aii Gwich'in occurred somewhere between 1847, upon establishment of Hudson's Bay Company at Fort Yukon, and the 1860s, with missionary efforts in the region (Dinero 2016). Up until the discovery of gold in the Gwich'in territories in the 1890s (1893 at Birch Creek), the subsistence economy was largely intact, and Native people remained independent and essential to the Euro-American fur trading economy (Mishler and Simeone 2004). The Gwich'in people increasingly participated in the cash economy, while maintaining a strong subsistence lifestyle. This increasing reliance on a mixed cash/subsistence economy, in combination with the establishment of schools and requirement that all children attend them, prompted a shift to a more stable village life, which opened the door for further changes to the traditional economy (Dinero 2016; Stern 2018).

Beginning with the gold rush and especially by the start of World War II, the Gwich'in people were presented with alternative ways of living, which were not oriented toward a life wholly dependent on the land. A living based on hunting, fishing, and trapping became only one of several choices; subsistence became a component of a "mixed, subsistence-market economy" (Walker and Wolfe 1987), rather than supplying the entire economy as it once did.

The Gwich'in people of Arctic Village and Venetie have a deep relationship with the land they occupy and the resources they use. In contrast to the Iñupiaq villages farther north, there is little economic development in the Gwich'in area and few opportunities for local employment (Kofinas et al. 2016). In most cases, seasonal employment rather than full-time or permanent employment directly supports the subsistence activities of individuals. They, in turn, share the harvest with residents, as well as those who live in villages and regional centers, including Fairbanks and Anchorage (Caulfield 1983). The relative lack of cash to support subsistence activities would make these communities more vulnerable to changes in the availability of resources, such as caribou. This is because residents have less capacity to travel great distances in search of subsistence resources or to purchase alternative foods that are less desirable.

Belief Systems

Iñupiaq

Traditional Iñupiaq belief systems consisted of two religious elements: hunting ritual and shamanism. These elements were similar to belief systems held by other Eskimo populations (Spencer 1984). Iñupiaq beliefs originally revolved around a system oriented to the environment and its animals.

Following proper hunting rituals was necessary to ensure a successful harvest. These rituals included actions taken before the hunt to avoid offending the animals and rituals taken after an animal was taken. Examples of this are offering freshwater to sea mammals, giving gifts to trapped land animals, and cutting the throat or opening the brain pan to free the soul (Spencer 1984). The more important the resource was to the community, the more elaborate and extensive the rituals and ceremonies associated with it. One of the most important ceremonies on the coast was the whale feast (Nalukataq); its inland counterpart was the caribou festival (Spencer 1959). The messenger feast (Kivgiq), which has seen a revival on the North Slope in recent years, was an opportunity for Iñupiat from across the region to come together for trading and sharing.

Shamanism was a second key component to Iñupiaq belief systems. Shamans played specific roles relating to illness, predicting weather, finding lost items, foretelling the future, and speaking to the dead (Spencer 1984; Hall 1984). Despite the existence of shamans in traditional Iñupiaq society, the traditional belief system was largely fatalistic (Chance 1990); in other words, Iñupiat believed that powers beyond their control governed their environment. Their rituals and shamans, while having some influence, might prove ineffective despite their efforts.

Belief systems among the Iñupiat of the North Slope were largely unchanged before 1890, even though the region had experienced several changes from the whaling industry and various exploratory expeditions. After 1890, a number of Christian missions were established in the region, and rapid changes to Iñupiaq belief systems began.

The introduction of Christianity also introduced a rippling effect of changes that altered some Iñupiaq cultural values and traditions, particularly those surrounding housing, morality, subsistence, and social organization; however, despite these changes, the Iñupiat of the North Slope today retain a strong cultural identity associated with traditional subsistence hunting and harvesting patterns, and many traditional belief systems are strongly held and celebrated. Contemporary Iñupiaq values strongly mirror traditional ones, and include cooperation, hunting traditions, family and kinship, respect for nature, sharing, and spirituality (NSB 2018a).

Coastal North Slope communities, such as Kaktovik and Nuiqsut, maintain a strong maritime culture that centers on the bowhead whale hunt and emphasizes cooperation, participation in hunting traditions, and sharing. Whaling captains continue to have central roles as leaders in their communities and across the region. To the Iñupiat, protecting the land and water is essential to maintaining a culture that relies on the harvest of wild resources. This includes maintaining lands that are untouched by industry and where residents can conduct subsistence activities in relative solitude.

For the program area and greater territory of the Kaktovikmiut ("people of Kaktovik"), this belief in the duty of the Iñupiat to protect their homeland and to serve as stewards of the land and sea is described in the City of Kaktovik's document "In This Place" and is succinctly expressed in the opening general statement as follows: "We the Kaktovikmiut, the people of Kaktovik, are principally Iñupiat Eskimo, Native people of the Arctic Slope, the country that drains northward from the Brooks Range to the Arctic Ocean. We use and occupy this country, its associated waters, and the sea; and have claimed it since time immemorial by virtue both of aboriginal rights and our continued and undisplaced use and occupance [sic]" (City of Kaktovik and Karl E. Francis & Associates 1991, page 1)

Gwich'in People

The Gwich'in people have a spiritual relationship with their environment that is integral to their cultural system. Before the gradual incorporation of Christian beliefs and Western values into their existing traditional belief system beginning in the mid-nineteenth century, the Gwich'in people followed a loosely organized, animistic religion. It centered on a reciprocal relationship between humans and the rest of the natural world (Slobodin 1981; VanStone 1974).

Gwich'in people's belief systems had a holistic view of nature, in that no distinction existed between humans and animals, and everything in nature was considered sentient or to have a spiritual essence. Plants and animals were not objects governed by instinct but social beings with a spiritual potency controlled by powerful spirits or guardians. According to testimony by Johnny Frank of Arctic Village, traditional spiritual beliefs held that humans and animals were once the same, and they all shared the same language. Caribou held a particularly special relevance to Gwich'in spirituality and were believed to share a physical and spiritual connection with humans (Dinero 2016). According to Gwich'in elders, before humans and animals separated, they reached an agreement in which they acknowledged each other's hardships and came to agreement regarding human-animal relations. As part of the agreement, humans were given some of the wisdom of the caribou, while the caribou were given the ability to run fast. Caribou were still allowed to retain some of the wisdom that was imparted to humans and, hence, humans and caribou share a special bond (Kofinas 1998). In fact, the Gwich'in people believe that a piece of caribou heart is in every human, and vice versa (Gwich'in Steering Committee 2004). The key cosmological figures among the Gwich'in people were Raven, the cultural hero Attachookaii, and the trickster Vasaagijik (Slobodin 1981).

Christian missionaries of various denominations had considerable effect on the traditional Gwich'in people's belief system and used an intense five-fold strategy of building, speaking, teaching, healing, and traveling to undercut traditional ways of life and to provide what were perceived as appropriate Christian alternatives (Fienup-Riordan 1992). Early in the twentieth century the Episcopal Church attempted to abolish the potlatch, but was rebuffed, and today the potlatch is stronger than ever and remains a significant part of Native identity. Others fused Christianity and traditional beliefs into a single belief system as some of the Dena'ina had done with the Russian Orthodoxy and the Iñupiat had done with the Anglicans and Presbyterians. Lastly, some individual Athabascans saw the presence of missionaries as a good thing, saving individuals from alcoholism, while others saw a bias against Native people and their traditional ways (Reckord 1979).

The proper relationship between humans and animals is a central tenet of the traditional belief system. Animals were not only a source of food but powerful spiritual beings that must be treated with respect. Animals and humans shared an essence of personhood; both were sentient and volitional. They acted on their own values and choices and shared a fundamental organization in that each had a soul, a language, a family, and similar emotional characteristics, including anger and a desire for vengeance.

Animals and humans existed in a reciprocal relationship in which humans needed to kill animals to survive and animals desired to give themselves as food, but only on the condition that humans treated them with respect. The importance of reciprocity extends to humans as well—failure to share resources with others is not only frowned on socially but is considered a violation of a kind of social contract with game animals, threatening the success of future harvests (Caulfield 1983).

The importance of reciprocity in human and animal relationships is evident in contemporary Gwich'in culture through their continued identification as the caribou people, their continued observance of certain customary laws, the continued practice of traditional rituals, such as the potlatch, and the strong belief in the sacredness of places like the Coastal Plain, due to its integral connection to caribou calving and migratory bird nesting grounds.

Direct and Indirect Impacts

Issuance of oil and gas leases under the directives of Section 20001(c)(1) of PL 115-97 would have no direct impacts on the environment because by itself a lease does not authorize any on the ground oil and gas activities; however, a lease does grant the lessee certain rights to drill for and extract oil and gas subject to further environmental review and reasonable regulation, including applicable laws, terms, conditions, and stipulations of the lease. The impacts of such future exploration and development activities that may occur because of the issuance of leases are considered potential indirect impacts of leasing. Such post-lease activities could include seismic and drilling exploration, development, and transportation of oil and gas in and from the Coastal Plain. Therefore, the analysis is of potential direct and indirect impacts on sociocultural systems from on-the-ground post-lease activities. As described in the previous section, Iñupiaq and Gwich'in sociocultural systems are based on social and kinship ties, subsistence harvesting, and a deep connection to the land and its resources. Oil and gas development in the program area would likely affect sociocultural systems by introducing changes to traditional subsistence lands and resources, the social, health, and cultural environment, and local and regional economies.

Alternative A

Under Alternative A, no oil and gas leasing program would take place in the program area. Sociocultural systems among the Iñupiat and Gwich'in would remain unaffected by additional oil and gas development and the associated economic, biological, and social changes. Iñupiaq and Gwich'in sociocultural systems would likely continue to evolve as a result of existing forces of change, such as increased modernization and technology, development and associated activities (such as oil and gas development and research) outside the Coastal Plain, infrastructure and transportation projects, changes to land status, environmental changes, and increased outsiders in traditional use areas.

Impacts Common to All Action Alternatives

This section discusses potential impacts on sociocultural systems from post-lease activities that are common to all alternatives. The primary factors that may result in impacts on sociocultural systems include: 1) changes in income and employment levels, 2) changes in available technologies, 3) disruptions to subsistence activities and uses, 4) influx of non-resident temporary workers associated with post-lease oil and gas activities, and 5) influx of outsiders coming into the subsistence study communities.

Changes in Income and Employment Levels

Increased income and employment levels—most likely to occur among the Iñupiat of the North Slope—could affect sociocultural systems by changing the socioeconomic status of certain community members, reducing the time spent by certain individuals on harvesting subsistence resources and thus affecting social ties in the community, and increasing the amount of cash available to engage in subsistence activities and support subsistence-related equipment and infrastructure. An influx of cash into a small, rural community can have both positive and negative impacts on sociocultural systems. Traditional Iñupiaq and Gwich'in societies are based on social and kinship ties, which are established and strengthened through the procurement, processing, consumption, and sharing of subsistence resources (see *Affected Environment* above).

Certain households or individuals play a particularly important role in the harvesting of subsistence resources and distribution of those resources to households and individuals who are unable to hunt or harvest for themselves. These super-harvester households have been identified through previous ADFG research, which found that 30 percent of households generally harvest 70 percent of the total community harvest (Wolfe 2004). An increase in employment opportunities may result in some of these households shifting from their role as super-harvesters to high-earning households, as they lack the time to engage in subsistence activities as frequently as they once did. This could result in weakening or shifting of certain social ties in the community.

While this could cause short-term social stresses in a community, Kofinas et al. 2016 notes that the role of super-harvester households often changes over time and that communities are in fact quite resilient to these changes. In addition, the roles of super-harvester households and high-earning households are not mutually exclusive; in fact, Kofinas et al. (2016) found that super-harvester households also tend to have high income.

In Kaktovik, 14.3 percent of all households were high-harvest high-income households; of all high-harvesting households, 43 percent were high-income, compared with 24 percent of medium-harvest households and 30 percent of low-harvest households (Kofinas et al. 2016); thus, an increase in income and employment may increase opportunities for subsistence harvesting. That said, a sudden and substantial increase in employment and income may cause a more dramatic shift in the role of super-harvester households in the community, and it may take longer for the community to adjust to the changes.

During the initial period of post-lease development, there may be a lack of super-harvester households as new roles are established. As a result, distribution of subsistence foods throughout the community could temporarily decline. If communities experience a dramatic change in the availability of such subsistence resources as caribou, there would likely be a tipping point where residents would no longer be able to adjust to such changes. The potential sociocultural impacts of such an occurrence would likely be negative and long term (Chapin et al. 2009).

In addition to super-harvester households, high earning households also play an important role in the subsistence economy. This is because they often provide financial support to subsistence harvesters in the community as well as in their own households. As noted above, super-harvester households also tend to be high-earning households. An increase in employment and income resulting from the proposed oil and gas leasing program could therefore have potential positive effects on social ties once community roles are established; however, increased income opportunities in a community can also cause greater potential income disparities between households, especially if certain households are not shareholders in the village or regional corporations. Such disparities can affect social relations and leadership roles in a community. In general, an increase in employment opportunities could strengthen residents' resolve to remain in their home communities rather than moving in search of employment. Subsistence activities have been shown to persist despite increased income and wage employment, which demonstrates that the importance of subsistence is not limited to its nutritional benefits alone (Kruse 1991).

Changes in income and employment associated with post-lease activities would have the most potential direct impact on the Iñupiaq community of Kaktovik and may also extend to other Iñupiaq communities, although direct participation in oil and gas activities by North Slope residents would be relatively limited (**Section 3.4.10**). Kaktovik is closest to the program area, and therefore, when compared with other North Slope communities, Kaktovik residents are most likely to obtain employment associated with development and support activities in the program area. Levels of local employment would depend largely on the implementation of adequate local hiring policies and opportunities for NSB-based businesses and corporations. In addition, residents of Kaktovik would likely see greater economic revenues associated with the oil and gas leasing program as shareholders of KIC. The City of Kaktovik may also receive bed tax revenues associated with increased visitors to the community; an increase in tax revenue could support sociocultural systems by contributing to community improvements (**Section 3.4.10**).

On a regional scale, Iñupiat communities across the North Slope may see increased economic activity resulting from post-lease activities as shareholders of the ARSC and through NSB revenues, and they may also be exposed to a greater number of employment opportunities. By contrast, Gwich'in residents would likely see only modest economic activity and revenues associated with profit sharing from ASRC to their regional corporation (Doyon, Inc.). The Gwich'in communities closest to the program area—Arctic Village and Venetie—do not belong to Doyon and do not have village corporations holding land in the program area; therefore, they would see limited economic activity and revenues associated with the proposed oil and gas leasing program (See **Section 3.4.10**). The comparative lack of economic activity for the Gwich'in people, especially the communities of Arctic Village and Venetie, could make those communities more vulnerable to social impacts, particularly those associated with disruption of subsistence activities. Without the increased economic activity associated with development, communities are more vulnerable to its impacts and less able to adapt to environmental and social changes resulting from the development.

<u>Changes in Available Technologies</u>

Increased income and employment resulting from future oil and gas exploration, development, and production could also increase access to technologies, such as subsistence equipment and fuel. Access to such technologies could aid subsistence users in accessing subsistence harvesting areas, particularly if development results in subsistence users having to travel farther or spend longer to find and harvest subsistence resources. Communities close to oil and gas development areas may also eventually have greater access to high-speed Internet and strong cell phone reception. In recent years, greater use of and access to cell phones and social media has shifted how residents in and between communities communicate with one another. In some ways, it has expanded social ties by facilitating connections across regions of Alaska and encouraged the establishment of trading relationships. Greater access to transportation and shipping options can also have a positive impact on sharing networks and the ability to bring goods directly into the community. Such changes would be most likely to occur for Kaktovik because of its proximity to the program area.

Disruptions to Subsistence Activities and Uses

Disruptions to subsistence activities associated with future oil and gas activities could potentially indirectly affect social cohesion. As noted above, increased income and employment levels could change social ties and organization by causing certain individuals and households to shift to new, nonsubsistence roles. In addition to the extent that development in the program area disrupts subsistence or reduces the availability of certain resources to subsistence harvesters, residents may either experience reduced harvests of subsistence foods, or they may spend greater time, effort, and expense in pursuit of subsistence resources (see **Section 3.4.3**).

Potential impacts on subsistence resource availability would likely occur throughout the life of post-leasing activities within the Coastal plain. Nuiqsut residents have reported impacts on resource availability associated with nearby developments but continue to harvest resources at levels similar to before; however, continued harvests do not imply an absence of impacts. Residents report adapting to changes in resource availability by shifting to new hunting areas, spending more effort and time on the land, or changing hunting methods, such as hunting caribou along newly introduced road corridors.

An inability to harvest adequate subsistence resources can have negative social consequences for a community. Decreased harvests of subsistence resources—particularly key resources, such as bowhead whales (for the Iñupiat) and caribou (for the Iñupiat and Gwich'in people)—results in decreased opportunities for participation in such activities as processing, consuming, and sharing subsistence foods and participating in culturally important feasts and festivals. These are all important in maintaining and strengthening social and cultural ties in the community.

The inability of subsistence harvesters to provide for their community can also have negative social and health/nutritional consequences (**Section 3.4.11**). Residents have reported that during times of reduced harvest success, they have witnessed increased social problems, such as drug and alcohol use, particularly among younger subsistence hunters (SRB&A 2009a). Increased access to program-related roads, introduction of new infrastructure in traditional use areas, and associated changes in subsistence travel routes and harvesting patterns could increase the risk of injuries and accidents during subsistence activities, causing negative social effects (**Section 3.4.11**).

Finally, decreased use of certain traditional areas, due to changes in resource availability, user access, or the degradation of one's experience on the land resulting from noise and human activity, can result in fewer opportunities for residents to pass on traditional knowledge about those places, weakening the cultural associations residents have with the land.

Potential impacts on subsistence would occur to varying extents for different communities. Direct impacts from future oil and gas exploration, development, and production on subsistence activities would likely be greatest for Kaktovik; however, potential indirect impacts on the availability of resources, such as caribou, could occur for Nuiqsut, Arctic Village, Venetie, and other communities that rely on the PCH and CAH (see **Section 3.4.3**).

Influx of Non-Resident Temporary Workers and Outsiders

Another potential source of potential impacts on sociocultural systems is an influx of non-resident temporary workers associated with future oil and gas activities into local communities and traditional use areas and a general influx of outsiders into local communities associated with increased development in the region. While interactions with non-locals has become increasingly common in rural Alaskan communities, most Iñupiaq and Gwich'in communities continue to be relatively remote and primarily Alaska Native.

Interactions with non-locals can sometimes cause discomfort for residents when non-locals do not respect or understand local traditional values and customs. Residents have expressed discomfort conducting subsistence activities when non-locals are around for fear that their traditions are misinterpreted, misunderstood, or exploited for political purposes. Such concerns have become particularly prevalent in today's climate of social media posts, viral videos, and negative online backlash (Oliver 2017).

Witnessing non-locals mistreating or disrespecting the land and its resources can also have negative cultural and spiritual impacts on locals, especially if the area holds particular importance to a community. In the case of the Coastal Plain, the area is in Kaktovik's core subsistence harvesting area and is considered sacred ground to many Gwich'in people because of its importance to the health and survival of the PCH.

The presence of temporary workers who are associated with future post-lease development in traditional hunting areas could result in negative interactions between subsistence users and workers due to a lack of cultural understanding and respect on the part of the workers, or miscommunication of policies and procedures surrounding use of the land by local residents for hunting purposes. If future oil and gas activities facilitate or promote access of outsiders into Kaktovik for reasons associated with development or otherwise, potential impacts could include increased social problems (e.g., outsiders bringing in drugs and alcohol), lack of infrastructure to accommodate the increase in visitors (e.g., lodging and transportation), and conflicts resulting from lack of knowledge or respect of traditional values.

An increase in population associated with post-lease activities is not expected for Kaktovik; workers are expected to stay in work camps and return to other areas of Alaska or outside Alaska (**Section 3.4.10**); however, while an increase in permanent residency is not likely, it is possible that Kaktovik would experience an increase in visitors associated with oil and gas industry, as has happened in Nuiqsut.

Alternative B

Under Alternative B, the types of potential impacts on sociocultural systems associated with future exploration, development, and production activities would be the same as those described under *Impacts Common to All Action Alternatives*, above. The duration of impacts would be long term for all types of impacts, although certain types of impacts, such as interactions with temporary workers, may be more frequent or intense during the exploration and construction phases of development. Potential impacts related to an increase in visitors to and an influx of nonresident temporary workers associated with future development would occur in the general vicinity of the action area or in the community of Kaktovik. Increases in income and employment levels may extend beyond the program area to other communities on the North Slope and possibly outside the North Slope. Changes related to disruption of subsistence activities and uses could extend outside the North Slope region to other communities that rely on the PCH and CAH herds.

Because of its proximity to the program area, the community of Kaktovik would experience the greatest intensity of effects associated with future oil and gas activities in the Coastal Plain. Potential impacts on sociocultural systems may also occur for other communities if future oil and gas exploration, development, and production in the program area results in changes to resource abundance or availability, particularly caribou, which is a resource of major importance to the closest communities of Kaktovik, Nuiqsut, Arctic Village, and Venetie. Because of the particular spiritual and cultural importance of the coastal plain and PCH calving grounds to the people of Arctic Village and Venetie, any disruption to that herd or perceived contamination or degradation of calving grounds in the program area would have sociocultural impacts on the Gwich'in people, in terms of their belief systems, cultural identity, and the impact of development in the sacred calving grounds of the PCH.

Alternative C

The types of potential impacts under Alternative C would be the same as those described under Alternative B. Because fewer acres of calving grounds would be available for leasing, the intensity of potential sociocultural impacts related to caribou under Alternative C would be less than Alternative B.

Alternative D

The types of potential impacts under Alternative D would be the same as those described under Alternative B. Because fewer acres of caribou calving grounds would be available for leasing, and because more lands would be subject to development restrictions, the intensity of potential sociocultural impacts under Alternative D would be less than under Alternative B. In particular, Alternative D2 would be somewhat less likely to affect sociocultural systems, when compared with Alternative D1. This is because of the greater restrictions under Alternative D2 on development in caribou summer habitat.

Cumulative Impacts

Past, present, and reasonably foreseeable future activities, in combination with oil and gas development in the program area, would increase the potential for sociocultural impacts, including changes in income and employment levels, changes in available technologies, disruptions to subsistence activities and uses, and increased interactions with outsiders. Past and present actions that have affected sociocultural systems among the Iñupiat and Gwich'in people include oil and gas development, onshore and offshore transportation and infrastructure projects, scientific research, increased recreation and tourism, demographic changes, changes in land status, and modernization. The proposed oil and gas leasing program, in addition to future activities, could lead to additional oil and gas development and other development and infrastructure projects. This could contribute to changes in sociocultural systems by affecting access to and abundance of subsistence resources, as well as the safety of subsistence harvesters.

Tensions between communities relating to differences in opportunities for increased economic activity, such as increased employment, and potential negative sociocultural impact, such as disruptions to subsistence levels, could strain social ties and reduce social cohesion. Income disparities or political differences in and between communities could also contribute to social tensions between residents and community institutions. Such changes could exacerbate political differences between Iñupiat and Gwich'in communities, potentially weakening social ties. If employment opportunities were to increase to the extent that fewer community residents have the time to engage in subsistence activities, then overall community harvests and participation could decrease, weakening the community's identity and association with the subsistence lifestyle (see **Section 3.4.3**) and causing reduced social cohesion and increased social problems.

Alternatively, increased income through employment or dividends could encourage residents to remain in their home communities and provide financial support for subsistence activities in communities, thus strengthening the mixed subsistence cash economy.

Increased interactions with outsiders in traditional use areas and communities has the potential to affect traditional values and belief systems over time and may also result in increased social problems, if such interactions lead to greater access to drugs and alcohol.

Cumulatively, strong local economies could have positive social impacts as long as communities are able to adapt to such changes, while maintaining cultural traditions and values, such as subsistence, humility, respect for elders, family and kinship, and avoidance of conflict. Communities that are most likely to experience potential sociocultural impacts would be those that experience impacts on subsistence, while not experiencing increases in income or employment levels, such as Arctic Village and Venetie.

Alternatives that allow the most land to be developed in the program area and that have fewer timing and other restrictions are likely to have the greatest potential contribution to cumulative effects on sociocultural systems. This is because future post-lease activities would have a greater effect on subsistence uses and resources and the greatest likelihood of interactions with outsiders, while increasing regional or local economic activity; thus, Alternative B would have the largest contribution to cumulative effects on sociocultural systems, while Alternative D2 would have the smallest contribution to cumulative effects on sociocultural systems.

3.4.5 Environmental Justice

Affected Environment

Environmental justice is defined in EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations. It requires that proposed projects be evaluated for "disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations."

In 2016, the DOI released the updated Environmental Justice Strategic Plan that establishes goals, objectives, and detailed guidance for federal agencies to ensure that no racial, ethnic, cultural, or socioeconomic group disproportionately bears the negative environmental consequences of governmental programs, policies, or activities (DOI 2016).

Guidelines for evaluating the potential environmental justice effects of projects require specific identification of minority populations, when either the minority population of the affected area exceeds 50 percent, or the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis.

These guidelines also stipulate that low-income populations in an affected area should be identified using annual statistical poverty thresholds (CEQ 1997). The State of Alaska socioeconomic characteristics were selected as the reasonable general reference population for both minority populations and low-income populations.

Guidelines on environmental justice also suggest that where an agency action may affect fish, vegetation, or wildlife, it may also affect subsistence patterns of consumption and indicate the potential for disproportionately high and adverse human health or environmental effects on low-income populations, minority populations, and Indian/Alaska Native Tribes.

It is relevant to identify differential patterns of consumption of natural resources among minority populations and low-income populations, where the term means differences in rates or patterns of fish, water, vegetation, or wildlife consumption among minority populations, low-income populations, or Indian/Alaska Native Tribes, compared with the general population (CEQ 1997). Subsistence patterns in the affected environment are covered in detail in **Section 3.4.3**; if subsequent analysis of the action alternatives finds high and adverse impacts on subsistence, these would be of environmental justice concern as well.

Kaktovik is the closest community to be potentially affected by the leasing program. Based on their identified use of subsistence resources (see **Section 3.4.3**), the communities of Nuiqsut, Arctic Village, and Venetie are also relevant to the environmental justice analysis.

According to 2010 Census data, American Indian/Alaska Native residents of Kaktovik, Nuiqsut, Arctic Village, and Venetie—specifically Iñupiat in Kaktovik and Nuiqsut and Gwich'in in Arctic Village and Venetie—account for between 87.1 and 91.6 percent of the total population of each community. The total minority[41] populations of these communities range from 90.0 to 98.2 percent of the total community population. The statewide population is 14.4 percent American Indian/Alaska Native and 35.9 percent minority overall.

The minority composition of Kaktovik, Nuiqsut, Arctic Village, and Venetie, compared with Alaska, is shown in **Table N-2** in **Appendix N**. Based on 2010 census data, the minority population in all four communities is well above the 50 percent threshold and meaningfully greater than the general reference population, as specified in the CEQ guidelines (US Census Bureau 2010). Based on minority population criteria, these communities should be considered for potential environmental justice issues when evaluating the effects of the action.

Additionally, as shown in **Table N-1** in **Appendix N**, while the proportion of low-income residents in Kaktovik and Nuiqsut is well below that seen in the general population of Alaska, the low-income population components of Arctic Village and Venetie are meaningfully greater, at about 4.6 and 5.3 times higher, respectively, with roughly half the residents in both communities living below the poverty level (US Census Bureau 2016). Finally, each of these four communities is predominantly Alaska Native, with associated tribal entities. As a result, each community meets more than one criterion for potential impacts of the action to be of environmental justice concern.

As noted in **Section 3.4.10**, residents of the NSB would experience a range of direct or indirect economic impacts from the action, such as increased economic activity and revenues. As shown in **Tables N-1** and **N-2** (**Appendix N**), while the low-income proportion of the NSB's overall population is roughly equivalent to that of Alaska, the minority proportion of the NSB's population is meaningfully greater than that of the state. The result is that there is the potential for impacts from future projects to disproportionately accrue to a population that is otherwise of environmental justice concern.

The CEQ guidance on environmental justice under NEPA (CEQ 1997) directs federal agencies to apply CEQ guidance with flexibility. It says to consider them as a point of departure, rather than conclusive direction in applying the terms of the EO 12898. Following this guidance, analyses of potential impacts should be highly sensitive to the history or circumstances of a given community or population.

As noted in the Sociocultural Systems and Economy affected environment discussions (**Section 3.4.4** and **3.4.10**, respectively), the different histories and circumstances of the relevant Iñupiat and Gwich'in people, such as outcomes under the ANCSA and the formation of the NSB, are likely to not only result in a differential distribution of potential impacts from the action but also to affect the vulnerability and resilience relative to potential adverse impacts.

As noted in **Section 3.4.4**, social and cultural values related to subsistence resources and activities represent another key area for the exploration of environmental justice. For example, primary concerns of the Gwich'in people expressed during public scoping were the sacredness of the caribou calving and bird nesting grounds in the program area. This is in addition to more direct potential impacts on the reliability of the PCH and waterfowl annual migrations through Gwich'in territory. In other words, potential

[41]For the purposes of environmental justice analysis, a minority population includes all persons other than those who self-identify in the census as both White and non-Hispanic or Latino.

environmental justice impacts related to potential adverse impacts on subsistence resources extend well beyond the immediate program area, and they encompass the social and cultural value of subsistence resources (and their uses), as described in ANILCA, as well as the value of direct reliance on these resources for physical sustenance.

Climate Change

As noted in BLM (2018a) climate change can be understood as an environmental justice issue. The Iñupiaq of the North Slope are disproportionately affected by it, both by the fact that climate change effects are more pronounced in the western Arctic and by the fact that Iñupiaq subsistence activities are particularly dependent on ice, wind, and permafrost conditions.

Climate change is changing the environment of the North Slope and affecting subsistence users' ability to access subsistence resources at appropriate times (Brinkman et al. 2016). The reduction of sea ice has exacerbated coastal erosion, the weather has become less predictable, the shore ice in spring is less stable for whaling, fall travel for caribou is hampered by a late and unreliable freeze up, spring hunting for geese is hampered by an early breakup, and ice cellars provide less reliable food storage. All of these issues create significant concerns for many Iñupiat because they are factors that cannot be controlled and that are threatening their way of life. Similar concerns also apply to those who are not on the North Slope but nevertheless depend on its subsistence resources, such as the Gwich'in communities of Arctic Village and Venetie.

Direct and Indirect Impacts

Issuance of oil and gas leases under the directives of Section 20001(c)(1) of PL 115-97 would have no direct impacts on the environment because by itself a lease does not authorize any on the ground oil and gas activities; however, a lease does grant the lessee certain rights to drill for and extract oil and gas subject to further environmental review and reasonable regulation, including applicable laws, terms, conditions, and stipulations of the lease. The impacts of such future exploration and development activities that may occur because of the issuance of leases are considered potential indirect impacts of leasing. Such post-lease activities could include seismic and drilling exploration, development, and transportation of oil and gas in and from the Coastal Plain. Therefore, the analysis is of potential direct and indirect impacts on environmental justice from on-the-ground post-lease activities.

This analysis of impacts related to environmental justice considers if implementation of the proposed alternatives would result in disproportionately high and adverse environmental or human health effects on the communities of Kaktovik, Nuiqsut, Arctic Village, or Venetie. These communities meet the demographic characteristics to be qualified as minority populations (and the latter two as low-income populations) and require evaluation for disproportionate impacts under environmental justice.

EO 12898 directs federal agencies, to the greatest extent practicable and permitted by law, to achieve environmental justice by identifying and addressing disproportionately high and adverse human health or environmental effects of proposed federal actions on minority and low-income populations. The NEPA analysis of environmental justice is also informed by CEQ guidance, as follows:

> Under NEPA, the identification of a disproportionately high and adverse human health or environmental effect on a low-income population, minority population, or Indian [or Alaska Native] tribe does not preclude a proposed agency action from going forward, nor does it necessarily compel a conclusion that a proposed action is environmentally unsatisfactory. Rather, the identification of such an effect should heighten agency attention

to alternatives (including alternative sites), mitigation strategies, monitoring needs, and preferences expressed by the affected community or population (CEQ 1997).

Federal agencies also are required to give affected communities opportunities to provide input into the environmental review process, including the identification of mitigation measures. The BLM has assured meaningful community representation in the process by holding public meetings in the communities of Kaktovik, Arctic Village, and Venetie, among others; coordinating directly with federally recognized tribal governments in compliance with EO 13175 and BLM's Tribal Consultation policy, which has resulted in government-to-government meetings with relevant entities in Kaktovik, Arctic Village, and Venetie, among others, and ANCSA corporation consultation meetings with the KIC and the ASRC, among others; and having several tribal governments sign on for participation as cooperating agencies, including the Native Village of Kaktovik, Arctic Village Council, Venetie Village Council, and the Native Village of Venetie Tribal Government.

Following CEQ (1997) guidance on evaluating environmental justice under NEPA, the analysis should recognize if the question of whether agency action raises environmental justice issues is highly sensitive to the history or circumstances of a particular community or population. The historical context in which environmental justice issues are considered is presented in the sociocultural systems analysis (**Section 3.4.4**). The BLM recognizes the interrelated cultural, social, occupational, historical, or economic factors that are likely to amplify the natural and physical environmental effects of post-lease oil and gas activities.

CEQ guidance also directs the BLM to consider any multiple or cumulative effects on human health and the environment, even if certain effects are not in the control or subject to the discretion of the agency (CEQ 1997); therefore, the BLM determined whether the potential environmental effects of post-lease oil and gas activities would be disproportionately high and adverse. It based this on whether there is or would be an impact on the natural environment that significantly and adversely affects Alaska Native residents of Kaktovik, Nuiqsut, Arctic Village, or Venetie. Such effects may include subsistence, sociocultural, economic, or public health and safety impacts on residents when those impacts are interrelated to impacts on the natural and physical environment.

Potential impacts for these resources are discussed in **Sections 3.4.3**, **3.4.4**, **3.4.10**, and **3.4.11**, and are not recapitulated in this section beyond brief summaries. This environmental justice analysis also considers that some Inupiaq entities and Iñupiat individuals, as shareholders in ANCSA corporations, would see increased economic activity and revenues from post-lease oil and gas activities.

Alternative A

No potential environmental justice impacts are evident in the analysis of Alternative A. Specifically, subsistence uses, sociocultural systems, and public health and safety among the Iñupiaq and Gwich'in peoples would be unaffected by oil and gas development in the program area. Iñupiaq and Gwich'in sociocultural systems would likely continue to evolve due to existing forces of change. The economic conditions and the local, regional, and state level are expected to continue along current trends.

Impacts Common to All Action Alternatives

For all action alternatives, potential environmental justice impacts would derive from disproportionately high and adverse human health or environmental effects identified in other resource area analyses that would accrue to minority populations, low-income populations, or Alaska Native tribal entities. Impacts identified as subsistence, sociocultural, and public health and safety are largely, if not exclusively, also of importance to environmental justice.

In the case of subsistence and sociocultural analyses, identified potential adverse effects are concentrated in communities with largely Alaska Native populations, namely Kaktovik, Nuiqsut, Arctic Village, and Venetie. All of these have affiliated tribal entities and, in the case of the North Slope communities, affiliated Alaska Native regional and local corporations, with substantial resident shareholder populations.

In the case of potential public health and safety impacts, nearly all of the identified potential adverse effects are concentrated in Kaktovik as the community closest to likely future development. In the case of economic impacts, with the exception of subsistence-related impacts that, in turn, have an economic dimension, few potential adverse impacts are identified, but potential localized economic impacts are noted as most likely to accrue to residents of Kaktovik and other NSB communities, both in terms of governmental revenues and in terms of returns to resident Alaska Native corporation shareholders.

<u>Subsistence Uses and Resources</u>
The primary factors that may result in potential impacts on subsistence resources and uses are noise, traffic, and human activity; infrastructure, including physical barriers; contamination; legal or regulatory barriers; and increased employment or income/revenue. These factors would affect resource availability, resource abundance, and user access for residents of the study communities, which in turn would result in adverse economic impacts for those whose cost of living would rise as a result of needing to purchase alternative foodstuffs.

In all cases, development could potentially affect subsistence uses of resources of major importance for the subsistence study communities. Kaktovik residents are the primary users of the program area and would therefore be most likely to experience potential direct impacts associated with development. Nuiqsut residents could experience potential direct and indirect impacts associated with harvests of marine mammals, such as the harvests of bowhead whale by Nuiqsut whalers near Cross Island, and indirect impacts associated with harvests of caribou, waterfowl, and fish. Arctic Village, Venetie, and other communities whose residents subsist in part on the PCH and CAH, could experience indirect impacts associated with caribou and, to a lesser extent, waterfowl. Impacts related to an increase in employment rates or income are most likely for the community of Kaktovik but would extend to other communities on the North Slope. Overall, future development in the program area would have potential lasting adverse effects on cultural practices, values, and beliefs through its impacts on subsistence.

<u>Sociocultural Systems</u>
The primary factors that may result in potential impacts on sociocultural systems include: 1) changes in income and employment levels, 2) changes in available technologies, 3) disruptions to subsistence activities and uses, 4) influx of non-resident temporary workers associated with the oil and gas leasing program, and 5) influx of outsiders coming into the study communities. An influx of cash into a small, rural community can have both positive and negative impacts on sociocultural systems.

<u>Economy</u>
As noted in **Section 3.4.10**, historically, very few North Slope residents participate in direct oil and gas activities in the North Slope; however, North Slope residents who live near existing oil developments have participated in oil and gas jobs, such as ice road monitors, camp security and facilities operators, and subsistence representatives.

As further noted in **Section 3.4.10**, in 2016, while 55 oil and gas jobs were held by NSB residents, or less that 0.5 percent of the total oil and gas jobs based on the North Slope, it is also possible that, with more education and training, the future composition of the oil and gas workforce would be different. Training programs geared toward developing special skills required in oilfield services are expected to create more employment opportunities for residents of Kaktovik in particular, given their proximity to the region where oil and gas activities are likely to occur. Petroleum development in the region is expected to generate revenues to the NSB government, the State, and the federal government from royalties, income taxes, production taxes, and property taxes, as shown in **Table 3-37**.

The City of Kaktovik would likely receive increased bed tax revenues with higher hotel occupancy, especially during initial development years (mobilization) and stakeholder engagement and industry community outreach; however, the change in the level of hotel occupancy is difficult to quantify at this point, because the timing and amount of local consultations and mobilization is uncertain and may vary. No changes to population growth rate or increase in population are expected in Kaktovik, because industry workers are expected to commute on a rotational basis, rather than relocating to Kaktovik or other North Slope communities.

Given that future oilfield workers would be housed in work camps at the CPFs and drill pads, no increase in demand for local services and other public infrastructure is anticipated in Kaktovik. As noted in **Section 3.4.10**, however, local businesses in Kaktovik, including the KIC and its subsidiaries, could increase their economic activity from participation in oil and gas activities occurring during the exploration, development, and production of petroleum resources in the Coastal Plain; however, the level of increased economic activity cannot be quantified with existing data.

<u>Public Health</u>

All action alternatives are likely to be below applicable air quality standards for all phases of a future development project. Water would be contaminated in the event of an accidental discharge; however, the likelihood of any such discharge occurring with the resultant human exposure is low, given the lease stipulations and ROPs around waste prevention, handling, disposal, spills, and public safety. If exposure were to occur, it would be likely short term and intermittent and unlikely to lead to significant health effects.

There is a low likelihood of contamination of subsistence food sources, with the possible exception of contamination through an oil spill or through contaminants mobilized through erosion or permafrost degradation. The history of oil and gas operations on the North Slope suggests a number of other potential oil and gas-related sources of contamination of subsistence foods (NRC 2003); however, the perception of contamination may result in stress and anxiety about the safety of subsistence foods and avoidance of subsistence food sources, with potential changes in nutrition-related diseases as a result. These health impacts (perceived or real) arise regardless of whether there is any contamination at levels of toxicological significance; the impacts are linked to the perception of contamination, not to measured levels.

Noise level increases from construction or operation of oil and gas facilities would result in potential effects, ranging from minor irritation and annoyance to more severe health outcomes. Given the likely location of development away from Kaktovik, individuals at cabins or camps near developments would be most affected. Until site-specific development activities are proposed, the extent of this effect is not possible to determine.

Increased income for Kaktovik residents and families could improve health through increases in the standard of living, reductions in stress, and opportunities for personal growth and social relationships; however, with other oil and gas development in the NSB, income and employment have been found to be associated with an increased prevalence of social pathologies, including substance abuse, assault, domestic violence, and unintentional and intentional injuries.

Future oil and gas development in the program area could increase the risk of injuries and accidents during subsistence activities. Increasing use of roadways increases the risk of motor vehicle accidents and injuries; however, the likelihood of accidents on ice roads or in-field roads is low, given the lease stipulations and ROPs that address vehicle and roadway use.

Alternative B

Subsistence Uses and Resources

Alternative B would result in the greatest potential impact on caribou calf survival and overall herd numbers, due to the amount of lands available for oil and gas leasing. Alternative B would include 0.5- to 1-mile setbacks (with no permanent oil and gas infrastructure, including roads and pipelines, allowed) for eight major rivers, many of which, such as the Hulahula, Okpilak, and Jago Rivers, are key drainages used for subsistence activities. Some TLs on human activity would be in place for calving and post-calving habitats of the PCH, which would reduce impacts on resource abundance and availability.

Sociocultural Systems

Because of its proximity to the program area, the community of Kaktovik would experience the greatest intensity of potential effects associated with the proposed oil and gas leasing program. Potential impacts on sociocultural systems may also occur for other communities if oil and gas development in the program area results in changes to resource abundance or availability, particularly of caribou, which is a resource of major importance to the closest communities of Kaktovik, Nuiqsut, Arctic Village, and Venetie.

Because of the particular spiritual and cultural importance of the coastal plain and PCH calving grounds to the people of Arctic Village and Venetie, any disruption to that herd or contamination or degradation of calving grounds in the program area would have potential sociocultural impacts on the Gwich'in people, in terms of their belief systems and cultural identity.

Economy

Potential economic effects would be similar to those discussed above in *Impacts Common to All Action Alternatives*. There would be unquantifiable differences in economic effects due to the ROPs associated with the various lease stipulations under Alternative B. Some of these actions would likely also result in delays in exploration, development, and production; therefore, this would also delay potential employment and income effects, as well as revenues that would otherwise accrue to the local, State, and federal governments.

Public Health

Potential threats to subsistence activities and harvest patterns are a primary source of ongoing stress in North Slope communities. Avoidance of productive subsistence areas may reduce harvests and exacerbate dietary and nutritional outcomes, independent of any potential direct impact on the animals themselves. Reductions in the success of subsistence harvests for Kaktovik residents could cause a shift from subsistence resources to store-bought foods, worsening nutritional outcomes and food insecurity.

Alternative C

Subsistence Uses and Resources

Under Alternative C, Lease Stipulations 6 and 7 would provide additional protections for caribou, and pads and CPFs would not be allowed within 1 mile inland of the coast under Lease Stipulation 9, although essential pipelines and roads may still occur. In addition, Lease Stipulation 8 would impose greater TLs on human activity in the PCH post-calving habitat area than Alternative B. Potential demographic impacts on the PCH would be less likely than under Alternative B, so the intensity of subsistence impacts under Alternative C would be less than Alternative B.

Sociocultural Systems

Of the lease stipulations noted above, the intensity of potential sociocultural impacts related to caribou under Alternative C would be less than Alternative B.

Economics

The potential economic effects under Alternative C would be similar in magnitude to the economic effects discussed above in *Impacts Common to All Action Alternatives*. Similar to Alternative B, there would be differences in economic effects resulting from areas available to lease in the program area, but these economic effects would be difficult to quantify at this leasing phase.

Public Health

Through additional protection for caribou, Alternative C would likely decrease the potential for impacts on Kaktovik residents' subsistence harvest and the likelihood and severity of health impacts from reduced subsistence harvests, increased reliance on store-bought food, and food insecurity.

Alternative D

Subsistence Uses and Resources

Under Alternative D, lease sales on calving grounds would be most limited of all action alternatives, and more lands would be subject to future development and TL; therefore, Alternative D would be the least likely to affect calf survival and overall herd numbers of all action alternatives. Alternative D also includes larger setbacks from key subsistence drainages than other action alternatives, including 4 miles of the Hulahula and 3 miles of the Okpilak Rivers, which would greatly reduce potential impacts on subsistence in those areas, particularly during the winter.

Under Alternative D, no pads or CPFs would be allowed within 2 miles of the coast, reducing potential impacts on coastal subsistence hunters and anglers. In addition, reclamation of infrastructure would be on ongoing process for each development area, thus lessening the duration of impacts for individual developments related to infrastructure. Alternative D would include additional design features meant to address impacts on subsistence resources and users, and more consultation with tribal governments on design features, timing, development methods, and access.

Sociocultural Systems

Because of increased caribou calving grounds avoidance and because more lands would be subject to development restrictions, the intensity of potential sociocultural impacts under Alternative D would be less than under Alternative B.

Economy

Given the higher level of restrictions under Alternative D, the difference in the level of economic effects under this alternative would be higher, compared with the differences in economic effects under Alternatives B and C. These increased restrictions would likely reduce the amount of oil produced and defer or reduce revenues and taxes.

Public Health

Similar to Alternative C, through additional protection for caribou, Alternative D would decrease the potential for impacts on Kaktovik residents' subsistence harvest and therefore the likelihood and severity of health impacts from reduced subsistence harvests, increased reliance on store-bought food, and food insecurity.

Cumulative Impacts

While there has been no previous oil and gas development in the Coastal Plain and very little oil and gas exploration in the same area, the North Slope as a region sustained contact with outside entities and institutions. This includes the decades of oil exploration and development conducted by the federal government and industry. This has directly affected habitat use and behavior of subsistence species and resulted in additive impacts on subsistence resources, harvest patterns, and users (BLM 2018a). These effects have altered livelihoods and ways of life and account for some of the social disruptions seen in villages today.

Oil and gas development has also provided the underpinning of a regional economy that has enabled the NSB a greater degree of local control and self-determination in addressing socioeconomic and sociocultural issues, although dependence on an undiversified economy based on the extraction of natural resources has created other challenges. The leasing program would likely contribute to potential cumulative impacts in a variety of ways across the subsistence, sociocultural, economic, and public health spectrum.

Subsistence Uses and Resources

Cumulative impacts on subsistence would alter subsistence use areas, user access, and resource availability for Iñupiaq and Gwich'in subsistence users. Over time, changes in how residents access and use the land and reduced opportunities for participation in subsistence harvesting, processing, distribution, and celebrations from decreased harvests would have negative effects on culture by weakening social ties and knowledge of cultural traditions.

Sociocultural Systems

Increased interactions with outsiders in traditional use areas and communities has the potential to affect traditional values and belief systems over time and may also result in increased social problems, if such interactions lead to greater access to drugs and alcohol. Cumulatively, strong local economies would have positive social impacts, as long as the communities are able to adapt to such changes, while maintaining cultural traditions and values. Communities that are most likely to experience negative sociocultural impacts would be those that experience impacts on subsistence, while not having increased income or employment opportunities, such as Arctic Village and Venetie; therefore, the action alternatives would constitute a disproportionate, adverse impact on the environmental justice communities of Arctic Village and Venetie. These effects would be highest under Alternative B, less under Alternative C, and the least under Alternative D.

Economy

The oil and gas leasing program and subsequent exploration, development, and production in the program area would increase oil and natural gas production on the North Slope and increase TAPS throughput. Economic activity would increase at the local, regional, and state level due to direct industry spending on labor, materials, and services. Government revenues would increase from shared royalties, tax payments such as property taxes, corporate income taxes, severance taxes, and other local taxes, although the cumulative impact cannot be quantified with existing data (see **Table 3-37** for incremental contribution of post-lease oil and gas activities). Job opportunities would increase for Alaskans, including residents of communities in the NSB. Labor income would increase in regions where industry spending would occur and where the oil and gas workforce resides, although the cumulative impact cannot be quantified with existing data (see **Table 3-35** and **Table 3-36** and accompanying discussions for the incremental contribution of post-lease oil and gas activities).

Public Health

As noted in **Section 3.4.11**, for most past, present, and reasonably foreseeable future projects, the village of Kaktovik and its residents have been buffered by surrounding undeveloped lands. Air and water quality in and around the village remains good, and the influx of oil and gas revenue for the NSB has improved infrastructure in the village.

High rates of accidents and injury are primarily due to subsistence activities, and food security for Kaktovik households remains a concern (see *Food, Nutrition, and Subsistence Activity* in **Section 3.4.11**). Future development offshore in the Beaufort Sea would likely increase the risk of accident and injury by changing the subsistence harvest patterns and requiring more time on the water to harvest animals. The onshore leasing alternatives would have similar contributions to the cumulative effects on public health for Kaktovik residents with the pathways described above.

Current levels of contamination of traditional food and water supplies in the region are low and, in the absence of major spills or accidents, are unlikely to significantly change under any alternative. Oil and gas development, particularly in areas of traditional use and subsistence harvest, would disrupt subsistence harvest patterns. Conflicts between uses of the land would lead to an increased risk of injury in hunters.

All action alternatives would increase the potential likelihood of injury due to industrial use of land previously used only for subsistence activity. Continuing economic development and increasing revenues to the local governments under all action alternatives would support maintenance of Kaktovik infrastructure and systems. The potential direct and indirect employment resulting from oil and gas exploration and development, combined with the government and Native corporation revenues, are all major contributors to the positive health changes in the NSB over the last few decades. The future oil and gas activities under all action alternatives would contribute to these ongoing changes, with greater levels of employment generally being more likely to be associated with good health.

3.4.6 Recreation

Affected Environment

Recreation opportunities and settings in the program area are largely as described in the Arctic Refuge CCP (USFWS 2015a), which is incorporated here by reference; a summary is provided below.

The primary recreation opportunities in the program area are wildlife viewing, camping, backpacking, hiking, photographing, hunting, fishing, and boating (Christensen and Christensen 2009). These activities include hunting and fishing for non-federally qualified subsistence users, permitted commercial activities, such as guided float trips and hunting, and individual visitors engaged in dispersed recreation, such as backpacking and photographing. Polar bear viewing and ski touring are also popular (USFWS 2018).

The recreation setting of the program area is remote; in many cases, visitors do not encounter other people during their visit. Many people visit the program area in the summer, when near constant daylight provides unique multiday recreation opportunities. Increasingly, visitors are coming to the program area later in the fall, experiencing rapid decreases in average daily daylight and increased opportunity to view the Northern Lights. Weather, surface water and land surface conditions, and near continual darkness limit or prevent access to many parts of the program area during the winter and spring.

There is limited overland motorized access to or in the program area. Motorized recreation opportunities and use of motor vehicles to access other forms of recreation consist mainly of snowmachines, which are legal during periods of adequate snow cover. Most snowmachine use is associated with subsistence activities. The only roads are near the community of Kaktovik. Access to inland areas is either by boat, such as along the Kongakut, Canning, or Hulahula Rivers, by aircraft, or by foot.

Most visitors to the inland portions of the program area arrive by chartered aircraft. Air operators providing transportation services to visitors are regulated through a special use permit system, which identifies the specifications for their operations. There is a relative absence of water bodies sizable enough to support float landings, so the vast majority of landings are made on land where surface conditions permit it. Visitors enter the program area directly via chartered aircraft, from the north via Kaktovik or, to a lesser extent, from the south via the Dalton Highway through the Arctic Refuge Wilderness Area.

In 2017, four commercial air service operators provided air taxi service for 1,400 visitors; another seven operators chartered polar bear viewing excursions for 1,600 visitors. Air taxi service supported recreation for 850 river floaters, 300 backpackers, 40 base campers, and 100 hunters (BLM 2018g).

Visitor use in the program area has increased in recent years with the emergence of polar bear viewing on waters immediately surrounding Kaktovik. Before the season for polar bear viewing, more than 90 percent of visitors access the program area via airplane, with more than 80 percent of all visitors arriving via chartered planes (Christensen and Christensen 2009). Other visitors accessed recreation opportunities in the program area via boat or on foot.

During the summer and fall, the Kongakut, Canning, and Hulahula Rivers support most water-based access to the interior areas. Visitors typically travel by plane to the rivers' headwaters in the southern portion of the program area and float northward toward the Arctic Ocean. Most recreation is in these river corridors.

In 2017, guided polar bear viewing accounted for approximately 54 percent of all reported guided recreation activities in the program area. Polar bears are viewed on waters next to Kaktovik.

Of the remaining 46 percent of visitors to the program area, use was more dispersed, and river floaters accounted for 60 percent of visitors, while backpackers, base campers, and hunters made up 40 percent of the activity types. Visitors for each of these four recreation types depend predominantly on use of river corridors during all or a portion of their visits (BLM 2018g).

As described in the Arctic Refuge CCP (USFWS 2015a), the Kongakut River is popular among visitors during late spring and early summer to observe the caribou migration and in August to hunt. Caribou are the primary game species hunted in the program area, which is entirely in GMU 26C. There is also subsistence hunting of caribou and marine mammals that takes place in the program area (see **Section 3.4.3**). In 2017, approximately 4 percent of all reported guided recreation in the program area was hunting. Of the visitors to the program area whose use was focused on river corridors and not polar bear viewing, approximately 8 percent were hunters (BLM 2018g).

Polar bear viewing is an increasingly popular activity in the program area. In 2013, it represented approximately one quarter of all recreation visits; in 2016 and 2017, it accounted for more than half (BLM 2018g). There are viewing opportunities near Kaktovik, including through guided viewing tours. Expanded infrastructure at Kaktovik supports international visitors seeking the unique opportunity of viewing polar bears outside of captivity.

Climate Change

The unique character of landscapes in the program area would continue to change in response to climate change. Increasing temperatures would directly affect recreation by reducing opportunities to participate in over-snow activities, such as ski touring. Warmer temperatures associated with climate change would increase the potential for direct and indirect impacts on recreation from the earlier thawing of permafrost and variable stream flows, which are altering or diminishing the quality of recreation and the ability of visitors to access them.

Direct and Indirect Impacts

Issuance of oil and gas leases under the directives of Section 20001(c)(1) of PL 115-97 would have no direct impacts on the environment because by itself a lease does not authorize any on the ground oil and gas activities; however, a lease does grant the lessee certain rights to drill for and extract oil and gas subject to further environmental review and reasonable regulation, including applicable laws, terms, conditions, and stipulations of the lease. The impacts of such future exploration and development activities that may occur because of the issuance of leases are considered potential indirect impacts of leasing. Such post-lease activities could include seismic and drilling exploration, development, and transportation of oil and gas in and from the Coastal Plain. Therefore, the analysis is of potential direct and indirect impacts on recreation from on-the-ground post-lease activities.

Potential impacts on recreation would result from management that enhances or diminishes the quality of the recreation setting, limits access or physically displaces visitors or subsistence users because of new surface disturbance or development, increases or decreases conflicts between recreation uses, such as in high use areas, increases or decreases the ability of commercial operators to carry out specially permitted activities, or enhances or diminishes subsistence opportunities. The effects of climate change described under *Affected Environment* above, could influence the rate or degree of the potential direct and indirect impacts.

Alternative A

Under Alternative A, no oil and gas leasing program would take place in the program area; there would be no potential direct or indirect impacts on recreation from post-lease oil and gas activities in the program area.

Impacts Common to All Action Alternatives

The magnitude, spatial extent, and duration of potential impacts on recreation would vary, based on season, type of recreation, and location in the program area. In general, the potential for impacts on recreation would be greatest during the summer and fall, when weather and daylight conditions allow for the greatest number and type of recreation uses. Similarly, the potential for impacts would be greatest along river corridors, the Beaufort Sea coastline, and other areas where the number of recreation users is highest. Because visitors to the program area generally expect a physical setting consisting of little to no human disturbance and a social setting with little to no interaction with other visitors or human activity, small changes to the physical and social setting can have disproportionately large impacts on user experiences.

Protective measures intended to limit ground disturbance and associated impacts on resources would improve recreation by limiting or prohibiting surface-disturbing activities that could diminish the quality of recreation experiences, conflict with recreation opportunities, or displace visitors and subsistence users. The magnitude of potential impacts on recreation would be directly related to the type and extent of proposed lease stipulations or ROPs under each alternative. In general, maintaining or improving resource conditions increases the quality of recreation (Dorwart et al. 2009).

The program area offers recreationists primitive recreation experiences, such as expedition-length float hunts and polar bear viewing, that are unique on a global scale and that depend largely on the physical setting. Visual quality contributes to the physical setting and directly influences recreationists' satisfaction with recreation in the program area. Undisturbed landscapes contribute to higher-quality recreation opportunities. Protective measures attached to leases, such as NSOs, which prevent surface disturbance and the placement of aboveground infrastructure, would eliminate the potential for changes to visual quality and associated physical setting. Where aboveground development is allowed, lease stipulations that minimize the visual contrast of new development, such as by requiring design elements that complement the predominant natural features of the characteristic landscape, would reduce the intensity of visual impacts and associated change to the recreation setting.

Night sky conditions are a component of visual quality that also contribute to the recreation setting and user experiences. The addition of artificial lighting at facilities in the future and from vehicles would diminish the quality of night sky conditions, especially in the winter and spring, when daylight hours are shortest. Diminished night sky conditions during the winter and spring would affect fewer visitors, compared with daytime visual impacts. This is because there are fewer visitors to the program area during that time of year; however, any new artificial light would result in a potential impact on those visitor experiences because there are very few artificial light sources in the program area.

Similarly, future artificial lighting during the limited nighttime hours in the summer and fall would result in a short but intense impact, which could diminish the overall quality of visitor experiences. There would also be potential indirect impact on the experience where artificial light reduces visitors' ability to observe the Northern Lights. Protective measures that prevent the placement of aboveground infrastructure or that specify the use of downcast lighting or other light trespass mitigation measures would minimize impacts on the quality of nighttime recreation.

The magnitude of potential impacts on the recreation setting from visual quality, including night skies, would decrease, relative to users' increasing distance from the source of any visual impact or artificial light; however, the relatively flat topographic characteristics of the program area would result in new mineral development infrastructure being visible from far distances. Also, because there is no development currently, any new development that would be visible to recreation users would modify the recreation setting and visitor experiences. Even with protective measures to minimize potential visual impacts, surface disturbance and infrastructure development would modify the existing character of the landscape, diminish visual quality, and directly affect the quality of the recreation setting and associated experiences. The intensity and duration of the impact would depend on the type and location of the development, relative to recreation opportunities.

Noise from mineral development following a lease sale would modify the recreation setting and could potentially diminish visitor experiences. The magnitude of impacts depends on the distance between the observer and the noise source, the duration and frequency of the noise, the time at which the noise occurs, the presence of topographical features or vegetation that decreases noise, and the lease stipulations or mitigation strategies that reduce noise levels. The use of compression technology would increase the noise levels associated with mineral production. More frequent aircraft and ground-based vehicle trips could also increase the occurrence of noise impacts from those sources. Potential noise impacts on recreation would diminish farther from the source, because noise diminishes with distance.

Lease sales resulting in future mineral exploration and production and associated pipelines, private roads, mineral material sites, and other infrastructure can physically displace recreation opportunities and prevent access to areas for recreation. The magnitude and type of potential impacts would depend on the location of the development and recreation activity affected. The potential for impacts would be greatest during the summer and fall when visitation is highest and near river corridors and other areas where visitors concentrate; however, permanent infrastructure would displace all types of visitors year-round and over the long term.

Overland heavy equipment vehicle use for future seismic work could displace winter users when the equipment is in use. Vehicle operation would also produce noise and artificial light, which could detract from the primitive recreation experience. Over snow heavy vehicles used for seismic work can leave grid lines on the landscape visible by aircraft passengers following snow melt. This is the result of compacted snow melting slower than surrounding areas, creating darker vegetation patterns matching the gridlines used for the seismic work. In the summer and fall, for visitors arriving by air, or where the grid lines are visible from elevated areas, this modification would influence visitor perceptions of the program area's setting. Once they are on the ground or in equal elevation to the grid lines, there would be potential impacts on visitor experiences.

Recreationists in the program area rely heavily on commercial operators for access to desired recreation opportunities and experiences. Changes in resource conditions, including physical resources, such as visual quality, and biological conditions, such as wildlife, would directly influence the quality of recreation experiences obtained through commercial operators. For example, mineral development in leased areas that relocates or decreases polar bear or caribou populations would diminish the ability of operators to provide clients with desired recreation experiences. This could lessen the viability of certain operations, resulting in fewer permitted operators, which would indirectly affect recreation by potentially reducing access to the program area via specially permitted means.

Alternative B

Under Alternative B, 1,563,500 acres are available for lease sales, 77 percent of which (1,204,000 acres) would be available for surface use. This would result in potential direct and indirect impacts on recreation throughout nearly the entire program area. The types of impacts described under *Impacts Common to All Action Alternatives* would result from lease sales that would be followed by the construction and operation of drill pads, CPFs, gravel roads, pipelines, STP, and gravel pits to support mineral development.

Over time as exploration, well pad development, road construction, and extraction occur, there would be a steady decline in the recreation setting from changes to the visual quality and night sky, compared with Alternative A. Noise from construction, production, aircraft, and vehicles would also diminish the quality of the recreation setting (see **Section 3.2.3**, Acoustic Environment). With the intensification of development through the construction and production phases, there would be a steady increase in surface disturbance, which would increase the potential for visitor displacement and restrictions on access for visitors and subsistence users. New roads would create up to 208 miles of dispersed, linear barriers. Year-round vehicle traffic on the roads would contribute to noise, visual, and light-related impacts on the primitive recreation uses that occur in the program area.

One-mile setbacks from the Canning, Hulahula, and Jago Rivers, and narrow setbacks for other rivers that serve as primary recreation use areas, would potentially directly impact the recreation setting and visitor experiences as described above. The narrow setback would provide little opportunity for vegetation or topography to provide consistent screening of new facilities or vehicle traffic from view of users in the river corridors. The intensity of the impact would depend on structure height, topography, and vegetation that influence a user's line of sight from the river corridor. Drill pads, roads, and pipelines near these river corridors would also physically displace visitors from areas outside the setbacks. Concentrating recreation uses in narrow river corridors would increase the density of activity in those corridors, compared with Alternative A, which would increase the number of interactions among visitors. This would directly affect the social setting and could increase the potential for conflicts among different types of recreation users.

There would be no specific protection measures to minimize disturbance in polar bear denning critical habitat, which could result in potential species displacement or decline. Over time, fewer species would result in fewer viewing opportunities, which would lessen the viability of commercial operators providing guided polar bear viewing experiences. This could reduce the number of specially permitted operators and indirectly limit future opportunities for visitors to experience polar bears outside of captivity.

Minimal protection measures for development in caribou summer, calving, and post-calving habitat areas could lead to displacement and possible decline in caribou populations, which would decrease hunting and viewing opportunities. Potential impacts on caribou populations would also indirectly affect the viability of commercial recreation uses that provide guided hunting and viewing opportunities. Fewer operators would result in an overall decline in opportunities to access the program area for recreation.

The long-term, permanent degradation of the program area's primitive recreation setting could result from not requiring final abandonment to meet minimal standards for WSR designation, not restoring general wilderness characteristics of the area, and allowing exceptions to abandonment conditions.

Alternative C

Compared with Alternative A, new oil and gas development following lease sales on up to 1,563,500 acres would potentially diminish the quality of the recreation setting and visitor experiences, displace visitors and subsistence users, and increase conflicts between users. Following the lease sales, the types of impacts described under *Impacts Common to All Action Alternatives* would result from the construction and operation of an anticipated 18 drill pads and construction of CPFs, gravel roads, pipelines, STP, and gravel pits to support mineral development. The intensity of impacts would be similar to those described under Alternative B; however, additional lease stipulations and a larger NSO area under Alternative C would result in potential impacts being experienced over a smaller area than under Alternative B.

Four-mile NSO setbacks from rivers, such as the Canning and Hulahula Rivers, would maintain recreation opportunities and avoid the displacement of visitors in those popular recreation corridors. The potential for user conflicts in river corridors would be the same as Alternative A. This is because the wide corridor setbacks would support visitor dispersion in the corridor without being constrained by development.

Where unobstructed by topography or vegetation, infrastructure and vehicle traffic would be visible from the rivers. This would alter the recreation setting and could contribute to diminished user experiences. Where vegetation and topography provide screening, impacts would be nearly the same as under Alternative A. The exception would be at nighttime, when artificial lighting skyward of any new facilities would be visible, which would affect recreation, as described under *Impacts Common to All Action Alternatives*, above. A narrower 1-mile setback along the Jago River would result in the same impacts as Alternative B. Outside the river corridor setbacks, the potential for displacing visitors and limiting access would be the same as Alternative B and as described under *Impacts Common to All Action Alternatives*, above.

Protection measures limiting activity in polar bear denning habitat and caribou summer, calving, and post-calving habitat would minimize the potential for species dispersion, or decline, which would indirectly maintain the quality of hunting and wildlife viewing experiences. This would also minimize impacts on the viability of specially permitted commercial operators.

In the long term, requiring final abandonment to meet minimal standards for WSR designation and intent to restore general wilderness characteristics of the area would allow the program area to return to a primitive recreation setting. The removal of facilities and restoration of disturbed areas would eliminate displacement and access impacts associated with those features.

Alternative D

Potential impacts on recreation under both subalternatives of Alternative D would be similar to those described under Alternative C. The exception would be that making 1,037,200 acres available for leasing, of which 708,600 acres (45 percent) would be NSO, would largely concentrate the *Impacts Common to All Action Alternatives* described above into a smaller portion of the program area. Compared with Alternative A, the greatest potential for impacts would be in the 328,600 acres (21 percent of the program area) available for leasing with surface use; however, some impacts associated with an anticipated 21 well pads and associated infrastructure would occur inside of the NSO areas. These would include changes to the recreation setting from artificial lighting and alteration of the recreation setting and visitor experiences from the visual presence of infrastructure and vehicles.

Cumulative Impacts

Potential cumulative impacts on recreation would be the result of actions or circumstances, both in or outside the ability of BLM to manage, that would enhance or diminish the quality of the recreation setting, limit access or displace visitors or subsistence users, increase or decrease conflicts between recreationists, increase or decrease the ability of commercial operators to carry out specially permitted activities, or enhance or diminish subsistence opportunities. Past, present, and reasonably foreseeable future actions described in **Appendix F** that would cumulatively impact recreation include increasing recreation use in the program area, and energy and infrastructure development.

Under all alternatives, there would be an increased demand for recreation use in the program area. This would be the case particularly on lands that are easily accessed from nearby communities or waterways. With this increased demand, the social recreational setting would continue changing, resulting in the potential for more frequent and intense user interactions. Under all action alternatives, with increasing demand, the displacement of visitors near leasing areas would increase recreation use in other locations in the program area. This would increase the potential for user conflicts in those areas. Over time, more rules and regulations to control access and use may be needed. These potential changes would cumulatively impact the quantity and quality of recreation opportunities that can be offered and the recreation experience and opportunities that can be provided.

Under all action alternatives, oil and gas development, would increase the presence of well pads, pipelines, roads, and other infrastructure, which would potentially displace recreation in the program area. Combined with increased visitation and other reasonably foreseeable future actions, new infrastructure development would diminish the quality of the recreation setting and associated recreation experience. These potential impacts would last until the infrastructure is removed and the areas reclaimed. The intensity of impacts on visitor experiences and recreation setting would be greatest in areas where infrastructure is visible, and operations are audible. Visitors displaced from certain areas because of oil and gas activity could choose alternate locations in the program area to recreate, which could lead to more frequent conflicts among recreationists in those areas. The effects of climate change described under *Affected Environment* above, could influence the rate or degree of the potential cumulative impacts.

3.4.7 Special Designations

Affected Environment

Arctic National Wildlife Refuge Purposes

The Arctic National Wildlife Range was established in 1960 by Public Land Order 2214 "For the purpose of preserving unique wildlife, wilderness and recreational values...." In 1980, ANILCA redesignated the range as part of the larger Arctic Refuge. It also designated much of the original range as wilderness under the 1964 Wilderness Act and provided four purposes that guide management of the entire refuge. Section 20001 of PL 115-97 Act amended Section 303(2)(B) of ANILCA to add a fifth purpose related to the oil and gas program on the Coastal Plain. **Table 3-31** identifies the section of this EIS where impacts of oil and gas leasing on Arctic Refuge purposes can be found.

Table 3-31
Arctic National Wildlife Refuge Purposes

Purpose	EIS Section Describing Impacts on Arctic Refuge Purpose
(i) to conserve fish and wildlife populations and habitats in their natural diversity	3.2.2 Air Quality 3.2.8 Soil Resources 3.2.10 Water Resources 3.3.1 Vegetation and Wetlands 3.3.2 Fish and Aquatic Species 3.3.3 Birds 3.3.4 Terrestrial Mammals 3.3.5 Marine Mammals
(ii) to fulfill the international fish and wildlife treaty obligations of the US	3.3.4 Terrestrial Mammals
(iii) to provide the opportunity for continued subsistence uses by local residents	3.4.3 Subsistence Uses and Resources
(iv) to ensure water quality and necessary water quantity in the refuge	3.2.10 Water Resources
(v) to provide for an oil and gas program on the Coastal Plain	3.2.5 Geology and Minerals 3.2.6 Petroleum Resources 3.4.10 Economy

Marine Protected Areas

The USFWS (2015a, Section 4.1.3.3, Marine Protected Area) described marine protected areas (MPAs). The discussion below tiers to and incorporates by reference relevant information, while placing emphasis on the program area.

MPAs come in a variety of forms and are established to protect ecosystems, preserve cultural resources, such as shipwrecks and archaeological sites, or sustain fisheries production. MPAs are defined as "...any area of the marine environment that has been reserved by Federal, State, territorial, tribal, or local laws or regulations to provide lasting protection for part or all of the natural and cultural resources therein" (EO 13158, May 26, 2000).

The DOI nominated the Arctic Refuge in 2005 and it was accepted for inclusion in the national system of MPAs. There are no special conditions for managing the Arctic Refuge MPA, but designation provides its managers with an opportunity to prioritize using existing management authorities and to better understand the ecological quality and function of its coastal areas.

All marine waters in the Arctic Refuge boundaries and marine waters and lagoons off the northern coast of the program area (1,631,500 acres; BLM GIS 2018) are listed as part of the National MPA System.[42] Shifting shorelines and marine-freshwater boundaries at river mouths create some variability in the acreage estimate for the refuge's contribution to the National MPA System, on the order of plus or minus several hundred acres (USFWS 2015a).

Wild and Scenic Rivers

The USFWS conducted a WSR review as part of their Revised CCP (USFWS 2015b, Appendix I Wild and Scenic River Review). The discussion below tiers to and incorporates by reference relevant information, while placing emphasis on rivers in the program area.

WSRs are rivers or segments of rivers designated by Congress under the authority of the Wild and Scenic Rivers Act of 1968 (PL 90-542, as amended; 16 USC 1271–1287). The purposes of the law are preserving the river or river section in its free-flowing condition, preserving water quality, and protecting its outstandingly remarkable values (ORVs). They are identified on a segment-specific basis and may include scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values.

The Wild and Scenic Rivers Act mandates protections for rivers that are designated rivers of the National Wild and Scenic River System. Federal managers of rivers that were recommended pursuant to a congressionally authorized WSR study are obligated to use existing management authorities to protect the characteristics of rivers for the conditions under which they were found eligible and suitable (USFWS 2015b). A river's preliminary classification (either wild, scenic, or recreational, based on level of development), free-flowing condition, water quality, and ORVs must be maintained. The WSR study for Arctic Refuge (USFWS 2015b) was an agency-directed study, not a congressionally authorized study; however, where practicable and where it does not conflict with the purposes of PL 115-97, stipulations would be applied to protect WSR characteristics on rivers determined to be suitable and recommended to Congress to be included in the system.

The Marsh Fork-Canning and Hulahula Rivers were found to be eligible and suitable for inclusion in the National Wild and Scenic River System (USFWS 2015b). The recommendation for this was carried

[42]See the viewer of the NOAA National MPAs here: https://marineprotectedareas.noaa.gov/dataanalysis/mpainventory/mpaviewer/.

forward to Congress in 2015. In the program area, the entire segment of the Hulahula River was found to be eligible and suitable, and the Canning, Jago, and Okpilak Rivers were found to be eligible in the Wild and Scenic River Review (USFWS 2015b; see **Map 3-46**, Special Designations in **Appendix A**). The Marsh Fork-Canning River is not in the program area.

The sizes and the ORVs and preliminary classification of each eligible and suitable river in the program area are presented in **Table 3-32**, below.

Table 3-32
Eligible and Suitable Rivers within the Program Area

River	Preliminary Determination	Miles USFWS-Administered Land	Preliminary Classification	Outstandingly Remarkable Values
Canning	Eligible	41	Wild	Cultural, wildlife, fish, recreational
Hulahula	Eligible and Suitable	26	Wild	Recreational and cultural
Jago	Eligible	36	Wild	Wildlife
Okpilak	Eligible	33	Wild	Scenic and geologic

Sources: USFWS GIS 2015

Wilderness Characteristics, Qualities, and Values

The USFWS (2015c, Appendix H, Wilderness Review) described the wilderness characteristics in the Arctic Refuge. This section tiers to and incorporates by reference relevant information, while placing emphasis on the program area location. There have been no new data on the wilderness values associated with the program area since the completion of the Arctic Refuge CCP (USFWS 2015c).

The 1964 Wilderness Act established a national system of lands to preserve a representative sample of ecosystems in a natural and wild condition for the benefit of future generations. Public Land Order 2214 (1960) established the original Arctic Range and identified three purposes of preservation: wilderness values, wildlife, and recreational values. ANILCA Section 101(b) outlines the intent "to preserve in their natural state extensive unaltered arctic tundra...ecosystems; and to preserve wilderness resource values and related recreational opportunities including but not limited to hiking, canoeing, fishing, and sport hunting, in large arctic and subarctic wildlands and on free-flowing rivers…." Further, ANILCA 304(g)(2)(B) requires the Secretary of the Interior to identify and describe "the special values of the refuge, as well as...wilderness value of the refuge" when developing plans. In the Arctic Refuge CCP (USFWS 2015a) the USFWS recommended the lands in the program area for wilderness designation; however, Congress did not act on these wilderness recommendations, and subsequently, the minimal management standard for the Coastal Plain must now be adjusted to account for the oil and gas leasing program required by the PL 115-97.

The Wilderness Act describes four primary qualities of wilderness:

- Generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable
- Has outstanding opportunities for solitude or a primitive and unconfined type of recreation
- Has at least 5,000 acres or is of sufficient size as to make practicable its preservation and use in an unimpaired condition
- May also contain ecological, geological, or other features of scientific, educational, scenic, or historic value

These qualities are found throughout the program area, except for certain tracts in the vicinity of Kaktovik.

Direct and Indirect Impacts

Issuance of oil and gas leases under the directives of Section 20001(c)(1) of PL 115-97 would have no direct impacts on the environment because by itself a lease does not authorize any on the ground oil and gas activities; however, a lease does grant the lessee certain rights to drill for and extract oil and gas subject to further environmental review and reasonable regulation, including applicable laws, terms, conditions, and stipulations of the lease. The impacts of such future exploration and development activities that may occur because of the issuance of leases are considered potential indirect impacts of leasing. Such post-lease activities could include seismic and drilling exploration, development, and transportation of oil and gas in and from the Coastal Plain. Therefore, the analysis is of potential direct and indirect impacts on special designations from on-the-ground post-lease activities.

Marine Protected Areas

The Arctic Refuge MPA was accepted for inclusion in the national system of MPAs in 2005. MPAs have legally established goals, conservation objectives, and intended purposes, such as to conserve biodiversity in support of research and education, to protect benthic habitat in order to recover over-fished stocks, and to protect and interpret shipwrecks for maritime education. These descriptors of an MPA are reflected in the site's conservation focus, which represents the characteristics of the area that the MPA was established to conserve (NOAA 2017).

<u>Alternative A</u>

Under Alternative A, no federal minerals in the program area would be offered for future oil and gas lease sales. Current management actions for the MPA would be maintained and resource trends would continue, as described in the Arctic Refuge CCP (USFWS 2015a). Alternative A would not meet the purpose of this EIS to inform the BLM's implementation of PL 115-97, including the requirement to hold multiple lease sales and to permit associated post-lease activities. There would be no potential direct or indirect impacts on MPAs from post-lease oil and gas activities under this alternative.

<u>Impacts Common to All Action Alternatives</u>

Under all action alternatives, the natural heritage conservation focus of the MPA could be affected by activities or development that cause a loss of sea ice, changes in freshwater input, increased rates of coastal erosion or accretion, increased shipping activity, offshore development, oil spills, or an introduction of invasive species associated with marine shipping.

<u>Alternative B</u>

Under Alternative B, potential impacts from exploration and development could affect the MPAs' natural biodiversity (see **Section 3.3.2** and **Section 3.3.5**). Marine and coastal ecosystem impacts would likely occur in the northwestern portion of the program area. This is because exploration wells would be focused in this high potential zone for oil and gas development. Barge landings and staging areas used to transport materials and supplies for facilities could have potential indirect long-term impacts on the MPA by increasing rates of coastal erosion. Gibbs and Richmond (2017) examined shoreline change along Alaska's arctic coast between 1947 and 2012. They found significant modification to coasts and beaches have occurred where production sites sit right on the coast. A more site-specific analysis would occur during the Application for Permit to Drill (APD) phase of development.

Lease Stipulation 9 would require lessees, operators, and contractors to conduct a coastline survey in the coastal area between the northern boundary of the Arctic Refuge and the mainland, and inland areas within 2 miles of the coast. The lessees, operators, and contractors would then be required to develop and implement an impact and conflict avoidance and monitoring plan to assess, minimize, and mitigate the effects of the infrastructure and its use on these coastal area habitats and their use by wildlife and people. This analysis would help reduce potential long-term impacts on the Arctic Refuge MPA natural heritage conservation focus that activities under this alternative could present.

Alternative B includes 1,563,500 acres available for oil and gas leasing and the fewest restrictions on potential disturbances to marine and coastal environments through NSO requirements (359,400 acres). Impacts on the Arctic Refuge MPA would be greatest under Alternative B, compared with the action alternatives, as there would likely be more transportation of materials and supplies for oil and gas development in the coastal areas. A more site-specific analysis would occur during the APD phase of development.

Alternative C

Under Alternative C, potential impacts would be similar to those described under Alternative B, but more constraints would apply, thereby reducing the intensity of impacts on the Arctic Refuge MPA.

Similar to Alternative B, the lessees, operators, and contractors would be required to develop and implement an impact and conflict avoidance and monitoring plan to assess, minimize, and mitigate the effects of the infrastructure and its use on these coastal area habitats and their use by wildlife and people. Under Alternative C, the Lease Stipulation 9 would also require NSOs, which would not permit exploratory well drill pads, production well drill pads, or CPFs for oil and gas development within 1 mile inland of the coast. The BLM Authorized Officer may approve infrastructure necessary for oil and gas activities in coastal habitats, such as barge landing, docks, spill response staging and storage areas, or pipelines, but approval would be on a case-by-case basis, in consultation with the USFWS or NMFS or both, as appropriate.

Alternative C presents the same number of acres available for oil and gas leasing as Alternative B, but more acres would be subject to restrictions on disturbances to marine and coastal environments (932,500 acres). Potential impacts on the Arctic Refuge MPA would be greater than under Alternative A due to the increase in transportation of materials and supplies for oil and gas development in the coastal areas than is likely to occur under current management. A more detailed, site-specific analysis would occur during the APD phase of development.

Alternative D

Under Alternative D, 526,300 acres would not be offered for lease sale. Impacts would be similar to those as described under Alternative B, but more constraints would apply, thereby reducing the intensity of potential impacts on the Arctic Refuge MPA. Lease Stipulation 9 would require NSO 2 miles inland of the coast for exploratory well drill pads, production well drill pads, or CPFs for oil and gas development.

Alternative D presents the fewest number of acres available for oil and gas leasing of the action alternatives (1,037,200 acres). Impacts on the Arctic Refuge MPA would be more than under Alternative A due to the increase in transportation of materials and supplies for oil and gas development in the coastal areas than is likely to occur under current management. A more site-specific analysis would occur during the APD phase of development.

Cumulative Impacts

Past actions and events contributing to cumulative effects in and near the Arctic Refuge MPA have resulted primarily from surface-disturbing activities such as oil and gas exploration, development, production, and transportation for these uses, including shipping routes for delivery of development materials. Oil and gas development near the program area is expected to continue, which would also increase associated transportation activities, such as shipping and barging materials and supplies to the program area. The greatest contribution to cumulative impacts would be under Alternative B, which would include the largest area available for oil and gas leasing and would have the fewest protections for the Arctic Refuge MPA conservation focus.

Wild and Scenic Rivers

Alternative A

Under Alternative A (No Action Alternative), no federal minerals in the program area would be offered for future oil and gas lease sales. Current management actions for WSRs would be maintained and resource trends would continue, as described in the Arctic Refuge CCP (USFWS 2015a). The USFWS would manage the four eligible or suitable rivers identified in **Table 3-32** to maintain their preliminary classifications of wild. There would be no potential direct or indirect impacts on WSRs from post-lease oil and gas activities under Alternative A.

Impacts Common to All Action Alternatives

Under all alternatives, the BLM would maintain water quality and ensure that authorized uses comply with state water quality standards. Management actions that prohibit surface-disturbing activities, including NSO, CSU, and TLs near the eligible and suitable WSRs (**Table 3-32**) would provide varying protections for ORVs. This would also ensure that the free-flowing condition of the river remains intact. Any developing infrastructure that is installed within 0.5 mile of any eligible or suitable river, such as bridges, have the potential to downgrade a river's eligibility and suitability of a wild river to that of a recreational river, which allows some development. General impacts resulting from oil and gas development in the program area could include potential soil erosion and habitat fragmentation, which could affect cultural, fish, geologic, recreation, and wildlife ORVs. The degree of impacts on WSRs would depend on the proximity of development to the WSR. Site-specific analysis would occur during the APD phase of development. Impacts on recreation uses are described under **Section 3.4.6**, Recreation.

Alternative B

Under Alternative B, Lease Stipulation 1 would require an NSO standard, which would prohibit permanent oil and gas facilities, including gravel pads, roads, airstrips, and pipelines, in the streambed and in the described setback distances outlined in **Table 3-33**.

Table 3-33
Eligible and Suitable River Setback Distances Under Alternative B

River	Preliminary Classification	Setback Distance
Canning	Eligible	From the western boundary of the Coastal Plain to 1 mile east of the eastern edge of the active floodplain
Hulahula	Eligible and Suitable	1 mile in all directions from the active floodplain
Jago	Eligible	1 mile from the banks' ordinary high-water mark
Okpilak	Eligible	1 mile from the banks' ordinary high-water mark

Source: USFWS 2015b

For streams entirely in the Coastal Plain (**Map 3-46** in **Appendix A**), the setback extends to the head of the stream as identified in the National Hydrography Dataset.[43] On a case-by case basis, essential pipeline and road crossings to the main channel would be permitted through setback areas. The setbacks may not be practical in river deltas. In these situations, permanent facilities would be designed to withstand a 200-year flood.

Overall, because this alternative offers the highest number of acres available for oil and gas leasing adjacent to WSRs (41,900 acres) and the fewest restrictions for disturbances to WSRs, Alternative B would have the greatest magnitude of impacts on WSRs of all the alternatives. Most of the acres available for oil gas leasing (41,700 acres) would be managed as NSO, but 200 acres would be subject only to standard terms and conditions and are areas of high HCP. A more site-specific analysis would occur during the APD phase of development to further analyze impacts on the free-flowing condition of rivers when locations of proposed developments, such as bridges, pilings, or any bank modifications, would be known.

Alternative C

Under Alternative C, the requirements of the Lease Stipulation 1 are the same as those described under Alternative B; however, under Alternative C, setback distances for oil and gas development would be increased to 2 miles for the Canning and Hulahula Rivers, thereby further reducing the potential for impacts on their preliminary classification, free-flowing condition, and ORVs.

Alternative D

Under Alternative D, potential impacts from requiring Lease Stipulation 1 would be similar as those described under Alternative B, but the setback distances would be larger for most of the eligible and suitable rivers outlined in **Table 3-34**. Alternative D would have 19,500 fewer acres of eligible and suitable WSR corridors in areas available for oil and gas leasing than under Alternative B, which reduces the potential for impacts on their preliminary classification, free-flowing condition, and ORVs.

Table 3-34
Eligible and Suitable River Setback Distances under Alternative D

River	Preliminary Classification	Setback Distance
Canning	Eligible	From the western boundary of the Coastal Plain to 3 miles east of the eastern edge of the active floodplain
Hulahula	Eligible and Suitable	4 miles in all directions from the active floodplain
Jago	Eligible	1 mile from the banks' ordinary high-water mark
Okpilak	Eligible	3 miles from the banks' ordinary high-water mark

Source: USFWS 2015b

Alternative D would provide further protections to the fish and recreational ORVs of the Canning and Hulahula Rivers by implementing ROPs, such as preparing a gravel mine site design and reclamation plan, which excludes this activity in areas that support populations of freshwater, anadromous, or endemic fish.

Cumulative Impacts

Past actions and events contributing to cumulative effects in or next to rivers have resulted primarily from surface-disturbing activities, such as oil and gas exploration, development, production, and transportation for these uses. Activities of oil and gas development near the program area is expected to continue. As a

[43]National Hydrography Dataset: https://nhd.usgs.gov/

result, surface-disturbing activities, such as oil and gas development, transportation, and recreation affecting rivers, would continue; however, the BLM and USFWS would maintain discretionary authority over most land uses and would permit only those actions that would not impair or conflict with river systems, reducing cumulative effects on these areas. As development and transportation increases, access and use in or next to rivers would also increase. The types of reasonably foreseeable future actions that could affect WSRs would be similar to past and present actions. Cumulative impacts may be reduced or avoided if future actions or decisions in the program area incorporate measures to reduce or avoid impacts on river-related values. Examples are maintaining ORVs or the free-flowing nature of eligible or suitable segments in the program area, in accordance with the Wild and Scenic Rivers Act.

Wilderness Characteristics, Qualities, and Values

In general, discussions of potential impacts on wilderness characteristics, qualities, and values tend to be more qualitative in nature, measured by the overall visual quality, naturalness, and wildness of an area that may be affected by changes to the types and levels of recreation, management actions, and surrounding land use. Indicators of wilderness characteristics include changes to the untrammeled and naturalness of the program area opportunities for solitude or primitive and unconfined recreation or to other unique or supplemental values.

Alternative A

Under Alternative A, no federal minerals in the coastal plain would be offered for future oil and gas lease sales. Current management actions for wilderness characteristics would be maintained and resource trends would continue, as described in the Arctic Refuge CCP (USFWS 2015a). Current USFWS management focuses on less manipulation of the environment and promoting actions that facilitate solitude, self-discovery, self-reliance, remoteness, and primitive or unconfined recreation that would have long-term effects on wilderness characteristics. There would be no potential direct or indirect impacts on wilderness characteristics from post-lease oil and gas activities under Alternative A.

Impacts Common to All Action Alternatives

Management actions associated with oil and gas activities that would affect the natural appearance of lands in the program area could include the presence or absence of roads and trails, use of motorized vehicles on those roads and trails, seismic data acquisition using vibroseis trucks, construction of facilities and infrastructure for energy development, or other actions that result in or prevent surface-disturbing activities. All of these activities affect the presence or absence of human activity and, therefore, could potentially affect an area's naturalness and opportunities for solitude in the program area.

Alternative B

Alternative B has the most acres available for oil and gas leasing and the fewest restrictions on surface disturbance. Potential impacts on wilderness characteristics under Alternative B from oil and gas development would be reduced in the areas being managed as NSO (359,400 acres) or areas with TLs (585,400 acres). Prohibiting surface-disturbing activities and new developments in certain locations through the NSO and TLs would maintain the program area's apparent naturalness and opportunities for solitude or primitive and unconfined recreation. Wilderness characteristics would be eliminated on a site-specific basis should new roads be authorized; however, the area would likely retain its overall wilderness character. Temporary and permanent access routes to a lease area traveled by developers would negatively impact the wilderness character of that area. The degree of potential impacts on wilderness character would depend on the intensity of development, which would be further analyzed during the site-specific APD phase of development.

Alternative C

Under Alternative C, potential impacts would be reduced in the areas being managed as NSO (932,500 acres) or areas with TLs (317,100 acres); however, wilderness characteristics could be affected by development in adjacent areas. Detrimental impacts on wilderness character would be similar to those described under Alternative B but to a lesser degree due to more areas not offered for a lease sale and being managed with NSO and TL requirements. Overall, Alternative C would make 1,563,500 acres available for oil and gas lease sales in the program area, which would affect wilderness characteristics more than Alternative A.

Alternative D

Under Alternative D, there would be no direct impacts on wilderness characteristics from oil and gas development in the areas that are not offered for lease sale (526,300 acres), although wilderness characteristics could be affected by development in adjacent areas. Potential impacts would be reduced in the areas being managed as NSO (708,600 acres) or areas with TLs (204,700 acres). Detrimental impacts on wilderness characteristics would be similar as those described under Alternative B, but to a lesser degree due to more areas not offered for a lease sale and being managed with NSO and TL requirements.

Alternative D would also implement the Lease Stipulation 10, which would further protect naturalness and opportunities for solitude from visual obstructions and noise in the program area and the adjacent Mollie Beattie Wilderness Area by prohibiting surface occupancy and planning to minimize aircraft operations flights below 2,000 feet and 3 miles of the southern and eastern boundaries of the Coastal Plain where they are next to the Mollie Beattie Wilderness Area.

Cumulative Impacts

Past actions and events contributing to cumulative effects in nearby Wilderness or lands with wilderness characteristics have resulted primarily from surface-disturbing activities, such as oil and gas exploration, development, production, and transportation on existing routes for these uses. Activities of oil and gas development near the program area is expected to continue. As a result, surface-disturbing activities affecting the indicators for wilderness characteristics would also continue. The greatest contribution to cumulative impacts under the action alternatives would be under Alternative B, which would include the most areas being available for oil and gas leasing and have the fewest protections for wilderness characteristics from surface-disturbing activities.

3.4.8 Visual Resources

Affected Environment

Visual resources are the visible physical features on a landscape, such as land, water, vegetation, animals, structures, and other features. The BLM completed a visual resource inventory (VRI) for the Central Yukon Planning Area (BLM 2018h) to the west of the Coastal Plain, using the process in its Visual Resource Inventory Handbook (H-8410-1). The VRI was based on physiographic provinces. Although the program area is not in the BLM's Central Yukon Planning Area VRI, the VRI is used to characterize its visual resources because physiographic provinces span both areas.

It is reasonable to characterize the program area using the Central Yukon Planning Area VRI because there are negligible differences between the two areas. The three physiographic provinces that span both areas are the Arctic Coastal Plain, Arctic Foothills, and Ambler-Chandalar Ridge and Lowland (**Map 3-1** in **Appendix A**). Physiographic provinces can span large geographic areas, regardless of landownership; the transitions between physiographic provinces are generally subtle.

Scenic quality is a measure of the visual appeal of a tract of land. All public lands have scenic value, but areas with the most variety and harmonious composition have the greatest value (BLM 2018h). In the VRI, each physiographic province was evaluated to determine its scenic quality. The Arctic Foothills and the Ambler-Chandalar Ridge and Lowland divisions received the highest scenic quality rating and have a great deal of visual variety, contrast, and harmony. The Arctic Coastal Plain received the second highest scenic quality rating and has a moderate amount of visual variety, contrast, and harmony. These three physiographic provinces are described below.

The Arctic Coastal Plain physiographic province occurs in most of the program area and covers 1,341,200 acres, 90 percent of the program area (BLM GIS 2018; Wahrhaftig GIS 1965). It is characterized by a smooth, poorly drained plain rising imperceptibly from the Arctic Ocean, with scattered groups of low hills to the east and a much flatter section to the west. An abrupt scarp between 50- and 200-feet high separates the Arctic Coastal Plain physiographic province from the Arctic Foothills to the south. Pingos are sufficiently abundant to give an undulatory skyline.

All the rivers in this unit feed into the Arctic Ocean, crossing the program area in braided channels and deltas, creating contrast between the adjacent landform and vegetation and the barren soils of gravel bars and delta areas. Water is a major element of this landscape. This physiographic province has a low variation in topographic relief and a low variety of plant species found in the vegetation types of wet and moist tundra; low shrubs create some diversities in color, texture, and form between the low-growing heaths and shrubs to the tall shrubs of willow and alder.

This Arctic Foothills physiographic province is in the southern part of the program area and covers 127,600 acres, 8 percent of the program area (BLM GIS 2018; Wahrhaftig GIS 1965). It is characterized by rolling plateaus and low linear mountains. It has broad east-west trending ridges, dominated locally by mesa-like mountains in the north, while the southern area displays irregular buttes, knobs, mesas, and east-west trending ridges rising 2,500 feet above the surrounding intervening, gently undulating, tundra plains. Major rivers are swift, braided courses across broad gravel flats. There are a few small thaw lakes in the river valleys and morainal lakes closer to the program area.

The Arctic Foothills are crossed by north-flowing braided rivers from sources in the Sadlerochit and Romanzof Mountains, creating contrast between the adjacent landform and vegetation and the barren soils of gravel bars. The entire area is underlain by permafrost, with ice wedges, stone stripes, polygonal ground, and other frost features creating contrast with different vegetation types and barren ground. This physiographic province has a moderate variation in topographic relief. It has a low variety of alpine and moist tundra species, such as low mat-like herbs, grasses, and heaths. High to medium shrub thickets create some diversities in color, texture, and form between the low-growing heaths and shrubs to the tall shrubs of willow.

This Ambler-Chandalar Ridge and Lowland physiographic province occurs in the southeast corner of the program area and covers 28,000 acres, or 2 percent of the program area (BLM GIS 2018; Wahrhaftig GIS 1965). It is characterized by east-west trending lowlands with elevations of 600 feet and low passes 3 to 10 miles wide, with elevations of 4,000 feet. Rolling to rugged ridges 25 to 75 miles long and 5 to 10 miles wide rise to 4,500 feet and are characteristic of the northern portion of this unit (Romanzof Mountains). Major rivers are tributaries of the Okerokovik and Angun Rivers. Large rock-basin lakes occur in the valleys, while floodplains of major streams have thaw and oxbow lakes. The entire area is underlain by permafrost.

All the rivers in this physiographic province feed into the Arctic Ocean, crossing the program area in braided channels and deltas, creating contrast between the adjacent landform and vegetation and the barren soils of gravel bars and delta areas. This physiographic province has a moderate variation in topographic relief and has a large variety of alpine tundra of low mat-like herbs, grasses, and heaths. It also features closed white spruce and birch forests, with high to medium shrubs, and open low-growing black spruce and willow shrubs. These create some diversities in color, texture, and form between the low-growing heaths and shrubs to the tall shrubs of willow.

Vegetation is an important component in determining the visual quality of an area, represented by species, variety, extent, and color. The more variety of species a landscape has, the higher the scenic quality. Vegetation visible in the program area is alpine tundra, closed spruce forests, moist tundra, open and low-growing spruce, shrub thicket, treeless bogs, and wet tundra.

Cultural modifications are also considered in determining the visual quality of an area. Cultural modifications can blend in with or stand out from the surrounding landscape. The program area is still primarily a natural landscape, where humans have not substantially changed the scenic quality; however, some areas have been modified by the activities of humans. Human-built structures are the most likely to be seen and have most modified the natural landscape. These structures primarily exist near the community of Kaktovik.

Native allotments and isolated cabins can also be found in the program area. Most of the buildings outside a community are in relative harmony with the landscape, as they are small and made of local materials and have primarily natural colors. Other modifications are airports and airstrips. While an airport is more developed and has tall structures associated with the site, the profile of an airstrip is low, with landform changes that are introduced by brown colors in predominantly green vegetation and more regular lines than the surrounding irregular vegetation.

Artificial light sources are mainly limited to the community of Kaktovik along the coast. Dispersed cabins, overland travel, recreation, and occasional single- and twin-engine aircraft overflights can also create limited, intermittent points of artificial light.

Summer travel is primarily by watercraft; however, snowmachine trails and winter travel routes can be seen from elevated locations. Summer all-terrain vehicle travel is low to nonexistent and does not leave visible trails.

Seismic exploration, authorized by Congress, was conducted in the program area during the winters of 1984 and 1985. Exploration during winter causes less damage to tundra vegetation and soils than in summer, but damage does occur. Because of the 1984–1985 seismic exploration, known as 2-D (two-dimensional) seismic, 1,250 miles of trails made by drill, vibrator, and recording vehicles crisscrossed the Coastal Plain tundra. Additional trails were created by D-7 Caterpillar tractors that pulled ski-mounted trailer-trains between work camps. The trails were about 4 miles apart. While 90 percent of all trails recovered well during the first 10 years after exploration, 5 percent of trails had still not recovered by 2009, 25 years after the disturbance. This indicates that about 125 miles of disturbed trail remained in 2009, based on a total length of about 2,500 miles of original trails, both seismic lines and camp-move trails (USFWS 2014). These trails disrupt the visual continuity of the expansive, undeveloped landscape.

Areas identified as having public concern for the scenic quality are known travel routes (especially rivers), areas of human habitation, areas of traditional use, and areas near Native allotments. Numerous areas are noted to have potentially high visual sensitivity. This is because area residents and visitors view the natural landscape as very important and have a high level of interest and sensitivity to changes to the natural landscape. Visual resources in the program area are viewed by various users of the Arctic Refuge. Views can be affected by weather conditions and time of day or year.

Users include the following:

- Individuals participating in cultural activities (see **Section 3.4.2**)
- Individuals conducting subsistence activities (see **Section 3.4.3**)
- Individuals in the village of Kaktovik (see **Section 3.4.4**)
- Recreationists (see **Section 3.4.6** and **Section 3.4.7**)
- Individuals in route to various destinations (see **Section 3.4.9**)

Climate Change

Changes to the presence and composition of vegetation and water sources resulting from changes to the climate would affect visual resources. Also, an increase in the active layer is expected from a warming climate, resulting in greater potential for areas of land subsidence. This would change landforms, as well as the vegetation and water sources that the land supports. In turn, the presence and behavior of animals viewed in the program area could also be affected. Changes to the physical characteristics of the environment and biological resources (i.e., resources that are visible) resulting from changes to the climate are described in more detail in the GMT2 Final SEIS (BLM 2018a).

Direct and Indirect Impacts

Issuance of oil and gas leases under the directives of Section 20001(c)(1) of PL 115-97 would have no direct impacts on the environment because by itself a lease does not authorize any on the ground oil and gas activities; however, a lease does grant the lessee certain rights to drill for and extract oil and gas subject to further environmental review and reasonable regulation, including applicable laws, terms, conditions, and stipulations of the lease. The impacts of such future exploration and development activities that may occur because of the issuance of leases are considered potential indirect impacts of leasing. Such post-lease activities could include seismic and drilling exploration, development, and transportation of oil and gas in and from the Coastal Plain. Therefore, the analysis is of potential direct and indirect impacts on visual resources from on-the-ground post-lease activities. Although the BLM administers the oil and gas leases, a BLM visual resource management system, VRI and contrast rating was not conducted; however, analysis that demonstrates contrast from current conditions would be conducted in subsequent NEPA analyses for oil and gas post-lease activities.

In the event of an oil spill, visual resources would be affected by the spill itself, cleanup activities, and any residual changes to the landscape. See **Section 3.2.11** for more discussion on oil spills. The effects of climate change described under *Affected Environment* above, could influence the rate or degree of the potential direct and indirect impacts.

Alternative A

Under Alternative A, no federal minerals would be offered for future oil and gas lease sales. Current management actions would be maintained, and resource trends would continue. There would be no new direct or indirect impacts on visual resources from post-lease oil and gas activities.

Impacts Common to All Action Alternatives

There would be no impacts on visual resources common to all action alternatives, because actions would occur in different areas according to lease stipulations in **Chapter 2** (**Map 2-2**; **Map 2-4**; **Map 2-6**; and **Map 2-8** in **Appendix A**).

Alternative B

Potential impacts on visual resources would occur from oil and gas actions, such as exploration, development, and operation. **Appendix B** identifies oil and gas actions that would likely occur.

Surface disturbance would affect visual resources. Although the 2,000 acres of surface disturbance at any given time that could occur represents 0.13 percent of the program area, it would not be clustered in a specific area but would be spread out. There would be various discrete facilities connected by a network of gravel or ice roads and pipelines. Approximately 208 miles of gravel road would be needed to connect facilities.

In addition to the 2,000 acres of surface disturbance, there would be additional surface disturbance at gravel pits that would affect visual resources. Under Alternative B, gravel needs for future roads and pads would be approximately 12,818,000 cubic yards. In the low-disturbance case, factoring in additional acreage for side slopes and overburden storage, approximately 165 to 176 acres of surface disturbance would be required to supply all Coastal Plain gravel needs, in the maximum disturbance case, up to 320 acres of surface disturbance would be required to supply Coastal Plain gravel needs.

The future pipelines are supported by vertical members. Only the VSMs, and not the pipelines, are included in the 2,000 acres of surface disturbance. As a result, pipelines would add to the disturbance that would affect visual resources. Under Alternative B, there could be four CPFs, two in the high HCP area, one in the medium HCP area south of Kaktovik, and one in the low HCP area. Under this alternative, the assumption is that one CPF could be on state or native lands. Approximately 210 to 250 miles of pipeline would be constructed in the Coastal Plain, depending on field design.

The potential impacts on visual resources from the 2,000 acres of surface disturbance, 12,818,000 cubic yards of mined gravel, and 210 to 250 miles of pipelines would affect visual resources. During construction, crews may be working concurrently at various locations. Views of the program area would be cluttered with construction equipment, construction materials, and temporary support infrastructure. The bold colors and geometric, boxy forms of artificial construction vehicles, materials, and equipment would not resemble the colors and forms of the surrounding terrain and vegetation. The contrast would be starker when the surrounding landscape is white with snow. Rigid vertical elements and horizontal pipelines would create various focal points on an open landscape and would not resemble other landscape elements, which is mostly short vegetation during the summer. These potential impacts would occur only when construction equipment, construction materials, and temporary support infrastructure are present.

Construction and operations would generate dust from vehicle movement, excavation, and wind. Fugitive dust would diminish atmospheric clarity. This potential impact on visual resources would persist until the dust settles or is blown elsewhere. Dust that settles on snow or ice would change the color of the surface from a light or white color to the color of the dust. This impact on visual resources would persist until the snow or ice melts and the dust is washed away.

Future construction would use vehicle lights and other lights to illuminate work sites for visibility and safety. Also, reflective surfaces on construction equipment and vehicles would create glare. During operations, lights would also be used to illuminate sites for visibility and safety. Also, reflective surface structures would create glare. The intensity and amount of light and glare would vary, depending on the intensity and angle of sunlight and the time of day and year. This would add artificial points of illumination that are nearly absent in the program area.

The potential impacts from construction lights would occur only when construction equipment and vehicles are present. The potential impacts from operations lights would be long term. The most noticeable operation lights would be at the pads, airstrip, and barge landing and on taller structures, such as the drill rigs. They would be more visible during nighttime and winter, when there are fewer daylight hours. Artificial light would, in turn, affect the presence and behavior of animals viewed in the program area. Given the negligible artificial light in the program area, operations lights would essentially be the only sources of light that would diminish the quality of dark skies.

The ground surface would be disturbed by covering it with gravel, such as for roads and pads. The flat and simple gravel base would not resemble the uneven and complex forms of the undisturbed areas immediately beyond the surface disturbance. It would also introduce linear and angular forms to a surface devoid of discernable forms. The gravel would create a sharp edge that boldly divides disturbed areas from undisturbed areas. The gravel roads would also introduce contrasting bands that divide the expansive landscape. These would be more prominent in areas where roads do not follow the slope of the terrain. Because of a lack of vegetation on the gravel base, the darker smooth gravel base would not resemble the rougher vegetation with muted greens and tans beyond the gravel. These changes would, in turn, affect the presence and behavior of animals viewed in the program area. These potential impacts would be long term.

Use of gravel pits would introduce points of disturbance on the landscape. Instead of adding gravel in the case of roads and pads, gravel would be removed from pits and relocated. Due to the number of outcrops and surface deposits in the Coastal Plain, pits would be constructed next to facilities or roads used for satellite access; additional road construction would not be needed to access gravel mines. The potential impacts on visual resources would be similar to the aforementioned impacts from ground disturbance for roads and pads; however, instead of having a flat form and straight lines, the pits would form sunken depressions and have curved lines. Also, the depth of the pits would allow for the collection of water, possibly creating new artificial lakes.

Similar to gravel roads, pipelines would impact visual resources. Pipelines would introduce linear and rounded forms to a landscape devoid of discernable forms. The pipelines would also introduce contrasting bands that divide the expansive landscape. These would be more prominent in areas where roads do not follow the slope of the terrain. The pipelines would stand out against the surrounding muted greens and tans. Depending on orientation, the texture of the pipelines would be smooth or bumpy, compared with the rougher vegetation. These changes would, in turn, affect the presence and behavior of animals viewed in the program area. These potential impacts would be long term.

The gravel pads would be developed with drills and facilities. The bold and rigid forms of the drills and facilities would contrast with the indistinct and soft forms of the surrounding undisturbed surface. The angular lines of the drills and facilities would create various focal points on an open landscape and would not resemble other landscape elements, which is mostly short vegetation during the summer. The vertical lines of the drills and facilities would be more visible during daytime and summer, when there are more daylight hours and opportunities for silhouetting to occur. The multiple colors of the drills and facilities would stand out against the muted greens and tans beyond the gravel pads. The contrast would be starker during the winter when the surrounding landscape is white this snow. The dispersed drills and facilities would create a stippled texture across a landscape with no vertical elements. These changes would, in turn, affect the presence and behavior of animals viewed in the program area. These potential impacts would be long term.

An example of what gravel roads, pads, drills, and facilities could look like is depicted in **Figures 3-8**, Visual Resources Photo 1, and **3-9**, Visual Resources Photo 2, in **Appendix A**.

The above potential impacts disrupt the visual continuity of the expansive, undeveloped, and open landscape by establishing dispersed, artificial structures and a network of roads and pipelines, none of which are found elsewhere in the program area. The locations of potential impacts on visual resources are shown in **Map 2-1** in **Appendix A**. Surface occupancy prohibitions would minimize impacts on visual resources associated with, for example, rivers.

Best Management Practices for Reducing Visual Impacts of Renewable Energy Facilities on BLM-Administered Lands (BLM 2013) presents BMPs to avoid or reduce visual impacts associated with the siting, design, construction, operation, and decommissioning of utility-scale renewable energy generation facilities, including wind, solar, and geothermal facilities. Although the publication is for renewable energy generation facilities, the BMPs are also directly applicable to oil and gas facilities. Implementing the BMPs or using them as mitigation would reduce impacts on visual resources.

Minimizing unnecessary disturbances through BMPs or mitigation is important to minimizing impacts on visual resources and, likely, other resources. This is because many impacts would persist until disturbed areas are reclaimed. Following the completion of reclamation, the reclaimed acreage would be regained against the 2,000-acre surface disturbance limit at any given time. This could allow for additional development of future fields as initial development is reclaimed; however, arctic vegetation does not regenerate quickly, extending the timeline for reclaiming disturbed areas, as evidenced by the time it is taking disturbances to recover from seismic testing in 1984 and 1985.

Alternative C

The potential impacts on visual resources would be similar to Alternative B; however, Alternative C would use approximately 12,643,000 cubic yards of gravel (175,000 cubic yards fewer than Alternative B) and, therefore, would involve less surface disturbance that would affect visual resources. Alternative C would also occur in different locations; see **Map 2-3** in **Appendix A**. For example, in the long term, three CPFs would be built, two in the high HCP area and one in the medium HCP area south of Kaktovik. Also, approximately 213 miles of gravel road would be needed to connect facilities. Surface occupancy prohibitions would minimize impacts on visual resources associated with, for example, rivers, which is more than Alternative B.

Alternative D

The potential impacts on visual resources would be similar to Alternative B; however, Alternative D would use approximately 12,626,000 cubic yards of gravel (192,000 cubic yards fewer than Alternative B); therefore, it would involve less surface disturbance that would affect visual resources. Alternative D would also occur in different locations, compared with Alternative B; see **Map 2-5** and **Map 2-7** in **Appendix A**. For example, in the long term, two CPFs would be built, one in the high HCP area and one in the medium HCP area south of Kaktovik. Also, approximately 218 miles (Alternative D1) or approximately 217 miles (Alternative D2) of gravel road would be needed to connect facilities. Surface occupancy prohibitions would minimize impacts on visual resources associated with, for example, rivers and wilderness areas, which is more than Alternatives B and C.

Cumulative Impacts

The program area is the geographic scope of the analysis area for cumulative impacts. Impacts on visual resources in the program area from past actions occurred from the 1984–1985 seismic exploration. About 125 miles of disturbed trail remained in 2009, based on a total length of about 2,500 miles of original trails (both seismic lines and camp-move trails) (USFWS 2014). The remaining trails create visible lines and faint variations in texture across the undeveloped landscape. Future seismic exploration would likely have more visible impacts on visual resources, because the trails would be several hundred feet apart, instead of 3 to 4 miles apart during the 1984–1985 testing.

Past and future actions and the action alternatives would have potential cumulative impacts on visual resources. Given the durations of actions and the extent of construction and operation, the cumulative impacts on visual resources from the action alternatives would overshadow all other impacts on visual resources. The effects of climate change described under *Affected Environment* above, could influence the rate or degree of the potential cumulative impacts. Alternative A would have no cumulative impacts on visual resources.

3.4.9 Transportation

Affected Environment

The affected environment for transportation in the program area is as described in the Arctic Refuge CCP (USFWS 2015a); a summary is provided below.

Except for in the village of Kaktovik, there are no designated roads in the program area; cross-country motorized travel, other than over snow, is prohibited. Year-round access to and in the program area is primarily via aircraft. There is a gravel landing strip at Kaktovik that supports air travel from outside the program area and serves as the departure point for aircraft traveling inland. Arctic Village and Venetie have gravel runways, which are owned by the Native Village of Venetie Tribal Government. Aircraft are permitted to land in the program area. Several short airstrips are used by small fixed-wing aircraft for landing on wheels to transport recreationists and researchers. Landing opportunities depend on topography, water levels, snow conditions, and weather. Kaktovik, Arctic Village, and Venetie all have regularly scheduled air service, although the frequency of service varies.

During the summer and fall, motorized and nonmotorized boats provide access along the program area's northern boundary with the Beaufort Sea. Motorized and nonmotorized rafts are used on the Kongakut and Hulahula Rivers to access recreation and subsistence opportunities in the central portions of the program area. Improved boat technology, such as inflatable pack rafts that have shallow hulls, support river transportation in shallower areas that were previously unreachable by boat.

In the winter and spring, as snow cover conditions permit, overland travel via snowmachines is possible, especially along frozen waterways and the edge of the Beaufort Sea. Most snowmachine travel in the program area originates and terminates at Kaktovik. Snowmachine use in the program area is primarily for subsistence use, local travel, and recreation.

Climate Change

Increasing climate temperatures and associated loss of snow cover would limit the locations and times of year when ice roads could be viable in the program area. Less snow cover and soft tundra surface conditions could result in transportation infrastructure being concentrated in smaller areas. This could intensify traffic on those roads and increase the potential for conflicts with other modes as more visitors frequent the area.

Direct and Indirect Impacts

Issuance of oil and gas leases under the directives of Section 20001(c)(1) of PL 115-97 would have no direct impacts on the environment because by itself a lease does not authorize any on the ground oil and gas activities; however, a lease does grant the lessee certain rights to drill for and extract oil and gas subject to further environmental review and reasonable regulation, including applicable laws, terms, conditions, and stipulations of the lease. The impacts of such future exploration and development activities that may occur because of the issuance of leases are considered potential indirect impacts of leasing. Such post-lease activities could include seismic and drilling exploration, development, and transportation of oil and gas in and from the Coastal Plain. Therefore, the analysis is of potential direct and indirect impacts on transportation from on-the-ground post-lease activities.

Potential impacts on transportation would be from management that increases or decreases opportunities for new transportation infrastructure, management of the timing, location, and type of vehicle use, and from changes in the level of public and subsistence use access in the program area. The magnitude, duration, and spatial extent of impacts on transportation would vary, based on the location and extent of transportation infrastructure, season and snow cover conditions, and other management, such as seasonal TLs for certain uses that would modify the nature of travel via certain modes.

Protective measures that specify the type and placement of new or expanded transportation infrastructure would affect the size, design, and location of the proposed infrastructure. For example, managing areas as NSO would preclude new transportation infrastructure. Lease stipulations that limit the placement of permanent transportation infrastructure, depending on season and snow cover conditions, would seasonally reduce private transportation opportunities for oil and gas development, while minimizing potential conflicts with the public and subsistence users.

Management that limits vehicle use based on location, vehicle type, or season can limit or preclude access for certain travel modes while increasing access for others. For example, seasonal or location-specific limitations on vehicles used for mineral development would minimize the potential for impacts on other travel modes used for subsistence uses or recreation.

New transportation infrastructure, such as seasonal or year-round roads, airstrips, or other facilities, would not be available for motorized public use. Accordingly, new infrastructure would have the potential to enhance nonmotorized public access only. The effects of climate change described under *Affected Environment* above, could influence the rate or degree of the direct and indirect impacts.

Alternative A

Under Alternative A, no oil and gas leasing program would take place in the program area; there would be no potential direct or indirect impacts on transportation from post-leasing oil and gas activities in the program area. Existing resource trends and impacts on transportation would continue to occur.

Impacts Common to All Action Alternatives

Under all action alternatives, lease sales would result in approximately the same number of subsequent gravel and ice roads, airstrips, fueling stations, and a barge landing area to support new oil and gas development. In areas subject to NSO, new roads, airstrips, and other transportation-related infrastructure would be precluded. Under all alternatives, there would be no gravel roads constructed during the exploratory drilling phases; potential direct and indirect impacts described above associated with gravel roads would occur only in the long term.

Under all alternatives, lease stipulations would limit the number of new roads to the amount necessary to support exploration and production activities. Protective measures would also require the free movement of caribou and subsistence users. These measures would maintain access for subsistence users; however, because transportation infrastructure would be closed to non-subsistence public users, there would be no increase in public access. In some areas, roads may obstruct cross country, over snow travel via other modes, or nonmotorized travel, such as skiing or hiking. Compared with Alternative A, there would be no change in public access from the construction of private landing strips.

Alternative B

Under Alternative B, anticipated transportation infrastructure development and associated potential impacts following lease sales would be as described under *Impacts Common to All Acton Alternatives*. Making available 1,563,500 acres for lease sales, 77 percent (1,204,000 acres) of which would be available for surface use, would allow for the construction of program-related roads throughout nearly the entire program area. Up to 208 miles of new gravel roadways would support private travel for oil and gas production, while ice roads would provide additional private access for exploratory drilling and would be the primary means of overland access during the winter and spring for developers.

Alternative C

The nature and types of potential impacts under Alternative C would be as described under *Impacts Common to All Action Alternatives*, above. Applying NSO to 59 percent (922,500 acres) of the area available for lease would limit the locations where new roads and other transportation infrastructure could be placed. This would minimize the areas where new transportation infrastructure associated with oil and gas development would conflict with public access; however, because approximately 213 miles of gravel roads are anticipated, there would be a higher density of roads in areas available for surface use.

Alternative D

Under both subalternatives of Alternative D, not offering 526,300 acres for lease sale and applying an NSO stipulation to 68 percent (708,600 acres) of the area available for lease would limit the locations where new roads and other transportation infrastructure could be placed. Compared with Alternative A, there would be no change in transportation conditions on approximately 1,251,900 acres (79 percent) of the program area that would either not be offered for lease sale or offered but managed as NSO. The nature and types of potential impacts described under *Impacts Common to All Action Alternatives* would be in the 328,600 acres (32 percent of leased areas; 21 percent of the program area) available for leasing with surface use.

Cumulative Impacts

Cumulative impacts on transportation would be the result of past, present, and reasonably foreseeable future actions that would increase or decrease opportunities for new transportation infrastructure, change the types of vehicles available for use, or change the level of public and subsistence use access in the program area. Past, present, and reasonably foreseeable future actions described in **Appendix F** that would cumulatively affect recreation include increasing visitation to the program area for recreation and mineral exploration, energy and infrastructure development, and climate variability.

Under all action alternatives, future oil and gas exploration and development, combined with increased visitation, would increase the potential for roads and other infrastructure to conflict with public access. These potential conflicts would be more likely along river corridors and the Beaufort Sea coastline, where visitor concentrations are highest. The effects of climate change described under *Affected Environment* above, could influence the rate or degree of the potential cumulative impacts.

3.4.10 Economy

Affected Environment

This section describes the existing socioeconomic conditions in areas that could be affected by exploration, development, and production in the Coastal Plain from the leasing program. All NSB communities, the NSB, and the state of Alaska are included for comparison purposes. Arctic Village and Venetie, which are communities outside the NSB, are also included in the discussion due to their reliance on subsistence resources in the program area.

This section provides baseline information on the following socioeconomic indicators: employment, income, population, and fiscal conditions (government revenues and expenditures). In addition, information on regional and village corporations and a description of local businesses, local facilities, and public infrastructure is presented.

Population

Table O-1 in **Appendix O** shows population estimates by the Alaska Department of Labor and Workforce Development (ADOLWD) by community/area from 2010 to 2017 (ADOLWD 2018a). At the NSB and state levels, population growth from 2010 to 2017 has been modest, at 4 percent. The communities of Kaktovik and Atqasuk have seen a slight decline in population, while all other communities in the NSB have experienced varying degrees of population growth. Arctic Village, Nuiqsut, and Point Lay have seen the most growth, each with more than 20 percent growth in population over this time frame.

Local Employment and Income

Table O-2 in **Appendix O** provides employment and wage data by community (ADOLWD 2018b). The local government sector employs the highest number of workers in all communities. Private sector employment is highest in Utqiaġvik, accounting for 43 percent of total resident employment, followed by Point Hope and Nuiqsut, where the private sector employs 39 and 38 percent of the resident workers. These communities also have the highest total wages in the region. Venetie has the highest rate of unemployment, with only 57 percent of residents employed. Artic Village and Venetie both show total community wages much lower than communities in the NSB. Employment and income at the borough and state levels are discussed in the regional economy and state economy sections, below.

Local Economy: Kaktovik

Kaktovik lies on the north shore of Barter Island on the Beaufort Sea coast, in the Arctic Refuge. It is the community closest to the program area. The following provides more details on the economy, infrastructure, and fiscal conditions of Kaktovik.

Kaktovik is the easternmost village in the NSB and is situated on approximately 1 square mile of land (630 acres) and water on the northeastern shore on the Kaktovik Lagoon. A detailed description of Kaktovik's history is provided in the Kaktovik Comprehensive Development Plan (NSB 2015a). Residents in Kaktovik are predominantly Iñupiat (88 percent of the population). According to population estimates published by ADOLWD (2018a), 234 people lived in Kaktovik in 2017. The NSB's most recent census report indicated there were 262 residents in Kaktovik in 2015, while ADOLWD estimated 243 residents in that same year (NSB 2015b).

Economic and employment opportunities are limited in Kaktovik because of its remoteness. Sixty-seven percent of the working residents are employed by the local government sector, and 33 percent work in the private sector, primarily by Native corporations and their affiliates (ADOLWD 2018c). The Borough and NSB School District provide most of the local employment, and the Village Corporation and city government also provide some employment opportunities. Besides the local government sector, residents are also employed in construction, finance, leisure and hospitality, and other sectors (**Table O-3** in **Appendix O**). Short-term construction or skilled labor jobs with the oil industry, private construction firms, and the ASRC and its subsidiaries and summer jobs related to tourism can also be found. Subsistence hunting, fishing, and whaling play a major role in the local economy (NSB 2018b).

There are 15 active businesses operating in Kaktovik, including the KIC, a hotel, a bed and breakfast, a store, and several tour and adventure businesses (ADCCED 2018a). The KIC runs the local store, which provides groceries, clothing, first-aid, hardware, camera film, and sporting goods. Fishing and hunting licenses, guide services, and aircraft and repair services for autos and aircrafts are locally available (NSB 2018b).

The KIC is the Village Corporation established pursuant to ANCSA. KIC owns approximately 92,000 acres of surface lands in and around the community. All of the corporation's land is in the Arctic Refuge boundary. Kaktovik Holdings, LLC is wholly owned by KIC and has three subsidiaries—Kaktovik Enterprises, LLC (which provides services on power generation, storage, and control), Kaktovik Environmental, LLC (which provides a variety of environmental engineering, consulting, and construction services), and Kaktovik Telecom, LLC (which provides full-service, turn-key solutions for all telecommunications and tower needs). The company's operations are in Alaska, the lower 48, and Guam (Kaktovik Holdings, LLC 2018).

The estimated per capita income in Kaktovik in 2016 was $21,925, which was lower than the $34,191 per capita income for the state (ADOLWD 2018d). The median family income was $66,250 compared to $87,365 for the state. The disparity between Alaska and Kaktovik income is important to note, given the high cost of living in Kaktovik.

The community incorporated as a second-class city in 1971.[44] For fiscal year (FY) 2018, Kaktovik adopted a $1.46 million operating budget (ADCCED 2018a) (**Table O-4** in **Appendix O**). Seventy-six percent of the City's operating revenues are generated by local funds, such as taxes, services, and enterprise revenues, which account for 57 percent of the locally generated revenues. Outside sources, including the community revenue sharing from the State and other grants contribute, 24 percent to their operating budget.

The NSB provides public electricity, piped water, sewer services, and trash pickup to the community. Kaktovik has a public safety building and a fire station equipped with fire engines and an ambulance. The Harold Kaveolook School offers education from pre-school through grade 12 and adult basic education.

[44]A type of general law municipality or city that has taxation powers but with certain limitations. Section 29.45.100 of the Alaska Statutes provides that limitations on the amount of property tax that may be collected apply only to taxes for operating expenses and not to taxes collected to pay for bonded indebtedness. A special limitation on taxation by second-class cities is that the city cannot levy property taxes exceeding 2 percent (20 mills) of the assessed value of property in the city in any one year (Office of the State Assessor 2017; ADCCED 2018a).

Communications include phones, internet, mail, public radio, and cable television. The community also has a health clinic staffed by community health aides.

Transportation to the village is provided by scheduled airlines and air taxi service from Barrow and Fairbanks. Freight arrives by cargo plane and barge (during the summer). Air travel provides the only year-round access to Kaktovik. Marine transportation provides seasonal access to Kaktovik.

Regional Economy

The program area is in the NSB jurisdiction. Its population is predominantly Iñupiat. In 2017, the NSB was estimated to have a population of 7,248 living year-round in its eight communities. In addition to the permanent local population, 2,601 oilfield workers lived in Prudhoe Bay in 2017, contributing to the total regional population of 9,848.

Oil and gas exploration and development is the primary industry in the NSB and the largest employer of the region's industrial workforce, including nonresidents. In 2016, approximately 14,000 oil and gas jobs (including oilfield services companies) were reported in the NSB (McDowell Group 2017). These jobs are based in the North Slope, in self-contained work sites that are far from the NSB communities; however, few of the jobs are held by residents of the NSB. In 2016, 55 oil and gas jobs were held by NSB residents, which amounts to less than 0.5 percent of the total oil and gas jobs based in the North Slope. Total earnings from the oil and gas extraction sector, which amounted to about $864 million, accounted for 69 percent of the total wages earned for all industries in the North Slope in 2016 (ADOLWD 2018e); however, a large portion of the earnings are not spent in the local and regional economy, as most workers reside permanently outside the NSB.

The unemployment rate in the NSB in 2016 was 6.5 percent, which was roughly the same as the statewide unemployment rate of 6.6 percent (ADOLWD 2018f).

The local government sector (primarily the NSB government) is the largest employer of North Slope residents. In 2016, the local government sector employed 1,988 residents, accounting for 61 percent of the resident workers in the region.

The NSB government was formed in 1972. It provides a wide range of public services to all of its communities, including capital projects. Its total general fund revenue for the FY 2017 to 2018 is approximately $376 million; 97 percent of the total general fund is sourced from property and sales taxes (ADCCED 2018b). Oil and gas property taxes are the primary source of revenue for the NSB government. In 2016, State-assessed oil and gas property in the NSB was valued at approximately $20.27 billion. The NSB received about $373 million in oil and gas property taxes (a tax levied on oil and gas infrastructure), accounting for 97 percent of the total property tax ($386 million) collected by the NSB that year (Office of the State Assessor 2017).

The ANCSA regional and village corporations in the North Slope are also important economic players in the region, employing residents participating in the oil and gas service industry and creating additional wealth in the region. ASRC is the regional ANCSA corporation that is owned by and represents the business interests of the North Slope Iñupiat. ASRC provides an array of oilfield engineering, operations, maintenance, construction, fabrication, regulatory and permitting, and other services for oil and gas companies.

Village ANCSA corporations in the NSB also are active in the oil and gas sector. For additional details on the North Slope ANCSA corporations, see the GMT2 Final SEIS, which is incorporated here by reference (BLM 2018a).

State Economy

The petroleum industry is a major sector in the Alaska economy. Economic events related to the petroleum industry have pervasive effects across the state's economy. The drop in oil prices in late 2014 resulted in a significant decline in State government revenues. In early 2015 and in 2016, the State government lost 1,200 jobs, while the oil and gas sector lost 2,900 jobs. Other sectors were also affected; for example, the professional and business services sector lost 1,600 jobs and the construction sector lost 1,400 jobs (Wiebold 2018).

In 2016, the oil and gas extraction sector contributed 10 percent of the state's total gross domestic product ($50 billion), the highest among all industries in Alaska (Bureau of Economic Analysis 2018). This does not include the oil and gas support industries and the oil pipeline transportation sector.

In 2016, there were 11,100 direct oil and gas jobs in the state (Fried 2017). In addition to the direct jobs, there are thousands of indirect jobs in security, catering, accommodations, facilities management, transportation, engineering services, and logistics, which support the oil and gas industry but are not categorized as oil and gas jobs. The most recent estimate for total direct and indirect jobs associated with the oil and gas industry in Alaska was 45,575 jobs in 2016; these jobs contributed $3.1 billion in total annual wages in Alaska (McDowell Group 2017).

The State government is highly dependent on oil revenue; its budget is sensitive to oil price and oil production. Petroleum-related revenues include oil and gas property tax, petroleum corporate income tax, oil and gas production taxes, mineral bonuses and rents, and oil and gas royalties (State and federal). The State's Unrestricted General Fund revenue is now forecast to be $2.3 billion in FY 2018 and $2.3 billion in FY 2019. The revenue forecast is based on an annual Alaska North Slope oil price of $61 per barrel for FY 2018 and $63 for FY 2019. The State expects oil prices to stabilize in the low $60s per barrel in real terms. The revenue forecast is also driven by an expectation for North Slope oil production to average 521,800 barrels per day in FY 2018 and increasing to an average of 526,600 barrels per day in FY 2019 (ADOR 2018).

In FY 2017, the State of Alaska received $12.9 billion in revenues from all sources: petroleum[45] ($1.7 billion), non-petroleum[46] ($1.2 billion), investment ($6.8 billion), and federal revenues ($3.2 billion). The General Fund Unrestricted Revenues (GFUR), the funds that are available for general state activities and capital projects, amounted to $1.35 billion, with petroleum revenues accounting for 65 percent of the unrestricted revenue. Petroleum royalties contributed $681 million to the GFUR, while petroleum property and oil and gas production taxes contributed $120 million and $134 million (ADOR 2018).

National Economy

Development in the Coastal Plain is anticipated to contribute to the nation's economy through job creation, increase in federal revenues, and increase in energy security (or reduced reliance on imported petroleum products). Comments from the public scoping for this EIS stated the importance of the

[45]Petroleum revenues include State taxes and royalties from oil production on both State and federal lands.
[46]Non-petroleum revenues include excise taxes, non-petroleum corporate income tax, fisheries tax, and other State taxes.

economic contributions of a leasing program in the Coastal Plain to the national economy and also the importance of preserving the region for its unique wildlife, wilderness, and recreation values.

Climate Change

Climate change could negatively affect the economy of the North Slope because villages are primarily located at or near sea level; any increase in mean sea level or violent storms may require relocating part or all of villages and subsistence camps. This would have a negative economic impact on the villages, the NSB, and the State if villages had to be relocated.

Direct and Indirect Impacts

Direct impacts from issuing oil and gas leases under the directives of Section 20001(c)(1) of PL 115-97 would include the federal government receiving bonus bids and rental payments from leasing; however, these payments cannot be quantified because there is not enough specificity at this time regarding the lease terms. There would be no other direct impacts on the environment from leasing because by itself a lease does not authorize any on the ground oil and gas activities; however, a lease does grant the lessee certain rights to drill for and extract oil and gas subject to further environmental review and reasonable regulation, including applicable laws, terms, conditions, and stipulations of the lease. The impacts of such future exploration and development activities that may occur because of the issuance of leases are considered potential indirect impacts of leasing. Such post-lease activities could include seismic and drilling exploration, development, and transportation of oil and gas in and from the Coastal Plain. Therefore, the analysis is of potential direct and indirect impacts on the economy from on-the-ground post-lease activities.

The potential economic impacts are evaluated with respect to jobs, income, and government revenues at the local, regional, and statewide level. As noted in *Affected Environment*, quantifying nonmarket values associated with the Arctic Refuge is not part of this analysis. The temporal scope of the analysis covers potential impacts of leasing activities as well as the subsequent exploration, development, and production activities that could ensue following the leasing program through 2050. The effects of climate change described under *Affected Environment* above, could influence the rate or degree of the potential direct and indirect impacts.

Alternative A

Under Alternative A, no federal minerals in the Coastal Plain would be offered for future oil and gas lease sales. The economic conditions at the local, regional, and state level, as discussed in *Affected Environment*, are therefore expected to continue. Alternative A would not meet the purpose of this EIS to inform BLM's implementation of PL 115-97, including the requirement to hold multiple lease sales and to permit associated post-lease activities. There would be no potential direct or indirect economic impacts under this alternative from post-leasing oil and gas activities.

Impacts Common to All Action Alternatives

The potential economic effects of the proposed leasing program are evaluated based on the hypothetical development scenario (**Appendix B**), which is a set of assumptions that reflect possible industry-wide exploration, development, and production activities. The scenario represents only a possible picture of the future. It is likely that different activities and timing would occur in the future, as each company that would participate in the leasing program would have its own unique plans about how to identify and recover oil and natural gas resources. Furthermore, market conditions change over time and can affect outcomes. It is difficult to anticipate what the actual development pattern would be, but the assumptions used in this analysis provide a reasonable basis to evaluate potential future economic effects.

PL 115-97 mandates that the first lease sale occur within the first 4 years of the implementation of the law and a second lease sale be held within 7 years. The hypothetical development scenario assumes that the first lease sale would occur within one year of the ROD and that industry would aggressively lease and explore the tracts offered in the lease sales. Several industry groups would likely independently explore and develop new fields.

The hypothetical development scenario also assumes that oil deposits of significant volumes would be discovered in the program area, resulting in the construction of up to 3 CPFs—one in the western portion of the high HCP area, one in the eastern portion of the high HCP area, and one in the medium HCP area south of Kaktovik (this CPF could be on Native lands). Development in distant and remote areas like the program area would take time; this analysis assumes that first oil production from the first CPF would occur 10 years from the first lease sale.

The exploration phase of each anchor field and associated satellite fields can occur over a span of 10 years. Exploration includes seismic surveys, well-site surveys, and drilling of exploration wells. Following discovery, the development phase normally takes 3 to 6 years. Development includes obtaining permits, fabricating production modules, constructing roads, pipelines, and other on-site facilities, transporting materials and facilities to the site, and implementing environmental studies and monitoring.

The production phase can start after development of a CPF and would continue until the end of life of each oil field. Production activities are the continued development-well drilling, production ramp-up, operations and maintenance of processing and other on-site facilities, well-workovers, infill drilling, and other support activities, including environmental monitoring. For a more detailed discussion of the typical exploration, development, and production activities occurring in the Alaska North Slope, see the NPR-A IAP/EIS (BLM 2012), which is incorporated here by reference.

For the purposes of this analysis, the projections based on the hypothetical development scenarios on potential economic impacts are carried through 2050 only. Within this time frame, only two anchor fields would be developed, with each one having its own CPF. A third CPF could be developed but would occur after 2050. Abandonment activities would also occur after this time frame. The first anchor field is assumed to have about 400 million barrels of proven producible reserves.

Six smaller satellite fields would be developed around this first anchor field, with more modest producible reserves of about 100 million barrels each. The assumption is that the second anchor field would be discovered and developed several years after the first anchor field and would have four smaller satellite fields that would be developed by 2050 and tie into its CPF.

A future natural gas transport pipeline from the North Slope to southcentral Alaska could be expected, where the gas would be transformed into liquefied natural gas. Liquified natural gas transported to global markets from the North Slope would be expected to come from established fields with proven reserves initially. If proven gas resources are discovered in the Coastal Plain, they would be transported to the pipeline to maintain pipeline capacity as the primary fields are depleted. Companies exploring the Coastal Plain would likely focus on crude oil discoveries, which are of higher value than natural gas. Any co-occurring gas produced with oil would be reinjected to maintain reservoir pressure or used to manufacture natural gas liquids to blend and transport with the oil (**Appendix B**).

Potential indirect effects related to oil or natural gas development would include the spin-off effects of spending; these are also referred to as multiplier effects. They include additional economic effects that would result from in-state industry spending on goods and services, workers' spending of wages, and government spending of royalties and tax payments during the construction and operations phases.

Like other development projects in the North Slope, many of the materials and equipment are expected to be purchased outside Alaska and would be shipped to the specific job site. Still, a significant portion of the total future development costs, both capital and operating costs, would be paid to companies in Alaska for construction, transportation, logistics, and other oilfield services.[47] Some of the contracts for construction and operations and maintenance of the facilities are expected to be awarded to Alaska owned and operated companies, including the North Slope regional and village corporations. These payments to local businesses would in turn generate additional economic activity in the state, resulting in indirect economic effects in the form of additional business sales, employment, and labor income. Likewise, potential local spending by workers as well as government spending of revenues would also generate multiplier effects statewide.

Potential impacts on subsistence activities could have impacts on cost of living for some families through the need to substitute store-bought foods for subsistence obtained foods. The potential impacts on subsistence are discussed in **Section 3.4.3.**

The following are some of the major assumptions and data sources used in the economic impact analysis:

- The hypothetical development baseline scenario provided the basis for modeling the potential oil and gas activities and time frames, which included assumptions of the number of CPFs, gravel roads and ice road construction, other on-shore facilities, including pipelines, and size of oil field discoveries.
- Estimates of production volumes by year were based on the size of each oil field and a production decline rate of 8 percent per year. This information was used to calculate potential royalty payments and other State and the federal government tax payments.
- Oil price projections were obtained from the Energy Information Administration's 2018 Annual Energy Outlook (EIA 2018). This information was used to quantify potential royalty payments and other fiscal effects.
- Construction costs were estimated based on costs provided in Attanasi and Freeman (2009) and cost data from other North Slope development projects. This information was used to calculate direct and indirect employment and income effects of construction spending as well as potential government revenues, including oil and gas property taxes and state corporate income taxes.
- Estimates of annual operating expenditures are based on the prevailing operating costs in the Alaska North Slope—a fixed $/well/year estimate of $300,000 and a variable operating cost component of $10 per barrel of oil. These were default values in the ADNR cash flow model

[47]The amount of direct in-state industry spending is based on purchase coefficients contained in the Alaska IMPLAN model. These in-state purchase coefficients reflect the availability of locally produced products in the state and are calculated from the trade model for the state in IMPLAN. The extraction of natural gas and crude petroleum sector, drilling oil and gas wells sector, and support activities for oil and gas operations sector require or demand different goods and services from other sectors of the economy. All have varying percentages of in-state purchases, with the highest percentages in the services sector and the least in the manufacturing sectors. There is not one specific in-state purchase percentage applied to the total direct oil and gas industry spending; rather the purchase coefficients in the model vary by the type of goods and services purchased.

(ADNR 2018b). This information was used to calculate the direct and indirect employment and income effects, as well as tax revenues during the production phase.

- Tariffs and transportation costs were used to calculate netback prices which are the bases for calculating royalty payments. Data on existing tariffs and transportation costs are from the ADNR Revenue Sources Book (ADNR 2018b).

The IMPLAN model for Alaska was used to estimate the potential direct and indirect employment and income effects of the various exploration, development, and production activities (MIG, Inc. 2018). The cash flow model developed by the ADNR (modified to fit the development and production assumptions used in this analysis) was used to generate the projected royalties and government taxes.

Jobs

Future exploration, development, and production activities in the program area for the two anchor fields and their associated satellite fields are estimated to generate about 250 direct jobs per year during exploration activities, 480 direct jobs per year during the development phase, and 730 direct jobs per year during the production phase. Exploration activities are anticipated to peak on the fifth year of the exploration phase, generating an estimated 650 jobs that year. The peak year of the development phase is estimated to generate 680 jobs, and 1,150 jobs are estimated to be required during the peak production year. Jobs during the exploration and development phases are seasonal and temporary, while production phase jobs are year-round and would last through the economic limit of the life of each oil field.

Table 3-35 also provides estimates of the indirect jobs that could be generated as a result of industry spending on exploration, development, and production activities.

Table 3-35
Projected Direct and Indirect Jobs: Exploration, Development, and Production Phases

Effects	Jobs (Average Number of Part-Time and Full-Time Jobs)	Annual Average	Peak
Direct	Exploration	250	650
	Development	480	680
	Production	730	1,150
Indirect	Exploration	190	560
	Development	3,180	4,570
	Production	3,160	4,970

Source: Northern Economics, Inc 2018 estimate

The assumed future exploration, development, and production activities are expected to generate job opportunities for workers residing in the North Slope, other areas of Alaska, and outside Alaska. The jobs shown in **Table 3-35** are total jobs that could be available for workers from any region, including outside Alaska. It is uncertain at this time how many workers from North Slope communities would participate in the direct oil and gas activities. Historically, very few North Slope residents participate in direct oil and gas activities in the North Slope. As noted in *Affected Environment*, above, less than 0.5 percent of the total oil and gas jobs in the North Slope in 2016 were held by NSB residents.

In 2016, 27.5 percent of the workers in the oil and gas extraction sector and 36.8 percent of the workers in oilfield services sector were from out of state (ADOLWD 2018g). These nonresident percentages have been consistent in the last decade, and it is possible that these levels would continue; however, it is also possible that, with more education and training, the future composition of the oil and gas workforce could be different.

Oil field development projects in the North Slope typically require specialty tradesmen and construction workers with the skills and experience in ice roads, pipeline construction, facilities construction, and drilling. North Slope residents who live near existing oil developments have participated in oil and gas jobs, such as ice road monitors, camp security and facilities operators, and subsistence representatives. The ADOLWD and the oil and gas industry have training programs geared to developing special skills required in oilfield services. This is expected to create more employment opportunities for residents of Kaktovik, given their proximity to the program area.

Population

No changes to population growth rates or increased population are expected in Kaktovik as a result of migration of industry workers for post-lease oil and gas activities. Workers are expected to commute to the work camps on a rotational basis and are not expected to relocate to Kaktovik or other North Slope communities.

At the state level, there could be potential increases in population, particularly in south-central Alaska, as nonresidents who would be working year-round at the oil company headquarters in Anchorage are expected to relocate to the region. Statewide population, however, would be affected by other economic and demographic factors and would be hard to predict.

Labor Income

The estimated labor income effects resulting from future exploration, development, and production of oil resources in the Coastal Plain region are presented in **Table 3-36**. The table shows projected direct and indirect annual average and peak labor income by phase.

Table 3-36
Projected Direct and Indirect Labor Income: Exploration, Development, and Production Phases

Effects	Labor Income (Millions of Dollars 2017)	Annual Average	Peak
Direct	Exploration	$29	$77
	Development	$97	$140
	Production	$125	$197
Indirect	Exploration	$10	$30
	Development	$214	$307
	Production	$212	$307

Source: Northern Economics, Inc 2018 estimate

As noted above, it is uncertain at this time how much of this total potential labor income would accrue to the local workforce, regional workforce, and Alaska workforce. Currently, about 36 percent of the total wages and salaries in the oil and gas extraction sector and 28 percent of wages and salaries in the oilfield services sector go to out-of-state workers (ADOLWD 2018g). It is possible that these percentages could change over time.

Economic Sectors

Industry spending during future exploration, development, and production phases would increase the level of activity in the Alaska economy, not just in the oil and gas extraction sector but also in other economic sectors, including oil field support services; construction, engineering, environmental, and other professional technical services; air, water, ground, and pipeline transportation sectors; retail and wholesale trade sectors; rental and leasing sectors; warehousing; accommodations and food services; and communications, IT support, management, and other business support sectors.

Government Revenues

Future petroleum development in the program area is expected to generate revenues to the NSB government, the State, and the federal government from royalties, income taxes, production taxes, and property taxes. The projected annual average and total government revenues by type of revenue are presented in **Table 3-37**. The total represents the estimated revenues through 2050. Property taxes would start accruing during the development or construction phase, while royalties and other taxes would be generated during the production phase.

At the local level, the City of Kaktovik could receive increased bed tax revenues with higher hotel occupancy during the initial years of development. Also, local consultations are likely going to occur and while mobilization of construction equipment would be occurring, and even during operations. The City of Kaktovik has just started implementing a 12 percent bed tax for hotel/motel accommodations. The change in the level of hotel occupancy is difficult to quantify at this point because the timing and amount of local consultations and mobilization activities are uncertain and may vary.

Table 3-37
Projected North Slope Borough, State, and Federal Government Revenues

Government Revenues (in Millions of Dollars, 2017)	Annual Average	Total
NSB Property Taxes	$52	$1,192
State Royalties	$894	$21,463
State Taxes	$2,151	$49,473
Federal Royalties	$894	$21,463
Federal Taxes	$462	$11,082

Source: Northern Economics, Inc 2018 estimate

At the regional level, the NSB government is anticipated to receive increased property tax revenues. Property tax payments would start to accrue during the construction phase. The State imposes oil and gas property taxes at a rate of $20 million. A local tax is levied on the State's assessed value for oil and gas property in the borough and is subject to local property tax limitations. The current NSB property tax rate is $18.5 million (the state portion of the property tax is $1.5 million). Total NSB property tax revenues through 2050 are estimated to amount to about $1,192 million (in 2017 dollars).

At the State level, there are several potential sources of revenues that could be generated from petroleum development in the program area. State government revenues during the production phase would include royalty payments, corporate income tax payments, severance tax payments, and continuation of property tax payments. The property tax payments would be based on the assessed valuation of the facilities developed on-site.

The state property tax rate is $20 million. A local tax is levied on the State's assessed value for oil and gas property in a city or borough and is subject to local property tax limitations. The current NSB property tax rate is $18.5 million; hence, the State portion of the property tax is $1.5 million. State corporate income tax is calculated as 9.4 percent of the Alaska share of worldwide income for each corporation. The model, however, does not take into consideration corporate worldwide income (which is unknown at this time) but simply evaluates all the costs and revenues and the resulting State income tax, given the 9.4 percent income tax rate.

Severance tax or production tax payments are based on the current tax rate of 35 percent of the production value, which is the value at the point of production, less all qualified lease expenditures (net value). Qualified lease expenditures include certain qualified capital and operating expenditures. Total estimated state taxes and royalties are shown in **Table 3-37**.

Any additional oil production in the North Slope extends the life of the TAPS and increased revenues for the State. Oil revenues depend on the oil production levels and the price of oil at the wellhead. Higher TAPS throughput results in lower pipeline tariffs and higher wellhead value. The State would receive higher revenues resulting from oil production in the region.

The assumed federal royalty rate is 16.67 percent of the wellhead value for oil. The expectation is that 50 percent of the federal royalties are shared with the State. Potential annual average State royalties could amount to about $894 million.

Other government revenues expected to accrue during the construction phase include ROW payments and gravel royalties; these estimates are not available at this time.

<u>Local Public Infrastructure and Local Businesses</u>

Given that the oilfield workers would be housed in work camps located at the CPFs and drill pads and away from the community of Kaktovik, there would be no anticipated increase in demand for local services and other public infrastructure in the community of Kaktovik.

Consultations and mobilization during leasing, permitting, and exploration and through the development phase could increase the number of people going in and out of the community. These could create temporary increases in demand for accommodations, travel services, retail services, and other personal services.

Local businesses, including KIC and its subsidiaries, could receive greater revenues during the exploration, development, and production of petroleum resources in the program area.

Alternative B

The potential economic effects under Alternative B would be similar in magnitude to the economic effects discussed in the section above. There could be unquantifiable differences in the level of economic effects, however, because of the lease stipulations and ROPs under Alternative B, as follows:

- Additional consultations with local, state, and federal stakeholders
- Additional studies that would be required for permitting
- Delays in exploration and development due to closures of certain environmentally sensitive areas
- Reductions in surface disturbance
- Additional facilities that could be required to address limited road access to the CPFs
- Additional infrastructure, such as bridges, that could be required to avoid environmentally sensitive areas

Some of these actions could result in higher employment and income effects due to additional expenditures that would have to be in compliance with the standard operating procedure, including additional spending on consultation, studies, and required orientation programs. Some of these actions could also result in delays in exploration, development, and production and would therefore also delay potential employment and income effects, as well as revenues that could accrue to the local, State, and federal governments. For example, some of the lease stipulations could result in deferred revenues and taxes due to delays in drilling or lower taxes and revenues due to increased costs, which reduce severance taxes and profits.

Alternative C

The potential economic effects under Alternative C would be similar to the economic effects discussed in the section above. As noted above, there could be differences in economic effects from the lease stipulations, but these effects would be difficult to quantify at this time; this is because the level and timing of activities could vary, depending on how each industry player would react under this alternative.

Alternative D

The potential economic effects under Alternative D would be similar in magnitude to the economic effects discussed in the section above; however, the higher level of restrictions under this alternative could reduce the amount of oil produced, could defer or reduce potential government revenues and taxes, and could result in lower economic revenues, relative to the other action alternatives.

Cumulative Impacts

Oil production from the North Slope is projected to decline from 522,000 barrels per day in FY 2018 to 493,000 barrels per day in FY 2027, as production from existing fields continues to decline (ADNR 2018b). Production from newer development projects, such as Point Thomson, GMT1, GMT2, and Willow, are expected to contribute to oil production in the next 10 years.

Point Thomson was brought online in April 2016, with production facilities designed to produce and reinject (cycle) 200 million cubic feet per day of gas and produce up to 10,000 barrels per day of natural gas condensate. This project opens the eastern North Slope to development and would lead to increased production into TAPS.

Project construction for GMT1 is well underway and is already producing oil. Peak workforce at GMT1 during construction is estimated to be 700 and the estimated peak monthly production is estimated to be between 25,000 to 30,000 barrels of oil per day (BOPD) (gross). GMT2 could begin construction in early 2019, with first oil planned for late 2021. The development plan is for up to 48 wells, with 36 wells being permitted initially. The project is estimated to cost $1.5 billion to develop, and peak production is expected to be 35,000 to 40,000 BOPD. The master development plan for the Willow Project was submitted to the BLM in 2018 to start the EIS process. The proposed action includes the construction, operation, and maintenance of a CPF; the construction of up to five well pads, with up to 50 wells on each pad; roads for field access and in-field transportation; an airstrip; a system of pipelines; and a temporary island in the Beaufort Sea to facilitate the delivery of modules for the project.

Willow is estimated to hold between 400 and 750 million barrels of recoverable oil equivalent, with peak production rates of about 100,000 barrels per day. The development is estimated to cost $2 billion to $3 billion over 4 to 5 years after a final investment decision is made. Oil production could start in the 2024 to 2025 timeframe (Bailey 2018).

The oil and gas leasing program and subsequent exploration, development, and production activities in the program area would increase oil production in the North Slope and, increase TAPS throughput, increase economic activity at the local, regional, and State level due to direct industry spending on labor, materials, and services, increase government revenues from shared royalties, tax payments such as property taxes, corporate income taxes, severance taxes, and other local taxes, increase job opportunities for Alaskans, including residents of communities in the NSB, and increase labor income in regions where industry spending would occur and where the oil and gas workforce resides.

There would be no additional economic effects under Alternative A since there would be no petroleum development without leasing. The non-use and passive use values of the Coastal Plain and its other ecosystem service values (although not quantified in this analysis) would maintain their current value and would not be diminished by oil and gas leasing development.

The potential cumulative impacts on the economy under the action alternatives would be similar; however, there may be differences in employment, income, and revenues due to differences in how the various lease stipulations under each of the action alternatives would affect industry response and spending. The non-use and passive use values of the Coastal Plain and its other ecosystem service values (although not quantified in this analysis) would be diminished from their current value by oil and gas leasing development. The effects of climate change described under *Affected Environment* above, could influence the rate or degree of the potential cumulative impacts.

3.4.11 Public Health

Affected Environment

The BLM NPR-A IAP/EIS (2012, Section 3.4.12) analyzed the public health status in the NSB, based on demographic and health infrastructure through 2010; it is incorporated by reference in this EIS. The BLM analysis considers all eight villages of the NSB, a broader perspective than the analysis for this EIS, which focuses primarily on the village of Kaktovik, due to its proximity to the program area.

Under NEPA regulations, projects that require an EIS must include an analysis of health impacts associated with federal actions. The discussion below is consistent with recent NEPA analyses on the North Slope by including a broad description of health conditions (BLM 2012). The wider scope of analysis results from changing expectations for what constitutes a sufficient examination of human health in the regulatory process. North Slope residents, the NSB municipality, and others have advocated strongly for the inclusion of a more systematic and broad-based appraisal of human health-related issues in the EIS process. This was corroborated by comments received during the scoping period. This EIS does not analyze specific developments in the program area; therefore, a health impact assessment was not completed for this analysis. Health impact assessments are expected to be developed for future development projects that would require additional NEPA analysis.

Oil and gas development has had mixed impacts on the North Slope. Specific to oil and gas development, the NSB Baseline Community Health Analysis Report (NSB 2012, page 45) provides the following commentary:

> The health impacts of oil and gas development in the NSB are complex, as it has touched many aspects of community life in the region. Following the formation of the NSB, oil and gas revenues have created employment opportunities, provided money for essential services and infrastructure, and raised the average household income. An influx of outside interests and money can also create conflict, alter social structure, and divide

communities, affecting community well-being. Real and potential impacts on the environment and subsistence are also ongoing sources of tension and concern.

The following descriptions summarize baseline public health data for the NSB and Kaktovik, the community closest to the program area.

Accidents and Injuries

Accidents are an important cause of injury and death in Kaktovik and the North Slope in general. Off-road vehicles accounted for 18 percent of injury deaths among North Alaska Natives, most which are snowmachine accidents (AN EpiCenter 2009). Motor vehicle accidents are not common in Kaktovik, due to the limited road system (NSB 2015a).

Suicide was the leading cause of injury death for the NSB between 1999 and 2005, comprising 39 percent of all injury deaths. This is among the highest suicide rates in Alaska, at 73.5 deaths per 100,000 (AN EpiCenter 2009).

Food, Nutrition, and Subsistence Activity

Subsistence is important for the people of Kaktovik for both food and cultural sustenance (see **Section 3.4.3**). The village's subsistence area extends into the program area and adjacent land and waters bounded on the south by the headwaters and the tributaries of the Hulahula, Jago, and Salderochit Rivers, west to the Sagavanirktok River and Dalton Highway, east to Demarcation Bay, and north about 60 miles in the Beaufort Sea.

Kaktovik's primary subsistence resources are caribou, sheep, bowhead whale, bearded seal, fish, and waterfowl (NSB 2015a). Approximately 60 percent of the subsistence harvest consists of marine mammals. Kaktovik residents hunt for bowhead whales from July to September in offshore areas between 15 and 30 miles from shore, between Camden Bay and Tapkaurak Lagoon. Bearded seal and ringed seal are other marine mammal sources. Hunting occurs from March to September, with most success in July and August between Prudhoe Bay and Demarcation Bay, with a maximum distance of 30 miles from the shore.

Caribou are another primary source of subsistence harvest and are hunted along the coast during the summer by boat and inland during the winter by snowmachine. Caribou can be hunted year-round, but mostly during July and August, when they are in their prime condition. Arctic cisco and Arctic char/Dolly Varden are the primary fish species and are harvested primarily in July and August, during the summer migration of the fish along the coast from the Mackenzie River to the Colville River (NSB 2015a).

According to 2015 NSB census data, 42 percent of Kaktovik Iñupiat residents depended on subsistence foods for over half of their diet, and 13 percent of Kaktovik Iñupiat households depended on subsistence foods for almost all their diet. Sharing the harvest is an important objective in subsistence lifestyles; 42 percent of households shared half or more of their harvests with others in the community (NSB 2015b).

Food security can be a source of stress in NSB households, particularly Iñupiat households. In the 2015 NSB census, 37 percent of household heads reported difficulty getting healthy food for meals, and 25 percent reported that there were times when there was not enough food to feed the household (NSB 2015b). For Kaktovik residents, 10 percent of household heads reported there were times when there was not enough food for the household. Most NSB household heads (71 percent) indicated that this was due to a lack of store-bought foods (NSB 2015b).

Exposure to Potentially Hazardous Materials

Residents of the NSB are concerned about environmental contamination, particularly as it relates to contamination of subsistence food sources. In a recent survey, 44 percent of Iñupiat village residents reported concerns that fish and animals could be unsafe to eat (Poppel et al. 2007).

Air quality issues in rural Alaska villages include diesel emissions, indoor air quality, road dust, solid waste burning, and wood smoke. NSB residents are also concerned about air pollution generated by oil and gas activities. Assessments of air pollution in Nuiqsut, 173 miles west of Kaktovik, have found that pollutant concentrations are generally well below the NAAQS (BLM 2018a). Researchers also sampled air and water for VOCs in Nuiqsut. Over half of the air samples included VOCs, but none exceeded federal and Alaska air quality standards. None of the water samples had VOC levels that exceeded ADEC standards (BLM 2018a).

The ADEC identified 22 potentially contaminated sites in Kaktovik. These were former landfills and dump sites, the tank farm terminal, and DEW Line network facilities. Five of the sites are still active; the cleanup for the remaining 17 sites has been completed (ADEC 2018c), although cleanup thresholds could have changed since the date of closure (ADEC 2017b).

Public Utilities and Services

Public utilities are an important component of community health and wellness. Safe drinking water and sewage treatment prevent the spread of many serious transmissible diseases. Insufficient heating has been linked with poor health outcomes, particularly in children and older people (BLM 2012).

The NSB provides utilities for all Kaktovik. Public facilities include water and sewer treatment plants and a landfill. Kaktovik's infrastructure has had several upgrades in recent years. A buried water and sewer treatment system for the village was completed in 2003. Freshwater sources are small thaw lakes and ponds, a few deep stream channels, and Fresh Water Lake, which is about 0.7 mile from the village. Water is pumped in the summer into the treatment plant and then into two storage tanks for winter use (NSB 2015a). Ninety-nine percent of Kaktovik residents have running water, compared to 92 percent for the NSB (NSB 2012).

The NSB operates a small power plant on the west side of Kaktovik. The facility generates electricity using diesel fuel and distributes electricity to the village through aboveground utility lines. The power plant is relatively new and should be sufficient for the next 15 to 25 years, assuming normal maintenance and upgrades (NSB 2015a).

Health Services Infrastructure

The NSB and the Arctic Slope Native Association are jointly responsible for delivering health services to residents. Kaktovik maintains a clinic that is staffed by medical personnel via the Community Health Aide Program. This clinic does not have a physician or physician's assistant in residence. The closest hospital to Kaktovik is the Samuel Simmonds Memorial Hospital in Utqiaġvik, 311 miles northwest. Cases are referred to Fairbanks or Anchorage if they cannot be adequately treated in Utqiaġvik (BLM 2012).

The leading clinical assessments made by community health aides in the NSB villages including Kaktovik in 2005–2006 include respiratory or ear-nose-throat problems, injuries, and preventative care (NSB 2012). The primary outpatient visit diagnoses at Samuel Simmonds Memorial Hospital were managing chronic health conditions, such as high blood pressure, diabetes, and arthritis, and treating acute respiratory infections (NSB 2012).

Climate Change

Further disruptions to subsistence patterns from global environmental and climatic changes could foreseeably have adverse effects on Kaktovik resident health, including changes to subsistence harvests; see **Section 3.4.3**. Changes to subsistence migration patterns and changing weather patterns and sea ice conditions could make travel more hazardous, increasing the risk of injury and trauma. Widespread thawing of permafrost would affect Kaktovik residents' ability to store meat in deep cellars. This would increase the amount of spoiled food and the potential for food-borne illness (USACE 2012).

Direct and Indirect Impacts

Issuance of oil and gas leases under the directives of Section 20001(c)(1) of PL 115-97 would have no direct impacts on the environment because by itself a lease does not authorize any on the ground oil and gas activities; however, a lease does grant the lessee certain rights to drill for and extract oil and gas subject to further environmental review and reasonable regulation, including applicable laws, terms, conditions, and stipulations of the lease. The impacts of such future exploration and development activities that may occur because of the issuance of leases are considered potential indirect impacts of leasing. Such post-lease activities could include seismic and drilling exploration, development, and transportation of oil and gas in and from the Coastal Plain. Therefore, the analysis is of potential direct and indirect impacts on public health from on-the-ground post-lease activities.

Potential impacts to public health and safety from post-lease activities could stem from a number of different pathways: safety, diet and nutrition, environmental contaminants, economic impacts, and public health services.

Alternative A

Under Alternative A, no federal minerals in the Coastal Plain would be offered for future oil and gas lease sales. Alternative A would not establish and administer a competitive oil and gas program for the leasing, development, production, and transportation of oil and gas in and from the Coastal Plain in the Arctic Refuge. Current management actions would be maintained, and resource trends would continue, as described in the Arctic Refuge CCP (USFWS 2015a). Under Alternative A, no impacts on public health and safety would occur from oil and gas development in the program area.

Impacts Common to All Action Alternatives

This section discusses potential impacts on public health and safety that are common to all alternatives. Common types of direct and indirect effects on public health associated with oil and gas development in the program area are changes in subsistence harvest patterns; increased travel time for subsistence harvesting; changes in air and water quality and noise pollution; increases in Kaktovik resident, village of Kaktovik, and NSB revenue; and changes in public health service use and access.

This section does not assess health impacts. It analyzes various leasing alternatives and does not analyze specific developments. Health impact assessments would be used during future NEPA analyses of specific development projects after the lease sales are complete.

<u>Safety</u>

Indigenous populations in the Arctic and elsewhere have very high rates of accidents and trauma. Clinical assessments at the Kaktovik clinic include a high percentage of injuries and accidents (NSB 2012). The high incidence of accidents is partly due to the risks associated with subsistence activities, especially given the hostile environment of northern Alaska (BLM 2012).

Future oil and gas development in the program area has the potential to increase the risk of injuries and accidents during subsistence activities. Oil and gas development in the program area is expected to affect caribou herd movements and to alter subsistence hunting patterns for Kaktovik residents (see **Section 3.4.3**). The disturbance of wildlife by industrial activity is likely to result in hunters traveling farther afield and possibly into unfamiliar terrain to harvest stocks.

Future oil and gas development is not expected to increase the Kaktovik road system from its current extent but would develop permanent and seasonal roads in the program area. If Kaktovik residents have easy access to program-related roads, it is likely that some would use the roads to access subsistence harvesting areas, particularly when overland snowmachine travel is difficult. As oil and gas development expands and access to program roads increases, so would the risk of accidents and injuries (BLM 2012). Access approvals for recreation or non-subsistence uses in the program area would be dealt with at the APD phase when users apply for use permits.

Under all the action alternatives, the main impact on accidental injuries would result from either altered travel patterns or increased travel time for subsistence activity. Under all the action alternatives, future development of fixed facilities in areas of traditional use is likely to result in voluntary displacement of subsistence. This potential impact would be most significant if large numbers of hunters avoid territory close to Kaktovik. All action alternatives have the same potential for development close to the village of Kaktovik.

Diet and Nutrition

Health impacts could result from changes in diet and nutrition when future oil and gas developments affect populations reliant on subsistence resources. Dietary changes could result from the displacement or contamination of food sources, avoidance or loss of traditional harvesting lands, and increased reliance on store-bought foods. Consumption of traditional foods is associated with reduced risk of chronic diseases, such as diabetes, hypertension, cardiovascular disease, and stroke (BLM 2012). Store-bought food in rural Alaskan villages tends to have low nutritional value, and the cost of buying nutritious foods is often prohibitively expensive. When subsistence resources become less accessible and people rely more heavily on store-bought foods, the nutritional value of the diet decreases, and the risk of chronic diseases increases.

In addition, 10 percent of Kaktovik household heads reported times when there was not enough food for their household (NSB 2015b). Studies have found a variety of adverse health impacts from food insecurity, including obesity, poor psychological functioning among children, poor cardiovascular health, and lower physical and mental health ratings. The costs associated with harvesting subsistence resources, the year-to-year variability in subsistence harvest, and the high cost of store-bought food all contribute to high rates of food insecurity.

The likelihood of impacts on subsistence harvests under all action alternatives is discussed in **Section 3.4.3**. Impacts on caribou migratory patterns and avoidance of development areas are expected from oil and gas development. Kaktovik residents are also likely to avoid areas of heavy development. Threats to subsistence activities and harvest patterns are a primary source of ongoing stress in North Slope communities. Avoidance of productive land could reduce harvests and exacerbate dietary and nutritional outcomes independent of any direct impact on the animals themselves. Any reductions in the success of subsistence harvests for Kaktovik residents would accelerate the transition from subsistence resources to store-bought foods, worsening nutritional outcomes and food insecurity.

Environmental Contaminants

Activities associated with future oil and gas exploration and development can affect human health via changes to air and water quality or an increase in noise pollution.

Air Quality

Air quality impacts are similar for all action alternatives, as each alternative permits up to 2,000 acres of disturbance and the point sources and their locations are unknown at this point. **Section 3.2.2**, Air Quality, describes the impacts of potential oil and gas development on air quality. The primary sources of airborne emissions are construction dust, road dust, vehicle and machinery emissions, flaring and venting of gas, burning of refuse, and emissions from power generation and other sources. The air pollutants emitted by these activities have been linked with a range of health effects, including asthma, chronic bronchitis, decreased pulmonary function, and cardiovascular events (BLM 2012).

Both the EPA and the State of Alaska have established legal limits for air pollution to protect public health (**Section 3.3.2**). Air quality changes are most likely to occur at and near the areas of oil and gas development. If the development areas are distant from Kaktovik, potential impacts on the health of Kaktovik residents as a whole are unlikely to be seen and overall impact on human health is likely to be low. Those most likely to be affected are those who stay in cabins or other residences near development areas. In particular, dust from construction or traffic could be an issue.

Based on previous development projects and studies on the North Slope, the overall potential impact on human health is likely to remain low as all action alternatives are likely to be below applicable air quality standards for all phases of development (**Section 3.2.2**); however, people who are particularly vulnerable to respiratory problems (such as children, the elderly, and people with certain chronic illnesses) could experience health problems at locations or during episodes with poorer air quality.

Water Quality

As described in **Section 3.2.10**, future oil and gas development could affect water quality through accidental spills or releases or as the byproduct of construction, excavation, or human habitation. Water quality has the potential to affect the health of Kaktovik residents through contamination of drinking water or through contamination of rivers and waterways near subsistence cabins or camps.

Water could be contaminated through accidental discharges into watercourses that supply human water sources, particularly in areas of cabins or transient subsistence uses of the land; however, the likelihood of any such discharge occurring with the resultant human exposure is low, given the lease stipulations and BMPs around waste prevention, handling, disposal, spills, and public safety. If exposure occurred under these circumstances, the exposure would likely be short term and intermittent and would be unlikely to lead to significant health effects. No development is allowed on Barter Island, so no impacts on Kaktovik's drinking water supply are expected.

Contamination of Food Sources

Section 3.4.3 states that there is a low likelihood of contamination of subsistence food sources, with the possible exception of contamination through an oil spill. This is supported by current low measurable impacts, despite high levels of oil and gas activities on the North Slope in the past. Although studies have found elevated levels of contaminants in several species, the levels found in subsistence foods in the North Slope area appear at present to be generally low and are lower than what would trigger public health concern (NSB 2006). Except in the event of a major spill (see **Section 3.2.11**), there are likely to be only negligible health effects from contamination of food sources as a result of any of the action alternatives.

Despite the current safety of traditional foods in the program area, Kaktovik residents remain concerned that oil and gas activities could potentially increase contaminant loads of subsistence foods to a level that would threaten human health. The perception of contamination may result in stress and anxiety about the safety of subsistence foods and avoidance of subsistence food sources, with potential changes in nutrition-related diseases as a result. These health impacts (perceived or real) arise regardless of whether or not there is any contamination at levels of toxicological significance; the impacts are linked to the perception of contamination, not to measured levels. Monitoring contaminants in subsistence foods (ROP 8) would help address subsistence user concerns related to contaminants and identify potential human health issues.

Noise

Noise levels could increase due to future construction or operation of oil and gas facilities, resulting in potential effects, ranging from minor irritation and annoyance to more severe health outcomes. Given the likely location of development away from Kaktovik, individuals at cabins or camps near developments would be most affected. Noise from future air traffic and other sources could create a nuisance around camps and cabins, possibly reducing their use as a base for subsistence harvests. Development-related noise could cause irritation, annoyance, or sleep disturbance among individuals who experience it (BLM 2012). Until site-specific development activities are proposed, the extent of this effect is not possible to determine.

Economic Impacts on Health

Economic growth and employment that are associated with future resource development can exert impacts on the health of populations. Increased income for Kaktovik residents and families has the potential to improve health through increases in the standard of living, reductions in stress, and opportunities for personal growth and social relationships (BLM 2012); however, there are negative impacts of economic growth as well. With other oil and gas development in the NSB, income and employment have been found to be associated with an increased prevalence of social pathologies, including substance abuse, assault, domestic violence, and unintentional and intentional injuries (BLM 2012).

Most oil and gas industry jobs in the North Slope have gone to transient workers, and oil and gas development in the program area is not expected to directly employ a large proportion of Kaktovik residents. The primary employment and income impacts on Kaktovik residents is anticipated to be indirect as a result of increased revenues to the NSB and village of Kaktovik, which allows for increased program spending and hiring. For a full description of socioeconomic impacts, see **Sections 3.4.4**.

Under all action alternatives, the increased revenue for the NSB and village of Kaktovik would allow for increased funding of existing health and social programs and an increase in indirect employment of Kaktovik residents (**Section 3.4.10**). Improvements to Kaktovik infrastructure would also be expected as a result of increased funding; possible capital projects are listed in Kaktovik's comprehensive development plan (NSB 2015a).

Public Health Services

Future oil and gas development would occur outside of Kaktovik and would be fully self-contained. Local Kaktovik health care services would not be affected by an influx of oil and gas workers because the worker camps would provide health services to them. There could be a slight increase in accidents due to changes in subsistence harvesting patterns, but these would be sporadic and well in the capacity of the Kaktovik local clinic and Samuel Simmonds Memorial Hospital in Utqiaġvik.

Anticipated tax revenues from oil and gas development under all action alternatives would support the current level of health care services in Kaktovik and should not affect demand. Episodic increases in disease occurrence, such as respiratory disease resulting from poor air quality, have the potential to cause short-term strain on the health care system; however, no such occurrences are likely under any of the action alternatives.

Alternative B

Under Alternative B, the types of potential impacts on public health and safety would be the same as those described above (*Impacts Common to All Action Alternatives*). The duration of all types of impacts would be long term for the duration of operation in the program area.

Under Alternative B, 721,200 acres of PCH calving habitat area would be available for leasing, which would result in the greatest potential impact on calf survival and overall PCH numbers out of all alternatives. Caribou is a primary subsistence species for Kaktovik residents. Any threat to herd numbers or contamination of meat would increase the likelihood and severity of health impacts resulting from changes in diet and nutrition and would exacerbate the current trends away from a traditional diet. In addition, changes to caribou herd numbers or movement could increase the distance and time that Kaktovik hunters travel and increase the potential for accidents or injury.

Alternative C

The types of potential impacts under Alternative C would be the same as those described under Alternative B. Under Alternative C, 476,600 acres of PCH calving habitat area would be NSO. In addition, Alternative C would impose greater TLs on human activity in the PCH post-calving habitat area than Alternative B. Potential impacts on PCH numbers would be reduced under Alternative C, compared with Alternative B, reducing the potential for impacts on diet and nutrition from reductions in subsistence harvests.

Alternative D

The types of potential impacts under Alternatives D1 and D2 would be the same as those described under Alternative B; however, the intensity of subsistence impacts would be substantially less under Alternatives D1 and D2. Less than half of the calving grounds offered for sale under Alternative B would be offered for sale under Alternatives D1 and D2, and more lands would be subject to development and TLs. Alternative D2 would be somewhat less likely to affect subsistence uses and resources, when compared with Alternative D1. This is because of the greater restrictions under Alternative D2 on development in caribou summer habitat. Protection of caribou calving areas would decrease the likelihood of diet changes and slow the trend from traditional foods to store-bought food.

Cumulative Impacts

As described in **Appendix F**, there are a significant number of activities planned or approved on the NSB and the program area. The village of Kaktovik and its residents have been buffered by the surrounding Arctic Refuge, which has limited oil and gas development in the immediate vicinity. Air and water quality in and around the village remains relatively untouched, subsistence harvests have not been noticeably affected, and the influx of oil and gas revenue for the NSB has improved infrastructure in the village. There is still a high rate of accidents and injury, primarily because subsistence activities and food security for Kaktovik households remain a concern.

Future development offshore in the Beaufort Sea could affect Kaktovik residents by interfering with marine mammal movement patterns. This could increase the risk of accident and injury by changing the subsistence harvest patterns and requiring more time on the water to harvest animals. In addition, the success rate for harvesting marine mammals could decline, reducing subsistence food for Kaktovik households and increasing food security concerns.

The action alternatives would have similar contributions to the cumulative effects on public health for Kaktovik residents with the pathways described above. All action alternatives would continue the ongoing transition from a subsistence-based diet to one that includes store-bought food. This is because oil and gas development could interfere with the success of subsistence activities. Alternatives C and D would lessen the potential negative impacts of oil and gas development by protecting the PCH calving range, including TLs in post-calving range and insect relief areas and larger buffers on important waterways and the coastal area. Alternative B would allow the most widespread industrial activity, with resulting potential impacts on subsistence harvest efforts, and could accelerate the transition away from a traditional diet and the subsequent increases in health risks.

Current levels of contamination of traditional food and water supplies in the region are low and, in the absence of major spills or accidents, are unlikely to significantly change under any action alternative.

Rates of accident injury are very high for Kaktovik residents. Disruptions to subsistence harvest patterns and conflicts between uses of the land can lead to an increased risk of injury in hunters. This is in addition to the risk of unpredictable weather and sea ice conditions associated with climate change. All action alternatives would increase the likelihood of potential injury due to industrial use of land previously used only for subsistence activity.

Increasing economic development and revenues to the local governments under all the action alternatives would support maintenance and improvement of Kaktovik infrastructure and systems. The direct and indirect employment resulting from oil and gas exploration and development, combined with the government and Native corporation revenues, are all major contributors to the positive health changes in the NSB over the last few decades. The activities under all action alternatives would contribute substantially to these ongoing impacts, with greater levels of employment generally more likely to be associated with good health.

3.5 Unavoidable Adverse Effects

Unavoidable adverse effects would be expected to occur during oil and gas exploration, development, and production. Many adverse impacts could be lessened by mitigation but would not be completely eliminated or reduced to negligible levels. Some are short-term impacts, while others may be long-term impacts. These have been described for each resource in **Sections 3.1 to 3.4**. Depending on the location and extent of oil and gas operations and adopted mitigation, unavoidable adverse impacts could include the following:

- Loss of soil productivity and sand and gravel resources, largely from construction of roads and pads and gravel mine development
- Loss of petroleum resources
- Increased risk of spills
- Changes in surface flow and drainage patterns due to construction of roads and pads and surface water withdrawal for ice roads, dust abatement, and operations
- Loss of vegetation habitat, including wetlands, due to construction of roads and pads and gravel mine development

- Loss, alteration, or fragmentation of wildlife habitat
- Changes in wildlife migration or travel patterns
- Continued change in access to and availability of subsistence resources

Before surface-disturbing activities begin, oil and gas leasing regulations (43 CFR 3104) require the operator on the ground to be covered by a bond. This bond provides monetary assurance to the BLM that the company would reclaim the pads, wells, and any associated surface disturbance to the standards of the BLM Authorized Officer. This is determined at the time of reclamation, thus allowing the BLM to take an adaptive management approach. On abandonment, the BLM would consider current data, technologies available, and the current resource situation in its determinations on specific reclamation. Additionally, the BLM retains the ability to increase the bond amount at any time during the lease, based on a recalculation of liability, such as an increased number of wells or a history of noncompliance with its operational standards.

3.6 Relationship Between Local Short-Term Uses and Long-Term Productivity

This section discusses the short-term effects of the leasing alternatives, including the potential use of the program area for oil and gas exploration and development, versus the maintenance and enhancement of potential long-term productivity of the program area's environmental resources.

Short-term in this discussion refers to the total duration of activities that could occur as a result of the leasing alternatives, primarily oil and gas exploration and production, whereas long-term refers to an indefinite period extending beyond the termination of the action. Specific impacts vary in kind, intensity, and duration according to the activities occurring at any given time. Activities during the production life of oil and gas leases executed based on the decision in the ROD for this EIS may result in chronic impacts over a longer period. Over the long term—several decades after completion of abandonment activities—natural environmental balances are generally expected to be restored, though that balance would not for all resources mean a return to the exact state prior to original disturbance.

For a discussion of short-term uses of the program area for hydrocarbon development and production activities versus the maintenance and enhancement of potential long-term productivity of environmental resources of the program area, see **Sections 3.1** to **3.4** of this document, and see Section 4.9 of the NPR-A EIS (BLM 2012) for a description of environmental resources on the North Slope.

3.7 Irreversible and Irretrievable Commitments of Resources

Irreversible or irretrievable commitments of resources refer to impacts on or losses of resources that cannot be reversed or recovered. These distinctions refer primarily to nonrenewable resources. A detailed description of irreversible or irretrievable commitments of resources from oil and gas development on the North Slope is in Section 4.10 of the NPR-A EIS (BLM 2012). There would be some irreversible or irretrievable commitments of resources that are described in greater detail in **Sections 3.1** to **3.4**, as follows:

- Removal of hydrocarbons from the reservoir
- Energy consumption associated with construction and operation phases
- Ground disturbance and permanent change resulting from gravel removal
- Surface water consumption for drilling and other industrial purposes with wastewater disposal via underground injection

- Loss or change in vegetation and wetlands where gravel is placed, regardless of whether it is removed at abandonment
- Loss or abandonment of wildlife habitat
- Loss or change in subsistence use of the program area, depending on final abandonment plans

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Glossary

Acidophilus: Acid-loving (as in bacteria or plants); growing well in an acid medium.

Active floodplain: The flat area along a water body where sediments are deposited by seasonal or annual flooding; generally demarcated by a visible high water mark.

Aerial: Consisting of, moving through, found in, or suspended in the air.

Alluvial: Sedimentary material consisting mainly of coarse sand and gravel.

Alternatives: The different means by which objectives or goals can be attained. One of several policies, plans, or projects proposed for decision-making.

Ambient: Used to describe the environment as it exists at the point of measurement and against which changes (impacts) are measured.

Ambient air quality standard: Air pollutant concentrations of the surrounding outside environment that cannot legally be exceeded during fixed time intervals and in a specific geographic area.

Amphidromous: Describes fish that spawn and overwinter in rivers and streams but migrate during the ice-free summer from these freshwater environments into coastal waters for months to feed.

Anadromous: Describes fish that mature in the sea and swim up freshwater rivers and streams to spawn. Salmon, steelhead, and sea-run cutthroat trout are examples.

Anchor field: An oil and gas field containing sufficient quantities of recoverable oil and gas to support the construction of infrastructure and processing facilities; satellite fields can then be constructed using the anchor field facilities.

Anoxic: The condition of an environment in which free oxygen is lacking or absent.

Anthropogenic: Of, relating to, or resulting from the influence of humans on nature.

Anticline: An inverted bowl-shaped structure formed when sedimentary rock layers are folded to produce an arch or elongated dome.

Aquatic: Growing, living in, frequenting, or taking place in water; in this Leasing EIS, used to indicate habitat, vegetation, and wildlife in freshwater.

Archaeological resource: Places where remnants, such as artifacts, of a past culture survive in a physical context that allows for their interpretation. Archaeological resources can be districts, sites, buildings, structures, or objects and can be prehistoric or historic.

Aufeis: Thick ice that builds up as a result of repeated overflow.

Authorized Officer (BLM): Designated BLM personnel responsible for a certain area of a project; for the Leasing EIS, generally this would be the BLM State Director.

Available: When referring to oil and gas leasing, available lands could be offered. Lands that are already leased could be offered for leasing if the existing lease ends.

Bank: (1) The rising ground bordering a lake, river, or sea; or of a river or channel, for which it is designated as right or left as the observer is facing downstream. (2) An elevation of the sea floor or large area, located on a continental (or island) shelf and over which the depth is relatively shallow but sufficient for safe surface navigation (e.g., Georges Bank); a group of shoals. (3) In its secondary sense, used only with a qualifying word such as "sandbank," "gravel bank," or "spoil bank," a shallow area consisting of shifting forms of silt, sand, mud, and gravel.

Barrel: Unit of measurement consisting of 42 gallons of oil or other fluid.

Baseline data: Data gathered before a proposed action to characterize pre-development site conditions.

Biodegradable: Capable of being broken down by the action of living organisms, such as microorganisms.

Biological assessment (BA): A document prepared by or under the direction of a federal agency; addresses listed and proposed species and designated and proposed critical habitat that may be in the action area and evaluates the potential effects of the action on such species and habitat.

Black water: Discharge that includes wastewater from any or all of the following: toilets, urinals, and sewage treatment systems.

Bonding capacity: An amount, determined by market analysts, based on a government entity's prior bonding experience, actual repayment performance, and its ability to service future, periodic debt. It affects the ability of municipalities to issue and sell bonds to generate funds for capital improvements.

Bottom-fast ice: Ice that is firmly attached or grounded to the bottom of a water body, which is often frozen from top to bottom.

Brackish: Water that is intermediate between salt water and freshwater; often occurs at the mouths of rivers, where freshwater mixes with salt water.

Brine: General description of water that is produced with oil. The water is associated with the oil-producing formation and can have varying amounts of dissolved salts.

Brood: A group of young birds being cared for by an adult bird; typically the surviving hatchlings from one or more clutches of eggs.

Bureau of Land Management (BLM): An agency of the United States government, under the US Department of the Interior, responsible for administering certain public lands of the United States.

Burin: A tool flaked into a chisel point for inscribing or grooving bone, wood, leather, stone, or antler.

Calving area: A large area where large mammals, particularly ungulates such as caribou, congregate to give birth to their young.

Capital expenses: The money spent to purchase or upgrade physical assets, such as buildings or machinery.

Caribou Study Community: Any community that is in game management subunits that overlap with the PCH or CAH herd ranges, and which have Federal Subsistence Board customary and traditional use determinations for those herds.

Carrion: Dead or dying animal flesh.

Class I air quality area: One of 156 protected areas, such as national parks over 6,000 acres, wilderness areas over 5,000 acres, national memorial parks over 5,000 acres, and international parks that were in existence as of August 1977, where air quality should be given special protection. Federal Class I areas are subject to maximum limits on air quality degradation called air quality increments (often referred to as prevention of significant deterioration [PSD] increments). All areas of the United States not designated as Class I are Class II areas. The air quality standards in Class I areas are more stringent than national ambient air quality standards.

Council on Environmental Quality (CEQ): An advisory council to the president, established by the National Environmental Policy Act of 1969. It reviews federal programs for their effect on the environment, conducts environmental studies, and advises the president on environmental matters.

Comprehensive Environmental Response Compensation and Liability Act of 1980 (CERCLA): Authorizes funds administered by the Environmental Protection Agency to identify and clean up hazardous waste sites; also known as Superfund.

Code of Federal Regulations (CFR): A codification of the general and permanent rules published in the *Federal Register* by the executive departments and agencies of the federal government.

cfs: Cubic feet per second; 1 cfs equals 448.33 gallons per minute.

Commercial field: Oil or natural gas fields that can be produced such that they provide a suitable return on investment.

Commercial oil or natural gas reserves: Resources that can be produced such that they provide a suitable return on investment.

Commercially recoverable: See *Commercial oil or natural gas reserves*, above.

Concern: A point, matter, or question raised by management or the public that must be addressed in the planning process.

Conglomerate: Sedimentary rock consisting of gravel and small boulders.

Consistency determination: A finding by a state or federal agency that a project or agency action is consistent with a required agency program, guideline, or regulation, such as the Alaska Coastal Zone Management Program.

Consultation: Exchange of information and interactive discussion; when capitalized it refers to consultation mandated by statute or regulation that has prescribed parties, procedures, and timelines, such as Consultation under NEPA or Section 7 of the Endangered Species Act.

Controlled surface use (CSU): A category of moderate constraint stipulations that allows some use and occupancy of public land, while protecting identified resources or values and is applicable to fluid mineral leasing and all activities associated with fluid mineral leasing, such as truck-mounted drilling and geophysical exploration equipment off designated routes and construction of wells and pads. CSU areas are open to fluid mineral leasing, but the stipulation allows the BLM to require special operational constraints, or the activity can be shifted more than 656 feet to protect the specified resource or value.

Criteria: Data and information that are used to examine or establish the relative degrees of desirability of alternatives or the degree to which a course of action meets an intended objective.

Criteria air pollutants: The six most common air pollutants in the US: carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), ozone (O_3), particulate matter (both PM_{10} and $PM_{2.5}$ inhalable and respirable particulates), and sulfur dioxide (SO_2). Congress has focused regulatory attention on these six pollutants because they endanger public health and the environment, are widespread throughout the US, and come from a variety of sources. Criteria air pollutants are typically emitted from many sources in industry, mining, transportation, electricity generation, energy production, and agriculture.

Cultural resources: The remains of sites, structures, or objects used by humans in the past, historic or prehistoric.

Cumulative effect or impact: The impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or non-federal) or person undertakes such actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over time.

Deferred: When referring to oil and gas leasing, indicates that lands would not be offered for lease until a specified period has expired. For example, a 10-year deferral would mean that the deferred lands would not be offered for leasing until for 10 years after the Record of Decision establishes the 10-year deferral.

Demersal: Living near, deposited on, or sinking to the seabed.

Density: The number of individuals per a given unit area.

Deposit: A natural accumulation, as of precious metals, minerals, coal, gas, and oil, that may be pursued for its intrinsic value, such as a gold deposit.

Development: The phase of petroleum operations that occurs after exploration has proven successful and before full-scale production. The newly discovered oil or gas field is assessed during an appraisal phase, a plan to fully and efficiently exploit it is created, and additional wells are usually drilled.

DEW-Line: Distant Early Warning Line. A site designed and built during the Cold War as the primary line of air defense warning of an "over the pole" invasion of North America.

Dilution: Mixing or thinning and therefore decreasing a certain strength or concentration.

Dispersion: Distributing or separating into lower concentrations or less dense units.

Dissociable: Able to break up into simpler chemical constituents.

Diversity: An expression of community structure; high, if there are many equally abundant species; low, if there are only a few equally abundant species; the distribution and abundance of different plant and animal communities and species in the area covered by a land and resource management plan.

Draft Environmental Impact Statement (DEIS): The draft statement of the environmental effects of a major federal action, which is required under section 102 of the National Environmental Policy Act and released to the public and other agencies for comment and review.

Drill pad: A drilling site, usually constructed of local materials such as gravel.

Drilling fluid (mud): A preparation of water, clay, and chemicals circulated in a well during drilling to lubricate and cool the drill bit, flush rock cuttings to the surface, prevent sloughing of the sides of the hole, and prevent the flow of formation fluids into the bore-hole or to the surface.

Duck pond: A small, flat-bottomed plastic receptacle placed under a vehicle to catch and contain any contaminated fluids that may melt or drip from the underside of the vehicle.

Economically recoverable: See *Commercial oil or gas reserves*, above.

Effect: Environmental change resulting from a proposed action. Direct effects are caused by the action and occur at the same time and place, while indirect effects are caused by the action but are later in time or farther removed in distance, although still reasonably foreseeable. Indirect effects may include growth-inducing 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. Effect and impact are synonymous, and both are used in this document.

Employment: Labor input into a production process, measured in the number of person-years or jobs; the number of jobs required to produce the output of each sector. A person-year is approximately 2,000 working hours by one person working the whole year or by several persons working seasonally. A job may be 1 week, 1 month, or 1 year.

Endangered species: Any species of animal or plant that is in danger of extinction throughout all or a significant portion of its range; plant or animal species identified by the Secretary of the Interior as endangered in accordance with the 1973 Endangered Species Act.

Energy budget: The flow of energy through an organism or ecosystem. For an organism, it is the amount of energy being absorbed (e.g., food) in relation to the amount of energy expended and lost as heat.

Environment: The physical conditions that exist in an area, such as the area that would be affected by a proposed project, including land, air, water, minerals, flora, fauna, ambient noise, and objects of historic or aesthetic significance; the sum of all external conditions that affect an organism or community to influence its development or existence.

Environmental assessment (EA): A concise public document, for which a federal agency is responsible, that serves to (1) briefly provide sufficient evidence and analysis for determining whether to prepare an environmental impact statement or a finding of no significant impact; (2) aid an agency's compliance with the National Environmental Policy Act when no environmental impact statement is necessary; and, (3) facilitate preparation of an environmental impact statement when one is necessary. .

Environmental impact statement (EIS): An analytical document prepared under the National Environmental Policy Act that portrays the potential impacts of the environment of a preferred action and its possible alternatives. An EIS is developed for use by decision-makers to weigh the environmental consequences of a potential decision.

Environmental justice: The fair treatment and meaningful involvement of all people, regardless of natural origin or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including racial, ethnic, or socioeconomic groups, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and tribal programs and policies. Executive Order 12898 directs federal agencies to achieve environmental justice as part of their missions by identifying and addressing disproportionately high adverse effects of agency programs, policies, and activities, on minority and low-income populations

Erosion: The wearing away of the land surface by running water, wind, ice, or other geologic agents, including gravitation creep.

Eskimo: An ethnonym (name given to a group by another group) referring to speakers of the Inuit language family who live in the Arctic and Subarctic regions of North America—Canada, Greenland, and Alaska—and eastern Siberia.

Essential fish habitat (EFH): As defined by Congress in the interim final rule (62 FR 66551), "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." For the purpose of interpreting the definition of EFH habitat, "waters" are aquatic areas and their associated physical, chemical, and biological properties; "substrate" is sediment underlying the waters; "necessary" refers to the habitat required to support a sustainable fishery and the managed species contribution to a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers all habitat types that a species uses throughout its life cycle.

Estuary: A partially enclosed body of water formed where freshwater from rivers and streams flows into the ocean, mixing with the salty seawater. Estuaries and the lands surrounding them are places of transition from land to sea, and from freshwater to salt water.

Ethnographic: Of or pertaining to the descriptive and analytical study of the culture of particular self-defined groups or communities.

Exception: A one-time exemption to a lease stipulation, determined on a case-by-case basis.

Exploration: The search for economic deposits of minerals, gas, oil, or coal through the practices of geology, geochemistry, geophysics, drilling, shaft sinking, and mapping.

Exploratory unit: Normally embrace a prospective area delineated on the basis of geological or geophysical inference and permit the most efficient and cost-effective means of developing underlying oil and gas resources.

Fast-ice zone: Area along the coast covered by sea ice that is continuous with and attached to the shoreline.

Feasible: Capable of being accomplished in a successful manner within a reasonable time, taking into account economic, environmental, legal, social, and technological factors.

Final environmental impact statement (final EIS): A revision of the draft environmental impact statement that includes public and agency comments on the draft.

Fisheries habitat: Streams, lakes, and reservoirs that support fish populations.

Fishery: The act, process, occupation, or season of taking an aquatic species.

Floodplain: The lowland and relatively flat area adjoining inland waters, including, at a minimum, that area subject to a 1 percent or greater chance of flooding in any given year.

Fluvial: Of or relating to a stream or river.

Fossil: Evidence or remnant of a plant or animal preserved in the earth's crust, such as a skeleton, footprint, or leaf print.

Fossil fuel: Petroleum, natural gas, and coal; fuel derived from biological material that was deposited into sedimentary rocks.

Frequency: The number of samples in which a plant or animal species occurs, divided by the total number of samples.

Fugitive dust: Particles suspended randomly in the air, usually from road travel, excavation, or rock loading operations.

Game management unit (GMU): A geographic division made by the Alaska Department of Fish and Game for the management of fish and wildlife in the State. Different GMUs have different hunting and fishing seasons, bag limits, and other harvest rules.

Geology: The scientific study of the origin, history, and structure of the earth; the structure of a specific region of the earth's surface.

Geomorphic: Pertaining to the structure, origin, and development of the topographical features of the earth's crust.

Gill net: Made of one or more layers of mesh, used to catch fish by entanglement as they attempt to swim through the net.

Glacial drift: Unsorted sediments deposited by glaciers and not subsequently reworked by water; coarse-grained materials, such as rock and sand, suspended in a fine-grained matrix, such as silt. The term applies to all mineral material transported by a glacier and deposited directly by or from the ice or by running water emanating from a glacier.

Global warming: An increase over time of the average temperature of the earth's atmosphere and oceans. It is generally used to describe the temperature rise over the past century or so and the effects of humans on the temperature rise.

Gray water: Discharge that includes wastewater from any or all of the following: kitchen sink, shower, drinking water, and laundry.

Greenhouse effect: A process by which thermal radiation from a planetary surface is absorbed by atmospheric greenhouse gases and is reradiated in all directions. Since part of this reradiation is toward the earth's surface and the lower atmosphere, it elevates the average surface temperature above what it would be in the absence of the gases.

Greenhouse gas (GHG): A gas that absorbs and emits thermal radiation in the lowest layers of the atmosphere. This process is the fundamental cause of the greenhouse effect. The primary greenhouse gases that are considered air pollutants are carbon dioxide, (CO_2), methane (CH_4), nitrous oxide (N_2O), and chlorofluorocarbons (CFCs).

Groundwater: Water found beneath the land surface in the zone of saturation below the water table.

Habitat: The natural environment of a plant or animal, including all biotic, climatic, and soil conditions, or other environmental influences affecting living conditions. The place where an organism lives.

Hazardous air pollutants (HAPs): Also known as toxic air pollutants, those that cause or may cause cancer or other serious health effects, such as reproductive effects or birth defects, or adverse environmental and ecological effects. The Environmental Protection Agency is required to control 187 hazardous air pollutants. Examples of HAPs are benzene (found in gasoline), perchlorethlyene (emitted from dry cleaning facilities), and methylene chloride (used as a solvent).

Hazardous waste: As defined by the Environmental Protection Agency, a waste that exhibits one or more of the following characteristics: ignitability, corrosivity, reactivity, or toxicity. Hazardous wastes are listed in 40 CFR 261.3 and 171.8.

Headwaters: The upper reaches of a stream where it forms.

Hydrocarbon: A naturally occurring organic compound composed of hydrogen and carbon. Hydrocarbons can occur in molecules as simple as methane (one carbon atom with four hydrogen atoms), but also as highly complex molecules, and can occur as gases, liquids, or solids. The molecules can have the shape of chains, branching chains, rings, or other structures. Petroleum is a complex mixture of hydrocarbons.

Hydrologic system: The combination of all physical factors, such as precipitation, stream flow, snowmelt, and groundwater that affect the hydrology of a specific area.

Impermeable: Not permitting passage of fluids through its mass.

Impoundment: The collection and confinement, usually of water (in the case of mining, tailings materials), in a reservoir or other storage area.

Increment: An amount of change from an existing concentration or amount, such as air pollutant concentrations.

Indigenous: Having originated in and being produced, growing, living, or occurring naturally in a particular region or environment.

Indirect impact: Impact caused by an action but later in time or farther removed in distance, although still reasonably foreseeable.

Infrastructure: The underlying foundation or basic framework; substructure of a community, such as schools, police, fire services, hospitals, water, and sewer systems.

Insect-relief area: An area of the North Slope with relatively low numbers of insects that caribou use for relief from insects.

Interstitial ice: Found in cavities or lodged between soil grains or rock crevices.

Irretrievable: Applies to losses of production, harvest, or commitment of renewable natural resources. For example, some or all of the wildlife forage production from an area is irretrievably lost during the time an area is used as an oil or gas development site. If the use changes, forage production can be resumed. The production lost is irretrievable, but the act is not irreversible.

Irreversible: A term that applies primarily to the use of nonrenewable resources, such as minerals or cultural resources, or to those factors that are renewable only over long time spans, such as soil productivity. Irreversible also includes loss of future options.

Isobath: Depth interval contour, as commonly mapped for lake or ocean bottoms.

Jurisdictional wetland: A wetland area delineated and identified by specific technical criteria, field indicators, and other information, for the purposes of public agency jurisdiction. The US Army Corps of Engineers regulates "dredging and filling" activities associated with jurisdictional wetlands. Other federal agencies that can become involved with matters that concern jurisdictional wetlands include the US Fish and Wildlife Service, the Environmental Protection Agency, and the Natural Resource Conservation Service.

Landfast ice: Stationary ice that is continuous with, and attached to, the shoreline and extends out into the waterbody.

Landform: Any physical, recognizable form or feature on the earth's surface having a characteristic shape, which is produced by natural causes. Landforms provide an empirical description of similar portions of the earth's surface.

Land management: The intentional process of planning, organizing, programming, coordinating, directing, and controlling land use actions.

Landscape: The sum total of the characteristics that distinguish a certain area on the earth's surface from other areas; these characteristics are a result not only of natural forces, but also of human occupancy and use of the land. An area composed of interacting and interconnected patterns of habitats (ecosystems), which are repeated because of geology, landforms, soils, climate, biota, and human influences throughout the area.

Land status: The ownership status of lands.

Land use allocation: The assignment of a management emphasis to particular land areas with the purpose of achieving the goals and objectives of some specified use(s) (e.g., campgrounds, wilderness, logging, and mining).

Laterally discontinuous: Not continuous in the horizontal plane. For example, in an area with laterally discontinuous permafrost, the permafrost is not uniformly found across the entire area without interruption.

Lead: Long cracks in the ice, used by both whales and boats to travel through the water.

Listed species: Species that are listed as threatened or endangered under the Endangered Species Act of 1973 (as amended).

Long-term impacts: Impacts that normally result in permanent changes to the environment. An example is the loss of habitat due to development of a gravel pit. For each resource, the definition of long-term may vary.

Management activity: A human activity imposed on a landscape for the purpose of harvesting, traversing, transporting, or replenishing natural resources.

Management area: An area delineated on the basis of management objective prescriptions.

Management concern: An issue, problem, or condition that influences the range of management practices identified in a planning process.

Management direction: A statement of multiple use and other goals and objectives, and the associated management prescriptions, standards, and guidelines for attaining them (36 CFR 219.3).

Marine: Of, found in, or produced by the sea.

Masu: A starchy tuber found in arctic and subarctic regions (vernacular is "Eskimo potato").

Mean: A statistical value calculated by dividing the sum of a set of sample values by the number of samples. Also referred to as the arithmetic mean or average.

Mean high water mark: With respect to ocean and coastal waters, the line on the shore established by the average of all high tides. It is established by survey based on available tidal data (preferably averaged over a period of 18.6 years because of the variations in tide). In the absence of such data, less precise methods to determine the mean high water mark are used, such as physical markings, lines of vegetation or comparison of the area in question with an area having similar physical characteristics for which tidal data are readily available.

Modification: A change to a lease stipulation either temporarily or for the life of the lease.

Migratory: Moving from place to place, daily or seasonally.

Mitigation: Steps taken to: (1) avoid an impact altogether by not taking a certain action or parts of an action; (2) minimize an impact by limiting the degree or magnitude of the action and its implementation; (3) rectify an impact by repairing, rehabilitating, or restoring the affected environment; (4) reduce or eliminate an impact over time by preserving and maintaining operations during the life of the action; and, (5) compensate for an impact by replacing or providing substitute resources or environments (40 CFR Part 1508.20).

Memorandum of Understanding (MOU): Usually documents an agreement reached among federal agencies.

Muktuk: Eskimo delicacy consisting of the skin and the thin layer of subcutaneous fat of whales.

National Environmental Policy Act (NEPA): An act declaring a national policy to encourage productive and enjoyable harmony between humankind and the environment; promote efforts to prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of humanity; enrich the understanding of the ecological systems and natural resources important to the nation; and establish a Council on Environmental Quality.

Net present value (NPV): The difference between the discounted value (benefits) of all outputs to which monetary values or established market prices are assigned and the total discounted costs of managing the planning area.

National Pollutant Discharge Elimination System (NPDES): A program authorized by sections 318, 402, and 405 of the Clean Water Act, and implemented by regulations 40 CFR 122. The NPDES program requires permits for the discharge of pollutants from any point source into waters of the United States.

Nearshore: Marine waters within the boundary of the Arctic Refuge boundary.

No-Surface-Occupancy (NSO): An area that is open for mineral leasing but does not allow the construction of surface oil and gas facilities in order to protect other resource values.

Non-Associated Gas: Gas in a reservoir having little or no crude oil.

NO_x: Mono-nitrogen oxides, including nitric oxide (NO) and nitrogen dioxide (NO_2). It is formed when naturally occurring atmospheric nitrogen and oxygen are combusted with fuels in automobiles, power plants, industrial processes, and home and office heating units.

Objective: A concise, time-specific statement of measurable planned results that respond to pre-established goals. An objective forms the basis for further planning to define the precise steps to be taken and the resources to be used to achieve identified goals.

Offshore: (1) In beach terminology, the comparatively flat zone of variable width, extending from the shoreface to the edge of the continental shelf. It is continually submerged. (2) The direction seaward from the shore. (3) The zone beyond the nearshore zone where sediment motion induced by waves alone effectively ceases and where the influence of the sea bed on wave action is small in comparison with the effect of wind. (4) The breaker zone directly seaward of the low tide line.

Oiled: Having oil on skin, fur, or feathers after coming into contact with an oil spill.

Ordinary High Water Mark: The line on the shore established by the fluctuations of water and indicated by physical characteristics such as a clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas.

Ozone: Form of oxygen found largely in the stratosphere; a product of the reaction between ultraviolet light and oxygen.

Particulates: Small particles suspended in the air, generally considered pollutants.

Pelagic: Pertaining to the ocean and especially to animals (typically marine mammals, birds, or fish) that live at the surface of the ocean away from the coast.

Per capita income: Total income divided by the total population.

Performance-based stipulation: A stipulation applied to a lease that provides a stated objective that must be met, along with requirements and guidelines, but provides some leeway as to how that objective can be met and maintained by the lessee; compare to prescriptive-based stipulation.

Permafrost: Permanently frozen ground.

Permanent oil and gas facilities: Production facilities, pipelines, roads, airstrips, production pads, docks, seawater treatment plants, and other structures associated with oil and gas production that occupy land for more than one winter season. Material sites and seasonal facilities, such as ice roads, are excluded, even when the pads are designed for use in successive winters.

Permeability: The property or capacity of a porous rock, sediment, or soil for transmitting a fluid; a measure of the relative ease of fluid flow under unequal pressure.

Photoperiod: In reference to cycles of light and darkness, the length of time that uninterrupted light is present, generally the length of daylight in a given 24-hour period.

Physiographic province: A region having a particular pattern of relief features or land forms that differs significantly from that of adjacent regions (e.g., Arctic Coastal Plain).

Pingo: A low conical hill or mound forced up by hydrostatic pressure in an area underlain by permafrost and consisting of an outer layer of soil covering a core of solid ice. Pingos range from 6 to 160 meters in height.

Plant community: A vegetation complex, unique in its combination of plants, which occurs in particular locations under particular influences. A plant community is a reflection of integrated environmental influences on the site, such as soils, temperature, elevation, solar radiation, slope aspect, and precipitation.

Pollution: Human-caused or natural alteration of the physical, biological, and radiological integrity of water, air, or other aspects of the environment that produce undesired effects.

Polygon: A surface landform resulting from repeated freeze-thaw cycles common in permafrost areas. Polygons are bounded by troughs of ice or water and generally occur in networks that form regular geometric designs with multiple square sides of nearly equal lengths.

Polynyas: Non-linear openings in the sea ice.

Pool: A subsurface oil accumulation.

Porosity: The ratio of the volume of void space in a material (e.g., sedimentary rock or sediments) to the volume of its mass.

Potable: Suitable, safe, or prepared for drinking, as in potable water.

Pot hunting: The removal or theft of artifacts from cultural resource sites by untrained individuals for profit and recreation.

Prescriptive-based stipulation: A stipulation applied to leases with exacting requirements applying to lessee activities; compare to performance-based stipulation.

Prevention of significant deterioration (PSD): A special permit procedure established in the Clean Air Act, as amended, used to ensure that economic growth occurs in a manner consistent with the protection of public health and preservation of air quality related values in national special interest areas.

Pristine: Pure, original, and uncontaminated.

Prospect: An area of exploration in which hydrocarbons have been predicted to exist in commercially recoverable quantities.

Public scoping: A process whereby the public is given the opportunity to provide oral or written comments about the influence of a project on an individual, the community, and/or the environment.

Pulse: A group of whales; the term is applied to whales migrating across the Chukchi and Beaufort seas, when there are more individuals in each pod of whales and more pods than usual.

Putrescible: Liable to decay.

Pyrogenic: Producing or produced by heat.

Raptor: Bird of prey; includes eagles, hawks, falcons, and owls.

Recharge: Absorption and addition of water into the zone of saturation.

Record of Decision (ROD): A document separate from, but associated with, an environmental impact statement, which states the decision, identifies alternatives (specifying which were environmentally preferable), and states whether all practicable means to avoid environmental harm from the alternative have been adopted, and, if not, why not (40 CFR 1505.2).

Recoverable reserves: Oil and gas reserves that may be recoverable by the application of technology, but not necessarily commercially recoverable.

Regulated air pollutants: Pollutants first set forth in the Clean Air Act of 1970 and are the basis upon which the Federal government and state regulatory agencies have established emission thresholds and regulations. Regulated air pollutants include criteria air pollutants, hazardous air pollutants (HAPs), volatile organic compounds (VOCs), and greenhouse gases. The same pollutant may be regulated under more than one of the regulatory standards.

Reservoir (oil or gas): A subsurface body of rock having sufficient porosity and permeability to store and transmit fluids. Sedimentary rocks are the most common reservoir rocks because they have more porosity than most igneous and metamorphic rocks and form under temperature conditions at which hydrocarbons can be preserved. A reservoir is a critical component of a complete petroleum system.

Resident: A species that is found in a particular habitat for a particular time period (e.g., winter resident or summer resident) as opposed to a species found only when passing through during migration.

Required Operating Procedure (ROP): Procedures carried out during proposal implementation which are based on laws, regulations, executive orders, BLM planning manuals, policies, instruction memoranda, and applicable planning documents.

Rideup: A raised-relief ice formation that is formed when a moving ice sheet is forced up and over other structures such as land or ice.

Riffles: Stream segments where the water is relatively shallow, current velocity is relatively high, and sediments are coarse; riffles are located in between areas of deeper, slower water (pools).

Rift zone: Zone of faulting where rocks are pulled apart.

Right-of-way (ROW): Public lands that the BLM authorizes a holder to use or occupy under a grant; examples are roads, pipelines, power lines, and fiber optic lines.

Riparian: Occurring adjacent to streams and rivers and directly influenced by water. A riparian community is characterized by certain types of vegetation, soils, hydrology, and fauna and requires free or unbound water or conditions more moist than that normally found in the area.

Risked mean: The arithmetic average of all possible resource outcomes weighted by their probabilities. Risked (unconditional) estimates of resources such as oil or natural gas consider the possibility that the area may be devoid of those resources. Statistically, the risked mean may be determined through multiplication of the mean of a conditional distribution by the related probability of occurrence.

Rolligon: A brand name or make of wheeled vehicle that exerts low pressure on the ground and is designed to travel across sensitive areas such as tundra with minimal disturbance.

Satellite field: An oil reserve located near an existing oil development, allowing shared use of the infrastructure.

Scenic River: River designation, under the Federal Wild and Scenic Rivers Program, on the basis of undisturbed and scenic character. Scenic rivers are given special management criteria by federal agencies.

Scoping process: A part of the National Environmental Policy Act process; early and open activities used to determine the scope and significance of the issues, and the range of actions, alternatives, and impacts to be considered in an Environmental Impact Statement (40 CFR 1501.7).

Sediments: Unweathered geologic materials generally laid down by or within waterbodies; the rocks, sand, mud, silt, and clay at the bottom and along the edge of lakes, streams, and oceans.

Seismic: Relating to or denoting geological surveying methods involving vibrations produced artificially by explosions.

Sensitive species: Plant or animal species that are susceptible or vulnerable to activity impacts or habitat alterations. Species that have appeared in the *Federal Register* as proposed for classification or are under consideration for official listing as endangered or threatened species.

Setback: A distance by which a structure or other feature is set back from a designated line.

Short-term impacts: Impacts occurring during project construction and operation, and normally ceasing upon project closure and reclamation. For each resource, the definition of short-term may vary.

Significant: The description of an impact that exceeds a certain threshold level. Requires consideration of both context and intensity. The significance of an action must be analyzed in several contexts, such as society as a whole, and the affected region, interests, and locality. Intensity refers to the severity of impacts, which should be weighted along with the likelihood of its occurrence.

SO_x: Sulfur oxides, including sulfur dioxide (SO_2). A product of vehicle tailpipe emissions.

Sociocultural: Of, relating to, or involving a combination of social and cultural factors.

Socioeconomic: Pertaining to or signifying the combination or interaction of social and economic factors.

Soil horizon: A layer of soil material approximately parallel to the land surface that differs from adjacent genetically related layers in physical, chemical, and biological properties.

Solid waste: Garbage, refuse, and/or sludge produced during oil and gas exploration and development activities.

Spawning: Production, deposition, and fertilization of eggs by fish.

Special use permit: A permit issued under established laws and regulations to an individual, organization, or company for occupancy or use of federal or state lands for some special purpose.

Spill Prevention Control and Countermeasure Plan (SPCC): A plan that the Environmental Protection Agency requires to be on file within six months of project inception. It is a contingency plan for avoidance of, containment of, and response to spills or leaks of hazardous materials.

Standard: A model, example, or goal established by authority, custom, or general consent as a rule for the measurement of quantity, weight, extent, value, or quality.

Stipulation: A requirement or condition placed by the Bureau of Land Management on the leaseholder for operations the leaseholder might carry out within that lease. The Bureau of Land Management develops stipulations that apply to all future leases within the Arctic Refuge Coastal Plain.

Stratigraphic trap: An oil or gas reservoir in which the hydrocarbons are trapped because of a lateral change in the physical characteristics of the reservoir or a change in the lateral continuity of the rocks.

Strike: The act of throwing a darting gun harpoon with a black powder or penthrite bomb into a whale. A strike may or may not result in a dead whale, which may or may not result in a landed whale. The International Whaling Commission considers and counts the number of strikes and landed whales in their quota allocation to the US government (and hence to the Alaska Eskimos). Unused strikes can be transferred to other individuals or groups harvesting whales.

Subsistence: Harvesting of plants and wildlife for food, clothing, and shelter. The attainment of most of one's material needs (e.g., food and clothing materials) from wild animals and plants.

Talik: An unfrozen section of ground found above, below, or within a layer of discontinuous permafrost. These layers can also be found beneath waterbodies in a layer of continuous permafrost.

Technically recoverable: Amount of oil or gas that can be recovered from a formation using current technology and practices.

Terrestrial: Of or relating to the earth, soil, or land; inhabiting the earth or land.

Thermokarst: Land-surface configuration that results from the melting of ground ice in a region underlain by permafrost. In areas that have appreciable amounts of ice, small pits, valleys, and hummocks form when the ice melts and the ground settles unevenly.

Threatened species: A plant or animal species likely to become an endangered species throughout all or a significant portion of its range within the foreseeable future.

Timing limitation (TL): This stipulation, a moderate constraint, is applicable to fluid mineral leasing, all activities associated with fluid mineral leasing (e.g., truck-mounted drilling and geophysical exploration equipment off designated routes, and construction of wells and pads), and other surface-disturbing activities (i.e., those not related to fluid mineral leasing). Areas identified for TL are closed to fluid mineral exploration and development, surface-disturbing activities, and intensive human activity during identified time frames. This stipulation does not apply to operation and basic maintenance, including associated vehicle travel, unless otherwise specified. Construction, drilling, completions, and other operations considered to be intensive are not allowed. Intensive maintenance, such as workovers on wells, is not permitted. TLs can overlap spatially with no surface occupancy and controlled surface use, as well as with areas that have no other restrictions.

Total petroleum system: The combination of geologic components and processes necessary to generate and store hydrocarbons, including a mature source rock, migration pathway, reservoir rock, trap, and seal. Includes all the petroleum generated by related source rocks and resides in a volume of mappable rocks. Geologic processes act upon the petroleum system and control the generation, expulsion, migration, entrapment, and preservation of petroleum.

Traditional knowledge: An intimate understanding by indigenous peoples of their environment, which is grounded in a long-term relationship with the surrounding land, ocean, rivers, ice, and resources. This understanding includes knowledge of the anatomy, biology, and distribution of resources; animal behavior; seasons, weather, and climate; hydrology, sea ice, and currents; how ecosystems function; and the relationship between the environment and the local culture.

Transfer payment: Money given by the government to citizens, such as Social Security, welfare, and unemployment compensation.

Trophic system: The process and organisms that move food energy through the ecosystem, often termed a food chain.

Tundra: Level or undulating treeless plain characteristic of northern Arctic regions, consisting of black mucky soil with permanently frozen subsoil and a dense growth of mosses, lichens, dwarf herbs, and shrubs.

Turbidity: A measure of the amount of suspended sediment in water.

Tussock: A small area of grass that is thicker or longer than the grass growing around it.

Unavailable: When referring to oil and gas leasing, unavailable lands would not be offered for oil and gas leasing.

Unconventional oil and gas: Reservoir oil and gas that cannot be efficiently extracted using conventional methods, examples include shale gas and tar sands.

Vibroseis: A device which uses a truck-mounted vibrator plate coupled to the ground to generate a wave train up to seven seconds in duration and comprising a sweep of frequencies. The recorded data from an upsweep or downsweep (increasing or decreasing frequency respectively) are added together and compared with the source input signals to produce a conventional-looking seismic section. The device is used increasingly in land surveys instead of explosive sources.

Volatile Organic Compounds (VOCs): A group of chemicals that react in the atmosphere with nitrogen oxides in the presence of sunlight and heat to form ozone. VOCs contribute significantly to photochemical smog production and certain health problems. Examples of VOCs are gasoline fumes and oil-based paints.

Waiver: A permanent exemption to a stipulation or lease.

Waterbody: A jurisdictional Water of the United States (see 33 CFR 328.4). Examples of "waterbodies" include streams, rivers, lakes, ponds, and wetlands.

Waterflooding: The injection of water into geological reservoirs to maintain or increase pressure in the reservoir and thereby assist in the extraction of oil.

Water quality: The interaction between various parameters that determines the usability or non-usability of water for on-site and downstream uses. Major parameters that affect water quality include: temperature, turbidity, suspended sediment, conductivity, dissolved oxygen, pH, specific ions, discharge, and fecal coliform.

Wetlands (biological wetlands): Those areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstance do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands include habitats such as swamps, marshes, and bogs (see jurisdictional wetlands).

Wild and Scenic Rivers: Those rivers or sections of rivers that are free of impoundments, with shorelines or watersheds still largely primitive and shorelines largely undeveloped, but accessible in places by roads.

Wilderness: A wilderness, in contrast with those areas where man and his works dominate the landscape, is hereby recognized as an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain. An area of wilderness is further defined to mean in this Act an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions and which (1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable; (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; (3) has at least five thousand acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition; and (4) may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value.

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