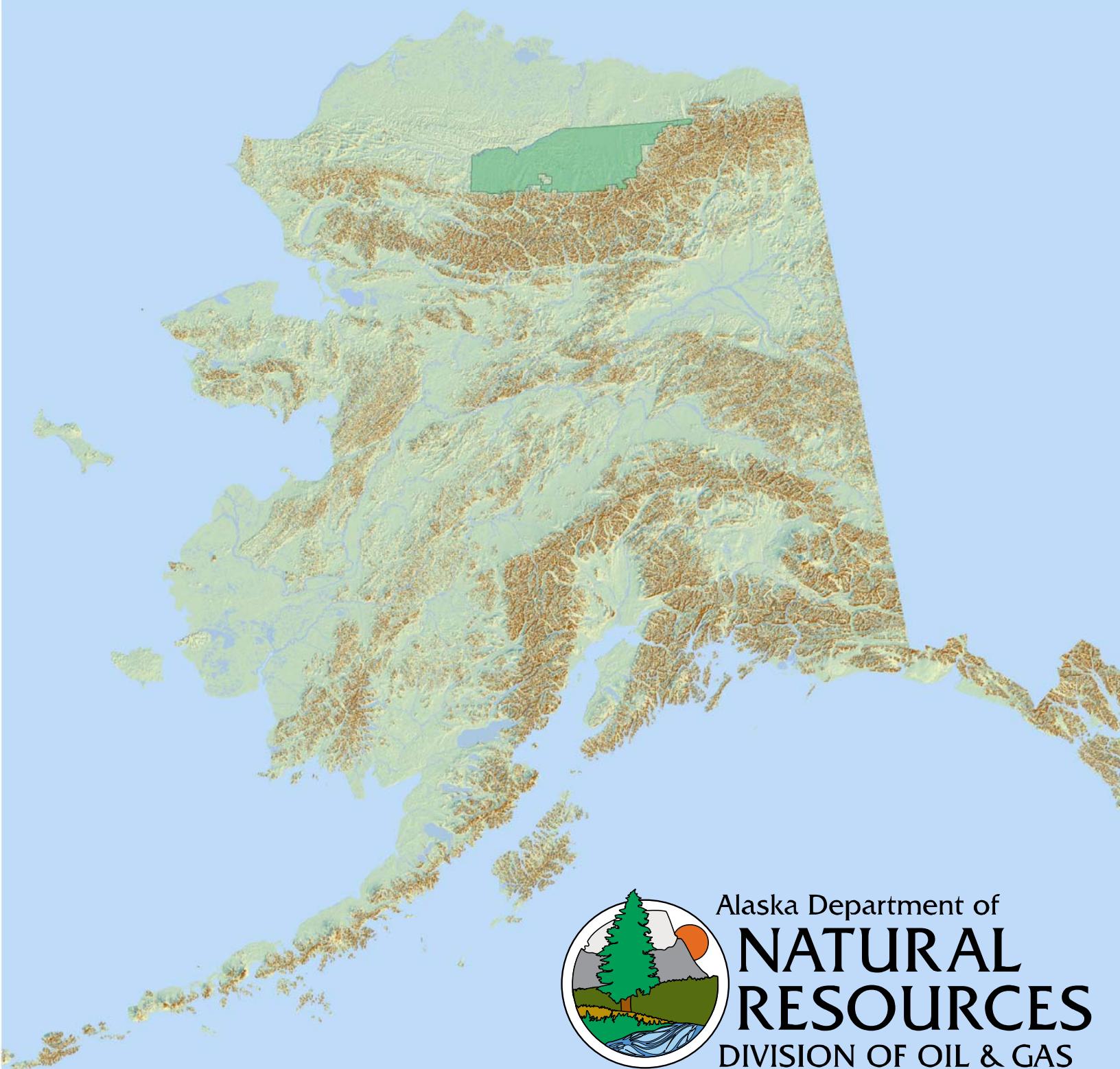


# NORTH SLOPE FOOTHILLS AREA WIDE OIL AND GAS LEASE SALES

Final Finding of the Director  
May 26, 2011



Alaska Department of  
**NATURAL  
RESOURCES**  
DIVISION OF OIL & GAS

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**Recommended citation:**

ADNR (Alaska Department of Natural Resources). 2011. North Slope Foothills Areawide oil and gas lease sales: Final finding of the Director. May 26, 2011.

This document is available online on the Division of Oil and Gas web site:  
<http://www.dog.dnr.state.ak.us/oil/>

This publication was produced by the Department of Natural Resources, Division of Oil and Gas. It was printed at a cost of \$33.33 per copy. The purpose of the publication is to meet the mandate of AS 38.05.035(e).

Printed in Anchorage, Alaska.

# NORTH SLOPE FOOTHILLS AREAWIDE OIL AND GAS LEASE SALES

Final Finding of the Director

Prepared by:  
Alaska Department of Natural Resources  
Division of Oil and Gas

May 26, 2011

## List of Abbreviations

<b>Agencies</b>		<b>Other</b>	
ADEC	Alaska Department of Environmental Conservation	2D	2-dimensional
ADF&G	Alaska Department of Fish and Game	3D	3-dimensional
ADNR	Alaska Department of Natural Resources	AAC	Alaska Administrative Code
ADOR	Alaska Department of Revenue	ACMP	Alaska Coastal Management Program
ADOT	Alaska Department of Transportation and Public Facilities	ACS	Alaska Clean Seas
AOGCC	Alaska Oil and Gas Conservation Commission	AGIA	Alaska Gasline Inducement Act
BLM	Bureau of Land Management	AIMS	Alaska Incident Management System
BOEMR	Bureau of Ocean Energy Management, E Regulation and Enforcement	ANCSA	Alaska Native Claims Settlement Act
Corps	U.S. Army Corp of Engineers	ANWR	Arctic National Wildlife Refuge
DCOM	Division of Coastal and Ocean Management	ARRT	Alaska Regional Response Team
DMLW	Division of Mining, Land and Water	AS	Alaska Statute
DO&G	Division of Oil and Gas	ASRC	Arctic Slope Regional Corporation
EPA	U.S. Environmental Protection Agency	BOP	blowout preventer
FERC	Federal Energy Regulatory Commission	CAH	Central Arctic herd
JPO	Joint Pipeline Office	CNG	compressed natural gas
MMS	Minerals Management Service	C-plan	Oil Discharge Prevention and Contingency Plan
NMFS	National Marine Fisheries Service	DRR	dismantlement, removal, and remediation
NSB	North Slope Borough	ERD	extended reach drilling
PHMSA	U.S. Pipeline and Hazardous Materials Safety Administration	FLIR	Forward Looking InfraRed
PSIO	Petroleum Systems Integrity Office	FY	fiscal year
SPCO	State Pipeline Coordinator's Office	GMU	Game Management Unit
USFWS	U.S. Fish and Wildlife Service	GOA	Gates of the Arctic National Park and Preserve
		GPS	global positioning system
		HIA	Health Impact Assessment
in	inches	LEOS	Leck Erkennung und Ortangs System
ft	feet	LNG	liquid natural gas
mi	miles	LPC	Lisburne Production Center
mm	millimeters	LVB	Line volume balance
m	meters	NAAQS	National Ambient Air Quality Standards
km	kilometers	NPDES	National Pollutant Discharge Elimination System
lb	pounds	NPR-A	National Petroleum Reserve-Alaska
gal	gallons	NSFP	North Slope Foothills Province
bbl	barrel(s) (42 gallons)	NSSRT	North Slope Spill Response Team
%	percent	PFD	Permanent Fund Dividend
°	degrees	PPA	Pressure Point Analysis
F	Fahrenheit	SRT	spill response team
C	Celcius	TAPS	Trans-Alaska Pipeline System
		TCH	Teshekpuk caribou herd
		TVB	Transient volume balance
		UIC	Underground Injection Control
		VSM	vertical support members
		WAH	Western Arctic herd

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# Chapter One: Executive Summary and Director's Final Finding and Signature

The State of Alaska is proposing to offer for lease all available state-owned acreage in North Slope Foothills areawide oil and gas lease sales from 2011-2020 (Map 1.1). The Director of the Alaska Department of Natural Resources (ADNR), Division of Oil and Gas (DO&G), has made a final finding that holding these lease sales is in the best interest of the state. The Director reviewed all facts and issues known or made known to him and limited the scope of the finding to the lease phase of oil and gas activities and the reasonably foreseeable significant effects of issuing leases (AS 38.05.035(e)(1)(A)). Conditions for phasing have been met under AS 38.05.035(e)(1)(C). The content of best interest findings is specified in AS 38.05.035(e), and topics that must be considered and discussed are prescribed in AS 38.05.035(g).

After weighing the facts and issues known to him at this time, considering applicable laws and regulations, and balancing the potential positive and negative effects given the mitigation measures and other regulatory protections, the Director has concluded that the potential benefits of lease sales outweigh the possible negative effects, and that North Slope Foothills areawide oil and gas lease sales will be in the best interests of the state of Alaska.

## A. Description of the Lease Sale Area

The area of the North Slope Foothills lease sale contains approximately 7.6 million acres in 1,347 tracts ranging in size from 1,280 to 5,760 acres. Approximately 3.2 million of these acres are either Native-owned or Native-selected, and will not be included in the lease sales. The area consists of unleased, state-owned lands lying between the National Petroleum Reserve-Alaska (NPR-A) and the Arctic National Wildlife Refuge (ANWR), south of the Umiat Baseline and north of the Gates of the Arctic National Park and Preserve (Map 1.2).

The lease sale area is within the North Slope Borough (NSB) and is adjacent to and north of the community of Anaktuvuk Pass. The communities of Barrow, Kaktovik, and Nuiqsut are nearby, but outside of the lease sale area. In 2008, the population of the Borough was 6,615. Approximately 74% of Borough residents are Alaska Native or part Native.

Evidence of human occupation and use throughout the lease sale area has been documented. Additional details of the discoveries can be found at ADNR, Office of History and Archeology.

Climate conditions in the Arctic vary dramatically. Summers are generally mild and the three-month ice-free season is critical to biological productivity. In contrast, winters are severe, forcing many migratory species to migrate south.

The primary geologic hazards in or near the sale area include faults and earthquakes, permafrost and frozen-ground phenomena, mass movements, river erosion, flooding and slope movements. Although geologic hazards could damage oil and gas infrastructure, the measures in this final best interest finding, along with regulations imposed by state, federal, and local agencies, are expected to avoid, minimize, or mitigate those hazards.

The lease sale has areas located within Alaska's coastal zone (Map 1.3) and those areas are subject to the Alaska Coastal Management Program (ACMP). Currently, there is no approved coastal district plan in effect for the NSB. Future exploration, development, and production activities within the coastal zone that require additional authorizations will undergo separate coastal zone consistency analyses if and when they are actually proposed. Future activities must comply with the ACMP and, once the NSB's plan is in effect, the enforceable policies of the NSB Coastal Management Program.

## B. Habitat, Fish, and Wildlife

The two primary ecoregions in the foothills are the Brooks Foothills, with rolling uplands, valleys, mountain ridges, and mesas, and the Brooks Range comprised of steep mountains, rocky ridges and slopes and alpine tundra. The ecoregions include terrestrial and freshwater habitats.

The terrestrial habitats support mammal wildlife species, including caribou, moose, muskoxen, and Dall sheep. The Central Arctic caribou herd migrates through the lease sale area, and portions of adjacent northern caribou herds have been observed in parts of the lease sale area. Brown bears and wolves have denning sites in the foothills area, and the moist tundra habitats provide nesting habitat for small mammals, including fox, wolverines and ground squirrels.

The area is seasonally inhabited by large numbers of migratory birds that breed, molt, migrate, and forage in the area each summer. Well over 100 species of birds visit the lease sale area and the adjacent lands of the northern region of Alaska. Some species, including the spectacled eider and Steller's eider, are listed as threatened or endangered under the federal Endangered Species Act. There are other species that are candidates for threatened or endangered status, including the yellow-billed loon. The Gates of the Arctic National Park and Preserve (GOA) is located within and also to the south of the lease sale area, and ANWR is a federal wildlife refuge adjacent to the lease sale area to the east.

The freshwater habitats range from small, intermittent streams to large rivers, and from small ponds to large lakes. The river systems identified in the Catalog of Waters Important for the Spawning, Rearing or Migration of Anadromous Fishes in the lease sale area are the Colville, Sagavanirktok, Ivishak, Nanushuk, Echooka, Saviukviayak, Itkillik, Anaktuvuk, Kanayut, Lupine, Ribdon and Canning rivers, portions of the Chandler River, and Accomplishment, Upper Section, Lower Section, Flood, Cobblestone, and May creeks. These river corridors are habitats for anadromous, amphidromous and resident fish species. Some common species are salmon, Dolly Varden, Arctic char, Arctic cisco, broad whitefish, Arctic grayling, burbot and lake trout.

## C. Current and Projected Uses

The North Slope Foothills area provides important terrestrial and freshwater habitats for mammals, birds, and freshwater fishes. The fish and wildlife of the area provide the resources for subsistence fishing and hunting, for small sport fisheries, and for sport hunting and trapping. The communities of Anaktuvuk Pass, Nuiqsut, Barrow and Kaktovik, and other NSB residents utilize the foothills region year-round for hunting and harvesting. There are no commercial fisheries in the North Slope Foothills area. To a small extent, the area is used for recreation, tourism, and arctic research. Coal mining prospecting proposals have been submitted to ADNR, Division of Mining, Land and Water (DMLW) for approval. The primary industrial use of the area is oil and gas development.

## D. Oil and Gas in the North Slope Foothills

The Alaska Department of Natural Resources has determined that the North Slope Foothills lease sale area has relatively high gas petroleum potential, and relatively low oil potential. This determination is based on a resource evaluation involving several factors including geology, geophysics, seismic data, and the exploration history of the area.

With the exception of the Umiat oil accumulation, discoveries in the lease sale area to date consist primarily of dry gas trapped in anticlinal fold structures. Exploration in the lease sale area may lead to discovery of natural gas, and less likely, related oil deposits. Oil and gas volumes discovered to date are currently best described as "sub-commercial resources" whose development potential is contingent upon constantly fluctuating economic factors and connection to markets. The lack of oil

and gas development infrastructure in the lease sale area is a major factor to be considered during development activities.

Oil and gas activities proceed in phases with the activities of each subsequent phase depending on the completion or initiation of the preceding phase. The lease sale phase is the first step in the process of developing the state's oil and gas resources after the Director issues a best interest finding. During the lease sale phase, the state conducts competitive areawide sales of oil and gas leases, offering for lease all available state acreage within the lease sale area. An oil and gas lease grants to the lessee the exclusive right to drill for, extract, remove, clean, process, and dispose of oil, gas, and associated substances; however, a plan of operations, subject to regulatory authorities and permits, must be approved before any operations may be undertaken on or in the leased area. The State has held 10 areawide lease sales for the North Slope Foothills since 2001.

In the exploration phase, information is gathered about the area's petroleum potential by examining surface geology, researching data from existing wells, performing environmental assessments, conducting geophysical surveys, and drilling exploratory wells. During the development phase, operators evaluate the results of exploratory drilling and develop plans to bring the discovery into production. Production operations bring well fluids and natural gas to the surface and prepare them for transport to the processing plant or refinery.

Transport of oil or gas would most likely be by a pipeline system, depending on the type, size, and location of the discovery. If commercial quantities of oil are found in the lease sale area, the oil will go to market via the Trans-Alaska Pipeline System (TAPS). In-field gathering lines will likely bring the oil from individual well sites to processing facilities for injection into TAPS.

Currently there are no natural gas pipeline systems serving the North Slope Foothills area. If established, the pipeline systems can carry natural gas, CNG (compressed natural gas), liquid natural gas (LNG), and other fractions of petroleum fluids and condensates. Transport of LNG or oil hydrocarbons can also be accomplished by vessels, if a marine terminal were established in a port in northern Alaska.

The Commissioner of ADNR may authorize the subsurface storage of gas to avoid waste or to promote conservation of natural resources. Subsurface storage of gas increases reliability of gas delivery to all sources of demand. The Commissioner has delegated the authority to authorize subsurface storage of oil or gas to the Director of the DO&G. Subsurface gas storage must comply with all applicable local, state, and federal statutes and regulations, and with any terms imposed in the authorization or in any subsequent plan of operation approvals, or in the Alaska Oil and Gas Conservation Commission (AOGCC) Storage Injection Order.

If oil zones are discovered and developed, the risk of an oil spill exists any time crude oil or petroleum products are handled or transported. However, companies do not store large volumes of crude oil at their facilities in the North Slope region. Produced oil is processed and transported as quickly as possible, reducing the possible size of a potential spill.

The oil and gas industry has been actively exploring and producing North Slope resources for more than 30 years. In this time, the vast majority of oil, produced fluid, seawater, and other industry-related spills have been smaller than 10 gallons with very few larger than 100,000 gallons. Spill records from Alaska Department of Environmental Conservation (ADEC) show that there have been 24 large spills reported in northern Alaska from October 2007 to November 2009. There were no large oil spills reported in the lease sale area, but two large spills of drilling mud occurred to the north of Gubik Well #3 in January and March of 2008. The most recent spill of produced water, natural gas and crude oil occurred on December 29, 2009 about 1.5 miles from the Lisburne Production Center (LPC). The pipeline released about 1,091 bbl of crude oil, produced water, and natural gas, and cleanup goals were achieved in January 2010.

Recognition of the difficulties of containment and cleanup of oil spills has encouraged innovative and effective methods of preventing and responding to potential spills. Risks of an oil spill can be avoided, minimized, and mitigated through preventive measures, monitoring, and rigorous response capability. Some of the measures to prevent oil spills during the exploration, development, production, and transportation of crude oil are presented as mitigation measures in Chapter Six and Chapter Nine. Prevention measures are also described in the oil discharge prevention and contingency plans that the industry must prepare before beginning oil operations. If exploration and development take place, additional site-specific and project-specific mitigation measures may be imposed, as necessary.

## **E. Governmental Powers to Regulate Oil and Gas**

All lease activities are subject to numerous federal, state, and local laws and regulations with which the lessee is obligated to comply. These government agencies have a broad spectrum of authorities to regulate and condition activities related to oil and gas; their roles in the oversight and regulation of oil and gas activities differ, although some agencies may have overlapping authorities. These agencies include the ADNR, ADEC, Alaska Department of Fish and Game (ADF&G), AOGCC; the U.S. Environmental Protection Agency (EPA); the U.S. Army Corp of Engineers (Corps); U.S. Pipeline and Hazardous Materials Safety Administration (PHMSA); the U.S. Fish and Wildlife Service (USFWS); and the NSB. The lessee is responsible for obtaining any additional authorizations, permits and approvals from other federal, state and local agencies for related activities, as needed. A discussion of governmental powers to regulate oil and gas is found in Chapter Seven.

## **F. Reasonably Foreseeable Cumulative Effects of Leasing and Subsequent Activity**

Potential effects of oil and gas lease sales can be both positive and negative. Most potentially negative effects on terrestrial and freshwater habitats, fish and wildlife species, and their uses, effects on subsistence uses, and on local communities and residents can be avoided, minimized, or mitigated through mitigation measures. A full listing of mitigation measures can be found in Chapter Nine.

Leasing activities alone are not expected to have any effects, other than to lease subsurface oil and gas rights, and to generate initial revenue to the state. Potential post-lease activities could have cumulative effects on the area's terrestrial and freshwater habitats, wildlife, birds, fish and vegetation. The wildlife habitat impacts may affect caribou, bears, muskoxen, moose, other furbearers, and birds. The potential impacts include: construction activities, seismic surveys, habitat loss, disturbance, gas blowouts and oil spills. Some positive impacts may include insect relief and earlier availability of forage along roads. Potential impacts to terrestrial habitats, wildlife and birds are discussed in Chapter Eight, and mitigation measures are addressed in Chapter Nine.

Impacts to river corridors can affect the fish, and the overwintering and spawning habitat areas. The potential impacts include: degradation of stream banks and erosion; reduction of or damage to overwintering and spawning areas; habitat loss due to gravel removal; high impact facility siting; effects due to water removal; siltation; impediments to fish passage and migration; and fish kills due to oil spills or freshwater habitat contamination. Impacts to freshwater habitats and fish species are discussed in Chapter Eight, and mitigation measures are addressed in Chapter Nine.

Activities that can cause impacts to wildlife and freshwater habitats are: construction and use of petroleum development support facilities and roads; seismic surveys; environmental and other studies; excavation of material sites; construction of pipeline systems and access corridors; construction and maintenance of bridges and fish crossings; transportation of machinery and labor to

the sites; and drilling and production activities. Reasonably foreseeable effects are addressed in detail in Chapter Eight.

The water quality of the lease sale area may be impacted by exploration and development activities: discharges of drilling muds, cuttings, and produced waters; increased turbidity from construction of gravel structures, roads and pipelines; and oil spills. Turbidity could be affected by construction of gravel structures, roads and pipelines, and from pipeline repair. These could have short- and long-term negative effects on water quality and freshwater habitats. Water use from lakes, ponds or groundwater wells may be required for the construction and maintenance of oil and gas activities. The extent and duration of water quality degradation resulting from accidental spills would depend on the type of product, the location, volume, season, and duration of the spill or leak, and the effectiveness of the cleanup response. Spills or leaks could result from accidents, during refueling, or from corrosion of pipeline systems.

Oil and gas exploration, development, and production activities may produce emissions that potentially affect air quality. Gases are emitted to the air from power generation, flaring, venting, well testing, leakage of volatile petroleum components, supply activities and shuttle transportation. Air quality throughout the sale area is good. Although oil and gas activities may produce emissions that have the potential to affect air quality, federal and state air quality regulations are expected to avoid, minimize, and mitigate those potential effects, particularly the regulations of the Clean Air Act (42 U.S.C. §§ 7401-7671), 18 AAC 50, and AS 46.14. See Chapter Seven for air quality regulation information.

Potential post-lease activities that could have cumulative effects on subsistence uses of the lease sale area include seismic surveys, discharges from well drilling and production, construction of roads and support facilities, and ongoing disturbances from production activities such as pipeline activities, vehicle, boat, and aircraft traffic. In addition, gas blowouts and oil spills could potentially occur during development and production. Subsistence uses of the North Slope Foothills area depend on the area's terrestrial and freshwater habitats, and the wildlife, birds and fish resources found in these habitats. Therefore, potential cumulative effects from oil and gas exploration, development and production on the area's habitats and the animal, bird and fish populations, could also affect subsistence uses. Potential effects on subsistence uses include: increased or decreased access to hunting and fishing areas; and increased competition for nearby subsistence resources. The purpose of mitigation measures is to avoid, minimize, or mitigate impacts to subsistence resources. Impacts to subsistence activities are discussed in Chapter Eight, and mitigation measures are addressed in Chapter Nine.

Impacts to sport fishing and hunting may occur in the lease sale area. These include seismic surveys, discharges from well drilling and production, construction of road and support facilities, and ongoing disturbances from production activities such as pipeline activities, vehicle, boat, and aircraft traffic. Petroleum development may also result in increased access to hunting and fishing areas. In addition, gas blowouts and oil spills could potentially occur during development and production and affect sport fishing and hunting activities. Impacts to sport fishing and hunting activities are discussed in Chapter Eight, and mitigation measures are addressed in Chapter Nine.

Historic and cultural resources could be affected by oil and gas exploration, development, and production activities. For example, historic and cultural resources may be encountered during field-based activities, and these resources could be affected by accidental oil spills, erosion and vandalism. The Alaska Office of History and Archaeology requires reporting of historical resources prior to disturbance. In the event that an increased amount of ground-disturbing activity takes place, the mitigation measures, lessee advisories, and regulations imposed by state, federal, and local agencies are expected to avoid, minimize, and mitigate effects to historic and cultural resources. Impacts to

historic and cultural resources are discussed in Chapter Eight, and mitigation measures and related lessee advisories are addressed in Chapter Nine.

## **G. Fiscal Effects and the Effects on Municipalities and Communities**

Alaska's economy depends heavily on revenues related to oil and gas production and the government spending resulting from those revenues. Oil and gas lease sales generate income to state government through bonus-bids; subsequent oil and gas production activities can also generate additional income to the state through rents, royalties, production taxes, petroleum corporate income taxes, and petroleum property taxes. Total oil revenue for fiscal year (FY) 2009 totaled \$5.18 billion.

Alaska North Slope production peaked at 2.006 million barrels per day in FY 1988 and has declined steadily since then. The Alaska Department of Revenue (ADOR) anticipates volumes will decline by 6.6% in FY 2010 to about 0.65 million bbl per day. For FY 2011, ADOR projects a decrease in North Slope production to 0.619 million bbl per day. The ADOR expects oil prices to average \$76.13 per bbl in FY 2010, and \$80.15 per bbl in FY 2011.

The Alaska Permanent Fund also derives revenue from oil and gas production. Oil and gas royalties and revenues contribute to the fund where investments are held by the fund to generate interest income, and annual permanent fund dividends (PFD) are paid to eligible residents.

Many jobs in the NSB are directly or indirectly linked to the oil industry or to its support industries. The finances of the NSB depend predominately on tax revenues from oil properties. Although the NSB relies on oil revenues, many local residents also pursue a traditional and community-based economic life. Approximately 98% of all local property tax collections come from oil producers, an estimated \$235 million in 2009. For FY 2010/2011, property tax receipts are anticipated to be \$278 million.

The health status of NSB residents is determined by a wide array of factors, including genetic susceptibility, behavioral change, environmental factors, diet, and socio-cultural impacts. Under AS 38.05.035(g)(B)(x), the scope of review for this best interest finding is limited to effects of exploration, development, production, and transportation involving oil and gas or gas only. The state is currently developing a policy regarding Health Impact Assessments. Health Impact Assessment is a tool that seeks to identify potential lasting or significant changes, both positive and negative, of different actions on the health and social well-being of a defined population as a result of a program, project, or policy.

## **H. Mitigation Measures and Other Regulatory Protections**

Mitigation measures address: facilities and operations; habitats, fish, and wildlife; subsistence and sport harvest activities; fuel, hazardous substances, and waste; access; prehistoric, historic, and archaeological sites; and local hire, communication, and training. Specific mitigation measures protect caribou, fish habitats and populations, bears, Dall sheep, brant, white-fronted goose, snow goose, tundra swan, king eider, common eider, Steller's eider, spectacled eider, and yellow-billed loon nesting and brood rearing areas. Subsistence and sport harvest activities are protected against interference through guidance for site selection and implementation of drilling and related development facilities. Fuel storage facilities and refueling are addressed with requirements for secondary containment and protection of floodplains. Waste reduction and proper waste disposal practices are required. Access to leased areas must be constructed to minimize adverse impacts. Prehistoric, historic and archaeological sites require mitigation activities and associated reporting. Local hiring, communication and training objectives are also addressed. Other regulatory requirements (lessee advisories) address other regulatory, permitting, or management authorities including: ADNR, Division of Coastal and Ocean Management (DCOM) and Office of History and

Archaeology; ADEC; ADF&G; the Alaska Department of Labor and Workforce Development; the Corps; PHMSA; USFWS; National Marine Fisheries Service (NMFS); and the NSB.

## **I. Director's Final Written Finding and Signature**

The Director of the Division of Oil and Gas has made a final finding that holding annual North Slope Foothills areawide oil and gas lease sales from 2011-2020 is in the best interests of the state. AS 38.05.035(e) and (g) require that before an oil and gas lease sale, the Director determine whether the lease sale is in the best interests of the state; these statutes also specify what must be considered in making that determination. Annually, the DO&G issues a call for substantial new information that has become available since the most recent finding, and based on information received, the Commissioner determines whether it is necessary to supplement the finding.

This final determination is based upon a review of all facts and issues known, or made known, to the Director. The Director limited the scope of the finding to the lease sale phase of oil and gas activities and the reasonably foreseeable significant effects of the lease sales (AS 38.05.035(e)(1)(A)). Conditions for phasing were met under AS 38.05.035(e)(1)(C). At the lease sale phase, the type, location, duration, timing, or level of any exploration or development activity that might subsequently occur cannot be predicted precisely. Therefore, the Director has not considered possible specific effects of unknown future exploration, development, and production activities that are outside the scope of the finding. The effects of future exploration, development, and production will be considered at each subsequent stage, when government agencies and the public review permit applications for the specific activities proposed at specific locations in the area. However, the Director did consider, in general terms, the potential effects that may occur subsequent to leasing.

In making this final finding, the Director considered and discussed, as required by AS 38.05.035(g): the property description and location of the lease sale area; the petroleum potential of the lease sale area; the fish and wildlife species and their habitats in the area; the current and projected uses in the area, including uses and value of fish and wildlife; the governmental powers to regulate oil and gas exploration, development, production, and transportation; the reasonably foreseeable cumulative effects of oil and gas exploration, development, production, and transportation on the lease sale area, including effects on subsistence uses, fish and wildlife habitats and populations and their uses, and historic and cultural resources; lease stipulations and mitigation measures, including any measures to prevent and mitigate release of oil and hazardous substances, to be included in the lease, and a discussion of the protections offered by these measures; the methods most likely to be used to transport oil or gas from the lease sale area and the advantages, disadvantages, and relative risks of each; the reasonably foreseeable fiscal effects of the lease sale and the subsequent activity on the state and affected municipalities and communities, including the explicit and implicit subsidies associated with the lease sale; the reasonably foreseeable effects of oil and gas exploration, development, production, and transportation on municipalities and communities within or adjacent to the lease sale area; and the bidding method or methods adopted by the Commissioner.

Although the initial benefit to the state will be the primary effect of leasing itself, the Director recognizes that oil and gas exploration, development, and production subsequent to leasing could result in effects such as impacts to terrestrial and freshwater habitats, and effects to species of fish, wildlife and birds. Therefore, general mitigation measures are included that will avoid, minimize, and mitigate potential negative effects. These measures address facilities and operations; habitats, fish, and wildlife; subsistence and sport harvest activities; fuel, hazardous substances, and waste; access; prehistoric, historic, and archaeological sites; and local hire, communications, and training.

Lessees must comply with all applicable local, state, and federal codes, statutes, and regulations. Lessee advisories notify lessees of other regulatory requirements, including those administered by:

the ADNR DCOM; ADEC; ADF&G; ADNR Office of History and Archaeology; the Alaska Department of Labor and Workforce Development; the Corps; PHMSA; USFWS; NMFS; and the NSB. Additional project-specific and site-specific mitigation measures will be applied as appropriate to future authorizations.

The state has sufficient authority through general constitutional, statutory, and regulatory empowerments; the terms of the lease sale; the lease contract; and plans of operations and development to ensure that lessees conduct their activities safely and in a manner that protects the integrity of the environment and maintains opportunities for subsistence and other concurrent uses.

No activity may occur without further review and proper authorization from the appropriate permitting agencies, and all activities must comply with the ACMP if they are proposed within the ACMP boundary. When lessees propose specific activities, more detailed information, such as site, type, and size of facilities, will be known. In most cases, permit applications are public information, and most permitting processes include public comment periods. The ADNR may impose additional terms during the permitting process if additional issues are identified.

After weighing the facts and issues known to him at this time, comments received in response to the call for agency information, and applicable laws and regulations, and balancing the potential positive and negative effects given the mitigation measures and other regulatory protections, the Director concludes that the potential benefits of the lease sale outweigh the possible negative effects, and that North Slope Foothills areawide oil and gas lease sales will best serve the interests of the state of Alaska.

A person affected by this decision who provided timely written comments may request reconsideration, in accordance with 11 AAC 02. Any reconsideration request must be received by the 20<sup>th</sup> day after the date of issuance, and may be mailed or delivered to:

Daniel S. Sullivan, Commissioner  
Department of Natural Resources  
550 W. 7th Avenue, Suite 1400  
Anchorage, Alaska 99501

Fax: 1-907-269-8918  
Email: [dnr.appeals@alaska.gov](mailto:dnr.appeals@alaska.gov) .

If reconsideration is not requested by that date or if the commissioner does not order reconsideration on his own motion, this decision goes into effect as a final order and decision on the 31<sup>st</sup> day after the date of issuance. Failure of the commissioner to act on a request for reconsideration within 30 days after issuance of this decision is a denial of reconsideration and is a final administrative order and decision for purposes of an appeal to Superior Court. The decision may then be appealed to Superior Court within a further 30 days in accordance with the rules of the court, and to the extent permitted by applicable law. An eligible person must first request reconsideration of this decision in accordance with 11 AAC 02 before appealing this decision to Superior Court. A copy of 11 AAC 02 may be obtained from any regional information office of the Department of Natural Resources.

*[Signature]*  
for Kevin R. Banks, Director

May 26, 2011  
Date

I concur with the Director that the North Slope Foothills oil and gas lease sales are in the state's best interest.

*[Signature]*  
for Daniel S. Sullivan, Commissioner

May 26, 2011  
Date

## **J. References**

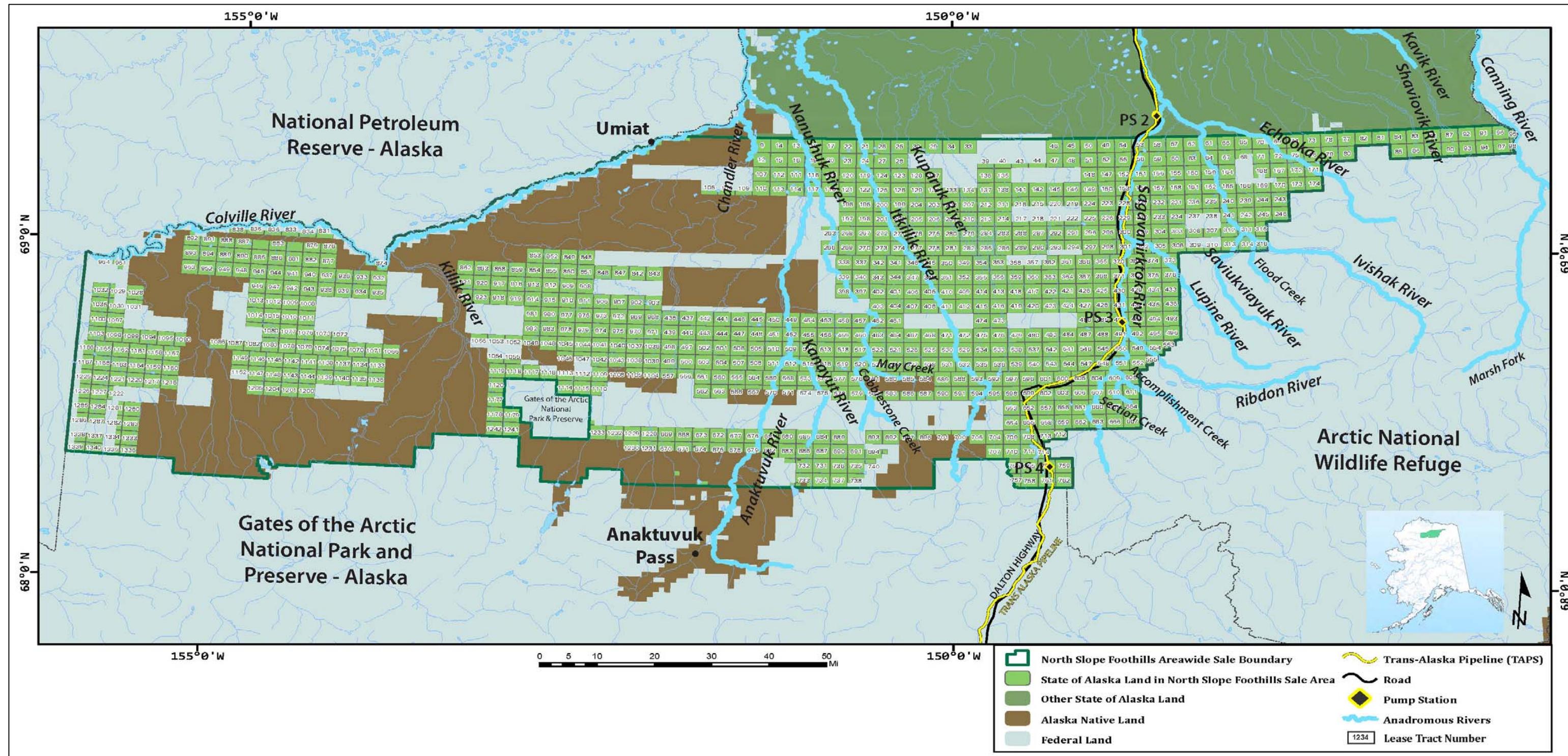
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## **K. Maps**

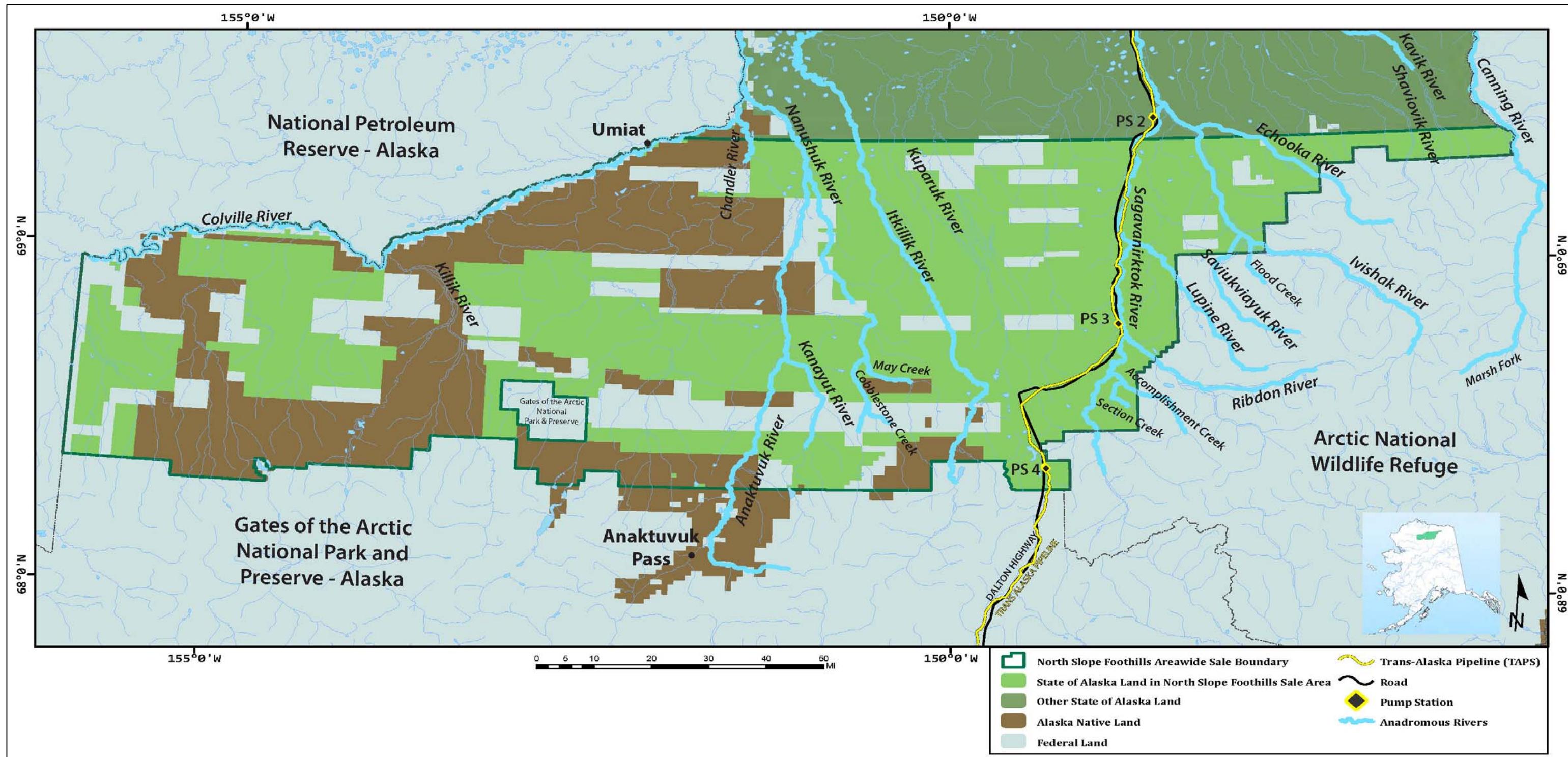




Source: ADNR 2010.

Map 1.1. Tract map of the North Slope Foothills Areawide lease sale area.

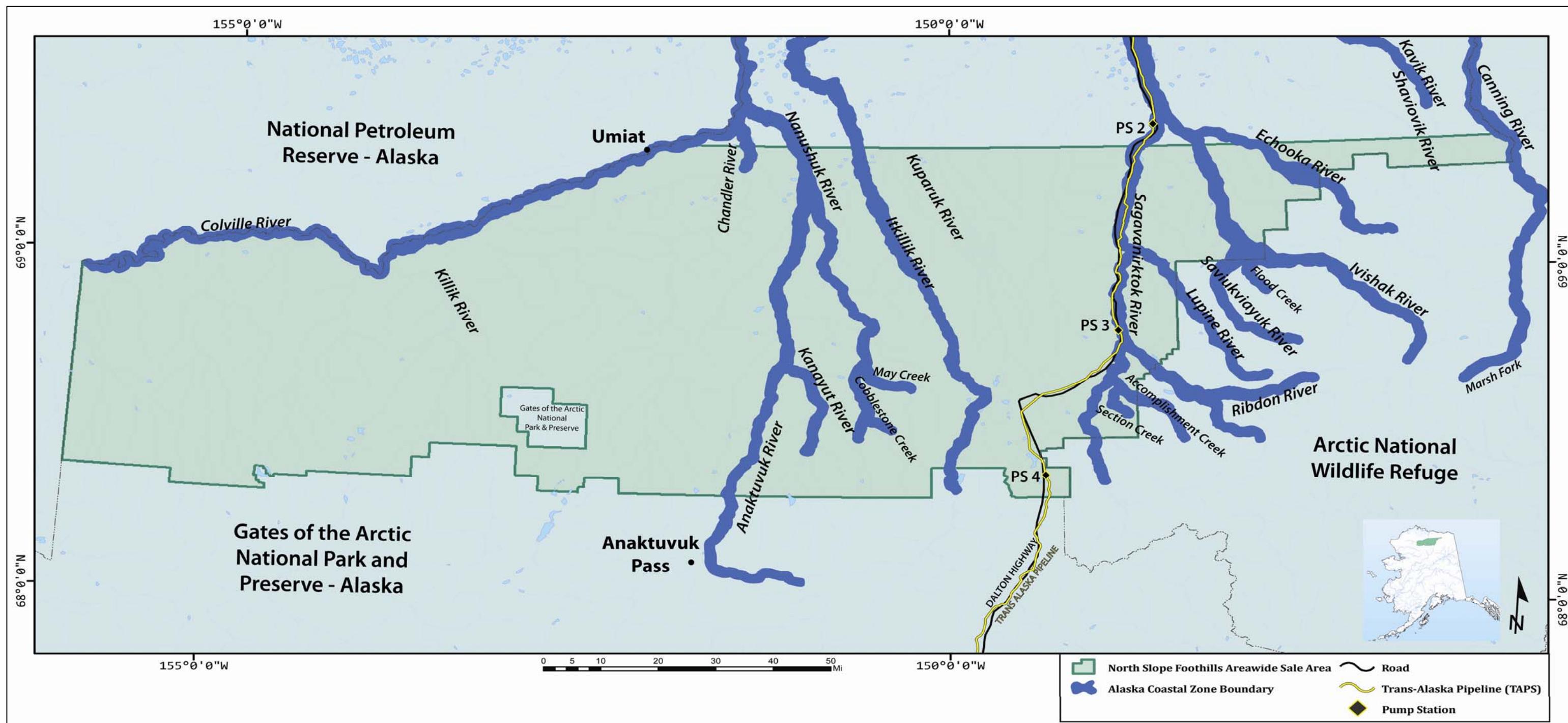




Source: ADNR IRM 2010.

Map 1.2. Land ownership in the North Slope Foothills Areawide lease sale area.







# Chapter Two: Introduction

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# Chapter Two: Introduction

The Alaska Department of Natural Resources is proposing to offer all available state-owned acreage in the North Slope Foothills Areawide in oil and gas lease sales to be held from 2011-2020. The North Slope Foothills Areawide is located between NPR-A on the west, and ANWR on the east, south of the Umiat Baseline and north of the Gates of the Arctic National Park and Preserve (Map 1.1). The gross acreage is in excess of 7.2 million acres; however, approximately 3.2 million of these acres are either Native-owned or Native-selected, and will not be included in the lease sales. Only those free and unencumbered state-owned oil and gas mineral estates within the tracts will be included in any leases issued.

## A. Authorities

The Alaska Constitution provides that the state's policy is "to encourage....the development of its resources by making them available for maximum use consistent with the public interest" and that the "legislature shall provide for the utilization, development, and conservation of all natural resources belonging to the State... for the maximum benefit of its people" (Alaska Constitution, article VII, §1 and 2). To comply with this provision, the legislature enacted Title 38 of the Alaska Statutes and directed ADNR to implement the statutes.

The legislature found that the people of Alaska have an interest in the development of the state's oil and gas resources to maximize the economic and physical recovery of the resources; maximize competition among parties seeking to explore and develop the resources; and maximize use of Alaska's human resources in the development of the resources (AS 38.05.180(a)(1)). The legislature also found that it is in the best interests of the state to encourage an assessment of its oil and gas resources and to allow the maximum flexibility in the methods of issuing leases and to offer acreage for oil and gas leases or for gas only leases (AS 38.05.180(a)(2)).

## B. Matters Considered and Discussed in Best Interest Findings ("g-list")

Alaska statutes govern the disposal of state-owned mineral interests. AS 38.05.035(e) states that upon a written finding that the interests of the state will be best served, the Director may, with the consent of the ADNR Commissioner (Commissioner) approve contracts for the sale, lease, or disposal of available land, resources, property, or interests in them. The written finding is known as a best interest finding and describes the lease sale area, considers and discusses the potential effects of the sales, describes measures to mitigate those effects, and constitutes the Director's determination that the interests of the state will be best served by the disposal. DO&G makes available both a preliminary and a final written finding and provides opportunity for public comment. The final written finding also discusses material issues that were raised during the public comment period.

AS 38.05.035(e) prescribes what, at a minimum, must be in these findings. AS 38.05.035(g) lists the following matters that DO&G must consider and discuss in its written finding:

- i. property descriptions and locations;
- ii. the petroleum potential of the sale area, in general terms;
- iii. fish and wildlife species and their habitats in the area;
- iv. the current and projected uses in the area, including uses and value of fish and wildlife;
- v. the governmental powers to regulate the exploration, development, production, and the transportation of oil and gas or of gas only;

- vi. the reasonably foreseeable cumulative effect of exploration, development, production, and transportation for oil and gas or for gas only on the sale area, including effects on subsistence uses, fish and wildlife habitat and populations and their uses, and historic and cultural resources;
- vii. lease stipulations and mitigation measures, including any measures to prevent and mitigate releases of oil and hazardous substances, to be included in the leases, and a discussion of the protections offered by these measures;
- viii. the method or methods most likely to be used to transport oil or gas from the lease sale area and the advantages, disadvantages, and relative risks of each;
- ix. the reasonably foreseeable fiscal effects of the lease sale and the subsequent activity on the state and affected municipalities and communities, including the explicit and implicit subsidies associated with the lease sale, if any;
- x. the reasonably foreseeable effects of exploration, development, production, and transportation involving oil and gas or gas only on municipalities and communities within or adjacent to the lease sale area; and,
- xi. the bidding method or methods adopted by the commissioner under AS 38.05.180.

To aid those interested in reviewing and commenting on the preliminary best interest finding, this document is organized for ease of reading and reviewing, and therefore does not necessarily follow the order of the “g-list”. The locations of “g-list” items in this document are listed in Table 2.1.

**Table 2.1. Locations of topics required by AS 38.05.035(g)(1)(B) – “g-list” – in this best interest finding.**

“g-list” Number	“g-list” Description	Location in Best Interest Finding
i	Property descriptions and locations	Chapter Three
ii	Petroleum potential	Chapter Six
iii	Fish, wildlife, and habitat	Chapter Four
iv	Current and projected uses; uses and value of fish and wildlife	Chapter Five
v	Governmental powers	Chapter Seven
vi	Reasonably foreseeable effects on subsistence; fish, wildlife, and habitat and their uses; and historic and cultural resources	Chapter Eight
vii	Mitigation measures	Chapter Nine
viii	Oil or gas transport	Chapter Six
ix	Reasonably foreseeable fiscal effects	Chapter Eight
x	Reasonably foreseeable effects on municipalities and communities	Chapter Eight
xi	Bidding method	Chapter Two

A compilation of other laws and regulations applicable to oil and gas activities in Alaska can be found in Appendix B. If the proposed activity occurs in the coastal zone, AS 46.40 requires that the activity be consistent with the ACMP and any approved coastal district plan in effect. For purposes of the lease sale phase itself, an ACMP consistency analysis will be released concurrently with the preliminary best interest finding. It will be followed by a proposed consistency determination and a final consistency determination.

## **C. Scope of Review**

The Director, in the written finding, shall establish the scope of the administrative review on which the Director's determination that the disposal will best serve the interest of the state is based and the scope of the written finding supporting that determination. The scope of the administrative review and finding may address only reasonably foreseeable, significant effects of the uses proposed to be authorized by the disposal (AS 38.05.035(e)(1)(A)). For an effect to be "reasonably foreseeable": (1) there must be some cause/result connection between the proposed disposal and the effect to be evaluated; (2) there is a reasonable probability that the effect will occur as a result of the disposal; and (3) the effect will occur within a predictable time after the disposal. Therefore, the finding does not speculate about potential but improbable future effects, but instead reviews reasonably foreseeable effects of the proposed disposal.

A reasonably foreseeable effect must also be "significant." Significant means a known and noticeable impact on or within a reasonable proximity to the area involved in the disposal.

Further, the Director may limit the scope of an administrative review and finding for a proposed disposal to:

- (i) applicable statutes and regulations;
- (ii) the facts pertaining to the land, resources, or property, or interest in them, that the director finds are material to the determination and that are known to the director or knowledge of which is made available to the director during the administrative review; and
- (iii) issues that, based on the statutes and regulations, on the facts as described, and on the nature of the uses sought to be authorized by the disposal, the director finds are material to the determination of whether the proposed disposal will best serve the interests of the state. (AS 38.05.035(e)(1)(B).)

Therefore, the scope of review in this finding addresses the reasonably foreseeable, significant effects of the uses to be authorized by the lease sale and is limited to the applicable statutes and regulations, the material facts and issues known to the Director that pertain to the lease sale phase, and issues that the Director finds are material to the determination of whether the lease sale will best serve the interests of the state. This includes consideration and discussion of facts that are material to issues raised during the period allowed for public comments, facts that are material to the matters listed in AS 38.05.035(g)(B)(i)-(xi), and the basis for the Director's final finding, that, on balance, holding oil and gas lease sales in the area would be in the state's best interest.

## **D. Phased Review**

Phased review recognizes that some disposals of oil and gas, or of gas only, may result in future development that cannot be predicted or planned with any certainty or specificity at the initial lease sale phase, and that any future development will be subject to detailed review before it takes place. In the case of oil and gas, DO&G cannot determine with any specificity or definition at the lease sale phase if, when, where, how, or what kind of exploration, development or production might ultimately occur as the result of a lease sale. Although advances in technology, unpredictable market

changes, and specific infrastructure requirements for possible production cannot be foreseen, new developments or improvements in any or all of these areas may occur.

Phasing allows the review and finding for a lease sale to focus only on the issues pertaining to the lease sale phase and reasonably foreseeable, significant effects of a lease sale. Additional authorizations are required for exploration, development, production, and other phases. When a project is multi-phased, review of issues that would require speculation about future factors may be deferred until permit authorization is sought at the exploration, development, and production phases. A discussion of governmental and public involvement at these later phases can be found in Chapter Seven.

Under AS 38.05.035(e)(1)(C), the Director may, if the project for which the proposed disposal is sought is a multiphased development, limit the scope of an administrative review and finding for the proposed disposal to the applicable statutes and regulations, facts, and issues identified above that pertain solely to the disposal phase of the project when:

- (i) the only uses to be authorized by the disposal are part of that phase;
- (ii) the disposal is a disposal of oil and gas, or of gas only, and, before the next phase of the project may proceed, public notice and the opportunity to comment are provided unless the project is subject to a consistency review under AS 46.40 and public notice and the opportunity to comment are provided under AS 46.40.096(c);
- (iii) the department's approval is required before the next phase may proceed; and,
- (iv) the department describes its reasons for a decision to phase.

The conditions under which phasing may occur have been met in this best interest finding for the North Slope Foothills areawide oil and gas lease sales. Accordingly, the review of activities in the lease sale area is of a multi-phased development. The Director, in making this finding, has limited the scope of the finding to the applicable statutes and regulations, facts, and issues that pertain solely to the lease sale phase of oil and gas activities and the reasonably foreseeable significant effects of a lease sale.

Condition (i) is met because the only uses authorized are part of the lease sale phase. The lease gives the lessee, subject to the provisions of the lease, the right to conduct geological and geophysical exploration for oil, gas, and associated substances within the leased area and the right to drill for, extract, remove, clean, process, and dispose of any oil, gas, or associated substances that may underlie the lands described by the lease. While the lease gives the lessee the right to conduct these activities, the lease itself does not authorize any exploration or development activities by the lessee on leased tracts.

Condition (ii) is met because the lease sale is of oil and gas or gas only, and before the next phase of the project may proceed, ADNR provides public notice and the opportunity to comment on proposed plans of operations in the lease sale area. Additionally, any plan of operations in the lease sale area that is within the coastal zone is subject to consistency with the ACMP standards, including public notice and opportunity to comment under AS 46.40.

Condition (iii) is met because ADNR's approval is required before the next phase (in this case exploration) may proceed. See Chapter Six for a discussion of post-leasing phases. Before exploration activities can occur on leased lands, the lessee must secure all applicable authorizations. Additional authorizations must also be secured for any subsequent development or production on the lease.

The plans of operation must identify the specific measures, design criteria, construction methods, and standards that will be employed to meet the provisions of the lease. A plan of operations is subject to extensive technical review by a number of local, state, and federal agencies. Oil and gas

exploration, development, or production-related activities will be permitted only if proposed operations comply with all local, state, and federal laws and the provisions of the lease.

Condition (iv) is met because ADNR describes above the reasons for its decision to phase.

The effects of future exploration, development, and production will be considered at each subsequent phase, when various government agencies and the public review applications for specific proposed activities at specific locations. However, this finding does discuss, in general terms, the potential effects that may occur with oil and gas exploration, development, production, and transportation within the lease area as well as proposed measures to be imposed as terms of the lease, subsequent permits, and plan of operations to mitigate possible adverse effects.

## **E. Areawide Lease Sales**

Before 1996, industry nominated particular, limited areas for oil and gas lease sales, ADNR evaluated those specific areas, and then offered them in lease sales. The areas nominated were frequently noncontiguous, and formed a patchwork of relatively small areas across a region. For subsequent lease sales, ADNR would repeat the evaluation for other patchwork portions of the area, often directly adjacent to those just evaluated. ADNR faced repeated and costly evaluations of similar resources and issues, and the public faced repeated requests to comment on areas with similar resources and issues or concerns. Furthermore, areas that were nominated for an oil and gas lease sale did not always receive bids, causing ADNR staff to spend time evaluating land that would never be leased.

Alaska statutes now allow ADNR to hold annual, areawide lease sales for areas that are included in a current, 10-year best interest finding (AS 38.05.180(d) and AS 38.05.035(e)(6)(F)). The areawide lease sale program currently includes five geographical regions: the Alaska Peninsula, Cook Inlet, Beaufort Sea, North Slope, and North Slope Foothills. Before conducting an annual lease sale, ADNR must determine whether or not substantial new information has become available that justifies a supplement to the current best interest finding. A supplement is an official addendum to the best interest finding, and usually adds, changes, or removes mitigation measures with which lessees must comply.

The areawide lease sale program provides several significant benefits. Every 10 years, it allows a thorough consideration and discussion of topics required by AS 38.05.035(g) for an entire area. It reduces redundant requests to the public for comments on similar geographic areas, improves government efficiency, and allows ADNR and the public to focus on substantial new information that has become available for each lease sale area since the previous lease sale. By conducting areawide lease sales at a set time each year, companies are provided with a stable, predictable schedule that allows them to plan and develop their exploration strategies and budgets years in advance. The public is also afforded a consistent process and timeline by which to provide new information that might affect mitigation measures. The result is more efficient exploration, earlier development, government efficiency, and mitigation measures that reflect current information.

The last best interest finding for the North Slope Foothills Areawide was issued on February 7, 2001, and was valid for lease sales held through 2010. Supplements were issued on January 30, 2002, and July 8, 2010, that made changes to three mitigation measures of the 2001 finding. The 2010 supplement also included supplemental information about the Deepwater Horizon incident that occurred in the Gulf of Mexico in 2010.

This best interest finding addresses North Slope Foothills Areawide oil and gas lease sales from 2011 through 2020.

## 1. Process

The process of developing a best interest finding includes many opportunities for participation, from the public, government agencies, Native organizations, resource user groups, environmental organizations, and others (Figure 2.1).

### a. Request for Agency Information

The process of developing a best interest finding begins with a request for information from agencies, local governments, and Native corporations. DO&G requests information and data about the region's property ownership status, peoples, economy, current uses, subsistence, historic and cultural resources, fish and wildlife, and other natural resource values. Using this information, as well as other relevant information that becomes available, DO&G develops a preliminary best interest finding and releases it for public comment.

On September 10, 2009, DO&G issued a Request for Agency Information to initiate the process of gathering information on the lease sales. The division received two responses from the DMLW, Mining Section, and ADF&G, Division of Habitat.

Comments from DMLW, Mining Section discussed a coal mining prospecting permit application under review for an area located within the lease sale area. The proposed permitting area, called Nanushuk, lies along the northern foothills of the Brooks Range, in an east-west belt extending from approximately five miles west of Toolik Lake to Banded Mountain, just west of the Anaktuvuk River. The DMLW review is ongoing, and more details about this project are provided in Section B(2) of Chapter Five.

Comments from ADF&G, Division of Habitat provided updates and current information for the fish and wildlife populations within the Game Management Units (GMU) in the lease sale area. The information provided by these agencies, as well as other relevant information, was incorporated into the best interest finding.

### b. Preliminary Best Interest Finding and Request for Public Comments

To obtain public comments on the preliminary best interest finding, DO&G follows the public notice statute, AS 38.05.945. This statute includes specific provisions for noticing best interest findings, as required under AS 38.05.035(e). These include: publication of both a legal notice and a notice in display advertising in newspapers of statewide circulation and in newspapers of general circulation in the vicinity of the proposed action; public service announcements on the electronic media serving the area to be affected by the proposed action; and one or more of the following methods: posting in a conspicuous location in the vicinity of the proposed action; notification of parties known or likely to be affected by the action; or another method calculated to reach affected parties. Notice must also be given to a municipality if the land is within the boundaries of the municipality; to a coordinating body or a community council if requested in writing; to a regional corporation if the boundaries of the corporation established by the Alaska Native Claims Settlement Act (ANCSA) encompass the land and the land is outside a municipality; to a village corporation organized under ANCSA if the land is within 25 miles of the village for which the corporation was established and the land is located outside of a municipality; to the postmaster of a permanent settlement of more than 25 persons located within 25 miles of the land if the land is located outside a municipality, with a request that the notice be posted in a conspicuous location; and to a nonprofit community organization or a governing body that has requested notification in writing and provided a map of its boundaries, if the land is within the boundaries.

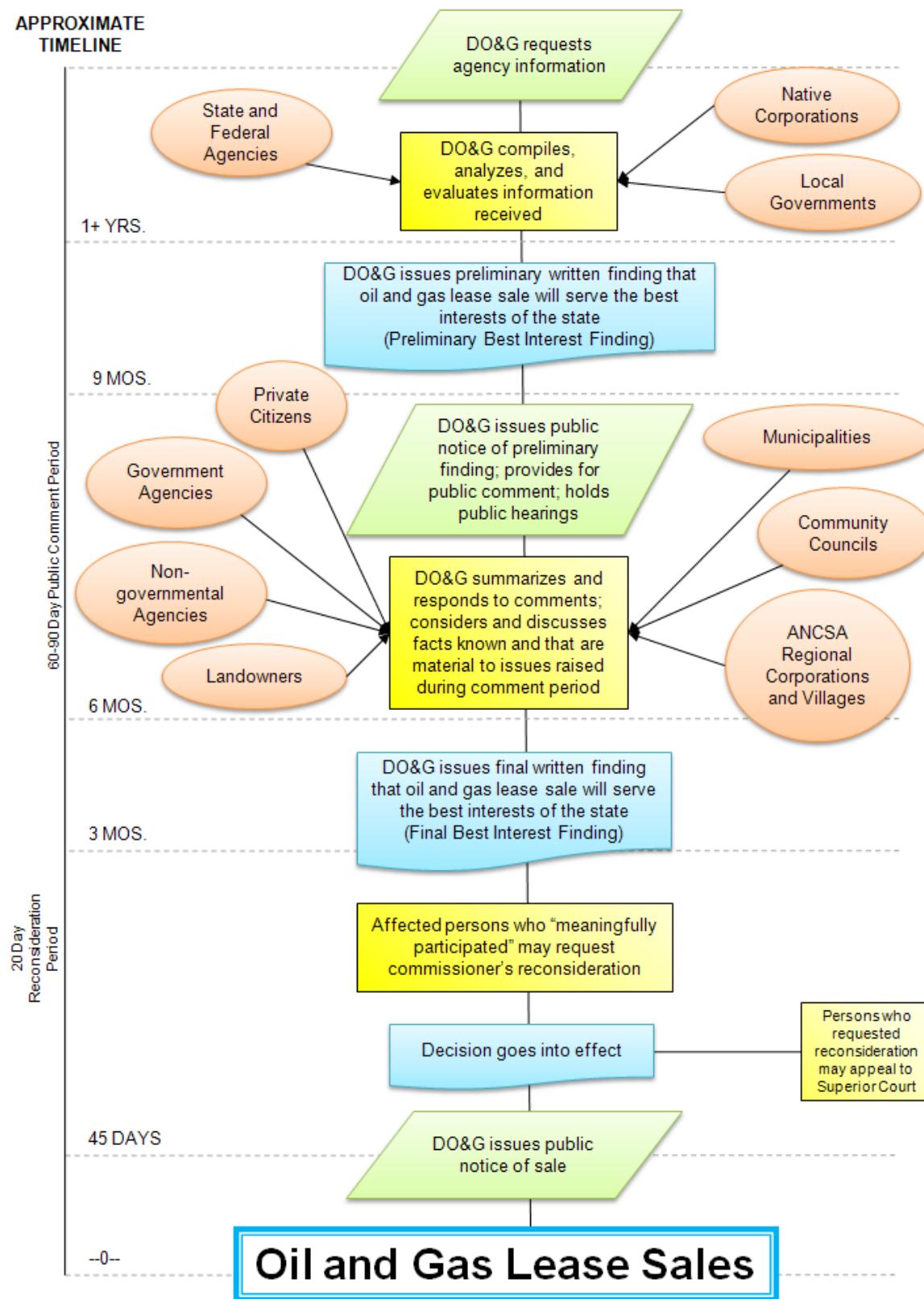


Figure 2.1. Public process for developing best interest findings for areawide oil and gas lease sales. Note that timeline is not to scale.

In addition, AS 38.05.946 provides that a municipality, an ANCSA corporation, or nonprofit community organization may hold a hearing within 30 days after receipt of the notice, which the Commissioner or his/her representative shall attend. The Commissioner has discretion to hold a public hearing.

Public comment assists in providing a body of information for the best interest finding review and analysis that is as complete as possible. Information provided by agencies and the public assists the Director in reviewing all of the facts and issues; determining which facts and issues are material to the decision of whether the lease sale is in the best interests of the state; and determining the reasonably foreseeable, significant effects of the proposed lease sale.

**c. Final Best Interest Finding**

After receiving public comments on the preliminary best interest finding, DO&G reviews all comments, revises the best interest finding as needed, and incorporates additional relevant information and issues brought up during the public comment period. The Director strikes a balance of interests, determines if the lease sale is in the best interest of the state, and makes a final finding. The final best interest finding for the North Slope Foothills will be issued at least 90 days before the lease sale.

**d. Request for Reconsideration and Appeal to Superior Court**

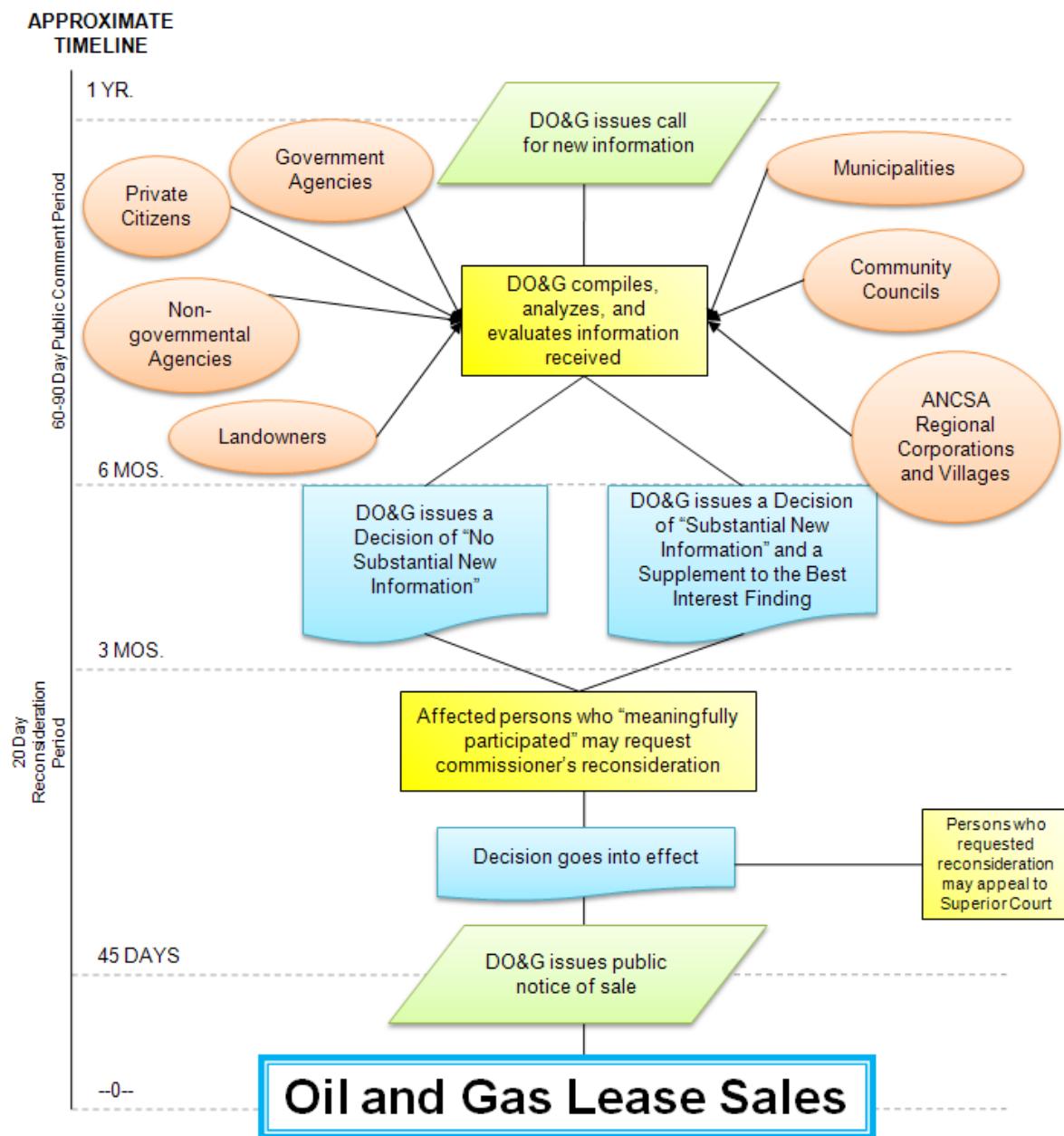
A person who is eligible to file a request for reconsideration and who is aggrieved by the final written finding may, within 20 days after issuance of the final written finding, file a request for reconsideration of the decision by the Commissioner. A person is eligible to file a request for reconsideration if the person “meaningfully participated” in the process set out for receipt of public comment and is affected by the final written finding. “Meaningfully participated” means submitting written comment during the period for receipt of public comment or presenting oral testimony at a public hearing, if a public hearing was held (AS 38.05.035(i)).

A person may appeal a final written finding to the superior court, but only if the person was eligible to request, and did request, reconsideration of that finding. The points on appeal are limited to those presented to the Commissioner in the person’s request for reconsideration (AS 38.05.035(l)). By requiring a party to exhaust the administrative review and reconsideration process before appealing to the superior court, the agency is given full opportunity to review, analyze, and respond to concerns before litigation. For purposes of appeal, the burden is on the party seeking review to establish the invalidity of the finding (AS 38.05.035(m)).

**2. Annual Lease Sales**

After a final best interest finding has been issued, DO&G may proceed with oil and gas lease sales in the area. As noted above, a written finding is not required for a lease sale in an area subject to a best interest finding issued within the previous 10 years unless the Commissioner determines that substantial new information has become available that justifies a supplement to the finding.

Before a lease sale, DO&G issues a Call for New Information requesting substantial new information that has become available since the most recent finding for that lease sale area was issued (Figure 2.2). This request is public noticed, and provides opportunity for public comment for a period of not less than 30 days. Based on information received, the Commissioner determines whether it is necessary to supplement the finding. Based on that determination, the Commissioner either issues a supplement to the finding or a “Decision of No New Substantial Information” 90 days before the lease sale. The supplement has the status of a final written best interest finding for purposes of filing an administrative appeal or a request for reconsideration.



**Figure 2.2. Annual public process for determining if a supplement to a best interest finding is necessary. Note that timeline is not to scale**

The process for requesting reconsideration by the Commissioner, and process for appealing to Superior Court are the same process as described above in Section E(1)(d).

### 3. Bidding Method and Lease Terms

Under AS 38.05.180(f) and 11 AAC 83.100(a), the leasing of oil and gas resources must be by competitive bidding. AS 38.05.180(f)(3) provides a number of leasing methods for competitive bidding that the Commissioner may adopt for an oil and gas lease sale:

- (A) a cash bonus bid with a fixed royalty share reserved to the state of not less than 12.5 percent in amount or value of the production removed or sold from the lease;
- (B) a cash bonus bid with a fixed royalty share reserved to the state of not less than 12.5 percent in amount or value of the production removed or sold from the lease and a fixed share of the net profit derived from the lease of not less than 30 percent reserved to the state;
- (C) a fixed cash bonus with a royalty share reserved to the state as the bid variable but no less than 12.5 percent in amount or value of the production removed or sold from the lease;
- (D) a fixed cash bonus with the share of the net profit derived from the lease reserved to the state as the bid variable;
- (E) a fixed cash bonus with a fixed royalty share reserved to the state of not less than 12.5 percent in amount or value of the production removed or sold from the lease with the share of the net profit derived from the lease reserved to the state as the bid variable;
- (F) a cash bonus bid with a fixed royalty share reserved to the state based on a sliding scale according to the volume of production or other factor but in no event less than 12.5 percent in amount or value of the production removed or sold from the lease;
- (G) a fixed cash bonus with a royalty share reserved to the state based on a sliding scale according to the volume of production or other factor as the bid variable but not less than 12.5 percent in amount or value of the production removed or sold from the lease.

For each lease sale under the 10-year North Slope Foothills Areawide Best Interest Finding, the Commissioner will adopt the bidding method or methods under AS 38.05.180(f) as the Commissioner determines is in the best interests of the state. The bidding method or methods may not be the same for each lease sale over the 10-year term of this best interest finding, but the method for each sale will be adopted from the methods set out in AS 38.05.180(f)(3). The bidding method or methods adopted for a particular lease sale will be published in the pre-sale notice describing the interests to be offered, the location and time of the sale, and the terms and conditions of the sale (AS 38.05.035(e)(6)(F)).

#### **4. Post Sale Title Search**

The North Slope Foothills lease sale area has been divided into tracts that will remain fixed for future lease sales. The extent of the state's ownership interest in these lands will not be determined before the lease sales. Instead, following each lease sale, ADNR will verify title only for tracts receiving bids. Therefore, should a potential bidder require title or land status information for a particular tract before a lease sale, it will be the bidder's responsibility to obtain that information from ADNR's public records. It is possible that a tract included in a lease sale may contain land that the state cannot legally lease because it is subject to an existing oil and gas lease or because the mineral estate is not state owned. Depending on the number of tracts leased and the complexity of the ownership, it could take weeks to months following a lease sale to complete the title work and issue all of the leases.

# Chapter Three: Description of the Lease Sale Area

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# Chapter Three: Description of the Lease Sale Area

## A. Property Description

The lease sale area contains approximately 7.6 million acres in 1,347 tracts ranging in size from 1,280 to 5,760 acres. The lease area lies between NPR-A on the west, ANWR on the east, south of the Umiat Baseline and north of the Gates of the Arctic National Park and Preserve. The gross acreage of the entire lease sale area is in excess of 7.6 million acres. However, approximately 3.2 million of these acres are either Native-owned or Native-selected, and will not be included in the lease sale (Map 1.1 and Map 1.2).

The sale area is within the NSB and encompasses an area of about 88,817.1 mi<sup>2</sup> of land and 5,945.5 mi<sup>2</sup> of water or approximately 15% of the state (NSB 2005). It extends from the Chukchi Sea on the west to the Canadian border on the east, and 225 miles from Point Barrow on the north to the foothills of the Brooks Range on the south. The borough has the powers of taxation, land management, and zoning, and is responsible for providing borough communities with public works, utilities, education, health, and other public services.

The anadromous waters in the lease sale area are the Colville, Sagavanirktok, Ivishak, Nanushuk, Echooka, Saviukviayak, Itkillik, Anaktuvuk, Kanayut, Lupine, Ribdon and Canning rivers, portions of the Chandler River, and Accomplishment, Upper Section, Lower Section, Flood, Cobblestone, May creeks (Johnson and Klein 2009).

Portions of the lease sale area are located within the coastal zone where activities are subject to the Alaska Coastal Management Program. The boundary of the coastal zone extends inland along river corridors of the anadromous rivers listed above, including the Colville, Chandler,



Upstream view of the Colville River at Umiat.

Itkillik, Anaktuvuk, Nanushuk, Sagavanirkto, Ivishak, Echooka, Lupine, Ribdon, Saviukviak, and Canning rivers, and the May, Cobblestone, Accomplishment, Upper Section, Lower Section, and Flood creeks (Map 1.3). Lakes are infrequent, but many swift rivers originating in the Brooks Range cross through the foothills, occasionally braiding across gravel flats. Some streams freeze solid each winter, creating large aufeis deposits that last well into summer (ADF&G 2006).

The Brooks Range is directly south of the lease sale area. This mountain range is a west-to-east trending range, which creates the watershed divide for several large river systems. The range varies in elevation from 4,000 to 10,000 feet, and reduces in relief toward the north across the Arctic foothills to the coastal plain (Hall 1984).

## **1. Land and Mineral Ownership**

The Alaska Statehood Act granted to the State of Alaska the right to select from the federal public domain 102.5 million acres of land to serve as an economic base for the new state. The Act also granted to Alaska the right to all minerals underlying these selections and specifically required the state to retain this mineral interest when conveying its interests in the land (AS 38.05.125). Therefore, when state land is conveyed to an individual citizen, local government, or other entity, state law requires that the deed reserve the mineral rights for the state. Furthermore, state law reserves to the state the right to reasonable access to the surface for purposes of exploring for, developing and producing the reserved mineral. Surface owners are entitled to damages under AS 38.05.130, but may not deny reasonable access. Mineral closing orders, which are commonly associated with surface land disposals, do not apply to oil and gas leasing.

ANCSA, passed by Congress in 1971, also granted newly created regional Native corporations the right to select and obtain from the federal domain lands the land and mineral estates within the regional Native corporation boundaries. It also allowed Native village corporations and individual Alaskan Natives to receive land estate interests. However, overlapping selections created conflicts and delays in conveying the land from the federal government, and some selected lands have yet to be conveyed.



North front of the Brooks Range along the southern margin of the central North Slope.

In Anaktuvuk Pass, the Arctic Slope Regional Corporation has ownership of the subsurface mineral estate for the village lands, and has also selected lands in the general Anaktuvuk Pass area for conveyance from the federal government. The federal government is the land manager for the nearby Gates of the Arctic National Park and Preserve (NPS 2009).

There are several parcels of which the surface estate was conveyed from the state through the federal government to Native allottees. The NSB also owns land as a result of the state's municipal entitlement program. Additional municipal conveyances are pending within the lease sale area. For the most part, the state, as the owner of the retained mineral estate, may lease these lands for oil and gas development.

Therefore, the North Slope Foothills Areawide lease sale contains tracts in which the state owns both the land estate and the mineral estate. Only those free and unencumbered state-owned oil and gas mineral estates within the tracts will be included in any lease issued.

## **B. Historical Background**

Evidence of human habitation and hunting along the upper Colville River has been dated to about 5,670 B.C. by researchers. In addition, evidence of habitation was found at Anaktuvuk Pass, dating from about 4,560 B.C. Researchers have noted that the tracking of movement of coastal inhabitants inland toward the Brooks Range and the movement of inland hunters to the coastal areas has been complex (Anderson 1984). Movement of inhabitants from the Noatak/Kobuk river region after 1,400 A.D. resulted in occupation of the Brooks Range and Colville Basin (Hall 1984, citing to Hall 1976).

The inhabitants of the Brooks Range were known as Nunamiat, formed from the Inupiaq for *nuna* 'land' and *miut* 'people of'. Social organization was founded upon maximizing hunting capabilities, mutual aid and building trading relationships. At various times during the nineteenth century migration was caused by changing economic conditions, which brought different societies together. For inhabitants of the mountains, the caribou was the primary component of their lifestyle, constituting more than 90% of the diet, clothing and shelter (Hall 1984). In the first half of the twentieth century, disease, starvation due to declining caribou herds in 1926-1927, and opportunities along the coast drew the mountain inhabitants to the coast. A few families returned to the area along the Killik River and Chandler Lake in about 1938, and a permanent community was established at Anaktuvuk Pass in the early 1950s (ADCRA 2009a; Hall 1984).

The incorporation of the NSB in 1972 provided residents with local government powers and a mechanism to assess and tax oil and gas infrastructure. Incorporation also created responsibilities of planning, zoning, education and utilities. Petroleum revenues and other funding have provided the borough with resources to pay for schools, fire stations, medical clinics, health care services, utilities, public safety facilities, family assistance programs, workforce development programs, community centers, public housing, administrative facilities, and jobs for borough residents.



Man gutting caribou near Anaktuvuk Pass, 1962.

Anchorage Museum (AMRC-wws-3421-52)

## C. Communities

### 1. North Slope Borough

The lease sale area is within the NSB. The borough has a population of 6,615 (U.S. Census Bureau Population Division, 2008) and is a home rule borough that was incorporated in 1972. The borough is Alaska's largest borough, and encompasses an area of about 88,817 mi<sup>2</sup> of land and 5,946 mi<sup>2</sup> of water, or approximately 15% of the state (NSB 2005). It extends from the Chukchi Sea on the west to the Canadian border on the east, and 225 mi from Point Barrow on the north to the foothills of the Brooks Range on the south (Map 1.1 and Map 3.1).

Approximately 74% of borough residents are Alaska Native or part Native. The majority of permanent residents are Inupiat Eskimos. Communities located within the borough include: Anaktuvuk Pass, Atqasuk, Barrow, Deadhorse/Prudhoe Bay, Kaktovik, Nuiqsut, Point Hope, Point Lay, and Wainwright (ADCRA 2009d). The borough has the powers of taxation, land management, and zoning, and is responsible for providing borough communities with public works, utilities, education, health, and other public services.

The median household income in 2000 for the borough was \$63,173, with \$20,540 per capita income. The total work force population was 4,875, with 2,993 reported as employed in these fields: 34% professional, 18% service, 22% sales and office, 15% construction and maintenance, 10% production and transportation, and less than 1% fishing, forestry and farming. The government of the NSB is funded by oil and gas revenues, and the economy is heavily dependent upon oil and gas development and the services needed for this industry. Oil operations provide employment for about 5,000 non-residents throughout the borough (ADCRA 2009d).

Most communities rely on air travel to provide year-round access, while land transportation provides seasonal access. The Dalton Highway provides road access to Deadhorse/Prudhoe Bay, though it is restricted during winter months. "Cat-trains" are sometimes used to transport freight overland from Barrow and the Trans-Alaska pipeline to North Slope communities during the winter (ADCRA 2009d).

### 2. Anaktuvuk Pass

Anaktuvuk Pass is a village with a population of 284, located at about 2,200 ft elevation in the Endicott Mountains of the Brooks Range, on the divide between the Anaktuvuk and John Rivers (Map 3.1) (ADCRA 2009a). It is about 250 mi northwest of Fairbanks, and about the same distance from Barrow. Anaktuvuk Pass was traversed and hunted regularly by the Nunamiat bands who lived in a nomadic lifestyle. It is the only remaining settlement of the Nunamiat people. The present day location was established in about 1938 when families living on the coast returned to the mountains at Killik River and Chandler Lake (ADCRA 2009a). In 1949 several families moved to the vicinity



Post office at Anaktuvuk Pass, 1962.

Anchorage Museum (AMRC-wws-3421-116)



DCRA 2008

Anaktuvuk Pass.

of the current village location. The majority of the population is Alaska Native (88.3%), who practice a traditional subsistence lifestyle (ADCRA 2009a).

The settlement encompasses 4.8 mi<sup>2</sup>. Contact Creek runs through the town center. A gravel airstrip provides year-round access. There is no road to the village, but cargo is transported from the Trans-Alaska pipeline haul road during winter months (ADCRA 2009a).

The utilities in the village are provided by the NSB. This includes electricity and water from two central wells. Most households have water delivered to water holding tanks, with 80% of them using running water in the kitchen (ADCRA 2009a).

The median household income in 2000 was \$52,500, with the per capita income reported as \$15,283 (ADCRA 2009a). The total potential workforce in 2000 was 205 people. There are 100 people reported as employed as 20% professional, 19% service, 21% sales and office, 21% construction and maintenance and 19% production or transportation (ADCRA 2009a).

Activities supported by the NSB provide government services and capital improvement projects, which have also led to service and temporary construction jobs for residents. The Nunamiat Corporation is active in the non-government business sector (ADCRA 2009a).

### **3. Nuiqsut**

Nuiqsut, population 424 (ADCRA 2009e) is located approximately 35 mi from the Beaufort Sea on the west bank of the Nechelik Channel of the Colville River delta (Map 3.1). It encompasses 9.2 mi<sup>2</sup> of land. The Colville Delta has traditionally been a gathering and trading place for the Inupiat and offers good hunting and fishing. The old Village of Nuiqsut was abandoned in the late 1940s. In 1973, the village was resettled by 27 families from Barrow. In 1973 and 1974, a school, housing, and other facilities were constructed by federal agencies. The City of Nuiqsut was incorporated in 1975 (ADCRA 2009e). In 2000, 89% of the population was Inupiat Alaskan Native.



DCRA

Nuiqsut.

The median household income in 2000 was \$48,036, and the per capita income was \$14,876. The total potential work force was 264 people, with 176 people employed as 17% professional, 22% service, 15% sales and office, 30% construction and maintenance, and 15% production and transportation, and less than 1% fishing, forestry or farming (ADCRA 2009e).

The NSB provides utilities to Nuiqsut. Water is derived from a lake, treated and delivered to individual resident's water tanks. Most homes have running water to the kitchen. The Alpine oil field will soon provide piped natural gas to Nuiqsut, which will lower the cost of running diesel electric generators for heating homes and other facilities (ADCRA 2009e).

The NSB owns and operates a gravel airstrip and year-round access is provided by air travel. Marine and land transportation also provide local seasonal access and snowmachines are used for local transportation in winter months (ADCRA 2009e).

#### **4. Barrow**

Barrow has a population of 4,054 (ADCRA 2009b), and is located 10 mi south of Point Barrow on the Chukchi Sea coast (Map 3.1). The area encompasses 18.4 mi<sup>2</sup> of land and 2.9 mi<sup>2</sup> of water. Barrow was incorporated in 1958. Formation of the NSB in 1972, the Arctic Slope Regional Corporation, and construction of the Prudhoe Bay oil fields and the Trans-Alaska Pipeline have contributed to Barrow's development.

In 2000, 64% of the population was Inupiat, 22% was white, and 9% was of Asian descent. The NSB is Barrow's primary employer; however employment is also provided by state and federal agencies and numerous other businesses that provide support services to oil and gas field operations (ADCRA 2009b).

The median household income in 2000 was \$67,097, with the per capita income of \$22,902 (ADCRA 2009b). The total potential work force is 3,069, with 1,986 reported as employed as 39% professional, 15% service, 24% sales and office, 13% construction and maintenance, 8% production and transportation, and less than 1% fishing, forestry and farming (ADCRA 2009b).



Barrow.

The NSB provides utilities to Barrow. Water is derived from a dam on Isatkoak Lagoon and is stored in a holding tank. The Barrow Utilities & Electric Cooperative operates the water and sewage treatment plants, generates and distributes electric power, and distributes piped natural gas for home heating. The local power plant is fueled by natural gas (ADCRA 2009b).

Year-round access is provided by air travel. The state owns the Wiley Post-Will Rogers Memorial Airport, which serves as the regional transportation center for the borough. The airport has a 6,500-foot-long asphalt runway. Marine and land transportation also provide seasonal access (ADCRA 2009b).

## **5. Kaktovik**

Kaktovik has a population of 272 (ADCRA 2009c), and is located on the north shore of Barter Island, between the Okpilak and Jago rivers (Map 3.1). The village encompasses 0.8 mi<sup>2</sup> of land and 0.2 mi<sup>2</sup> of water and lies within the Arctic National Wildlife Refuge (ANWR). The village was incorporated in 1971. The island served as a major trade center for the Inupiat, particularly as a bartering place for Alaska Inupiat and Canadian Inuit (ADCRA 2009c).

The median household income in 2000 was \$55,625, with the per capita income of \$22,031. The NSB, city services and school provide most of the year-round employment. The total potential work force is 190 people, with 117 reported as employed as 21% professional, 30% service, 24% sales and office, 10% construction and maintenance, and 15% production and transportation (ADCRA 2009c).

The NSB provides utilities to Kaktovik. Water is derived from a surface source, treated and stored in a 680,000-gallon water tank, and delivered by truck to home holding tanks. Approximately 80% of homes have running water in the kitchen. Homes that are not connected to the water and sewer system utilize holding tanks that are pumped and hauled on a regular basis (ADCRA 2009c).

Year-round access is provided by air travel. The Barter Island Airport is owned by the U.S. Air Force and operated by the borough. Marine and land transportation also provide seasonal access (ADCRA 2009c).



Kaktovik.

## **D. Cultural Resources**

The ADNR Office of History and Archaeology has records of historic and archaeological sites throughout north Alaska. They maintain the Alaska Heritage Resource Survey (AHRS). There are documented reports of known concentrations of site localities and scattered historical resources throughout the lease sale area (Dale 2009, personal communication).

Cultural and historic resources are those sites and artifacts having significance to the culture of Arctic people. Historic and cultural sites are those identified by the National Register of Historic Sites, and include those identified in the NSB Traditional Land Use Inventory (TLUI), by the Commission on Inupiat History, Language and Culture, and sites identified in other published studies. Many places, such as ancient village locations along the tributaries of the Colville River, which contain archaeologically important relics, continue to be used today.

The AHRS and the TLUI are comprised of “restricted access documents” and specific site location data should not appear in final reports or be distributed to others.

## **E. Temperature and Precipitation**

Surface conditions in the Arctic vary dramatically. In summer, the climate is generally mild. The three-month ice-free season is critical to biological productivity. In contrast, winters are severe, forcing many species to migrate south.

At Anaktuvuk Pass, the average temperature in January is -14°F. Average summer temperature is 50°F. Precipitation averages 11 inches and snowfall averages 63 inches per year (ADCRA 2009a).

At Nuiqsut, temperatures range from -56 to 78°F. The daily minimum temperature is below freezing 297 days each year, on average. Precipitation averages 5 inches with the annual snowfall of 20 inches (ADCRA 2009e).

At Kaktovik, temperatures range from -56 to 78°F. Precipitation averages 5 inches with the annual snowfall of 20 inches (ADCRA 2009c).

At Barrow, temperatures range from -56 to 78°F. Precipitation averages 5 inches with the annual snowfall of 20 inches (ADCRA 2009b). The average summer temperature is about 40 °F. The daily minimum temperature is below freezing 324 days of the year. The sun does not set between May 10 and August 2 each year, and does not rise between November 18 and January 24 each winter (ADCRA 2009b).

## **F. Climate**

The climate of the NSB and its villages is an Arctic climate. A study conducted of mean temperatures from 1951 to 2001 in Barrow showed a cooling trend of -0.28°C per decade from 1951 to 1975, and a warming trend of +0.52°C per decade since 1977 (Hartmann and Wendler 2005).

Temperature and precipitation records from 1949 to 1998 throughout Alaska show annual and seasonal mean temperature increases throughout the entire state. Barrow showed decreases in annual and winter precipitation (Stafford 2000).

Global surface temperatures have increased about 0.9°F since the late 19<sup>th</sup> century. The increase per decade was 0.05°C for the past century, and was about 0.16°C per decade during the past 30 years (NCDC 2008).

Temperature increase in Alaska over the last 59 years averages 3.1°F, although the temperature changes vary greatly across the state. Most of the change has occurred in winter and spring months (ACRC 2009).

At northern latitudes potential effects of climate changes include rising temperatures, melting glaciers, reduction in seasonal sea ice cover resulting in increased storm effects and higher coastal erosion rates, increased permafrost melting, shifting vegetation zones, increased fires, insect outbreaks, changing animal migration paths, and changing subsistence patterns. Climate changes and associated geologic hazards may threaten and negatively impact Alaskans and other users of the Arctic (DGGS 2010).

In 2006, the Alaska Climate Impact Assessment Commission was formed to assess the effects of climate change on citizens, resources, economy, and assets of the State of Alaska (ACIAC 2008). In September 14, 2007, Administrative Order 238 was signed, creating the Climate Sub-Cabinet to develop an Alaska Climate Change Strategy. The strategy serves as a guide for responding to climate change and will identify immediate priorities as well as long-term strategies, including recommendations for saving energy and reducing greenhouse gas emissions (Alaska Climate Sub-Cabinet 2009). On April 17, 2008, the Governor's subcabinet released its report of recommended actions including emergency planning and training, erosion control, and village relocation planning (IAW 2008).

The State of Alaska Climate Change Sub-cabinet combines representation from the ADEC, ADF&G, Alaska Department of Transportation and Public Facilities (ADOT), ADNR, Department Commerce, Community and Economic Development, University of Alaska, and the Office of the Governor. It is tasked with providing assessments and recommendations for adaptation, mitigation and for defining research needs to assist Alaskans with the impacts of climate change. In 2009, the ACIAC released a report that addressed mitigation, presented a range of potential mitigation measures, and stated that more analysis is needed for effective mitigation (ACIAC 2009). Barrow is named as one of the 31 Alaskan villages imminently threatened by coastline impacts (Alaska Climate Sub-Cabinet 2009).

## **G. Geologic Hazard Assessment**

When assessing the kinds of geologic hazards and their potential impact it is critical to have an understanding of the types of geologic materials and processes present, their properties and distribution. The primary geologic hazards in or near the North Slope Foothills lease sale area

include faults and earthquakes, permafrost and frozen-ground phenomena, mass movements, river erosion, flooding and slope movements. These geologic hazards could impose constraints to exploration, production, and transportation activities associated with possible petroleum development, and should be considered in the siting design, construction, and operation of facilities.

Long, linear ridges, buttes, and mesas composed of tightly folded sedimentary rocks divide narrow alluvial valleys and glacial moraines. Above a thick, continuous layer of permafrost are ice-related features, such as gelifluction lobes, pingos, and ice-wedge polygon networks. Because the permafrost impeded drainage, soils are usually saturated and have fairly thick organic horizons (ADF&G 2006).

## **1. Geologic Materials**

Most surficial geologic mapping in the region has been done at a reconnaissance level and more detailed work should be completed prior to siting design and infrastructure development. Reconnaissance mapping of the Phillip Smith Mountains (Hamilton 1978), Chandler Lake (Hamilton 1979), and Killik River (Hamilton 1980) quadrangles was completed at a scale of 1:250,000 and engineering-geologic maps have been published for the Ikpikpuk River (Carter and Galloway 1988) and Umiat quadrangles (Carter and Galloway 1986). Other maps have been published documenting surface geologic materials and hazards along potential transportation corridors within the lease sale area (Stevens and Smith 2003a; Stevens and Smith 2003b; Stevens and Smith 2003c; Stevens and Smith 2003d; Stevens and Smith 2003e; Stevens and Smith 2003f).

Geologic materials may be composed of bedrock, unconsolidated materials, or a mixture of both. In general bedrock outcrops are more common at higher elevations and close to the Brooks Range, although exposures along streams and steeper slopes are not uncommon in northern areas. Valley bottoms, slopes and low hills are typically characterized by unconsolidated deposits.

Unconsolidated deposits in the lease sale area include alluvium, outwash, glacial drift, colluvium and low-lying silt and sand deposits. Alluvium and outwash are generally found along stream bottoms



Polygonal ground in the Anaktuvuk Pass area.

P. Karczmarczyk, ADOTPF, 2009

and former glacial drainage channels and include terrace and floodplain materials. These deposits typically range from poorly sorted to moderately well stratified subangular coarse gravel with cobbles and boulders near moraine fronts and at the heads of mountain valleys to well-sorted sandy gravel with subrounded pebbles and cobbles along some stream stretches (Hamilton 1978; Hamilton 1980).

Glacial drift consists of poorly sorted nonstratified material, ranging in composition from silty sandy boulder gravel to clayey stony silt, with local stratified ice-contact deposits consisting of moderately well sorted sand and gravel (Hamilton 1978; Hamilton 1980). These deposits are associated with Tertiary, Pleistocene and Holocene glacial advances northward from the Brooks Range and may form arcuate landforms (moraines) adjacent to stream valleys. Thin glacial drift locally mantles upland areas, especially in the northern foothills of the Brooks Range. Younger deposits tend to retain primary glacial morphology while older deposits have less relief and are more heavily modified by slope processes.

Colluvial deposits associated with downslope movement of material are common throughout the study area. Such deposits are found along and at the base of many slopes, and range from angular rock debris to poorly sorted, nonstratified mixtures of sand silt and clay (Hamilton 1980). These types of deposits may pose significant geologic hazards due to their potential instability.

Deposits in the low-lying areas beyond the limits of glaciation in the northern part of the study area generally consist of silt and sand, commonly in the form of loess and dunes. Loess deposits typically contain abundant ice in the form of lenses, wedges and interstitial grains (Hamilton 1980). Such deposits may be organic rich and are especially subject to hazards associated with permafrost. These deposits commonly display evidence of solifluction and slope movement on steeper surfaces (Hamilton 1980).

## **2. Faults and Earthquakes**

Surface faults have been mapped throughout the central North Slope, including high-angle faults, basement-involved normal faults, listric growth faults, and north-dipping gravity faults. Locally, two or more types may occur in close proximity to each other.

North of the lease sale, high-angle faults exist along the Barrow Arch extending into Harrison Bay. Along the Barrow Arch they are related to the basement tectonics of the Arctic Platform, while in Harrison Bay they offset the Tertiary and older units. Displacement of Pleistocene or Holocene sediments has not been documented and there has been no recent seismicity associated with these faults. Thus, differential movement along these faults seems to have ended prior to the beginning of the Quaternary period (Craig and Thrasher 1982).

A number of shallow faults have been mapped north of the Arctic Platform. Included in these faults are the upper extensions of detached listric growth faults that exist deep in the Brookian section. These faults have been mapped in the greatest detail in the Camden Bay area where some of these faults may have been reactivated in the late Cenozoic and can have several tens of meters of offset. Shallow faults have also been mapped beneath the outer shelf, west of Cape Halkett and are reported to show from 3 to 10 m of Quaternary offset (Grantz et al. 1983). The Neotectonic map of Alaska shows these structures as active during the Holocene and late Pleistocene (Plafker et al. 1994).

On the outer Beaufort shelf and upper slope, seaward of the 50-65 m isobaths, are gravity faults that are related to large rotational slump blocks (Grantz and Dinter 1980; Grantz et al. 1982). South of these slumps, which bound the seaward edge of the Beaufort Ramp, these faults have surface offsets ranging from 15 m to as high as 70 m (Grantz et al. 1982). Grantz and others (1982) have inferred that these faults have been active in recent geologic time. Similar gravity fault features occur offshore and along the coast of the Gulf of Mexico and have been shown to move seismically and aseismically (creep).

Within the lease sale, many east-west trending structures have been mapped along the north side of the Brooks Range (Map 3.2). These structures offset Paleogene bedrock (older than ~24 million years) and are not known to have been active in the Quaternary.

Several active faults exist south of the lease sale area, including the Kobuk fault, Preacher fault, Medicine Lake lineament, Dall Mountain fault, Pivot fault, and the Kaltag fault (Map 3.2). Quaternary activity is inferred for all of these faults (Plafker et al. 1994), however, little is known about their rupture histories. The Kobuk fault extends roughly east west approximately 200 km south of the lease sale and is characterized by north side up motion. The Kaltag fault, Preacher fault, and Medicine Lake lineament are part of the Tintina fault system that extends across central Alaska in an arcuate bend roughly parallel to the Alaska Range and the Denali fault to the south. Motion along the Tintina system is right lateral strike-slip with a component of north-side-up displacement in some localities. Large magnitude earthquakes along these structures could generate strong ground motions; however, due to their distance from the lease sale, the effects of seismic shaking are expected to be minor.

Since 1968, 130 earthquakes of magnitude M=2 have been recorded in the region surrounding the lease sale, with only four events of magnitude M $\geq$ 5.0 (Map 3.3). Although seismicity is diffuse in northern interior Alaska, several prominent NE- to NNE-striking seismic trends, including the Dall City, Rampart, Minto Flats, Fairbanks, and Salcha seismic zones, occur south of the lease sale area (Biswas and Gedney 1979; Rupert and Hansen 2008). At least 9 historic earthquakes of magnitude M $\geq$ 6.0 have occurred within this belt of seismicity (Rupert and Hansen 2008). The Dall City and Rampart seismic zones have not been associated with particular surface faults; however this lack of surface-fault evidence is likely due to lack of investigation. To the northeast, these seismic zones extend across the eastern end of the lease sale area, but become more diffuse and less defined. Along strike of the zone, the Camden Bay area is seismically active with several faults mapped as historic and late Pleistocene (Plafker et al. 1994).

### **3. Permafrost, Frozen Ground and Thermokarst**

Permafrost is defined as ground (soil and rock as well as included ice and organic matter) that remains at or below 0°C for at least 2 consecutive years and can be found in both unconsolidated sediment and in bedrock (Noetzli and Gruber 2009; Pullman et al. 2007; French 2007). In the sale area permafrost is considered continuous, occupying 90-100% of the land area with unfrozen areas generally present only below rivers or lakes (Brown et al. 1997). For the most part permafrost is overlain by an active layer of unconsolidated sediment. This active layer refers to a surface layer of ground or soil above permafrost that is alternately frozen each winter and completely thawed each summer (Gary et al. 1972).

Depth of permafrost is variable and depends on the amount of solar radiation, aspect, thickness and duration of snow cover, material properties, altitude and latitude (French 2007). Permafrost thickness has been measured from numerous wells north of the lease sale area where it generally thins from east to west. East of Oliktok Point, it has been measured to be 500 m thick, whereas west of the Colville River it has been measured to be 300 to 400 m thick (Osterkamp and Payne 1981). At Umiat the depth of permafrost has been measured to be 322 m (French 2007; Washburn 1979). Records from the northern Brooks Range and Foothills suggest the base of permafrost lies at a depth of 150-300 m in the Killik Quadrangle (Hamilton 1980) and 150-250 m in the Chandler Lake Quadrangle (Hamilton 1979). Ferrians (1965) and Williams (1970) provide additional information regarding permafrost depth in and near the sale area.

Many geologic hazards in permafrost regions are related to the changes in both the active layer and permafrost thickness related to seasonal and long term temperature fluctuations (Kane et al. 1991; French 2007), as well as to manmade ground disturbances and structures. Surface response to melting permafrost and seasonal ground ice is not uniform, and is related to the amount and type of

ground ice and the interactions of slope position, soil texture, and hydrology (including snow cover), as well as vegetation and the effects of fire over time (Jorgenson et al. 2008; French 2007). Ice content in the permafrost varies throughout the sale area from segregated ice to massive ice in the

form of wedges and pingos, and is highest in fine-grained, organic-rich deposits and lowest in coarse granular deposits and bedrock (Collett et al. 1989). Lilly et al. (2008) suggest that changes in the distribution of ice in soil pore space can impact sediment strength on both seasonal and long term scales. Generally, soil strength is greater during the winter when soil water is frozen than during summer months when melting occurs.

Natural (forest fires, floods and erosion) and manmade ground disturbances often lead to an increase in thawing of permafrost resulting in instability of the ground surface and ground settlement (Richter-Menge et al. 2006).

Such disturbances may make the surface unsuitable for many construction purposes (Carter and Galloway 1986). Ground settlement occurs whenever a heated structure is placed on ground underlain by shallow, ice-rich permafrost, and proper engineering measures are not taken to adequately support the structure and prevent the structure's heat from melting the ground ice. Degree of settlement is a function of the original thickness of the active layer, the increase in the active layer as it adjusts to the surface disturbance, and the thaw strain of the underlying permafrost (Pullman et al. 2007). In general the magnitude of settlement depends on the nature and abundance of ice and the severity of the disturbance. Arctic lowland areas are particularly at risk for thaw subsidence because of the high volume of ground ice at the top of the permafrost (Jorgenson et al. 2006). Pullman and others (2007) suggest potential for thaw settlement is least in areas of active river deposits and eolian sand and can be greater than 1 meter in areas of alluvial marine deposits.

In addition to settlement, seasonal freeze-thaw processes will cause frost jacking of nonheated structures placed on any frost-susceptible soils unless the structures are firmly anchored into the frozen ground with pilings or supported by non-frost-susceptible fill (Combellick 1994). The depth of this layer of seasonal thaw is generally less than 1 m below the surface and 2 m beneath most active stream channels and is dependent on site-specific hydrological and geotechnical water crossing conditions. Borings along the Colville River, for example, show it remains thawed year-round (Collett et al. 1989). The frost susceptibility of the ground is highest in fine-grained alluvium, colluvium, thaw-lake and thermokarst deposits; moderate in alluvial-fan deposits and till; and lowest in coarse-grained flood-plain deposits, alluvial terrace deposits and gravelly bedrock (Carter et al. 1986; Ferrians 1971; Yeend 1973a; Yeend 1973b; Carter and Galloway 1986).



Example of thermokarsting on the North Slope.

DO&G Permitting Staff

Thermokarst is caused by the elevation of ground temperatures, generally because of disturbance or removal of insulating vegetation that results in local melting of ground ice. This may cause uneven topography in the form of mounds and sink holes. Even small disturbances such as a vehicle driven across the tundra can create thermokarst features. In the past, off-road and seismic trail disturbances associated with oil development activities have led to the development of thermokarst (Pullman et al. 2007). This can be mitigated through seasonal and area restrictions on vehicles.

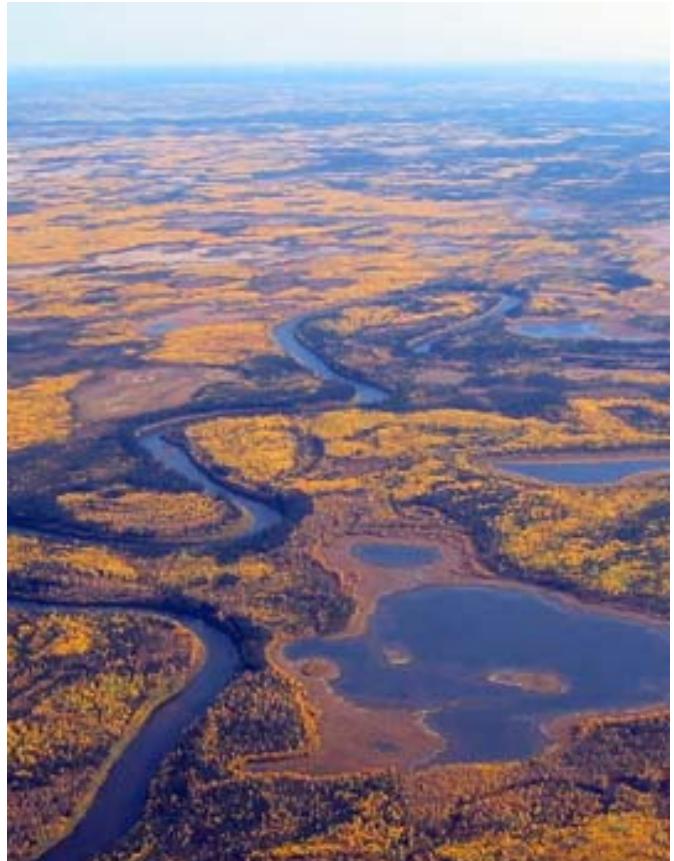
Many geologic processes in areas of permafrost and seasonally frozen ground are sensitive to seasonal and long term variability of climate; long-term records indicate that temperatures at the depth of zero seasonal temperature variations in permafrost are warming on the North Slope (Richter-Menge et al. 2006; Pavlov and Malkova 2008). Ground subsidence, increased erosion, change in the hydrologic regime, and the other potential impacts of permafrost degradation described above will negatively impact infrastructure if climate continues to warm unless new mitigation techniques are adopted (Alaska Regional Assessment Group 1999).

As a result, continued monitoring of permafrost stability, including water content and temperature variability of soils, and continued assessment of mitigation techniques are necessary. Frozen-ground problems can be successfully mitigated through proper siting, design, and construction, as demonstrated at Prudhoe Bay and elsewhere. Structures such as drill rigs and permanent processing facilities should be insulated to prevent heat loss into the substrate. Pipelines can be trenched, back-filled, and chilled (if buried) or elevated to prevent undesirable thawing of permafrost. In addition, ADNR regulates winter travel across the tundra and authorizes travel only after determining that the tundra is sufficiently frozen and protected by ample snow cover so that the travel will not have major environmental effects such as permafrost degradation (Bader and Guimond 2006).

## 4. Mass Movement

Mass movement is the downward and outward movement of slope-forming material under the influence of gravity (Goudie 2004). Melting ice and permafrost can facilitate movement due to the lubricating effect of water and reduction of effective stress in saturated materials. Mass-movement processes present a significant geologic hazard in the study area because they can lead to slope instability, which can impact infrastructure and development (Carter and Galloway 1986; Stevens and Smith 2003a; Stevens and Smith 2003b; Stevens and Smith 2003c; Stevens and Smith 2003d; Stevens and Smith 2003e; Stevens and Smith 2003f).

In the lease sale area, mass-movement processes commonly produce solifluction deposits, slides, flows, slumps, talus and rockfalls (Hamilton 1978; Hamilton 1979; Hamilton 1980; Nelson et al.



Discontinuous permafrost, Yukon Flats;  
similar to permafrost of the North Slope Foothills area.

USGS

2001; Hobson 2006; ACIA 2004). Geologic hazards associated with mass movement are not restricted to unconsolidated materials. Depending on temperature, and material properties such as porosity, permeability and the presence or absence of discontinuities, ice can occur in bedrock (French 2007) and may influence its stability (Noetzli and Gruber 2009). Repeated expansion and contraction of ice can potentially enlarge discontinuities, leading to failure. Melting ice can also lead to mass movement by lubricating surfaces along discontinuities. Mass movement associated with bedrock failures is especially important in portions of the lease sale area where steep bedrock slopes exist (Hamilton 1978; Hamilton 1979; Hamilton 1980).

Mass movement of snow can also be a potential hazard in the lease sale area. Avalanches, which involve the downhill movement of snow, ice and rock debris, are possible, especially where snow accumulates on oversteepened slopes (French 2007). Slushflows, which are flowing, water-saturated snow masses, may develop on steep slopes if water content of snow increases (Tomasson and Hestnes 2000). Conditions are often favorable for slushflows during rapid snowmelt or after large rain events when snow cover is abundant. Both avalanches and slushflows have the potential to cause significant damage and destruction. In January 1983, slushflows damaged or destroyed 20 houses in Northwest Iceland (Tomasson and Hestnes 2000).

In addition to hazards associated with slope movement itself, increased erosion can occur as material is delivered to streams from mass movement processes (Hobson 2006).

## **5. River Erosion and Flooding**

Stream sediment load, discharge, and amount and type of bank vegetation, as well as sediment cohesiveness, influenced by the degree and depth of seasonal frost, and permafrost, are all important factors in determining the effectiveness of stream erosion in the study area (Veldman and Ferrell 2002; Vandenberghe 1993). High erosion rates are documented along braided channels, which usually develop in areas composed of noncohesive sediment (Scott 1978). In a study along the Sagavanirktoq River, aerial photographs showed a maximum erosion rate of 4.5 m per year during a 20-year period. In this area, most of the erosion appeared to occur in small increments during seasonal breakup flooding and was concentrated in specific areas where conditions were favorable for thermo-erosional niching (Combéllick 1994).

Erosion rates and river-bank stability must be considered in facility siting, design, construction and operation. Vandenberghe (1993) suggests that past climatic changes have impacted stream erosional and depositional processes and, with recent studies indicating climatic warming (Richter-Menge et al. 2006; Pavlov and Malkova 2008), there is potential for increased rates of erosion, especially as permafrost melts along river banks, thus reducing sediment cohesiveness. Facility siting, design and construction must be considered in determining the optimum oil and gas transportation mode. Structural failure can be avoided by proper facility setbacks from river banks. Docks and road or pipeline crossings can be fortified with concrete armor, and by placing retainer blocks and concrete-filled bags in areas subject to high erosion rates.

Floods occur annually along most of the rivers and many of the adjacent low terraces in the lease sale area due to seasonal snowmelt and ice jams (Rawlinson 1993; Walker and Hudson 2003). Spring ice breakup on rivers in the region often occurs over the first few days of a three-week period of flooding in late May through early June. Up to 80% of the flow occurs during this period (Walker 1973). The geologic impact of flooding is in large part related to the magnitude and timing of seasonal ice breakup. The formation of ice jams is strongly linked with catastrophic flooding (Walker and Hudson 2003). Some of the most damaging floods are associated with an above-average snowpack that is rapidly melted by rainstorms and sudden warming.

During flooding, small changes in river flow can be caused by changes in sediment bars. Consequently, areas of significant bank erosion can be variable. The amount of erosion depends on

factors such as sediment character, amount of water and its level with respect to the river bank (Veldman and Ferrell 2002). Ice carried along by rivers can also produce significant erosion, especially if breakup occurs during lowering river stage, allowing the ice to erode stream banks (Walker and Hudson 2003).

In addition to seasonal flooding, many rivers in the lease sale area are subject to seasonal icing prior to spring thaw. This is due to overflow of the stream or groundwater under pressure, often where frozen or impermeable bed sections force the winter flow to the surface to freeze in a series of thin overflows, or where spring-fed tributaries overflow wide braided rivers (Veldman and Ferrell 2002). In areas of repeated overflow, residual ice sheets often become thick enough to extend beyond the flood-plain margin. These large overflows and residual ice sheets have been documented on many of the streams in the study area but warrant further study prior to infrastructure siting design and development (Stevens and Smith 2003a; Stevens and Smith 2003b; Stevens and Smith 2003c; Stevens and Smith 2003d; Stevens and Smith 2003e; Stevens and Smith 2003f; Dean 1984; Combellick 1994).

Seasonal flooding of lowlands and river channels is extensive along major rivers that drain into the sale area. Thus, measures must be taken prior to facility construction and field development to prevent losses and environmental damage. Pre-development planning should include hydrologic and hydraulic surveys of spring break-up activity as well as flood-frequency analyses. Data should be collected on water levels, ice floe direction and thickness, discharge volume and velocity, and suspended and bedload sediment. Also, historical flooding observations should be incorporated into a geologic hazard risk assessment. All inactive channels of a river must be analyzed for their potential for reflooding. Containment dikes and berms may be necessary to reduce the risk of flood waters that may undermine facility integrity.

## **H. Mitigation Measures**

Several geologic hazards exist in the North Slope Foothills area that could pose potential risks to oil and gas installations. As discussed above, these potential hazards include earthquakes, permafrost and frozen-ground phenomena, river erosion, flooding, overpressured and unstable sediments, and shallow gas deposits and gas hydrates.

The risks from earthquake damage can be minimized by siting onshore facilities away from potentially active faults and unstable areas, and by designing them to meet or exceed national standards and International Building Code seismic specifications specific for Alaska. National industry standards help assure the safe design, construction, operation, maintenance, and repair of pipelines and other oil and gas facilities. Sometimes referred to as “technical standards” they establish standard practices, methods, or procedures that have been evaluated, tested, and proven by analysis and/or application. These standards are intended to assure the safe design, construction, operation, maintenance, and repair of infrastructure. National consensus standards, such as the American Petroleum Institute, American Society of Mechanical Engineers, National Fire Protection Association, and National Association of Corrosion Engineers, can carry the equivalent weight of law. In fact, many of them are codified by incorporation of all or parts of them into regulations by reference. They are constantly reviewed and upgraded by select committees of engineers and other technical experts (PHMSA 2008).

Design for arctic based development should consider all environmental events which influence the design of an arctic structure (API 2001). Design conditions are those environmental conditions to which the structure is designed. Additional precautions should be taken to identify and accommodate site-specific conditions or events that can act on a structure such as unstable ground, flooding, and other localized hazards. Proper siting and engineering will minimize the detrimental effects of these natural processes.

Safe design of oil and gas facilities are based upon design codes and recommended practices that assist the engineer by setting out procedures for achieving acceptable levels of safety. Recommended practices provide guidance for the design of arctic structures and pipelines considering the environment and permafrost. Once the design conditions have been established for each process, they become the basis for that system's design. The primary goal of codes is safety, which is accomplished by providing a minimum set of rules which must be incorporated into a sound engineering design concerning materials, fabrication, testing, and examination practices used in the construction of these systems. All of these are intended to achieve a set of engineering requirements deemed necessary for safe design and construction of these structures and their associated piping systems. Lessees are responsible for following design codes and recommended practices to ensure the safety and integrity of their facilities and operations.

Although geologic hazards could damage oil and gas infrastructure, measures in this final best interest finding, along with regulations imposed by state, federal, and local agencies, in addition to design and construction standards discussed above, are expected to avoid, minimize, or mitigate those hazards. Mitigation measures address siting of facilities, design and construction of pipelines, and oil discharge prevention, gas incident prevention and contingency plans. All lessees are encouraged to refer to the available investigations and associated findings relating to assessment of natural and geologic hazards and mapping of surficial geology within the North Slope Foothills prior to planning, siting, constructing, and maintaining of oil and gas facilities to reduce negative impacts. Additionally, a complete listing of mitigation measures is found in Chapter Nine.

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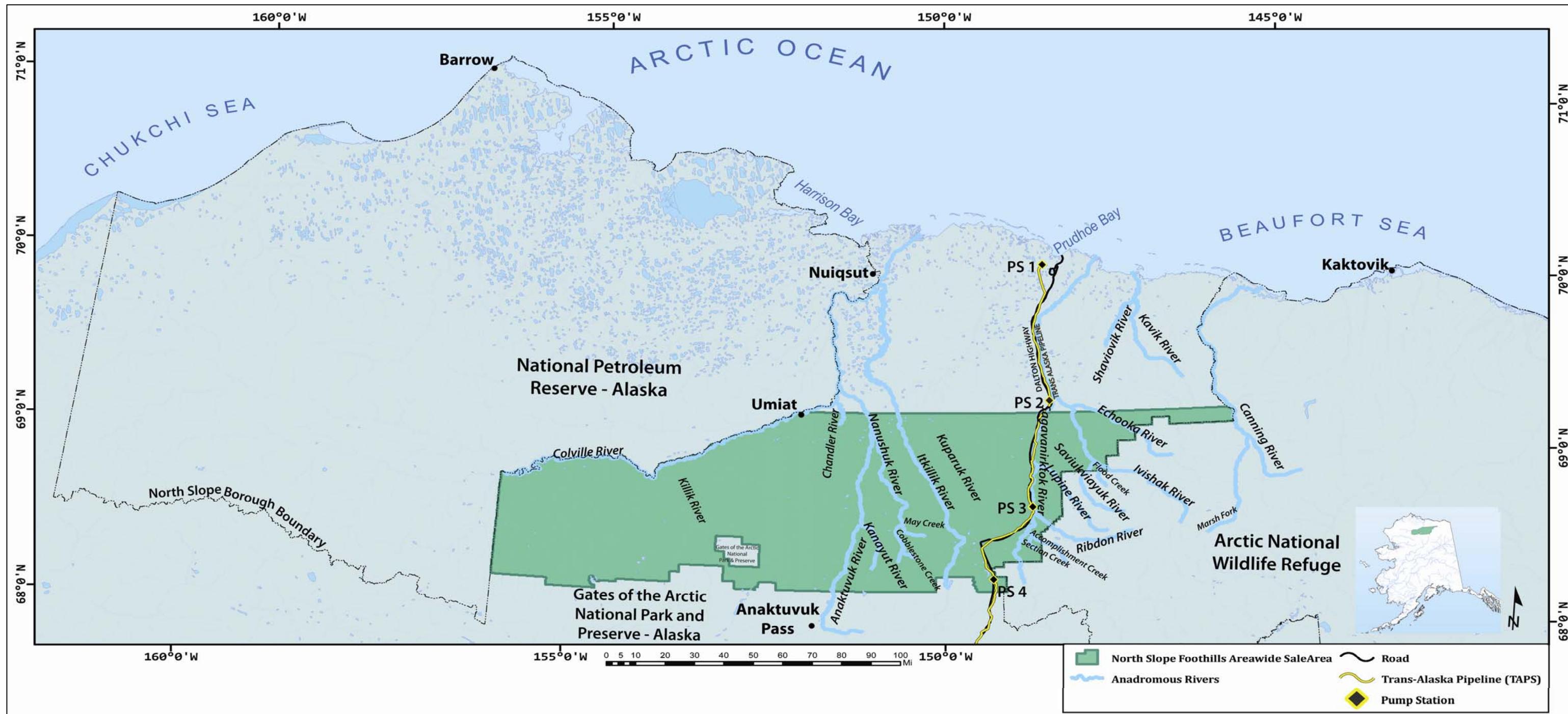
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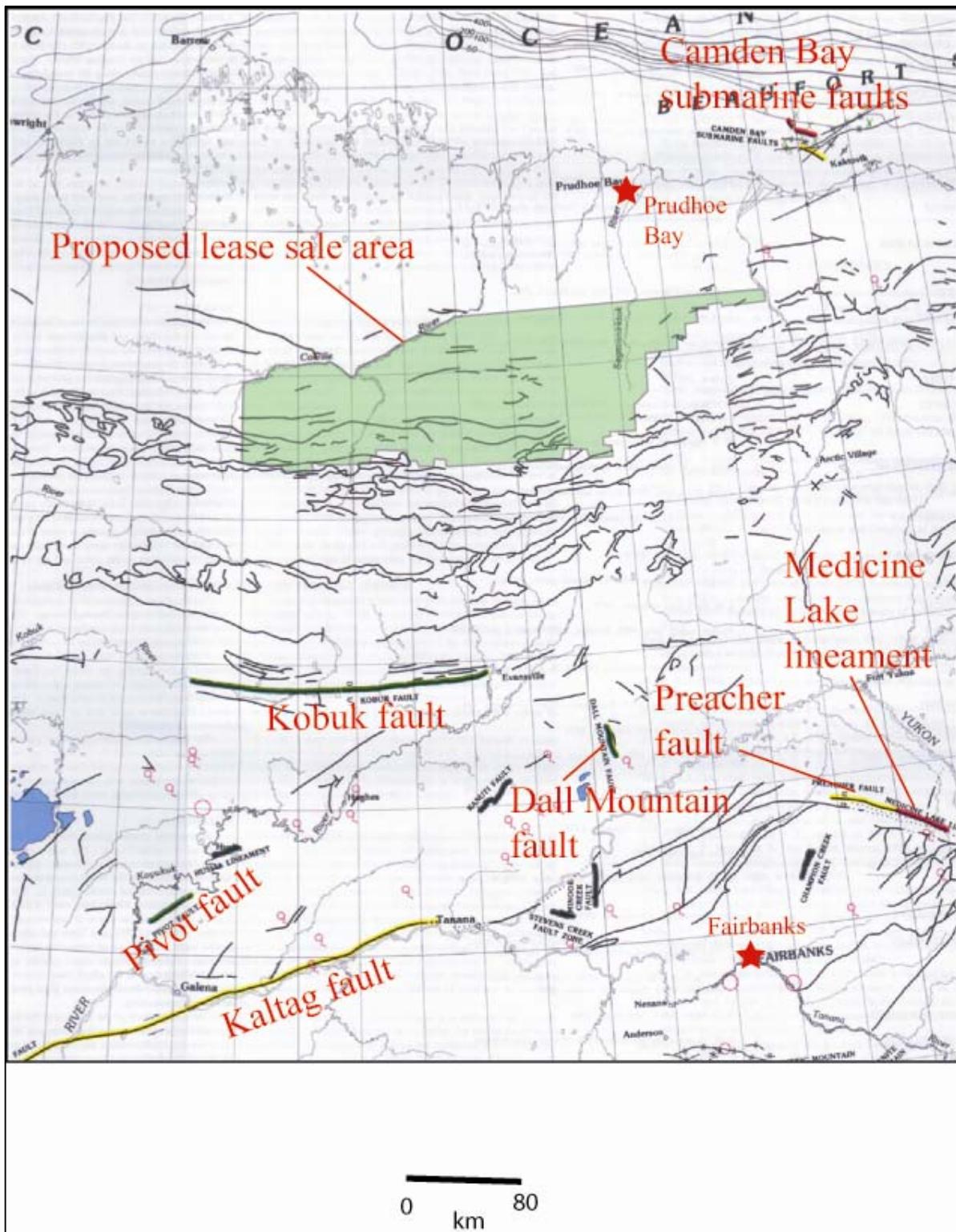
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## **J. Maps**





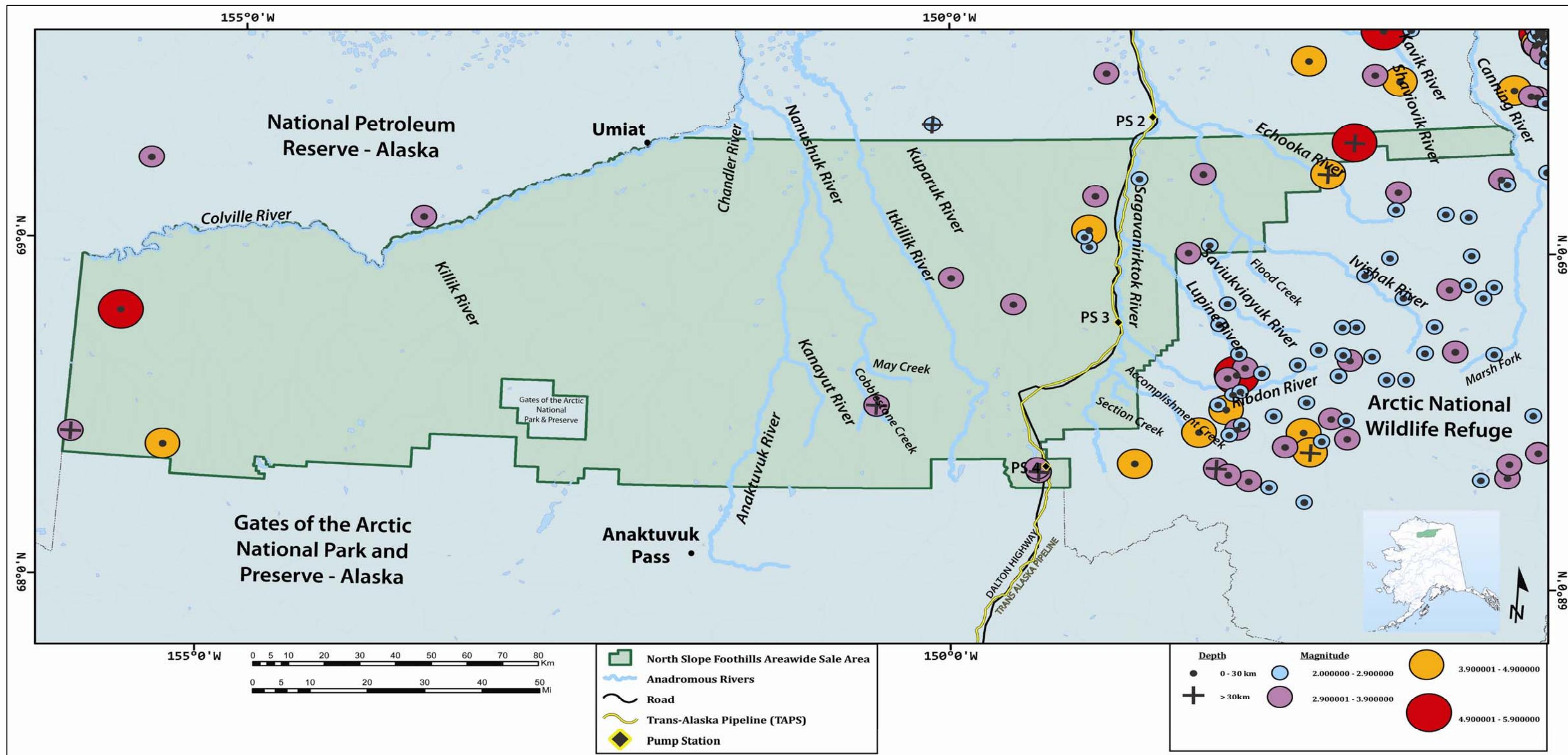




Source: Plafker et al. 1994.

**Map 3.2. Locations of faults in and around the North Slope Foothills lease sale area.**





Source: AEIC 2010.

### **Map 3.3. Locations of earthquakes in and around the North Slope Foothills lease sale area.**



# Chapter Four: Habitat, Fish, and Wildlife

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# Chapter Four: Habitat, Fish, and Wildlife

AS 38.05.035(g) directs that best interest findings consider and discuss the populations of fish and wildlife species and their habitats in the lease sale area. The North Slope Foothills lease sale area includes a wide variety of terrestrial and freshwater habitats, and a broad diversity of fish and wildlife species that support a host of subsistence, economic, and recreational activities in the area.

The lease sale area is identified as part of a large ecological region classified as Arctic tundra. This region extends across northern Alaska and continues to the east into Canada. The region is characterized by dwarf shrubs changing to very low flattened plants within the north coastal plains.

Wetlands are common in low-lying areas, mainly supporting sedge and moss covers (CEC 1997). Wetlands are transitional zones between aquatic and terrestrial habitats that are characterized by poor soil drainage, and are primarily of four types in Alaska: bogs, grass wetlands, sedge wetlands, and marshes. Wetlands are used by migratory birds along the flyways, are highly productive habitats, and are important in preserving biological diversity (ADF&G 2006). The USFWS has developed a wetlands inventory for part of the sale area (USFWS 2009f).

The riparian habitats of the region are important to wildlife, birds, and fish. Riparia provide concentrated and diverse habitats, and reserves for other impacted habitats (Naiman et al. 2005). These riparian habitats are locations where terrestrial areas are regularly influenced by fresh water (Naiman et al. 2005). Wildlife seek availability of food, cover, territory, and access to water. The riparian river basin areas of the North Slope Foothills are important habitats within the Arctic region.

## A. Ecoregions

The sale area is in the gently rolling foothills of the Brooks Range. The two ecoregion types found in this area are the Brooks Foothills ecoregion, the primary type, and the Brooks Range ecoregion to the south (ADF&G 2006). These are briefly described here.

### 1. Brooks Foothills

The Brooks Foothills ecoregion is comprised of gently rolling hills and broad ridges north of the Brooks Mountain range. (ADF&G 2006). The foothills are comprised of rolling uplands of moist tundra with outcrops of ridges, mesas, and bluffs such as Gunsight, Table Top, Itigaknit, and Imnavait mountains, Hatbox Mesa, and Tuktu Bluff. The elevation ranges from a low of 500 ft in the valleys of the northern section of the sale area, to a high of 6,000 ft near the boundary of the



Tundra habitat, looking south toward the Brooks Range, 1002 area ANWR.

Gates of the Arctic National Park and Preserve. Permafrost in the foothills area is generally shallow and surface ice may be present (AEIDC 1975).

The central and eastern portions of the sale area contain several lakes. In addition, wetlands are present in more than 83% of the Brooks Foothills ecoregion. Wetlands are found in the valleys and basins associated with river systems (ADF&G 2006).

Tundra habitats are cold-climate landscapes with vegetation, but are devoid of trees. A short growing season combined with long, cold, dark winters and low precipitation accompanied by strong, bitter, dry winds characterize this habitat. Precipitation is low in the foothills with about 6 to 10 in, and average annual temperature ranges from 9° to 20°F (ADF&G 2006). The precipitation includes snow, which has an average conversion rate of ten in of snow, that translates to one in of water. Winds are generally lighter than found at the coast, but can be stronger through the mountain passes. Cold winter temperatures combined with strong winds produce a chill factor that requires extreme caution in outdoor activities. February is the coldest month, except at Anaktuvuk Pass where January is recorded as the coldest. Average winter temperature is -35° F in the foothills. In July, the average temperature ranges from low to mid-60° F (AEIDC 1975).

The distribution of vegetation in the northern foothills of the sale area is affected by soil conditions, elevation, and drainage. Moist tundra is the dominant plant community of the foothills region. The dominant vegetation type across the foothills is tussock tundra, with willows in the small drainages, wet sedge tundra in old drained lakes, and *Dryas* tundra on the drier ridges (ADF&G 2006). Cottongrass tussocks 6 to 10 in high, with other sedges and forbs and scattered dwarf shrubs, separated by narrow channels, cover large area of rolling terrain. Other plants growing with the cottongrass include small shrubs such as dwarf birch, willows, Labrador tea, and a few herbs like bistort and cloudberry (AEIDC 1975). Prostrate woody shrubs, mosses, sedges and lichen cover the mountainsides and valleys (ADF&G 2006).

The high brush plant community occurs along the floodplains of many large rivers of the Arctic region, particularly in the mountains and foothills. Vegetation along rivers is dominated by willow. The rest of the ecoregion is dominated by vast expanses of mixed shrub-sedge tussock tundra. *Dryas* tundra occurs on ridges, and calcareous areas support sedge-*Dryas* tundra (ADF&G 2006). Soils are usually well-drained gravel, sand, or silt, and the active layer is deeper than in the remainder of the Arctic. Spring floodwaters and floating ice may destroy some vegetation, so the community is constantly changing. Newly exposed gravel bars are invaded by a pioneer flora with such species as horsetail, alpine bluegrass, and dwarf fireweed (AEIDC 1975).

## **2. Brooks Range**

The southern border of the sale area is the Brooks Range ecoregion, and is the northern extension of the Rocky Mountains. This mountain range is a series of high, rugged mountain peaks that extend from the Canadian border across Alaska to the Chukchi Sea. This ecoregion is characterized by steep mountains composed of uplifted sedimentary and metamorphic rock with scattered glaciers about 5,940 ft (1,800 m). The Brooks Range is the main watershed divide between the Arctic and interior Alaska. High energy streams flow northward through steep valleys, and numerous lakes are found in the central and eastern areas of the range. Steep slopes remain barren due to instability. Upper and intermediate slopes contain alpine heath communities, lower slopes have moist sedge-tussock expanses, and shrub communities form along major rivers (ADF&G 2006).

Alpine tundra communities of the Brooks Range ecoregion occur in mountainous areas and along well-drained, rocky ridges. The coarse soil is rocky and dry, and much of the area is a community of low, mat-forming heather vegetation. Exposed outcrops and talus slopes sustain sparse islands of cushion plants and lichens among the rocks. The high brush community, found in areas that have not been disturbed for several decades, includes willows, a few herbs, a variety of mosses and lichens,

and possibly alder and a few well developed stands of cottonwood near springs in the eastern foothills of the Brooks Range (AEIDC 1975).

The low growth plant form protects the vegetation from abrasion by blowing snow and sand in the exposed, windswept habitat. Important plants include mountain avens, willows, and heather. Lichens, especially reindeer moss and other mosses, are common. Grasses, sedges, and a few herbs are also evident. Cushion plants such as moss campion and saxifrages, as well as many lichens, occur in the dry talus communities (AEIDC 1975). Wetlands occupy at least 20% of the Brooks Range ecoregion (ADF&G 2006).

## **B. Terrestrial Habitats**

Terrestrial habitats in the North Slope Foothills area are composed of several overlapping systems that provide important habitat for wildlife, fish and humans.

### **1. Terrestrial Mammals**

The foothills provide habitat for wide-ranging mammal wildlife species including several caribou herds, moose, and muskoxen. The foothills also contain denning sites for brown bears and wolves. The moist tundra provides nesting habitat for small mammals, such as the insular vole (ADF&G 2006). Six ADF&G Game Management Units (GMU) exist in the lease sale area: GMUs 24A, 24B, 25A, 26A, 26B, and 26C (Map 4.1).

#### **a. Caribou**

Caribou and other mammals of northern Alaska live in the varied habitats of the coastal plain and nearby uplands. There are three major herds of caribou (*Rangifer tarandus*) present throughout the sale area, the Central Arctic herd (CAH), the Western Arctic herd (WAH) and the Teshekpuk



Fortress mountain formation (foreground) in the Brooks Range.

caribou herd (TCH). The discussion of the annual lifecycle of the migrating caribou in this section begins with the use of habitat by caribou for calving.

The CAH and WAH caribou herds migrate through the foothills to reach their calving grounds in the Arctic coastal plain. Generally, caribou arrive on calving and foraging areas on the coastal plain in late May to June and summer there through mid-August. Substantial numbers of the WAH spend the summer to the west of the lease sale area in the DeLong Mountains and Utukok Uplands. The CAH is usually found near the Arctic coast between the Colville and Canning Rivers, but at times may move into the foothills of the Brooks Range during the summer months (*Lenart In Prep-b*). The CAH's summer range extends from Fish Creek just west of the Colville River, eastward along the coast to the Katakturuk River (ADF&G 2007). The Etivluk, Anaktuvuk, and Chandler river valleys are particularly important WAH spring migration corridors for pregnant females heading westward toward the Utukok Uplands calving area (*Dau In Prep*). The caribou primarily roam outside of the foothills sale area during spring through the summer months.

Caribou wander widely and are very efficient at moving across both boggy and rugged terrain. Caribou must keep moving to find adequate food. This distributes feeding pressure and tends to prevent overgrazing. They commonly travel vast distances to reach suitable foraging sites on widely separated season ranges. Feeding opportunities are limited in windswept insect relief areas, so caribou move inland to better foraging areas whenever insect harassment temporarily subsides, and return to the coast when harassment increases. In summer, caribou eat a wide variety of plants, apparently favoring the leaves of willows, grasses, and herbaceous and flowering plants (ADF&G 1994d).

Distribution of caribou on the coastal plain can change dramatically within a 24-hour period. The frequency and extent of movement and habitat use during summer is influenced by weather and insect avoidance. Caribou move, sometimes running long distances, from inland feeding areas to windswept, but vegetation-free areas near the coast that offer relief from the insects, but return to forage when insect harassment subsides. Further inland, caribou may move to river bars, ridge tops and bluffs (ADF&G 1994d). Caribou also tend to congregate on gravel drilling pads and roads which are generally raised above the tundra and more exposed to the elements. Man-made pads and roads may allow the caribou to remain in preferred foraging habitat (Pollard et al. 1996).

Movement within the North Slope area between the summer and winter ranges is inconsistent, but predominately north-south along river corridors through mountain passes, but some may take routes straight over mountains (Map 4.2). Caribou populations, migration routes, wintering and summer ranges and other habitat uses vary over time and are difficult to predict.

Fall migration southward for the CAH occurs between mid-August and early November, primarily along the Itkillik, Kuparuk, Sagavanirkok, and Ivishak river valleys. During the rut in October, large concentrations can be found from Galbraith Lake to the upper Sagavanirkok River and Accomplishment Creek on the north side of the Brooks Range to the Chandalar Shelf and upper Chandalar River, located outside of the sale area on south side of the range.

Annual selection of winter range for portions of the herd appears to change over time. During winter, they use windswept upland areas, or areas of lighter snow cover where they can dig through the snow to feed on lichens, "reindeer moss," and dried sedges (ADF&G 1994d). On the north side of the range caribou are usually found east of the Dalton Highway in the area of the upper Sagavanirkok River foothills and some as far east as the Canning River, but may be found west of the highway in the uplands of the Itkillik, Kuparuk, and Toolik River drainages. Since the mid 1990's many CAH caribou have wintered on the south side of the range from Chandalar Shelf to as far east as the Arctic Village area (*Lenart In Prep-b*).



DCRA 2006

Caribou near Deadhorse.

### ***i. Caribou Herd Characteristics***

The CAH frequently mixes with the TCH where their ranges overlap along the Colville River. Occasionally the CAH mixes with the Porcupine caribou herd along the Canning River and south side of the Brooks Range. The CAH's winter range is located in the northern and southern foothills and mountains of the Brooks Range (ADF&G 2007). Comingling of the CAH with the WAH is uncommon, but has occurred in the Galbraith Lake area and also on the south side of the range.

The WAH caribou are as likely to climb directly over mountain ridges and use the major river systems west from the Anaktuvuk River for both fall and spring migration. Most of the WAH do not move east of the Anaktuvuk River; however, in some years tens of thousands may migrate along the Anaktuvuk River and through Anaktuvuk Pass. Much of the herd winters to the south of Anaktuvuk Pass, although some may winter in the mountains and foothills between Anaktuvuk and Howard Passes and as far north as Umiat, near the Colville River (*Dau In Prep*).

The TCH usually migrates during October and November and winters on the Arctic coastal plain with some animals wintering in the foothills and mountains of the Brooks Range. Beginning in the early 2000s most of the herd began wintering between Teshekpuk Lake and Anaktuvuk Pass. A portion of the herd migrates in a broad front using all major drainages from the Anaktuvuk River. The TCH may use the Brooks Range for wintering with a few animals that may be found over on the south side of the range (*Parrett In Prep*).

### ***ii. Population Status***

In recent years the CAH and TCH populations have been increasing, while the WAH has declined since 2003, as discussed below.

The range of the Central Arctic herd (CAH) extends from the northern foothills to the Beaufort Sea, and from the Colville River to the just east of the Canning River. Tracking of the CAH from 1985 to 1990 showed migration throughout the sale area (Geomatics 2002). In 2002 the herd was estimated to be 31,857 caribou (ADF&G 2007). By 2008 the CAH has continued to expand to an estimated 66,772 caribou (*Dau In Prep*).

The Western Arctic herd (WAH) ranges over approximately 140,000 mi<sup>2</sup> (363,000 km<sup>2</sup>) of northwestern Alaska, including the Brooks Range and its northern foothills, west of the trans-Alaska pipeline (ADF&G 2007). The herd population in 2003 was 490,000, and has declined to 377,000 caribou in 2007 (Dau *In Prep*).

The Teshekpuk herd (TCH) ranges near Teshepuk Lake and in the western portion of the lease area. The population in 2002 was estimated at 45,166 caribou (ADF&G 2007 citing to Carroll 2003). In 2008, the herd is estimated at over 64,000 caribou (Dau *In Prep*)

### **b. Moose**

Moose (*Alces alces gigas*) are currently distributed across the North Slope region, but concentrated along riparian habitat of major rivers flowing north from the Brooks Range. Riparian shrub habitats are important for many Arctic herbivore animals, especially in the winter (Butler and Keilland 2008). Breeding populations have migrated north and become established on the lower Colville River and Kavik rivers, the northern extent of the moose's range (Map 4.3).

Following the snow melt, usually in May, moose may disperse across the tundra coastal plain. Many move into small tributaries and hills surrounding riparian habitat, and some migrate as far as the foothills of the Brooks Range (ADF&G 2008b). Calving occurs during this period in May, where cows may be widely dispersed. Rutting occurs between late September and early October when large congregations may be observed (ADF&G 1986b). Most moose follow riparian corridor habitats during winter. Lenart (2008) reports that moose are limited to use of riparian habitat in winter in GMU 26. In the lease sale area, the largest winter concentrations of moose are found in the inland portions of the Colville River drainage (ADF&G 2008b).

#### ***i. Population Status***

The moose count for GMU 26B and 26C peaked in the late 1980s, with a count of about 1250-1350 moose (Lenart 2008). Between 1997 and 2008 the population steadily increased. The estimated moose count in 2005 for Game Management Unit (GMU) 26A was 1,048 (ADF&G 2008a). The population in GMU 26B was 400 to 550 moose during the years of 2004 through 2008 (ADF&G 2008b). The estimated population in GMU 26B is approximately 550 to 650 moose (Lenart 2008).

### **c. Brown Bear**

Brown bears (*Ursus arctos*), also known as grizzly bears, may be found throughout the sale area. Bears hibernate in dens in a variety of terrain ranging from pingos and stream and lake banks at low elevations to mountain slopes near the crest of the Brooks Range (ADF&G 2006; Map 4.4).



Brown bear.

Brown bears on the coastal plain travel along the major river corridors and feed in riparian areas the majority of the time (Shideler and Hechtel 2000).

Bears were found to be most numerous in the mountain habitats, as are found in the lease sale area of the North Slope Foothills (Shideler and Hechtel 2000, citing to Rausch 1953 and Bee and Hall 1956). They normally emerge in April or May. Adult males emerge first, followed by single females, then females with young. In spring they are commonly found along major river valleys and later move to smaller tributaries and poorly drained areas to feed (ADF&G 1986b). They are typically solitary except where food sources are concentrated, such as streams or carcasses (ADF&G 1994c).

During the summer, bears most frequently feed on grasses and forbs in wet sedge meadows, around late snow bank areas, and tussock tundra, and in the fall tend to use the floodplains, dry ridge areas or mountain slopes to feed on roots, berries, and ground squirrels (ADF&G 1986b). Bears prey on both calf and adult moose, muskoxen, and caribou, and can detect carrion and human garbage more than a mile away (ADF&G 1994c).

The highest concentrations of bear are found each fall in berry feeding areas along the Colville, Itkillik, Chandler, Anaktuvuk, Sagavanirkok, and Ivishak rivers (Map 4.4). The bears enter their dens around September to early October and remain there until spring.

#### ***i. Population Status***

The population in 1989 in GMU 26A west was estimated at 400 bears, and for 26A east was estimated at 500 to 720 bears. The GMU 26A is divided into east and west along the 159° W longitude (Carroll 2007). From the survey period ending in 2003 the estimate for GMU 26B was 269 bears, and over 390 bears for GMU 26C based on a previous survey in 1993 (Lenart 2007). Currently, the density is estimated to be stable or possibly increasing slowly based on consistent habitat conditions and low harvest rates. In general, productivity for brown bears in the North Slope region is low to moderate and variable, and declines from west to east, with greater densities in the North Slope foothills (Carroll 2007; Lenart 2007).

#### **d. Muskoxen**

Muskoxen (*Ovibos moschatus*), also called omingnak or the bearded one, are large mammals that have been reestablished in 1969-1970 into Alaska's Arctic habitat (USGS 2009). Muskoxen are not migratory, but they may move in response to seasonal changes in snow cover, vegetation, and natural behavior.

Muskoxen use riparian cover habitats along river corridors, flood plains and foothills in all seasons. Animals select moist sedge habitats during late winter and the spring calving seasons. In research conducted about muskoxen they found that upland shrub habitat was selected only during calving. Bare cover was selected in all seasons except spring. Mountain terrain was avoided in all seasons (USGS 2009, citing to Reynolds 1998).

Adult females, young animals, and some males live in social groups year round. Other males are solitary in summer and live in groups in winter (USFWS 2009d). In research studies, seasonal changes in movements, activity and habitat are related to forage availability and the energy budgets of the animals (USGS 2009, citing to Jinfor 1980, Thing et. al. 1987). Researchers observed groups of muskoxen along river corridors and uplands during summer and winter field surveys (USGS 2009, citing to Wilson 1992).

Calving occurs from late March or April through mid-June (USGS 2009). In summer and fall muskoxen are found along major river drainages, such as the Canning River, where they feed on dried sedges and grasses (USFWS 2009d). The rut occurs during August through October.



DCRA 2009

Muskox.

The strategy of muskoxen during calving and winter seasons is to conserve energy by restricting movements and activity, and selecting habitats with low snow cover (USGS 2009; Reynolds 1998). Winter foraging sites were frequently narrow windblown bluffs adjacent to rivers where snow accumulation was low (USGS 2009, citing to Nelleman and Reynolds 1997). These animals are poorly adapted for digging through heavy snow for food, so winter habitat is generally restricted to areas with shallow snow accumulations or areas blown free of snow (ADF&G 1994h).

#### ***i. Population Status***

Muskoxen have dispersed from the Arctic National Wildlife Refuge (ANWR) westward into eastern GMU 26A, but are currently at low population numbers. The population in 1995 had expanded westward to the Itkillik River (USGS 2009, citing to Reynolds 1998). Precalving surveys in GMU 26A east and 26B during the 1990's showed a steady increase in muskoxen before stabilizing at about 250 to 300 animals by 2003. A decline to an estimated 216 animals was observed in 2006, but has since stabilized (Lenart *In Prep-a*)

#### **e. Dall Sheep**

Dall sheep (*Ovis dalli dalli*) live on ridges, dry meadows and steep mountain slopes (USFWS 2009a; Map 4.5). Dall sheep eat grasses, sedges, broad-leaved plants, and dwarf willows. Dall sheep may also supplement their diet with the use of mineral licks (USFWS 2009a).

Movement occurs seasonally between summer and winter ranges (USFWS 2009a). They roam in small social units of a female ewe and groups of lambs and yearlings, or a group of male rams. Habitats with light snowfall allow access to winter forage, while heavy snows can cause declines in population (USFWS 2009a).

Lambing occurs in late May or early June in the most rugged cliffs available on spring ranges. Ewes and calves remain until the lambs are strong enough to travel. Lambs begin feeding on vegetation within a week after birth and are usually weaned by October (ADF&G 1994f).

The Dall sheep's summer range is relatively widespread with an abundant, wide variety of forage, and many sheep may travel miles to visit mineral licks. Winter diet is much more limited and consists primarily of dry, frozen grass and sedge stems available when snow is blown off the winter ranges. Some populations use significant amounts of lichen and moss during winter (ADF&G 1994f). There is no current information on the size of the Dall sheep population in the lease sale area at this writing.

#### **f. Furbearers**

##### **i. Wolves**

Wolves (*Canis lupus*) exist in a wide variety of habitats, and are primarily found in the mountains and foothills along major rivers. Some wolves are solitary hunters, and some may hunt in pairs. Others may change packs or move to new areas. In winter wolf packs stay together to hunt. Wolves hunt caribou, Dall sheep, moose, small rodents, birds and ground squirrels (USFWS 2009b).

ADF&G conducted a survey in 2008 within GMU 26A, that covered an area of 17,800 km<sup>2</sup>, extending to and including the Killik River drainage to the west, the Anaktuvuk River drainage to the east, the Colville River drainage between the mouths of the Killik and Anaktuvuk rivers to the north, and latitude 68°17' to the south. The results of this survey indicated a calculated density of 3.3 wolves/1,000 km<sup>2</sup> for wolves that were visibly seen by researchers, and a calculated density of 4.4 wolves/1,000 km<sup>2</sup> for all wolves within the study area (Carroll *In Prep*).

##### **ii. Other Furbearers**

Several other terrestrial mammals have been documented in the sale area. Red fox (*Vulpes vulpes*) are relatively common; whereas, Arctic fox (*Alopex lagopus*) seldom range into the sale area. The southern boundary of known habitat for the Arctic fox is the southern extent of the coastal plain (Burgess 2000, citing to Smits and Slough 1993). Other common furbearers in the region include, as follows: the river otter (*Lutra canadensis*), Alaska marmot (*Marmota broweri*), and the snowshoe hare (*Lepus americanus*). Information on the abundance and distribution of these species is limited (ADF&G 1994a).

Other mammals found in the Arctic region include the Arctic hare, Arctic ground squirrel and lemming (CEC 1997). The USFWS has reported that other mammals are also found on the Arctic Refuge, an area located directly to the east of the sale area: wolverines; shrews; beavers; muskrats; voles; coyotes; lynx; black bear; and weasels (USFWS 2009c).

There is no current information on the size of the other furbearer populations in the lease sale area at this writing.

## **2. Terrestrial Birds**

Alaska's tundra supports numerous migratory bird species, providing important breeding, nesting, rearing, staging, refugia, and overwintering habitat (ADF&G 2006; CEC 1997; Table 4.1.; Map 4.6).

Some bird species known to nest in the Arctic near the lease area are the red phalarope, northern phalarope, pectoral sandpiper, semipalmated sandpiper, buff-breasted sandpiper, dunlin, lapland longspur, and savannah sparrow. Several species of relatively common waterfowl nest in wetlands, listed as follows: tundra swan, Canada goose, northern pintail, long-tailed duck (old squaw), common eider, king eider, and spectacled eider. Arctic and red-throated loons breed on small lakes, as do sabine's gulls and Arctic terns (Office of the Governor of Alaska 1995).

**Table 4.1. Some bird species that may be found in the North Slope Foothills lease sale area.**

Common Name	Habitat Type												
	Forest				Shrub				Tundra			Water	
Common Name	DF	CF	CD	WDF	DS	LS	MS	TS	MT	WT	ADT	LP	RS
Red-throated loon									*	*			
Pacific loon										*			
Common loon										*			
Yellow-billed loon										*			
Horned grebe										*			
Red-necked grebe										*			
Tundra swan										*			
Trumpeter swan										*			
Greater white-fronted goose								*					
Snow goose								*					
Emperor goose								*			*		
Canada goose								*			*		
Brant									*				
Mallard										*	*		
Green-winged teal										*			
American widgeon										*	*		
Northern pintail										*	*		
Northern shoveler										*			
Canvasback										*			
Greater scaup										*			
Lesser scaup										*			
Common eider											*		
King eider								*					
Black scoter										*	*		
White-winged scoter										*	*		
Surf scoter											*		
Harlequin duck										*	*		
Old squaw										*			
Common goldeneye										*			
Bufflehead										*			
Red-breasted merganser										*	*		
Golden eagle											*		
Bald eagle	*	*									*	*	
Northern harrier					*	*	*	*		*	*	*	
Sharp-shinned hawk			*	*									
Northern goshawk			*	*									
Red-tailed hawk	*	*	*	*									
Rough-legged hawk										*			
Osprey											*	*	
American kestrel			*	*									
Merlin			*	*					*				
Peregrine falcon			*						*		*		
Gyrfalcon									*		*		
Spruce grouse		*	*										
Ruffed grouse	*		*										
Sharp-tailed grouse	*	*	*							*	*	*	
Willow ptarmigan						*			*	*	*	*	

-continued-

**Table 4.1. Page 2 of 4.**

Common Name	Habitat Type												
	Forest				Shrub				Tundra			Water	
	DF	CF	CD	WDF	DS	LS	MS	TS	MT	WT	ADT	LP	RS
Rock ptarmigan					*				*	*	*		
Sandhill crane									*				
Semipalmated plover												*	*
Black-bellied plover									*	*			
Lesser Golden plover					*				*	*	*		
Bar-tailed godwit										*			
Whimbrel									*	*			
Lesser yellowlegs		*							*	*		*	*
Solitary sandpiper													*
Spotter sandpiper													*
Wandering tattler											*		
Red-necked phalarope									*		*		
Red phalarope									*		*		
Long-billed dowitcher									*		*		
Stilt sandpiper									*				
Common snipe		*							*	*			
Ruddy turnstone					*	*	*				*		
Surfbird											*		
Dunlin									*				
Sanderling													*
White-rumped sandpiper									*				
Western sandpiper			*								*		
Least sandpiper									*	*			
Semipalmated sandpiper									*				
Baird's sandpiper					*						*		*
Pectoral sandpiper										*			
Upland sandpiper			*						*				
Buff-breasted sandpiper									*				*
Parasitic jaeger									*	*	*		
Pomarine jaeger									*				
Long-tailed jaeger					*				*	*	*		
Bonaparte's gull											*		
Herring gull											*		
Glaucous gull									*		*		
Mew gull									*		*		*
Glaucous-winged gull									*		*		
Sabine's gull									*		*		
Arctic tern											*		*
Short-eared owl					*	*	*	*			*		
Great-horned owl	*	*	*										
Great Gray owl		*	*										
Snowy owl									*	*	*		
Boreal owl		*	*										
Northern hawk-owl	*	*	*	*					*				
Belted kingfisher	*											*	*
Northern flicker	*				*								
Downy woodpecker	*				*								
Hairy woodpecker	*	*	*										

-continued-

## Chapter Four: Habitat, Fish, and Wildlife

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**Table 4.1. Page 3 of 4.**

Common Name	Habitat Type												
	Forest				Shrub				Tundra			Water	
	DF	CF	CD	WDF	DS	LS	MS	TS	MT	WT	ADT	LP	RS
Three-toed woodpecker	*	*											
Black-backed woodpecker	*	*											
Olive-sided flycatcher	*	*	*										
Say's phoebe					*						*		
Alder flycatcher							*	*					
Horned lark						*			*	*	*		
Tree swallow					*	*						*	*
Violet-green swallow	*	*	*	*								*	*
Bank swallow												*	*
Cliff swallow					*							*	*
Gray jay	*	*	*					*					
Common raven	*	*	*		*	*	*	*	*	*	*	*	*
Black-capped chickadee	*	*	*	*						*	*		
Siberian tit					*								
Boreal chickadee		*	*	*									
Arctic warbler						*	*	*					
Ruby-crowned kinglet	*	*	*	*			*	*					
Swainson's thrush	*		*				*	*					
Gray-cheeked thrush	*	*	*				*	*					
Varied thrush	*	*	*					*					
American robin	*	*	*	*		*	*	*	*	*	*		
Northern wheatear									*		*		
Bluethroat						*			*	*	*		
Northern shrike					*			*	*				
American (water) pipit						*			*		*		
Yellow wagtail						*			*	*	*		
American dipper												*	
Bohemian waxwing	*		*	*				*				*	
Orange-crowned warbler	*		*					*					
Yellow-rumped (myrtle) warbler	*	*	*					*					
Blackpole warbler		*	*					*					
Yellow warbler					*			*					
Wilson's warbler	*		*				*	*					
Northern waterthrush	*		*					*				*	
Savannah sparrow					*	*	*		*		*		
American tree sparrow	*		*	*	*	*	*	*	*		*		
Dark-eyed junco	*	*	*										
Golden-crowned sparrow					*			*	*				
White-crowned sparrow	*	*			*	*	*		*				
Fox sparrow					*			*	*				
Lincoln's sparrow						*	*	*					
Smith's longspur							*				*		
Lapland longspur							*			*	*	*	
Snow bunting							*				*		
Rusty blackspur	*	*	*	*				*					
White-winged crossbill	*		*										
Pine grosbeak	*	*	*										

-continued-

**Table 4.1. Page 4 of 4.**

Common Name	Habitat Type												
	Forest				Shrub				Tundra			Water	
	DF	CF	CD	WDF	DS	LS	MS	TS	MT	WT	ADT	LP	RS
Common redpoll	*	*	*	*			*	*	*				
Hoary redpoll	*	*	*	*			*	*	*				
Rosy finch					*								
Northern phalarope <sup>a</sup>													
Spectacled eider <sup>a</sup>													
Whistling swan <sup>a</sup>													

Source: NPS 2000.

Notes: These bird species have been documented in the Gates of the Arctic National Park, which is adjacent to the lease sale area. All listed species have not necessarily been documented in the lease sale area itself.

Habitat types are: DF - deciduous forest; MT - moist tussock tundra; CF - coniferous forest; WT - wet sedge tundra; CD - coniferous/ deciduous mix; ADT - alpine/ dry tundra; WDF - woodland/ dwarf forest; LP - lakes and ponds; DS - dwarf shrub mat (to 18 inches high); RS - rivers and streams; LS - low shrub thicket ( to 3 ft tall); MS - medium shrub thicket (about 6 ft tall); TS - tall shrub thicket (over 6 ft tall).

<sup>a</sup> Not documented by NPS for Gates of the Arctic National Park, but has been documented in the lease sale area.

The Colville River Bluffs contain nesting and feeding habitat for the peregrine falcon and other raptors (ADF&G 2006). Moist tundra areas found mainly between the rivers are home to snowy owls, ravens, and northern harriers (AEIDC 1975). Representative bird species include the following: snow, Brant and Canada geese; yellow-billed, Arctic, and red-throated loons; whistling



Tundra swans.

swans; long-tailed ducks; gyrfalcons; willow and rock ptarmigan; red-necked phalarope; parasitic jaeger; snowy owls; hoary redpoll; and snow bunting (CEC 1997). Moist tundra also provides nesting habitat for Baird's, stilt and buff-breasted sandpipers (ADF&G 2006).

Specific information is lacking for most of the birds found in the lease sale area. Some species of common interest are discussed here for which there is documented information: the tundra swan; and the peregrine falcon.

Tundra swans arrive to the Arctic coast in late May and early June in the Arctic Refuge, which is located directly east of the sale area. They nest on sedge habitat in upland tundra near river deltas on the coastal plain (Smith et al. 1993). During the summer the swans move around locally, feeding on submerged and emergent aquatic plants. Adults molt from mid-July through August and fall migration begins late September (Johnson and Herter 1989). In September flocks of family groups depart, returning to the Arctic coastal plain the following year (USFWS 2009e).

There are several bird species that may be found in the lease sale area that are currently identified or nominated as threatened or endangered under the federal Endangered Species Act. The species that may be found in the lease sale area are the spectacled eider (threatened), the Stellar's eider (threatened), and the yellow-billed loon (proposed candidate).

## **C. Freshwater Habitats**

Freshwater habitats of the North Slope Foothills area include: several large river systems; an abundance of lakes, streams, and wetlands; and numerous seasonal ponds and creeks. They serve as movement corridors, provide habitat for spawning, rearing and overwintering, vegetative cover, are significant sources of detritus, and are frequently migrations corridors for wildlife (ADF&G 2006). Freshwater habitats range from small, intermittent streams to large rivers, and from small ponds to large lakes. Water sources for these habitats include glacial melt, snowmelt, precipitation, and groundwater such as springs and upwelling areas. Lake and pond habitats are influenced by substrate, bathymetry, and geologic structures (ADF&G 2006).

The anadromous waters in the lease sale area are the Colville, Sagavanirktoq, Ivishak, Nanushuk, Echooka, Saviukviayak, Itkillik, Anaktuvuk, Kanayut, Lupine, Ribdon and Canning rivers, portions of the Chandler River, and Accomplishment, Upper Section, Lower Section, Flood, Cobblestone, May creeks (Johnson and Klein 2009; Map 4.7). Other major waterways are located in the sale area, but have not been established as being determined to be anadromous waters. These river systems include the Kuparuk, Killik rivers and their tributaries.

The type of habitat provided by streams and rivers is defined by the substrate, which ranges from large boulders, cobble, gravel, glacial silt, clay, and mud. Stream and river morphology also contributes to defining the habitat, including such characteristics as straight, meandering, or braided; and morphologic complexity is an important contributor to habitat quantity and quality (ADF&G 2006).

The freshwater habitats of the Arctic are home to many species of fish (Table 4.2.). There are multiple types of fish lifestyles found in the Arctic freshwaters. Those fish that spend most of their lives at sea, and return only to spawn, are termed anadromous fish. Examples are some salmon species, i.e. pink, chum, Chinook and coho. Species that spend summer feeding at sea, and move to freshwater rivers and streams in late summer and fall, to spawn and live for the winter, are called amphidromous fish. Some examples of these fish are Dolly Varden, Arctic char, Arctic cisco, and broad whitefish. Fish that reside in freshwater for their entire lifecycle are called resident fish, such as Arctic grayling, burbot and lake trout (Reynolds 1997).

The lease sale area contains habitat important to populations of anadromous, amphidromous, and resident freshwater fish (Map 4.7). Numerous oligotrophic lakes that lack plant nutrients and contain

a large amount of dissolved oxygen are located primarily in the central and eastern foothills area. These lakes vary in size from a few acres to thousands of acres. The lakes provide unique habitat for lake trout and lake resident Arctic char, two species with narrow environmental tolerances. The lakes also support significant populations of Arctic grayling, lake trout and whitefish (ADF&G 2006).

**Table 4.2. Some waterways and fish species found in the North Slope Foothills lease sale area.**

Freshwater Species	Anadromous Species
Sheefish	Least cisco
Round whitefish	Bering cisco
Lake trout	Arctic cisco
Arctic char	Broad whitefish
Northern pike	Humpback whitefish
Lake chub	Pink salmon
Longnose sucker	Chinook salmon
Trout-perch	Chum salmon
Burbot	Coho salmon
Ninespine stickleback	Rainbow smelt
Slimy sculpin	Arctic lamprey
Threespine stickleback	Dolly Varden
Alaska blackfish	
Arctic grayling	

Source: USFWS 2010.

A critical and limiting habitat factor affecting the freshwater fish populations is the available suitable habitat in the winter. Fish overwinter areas represent a small percentage (about 3%) of the total water volume available during the summer (Schmidt et al. 1989). Fish that overwinter in Arctic freshwaters rely on these protective havens for the success of their populations. The fish of all stages may crowd into the same unfrozen river area for the entire winter (Schmidt et al. 1989). Different fish species overwinter in dissimilar habitat types. For example the Arctic char are found in the middle and upper rivers, as compared to other anadromous species that prefer deep pools and river deltas for overwintering habitats (Schmidt et al. 1989, citing to Craig and McCart 1974). The anadromous fish populations have reduced risk of extinction by spreading their members over different overwintering sites (Schmidt et al. 1989, citing to Craig 1989).

## 1. Dolly Varden

Dolly Varden is an amphidromous species that summers in coastal waters and returns inland to spawn and overwinter in northern rivers. In the north these fish spend their lives migrating between salt water habitats to freshwater overwintering areas in rivers in locations of spring upwelling (Viavant 2008; Scanlon 2008). Dolly Varden spawn and rear in fresh water prior to smolting, but feed as adults in marine waters. At maturity, usually around age 5 or 6, Dolly Varden return to spawn in the stream from which they originated (ADF&G 1994g). Dolly Varden spawn in streams

during fall from mid-August to November. Hatching of eggs may occur in March, and they emerge in June. Dolly Varden remain in freshwater locales for several months or years before migrating to coastal waters. They usually migrate to the sea in their third or fourth year during September and October (ADF&G 1986b).

Rivers in the lease sale area known to support significant populations of Dolly Varden and Arctic char include the Canning, Sagvanirktot, and Anaktuvuk rivers (Map 4.8). The fish return to overwinter in fresh water each winter because they cannot tolerate the super-cooled water temperatures of the arctic sea water, and must overwinter in fresh water for five or more winters before spawning (Viavant 2008).

Fish use strategies to survive the winter by locating safe havens from predators, and live in areas free of anchor ice and rich in groundwater fed tributaries. To reduce energy loss, fish metabolism and oxygen requirements reduce, fish move to deeper groundwater fed sections, and benthic feeding in fish crowded zones occurs. Fish have been found to winter in the same river areas year after year (Reynolds 1997). Winter is the limiting, most critical period for Alaskan freshwater fish habitats (Reynolds 1997, citing to Craig 1989 and Johnson 1976).

Overwintering locations may be different from spawning, because non-spawning fish from neighboring tributaries may concentrate in a single river drainage. The upper Ivishak River provides overwintering areas used also by fish from the Ribdon, Lupine and Echooka rivers (Scanlon 2008).

The Ivishak, Anaktuvuk and Kongakut rivers have documented overwintering populations of Dolly Varden (Viavant 2007, citing to Bendock 1980, 1982, 1983; Craig 1989; Furniss 1975; Yoshihara 1972, 1973; Viavant 2008; Winters 2000). Aerial monitoring of Dolly Varden in the Ivishak River in 2006 resulted in a count of 5,411 in a known overwintering area (Viavant 2008).

## **2. Arctic Grayling**

Arctic grayling (*Thymallus arcticus*) are resident fish, and can be migratory, or may remain in the same section of a stream. They seek the deep reaches on lower clear rivers, and tolerate low oxygen



Colville River.

regimes over long winter seasons (Reynolds 1997). They may move into river deltas and coastal waters near to the shore after spring break-up, and spawn in May and June in the northern foothill streams. Adults leave these smaller feeder streams shortly thereafter to spend their summer in the main streams and rivers. Juveniles remain in the foothill streams throughout the summer and leave for deeper water before freeze-up in September (ADF&G 1994b).

### **3. Broad Whitefish**

Broad whitefish (*Coregonus nasus*) are found in Arctic Ocean drainage river systems, and are amphidromous in lifestyle. After spawning, usually at age 4 or 5, these fish migrate back downstream during freeze-up to overwinter under the ice in deep freshwater pools and lakes. Broad whitefish use the lakes and river pools for summer feeding areas, and in some cases, overwintering habitat (Gallaway et al. 1997). It is possible that on some North Slope river drainages, all members of a population may occupy a single spring fed pool during winter (Reynolds 1997, citing to Craig, 1978). They migrate out of the larger rivers, such as the Sagavanirktok, during spring breakup in early June. After spending summer feeding in shallow bays and lagoons along the coast they return to their gravel spawning areas in the foothill streams in late July and August (ADF&G 1986b).

Broad whitefish have been found to live in deep freshwater lakes connected to river systems, with some living in the lakes year round (Gallaway et al. 1997, citing to Bond 1982, and Bond and Erickson 1985). The lack of connected deep, freshwater lake systems in the Sagavanirktok River has created a disjunct spawning population of broad whitefish. The lack of suitable overwintering habitat places severe constraints on these fish populations (Gallaway et al. 1997).

### **4. Salmon**

Chum salmon (*Oncorhynchus keta*) are found in the Arctic Ocean from Canada west to the waters of Siberia, and are anadromous fish. They are known locally as dog salmon. After spending the summer in freshwater rivers, they migrate to the sea where they spend one or more of their winters at sea. Chum salmon then return to spawn in the side channels of large northern rivers (ADF&G 1994e).

Pink salmon (*O. gorbuscha*) are anadromous fish native to Arctic coastal waters. Adult fish migrate into rivers between late June and mid-October. Most spawn within a few miles of the coast, and may spawn in the intertidal zone or mouth of streams. Pink salmon mature in two year cycles, making odd-year and even-year populations unrelated. This population is the smallest of the Pacific salmon found in North America (ADF&G 1994i). The egg stage of the pink and chum salmon are the only part of the population that overwinters in Arctic rivers (Reynolds 1997).

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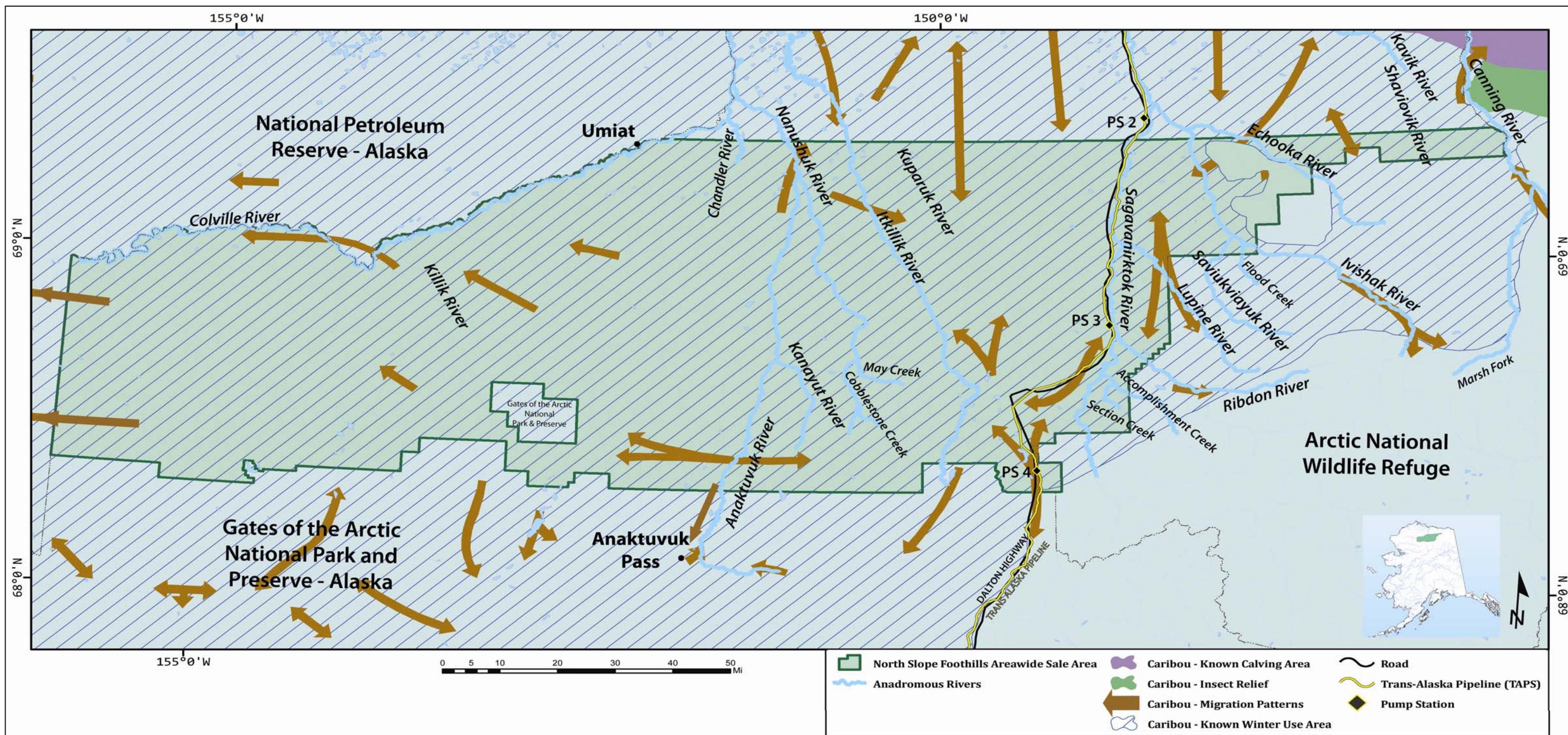
## **E. Maps**





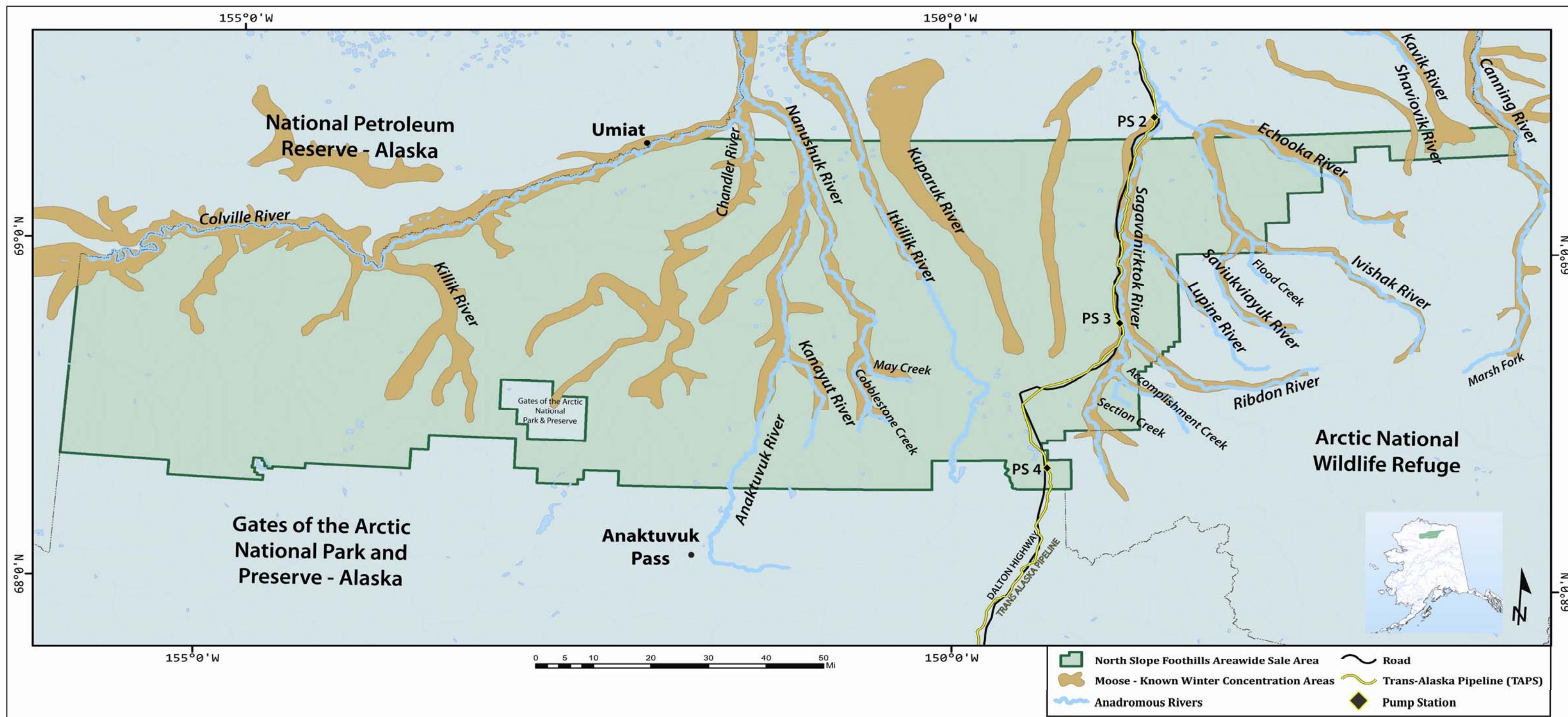
Map 4.1. ADF&G Game management units (GMUs) in the North Slope Foothills lease sale area.





Map 4.2. Caribou habitat in the North Slope Foothills lease sale area.



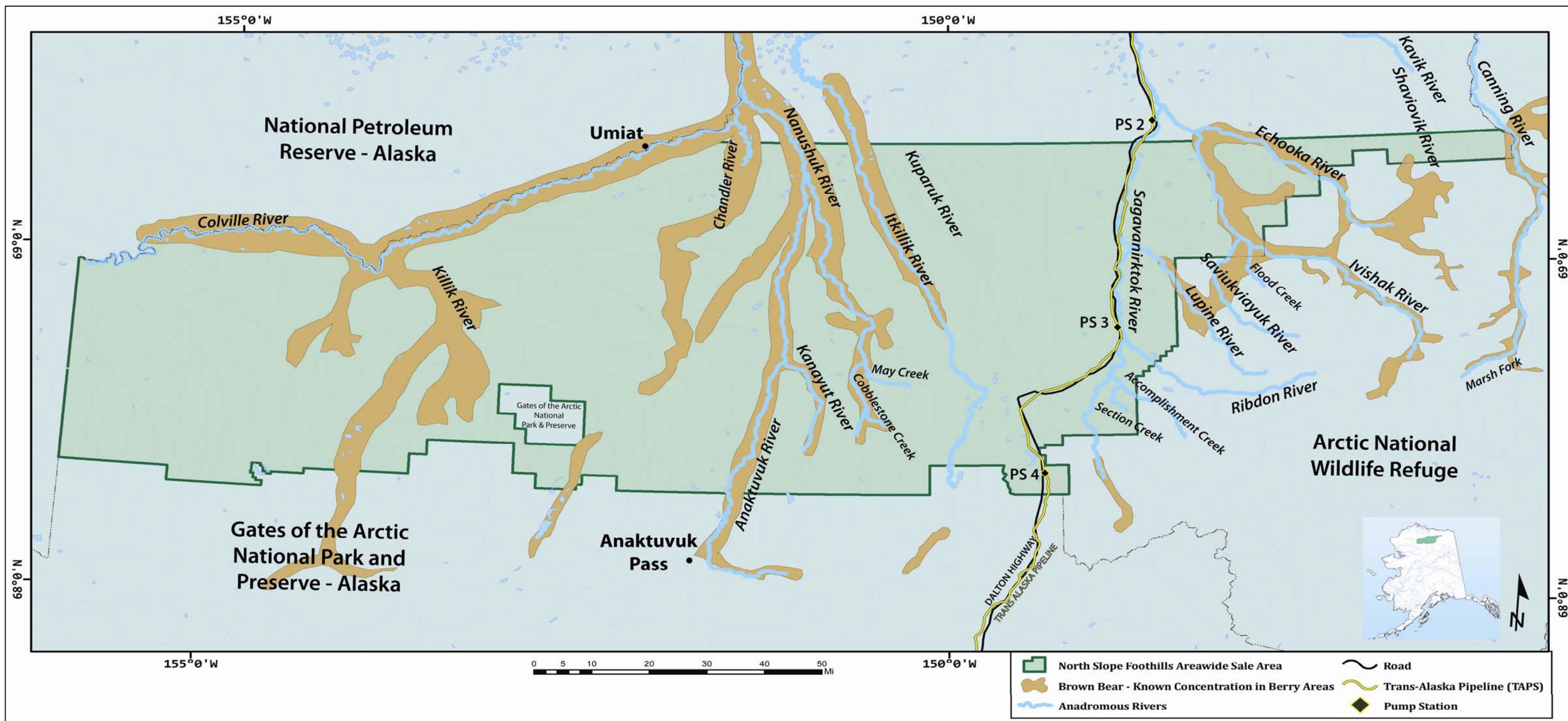


Note: Moose are found throughout the lease sale area (spring – fall).

Source: ADF&G 1986a.

Map 4.3. Moose habitat in the North Slope Foothills lease sale area.

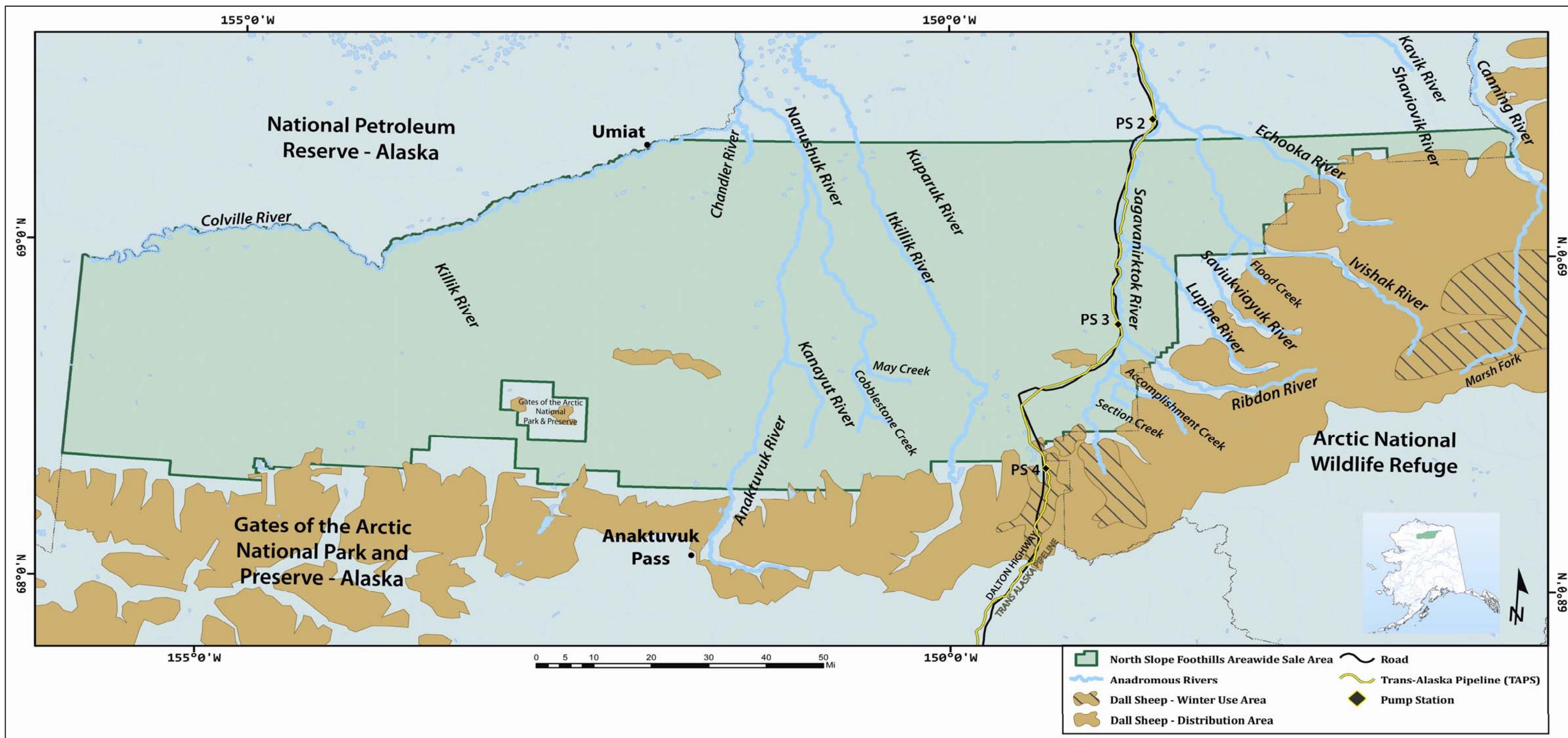




Source: ADF&G 1986a.

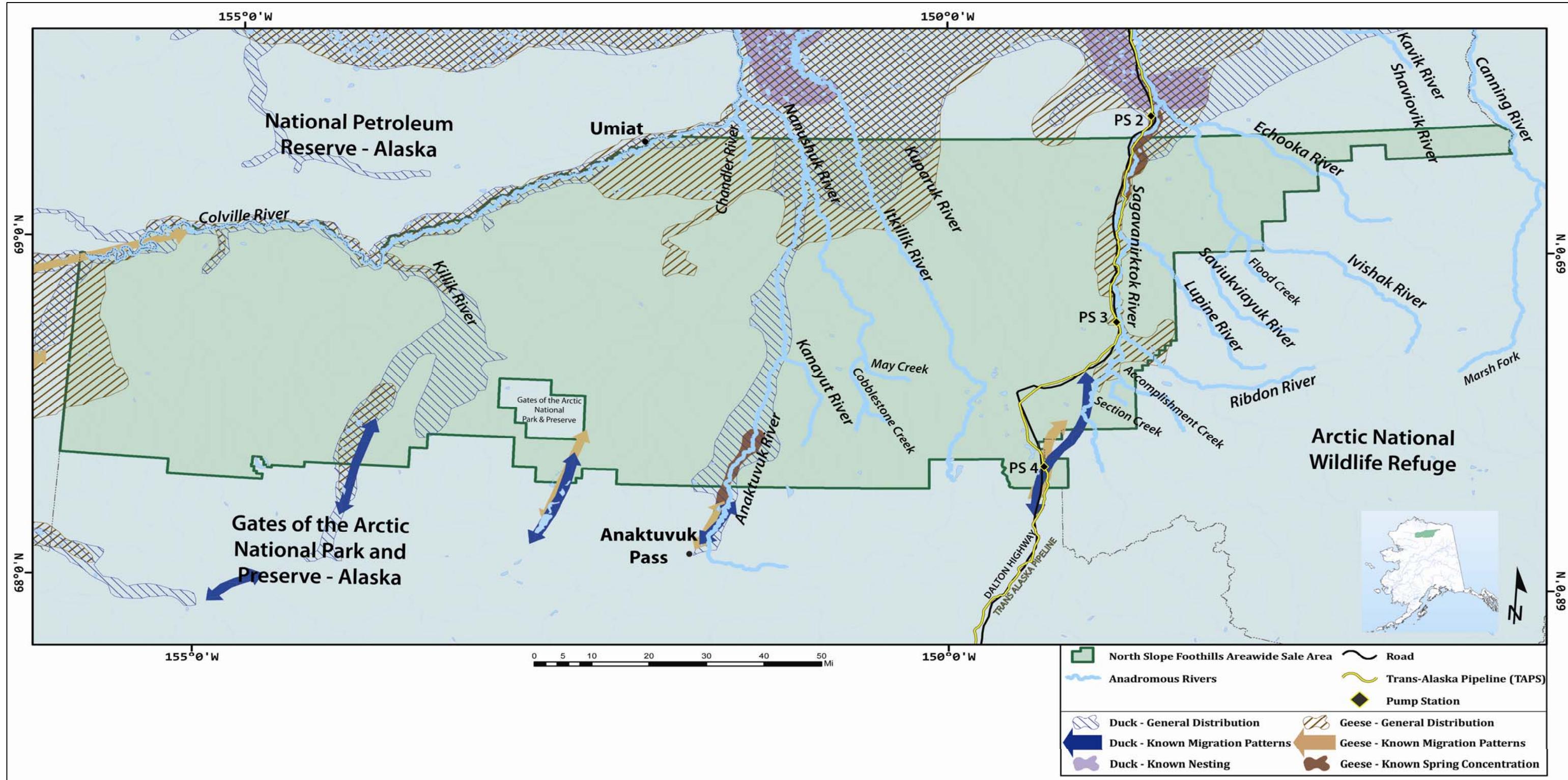
Map 4.4. Brown bear habitat in the North Slope Foothills lease sale area.





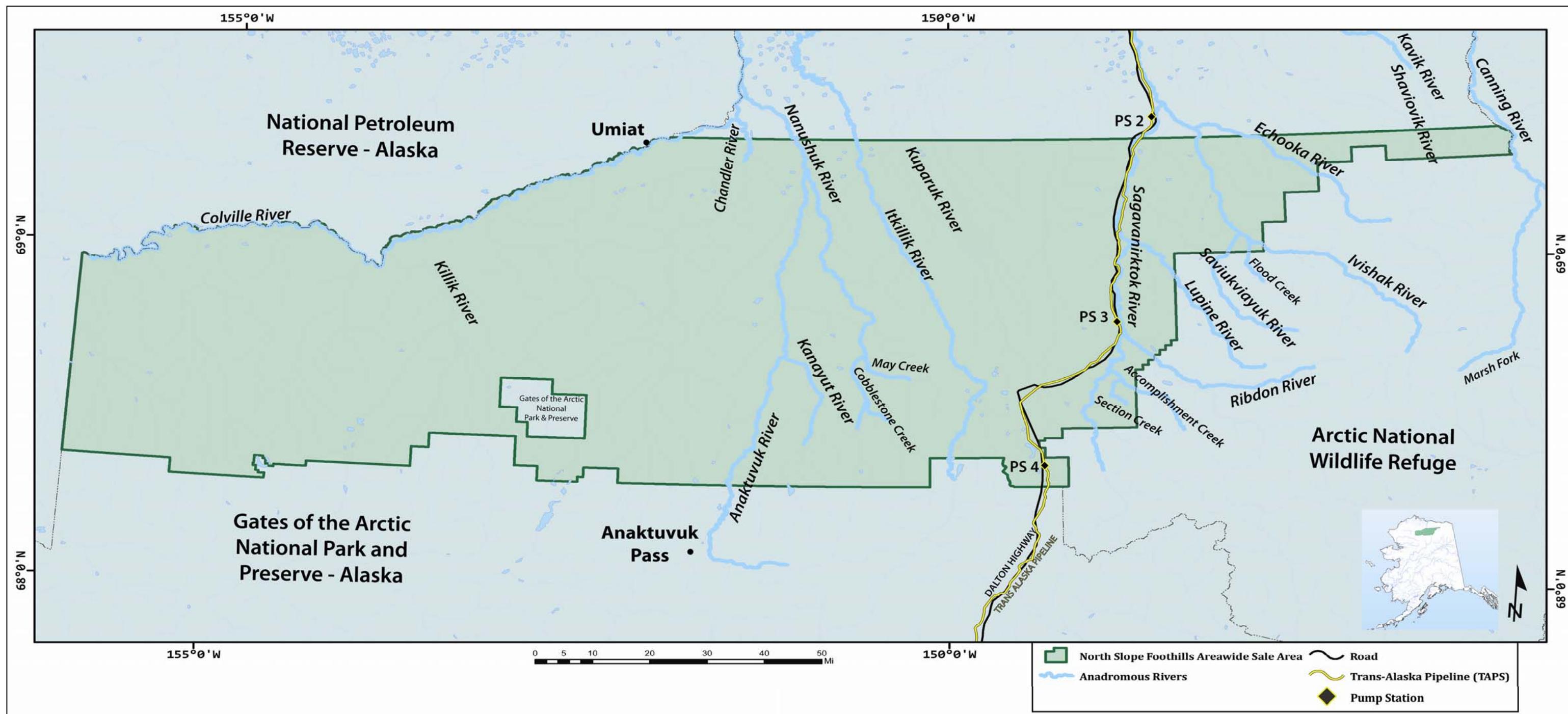
Map 4.5. Dall sheep habitat in the North Slope Foothills lease sale area.





Map 4.6. Duck and goose habitat of the North Slope Foothills lease sale area.

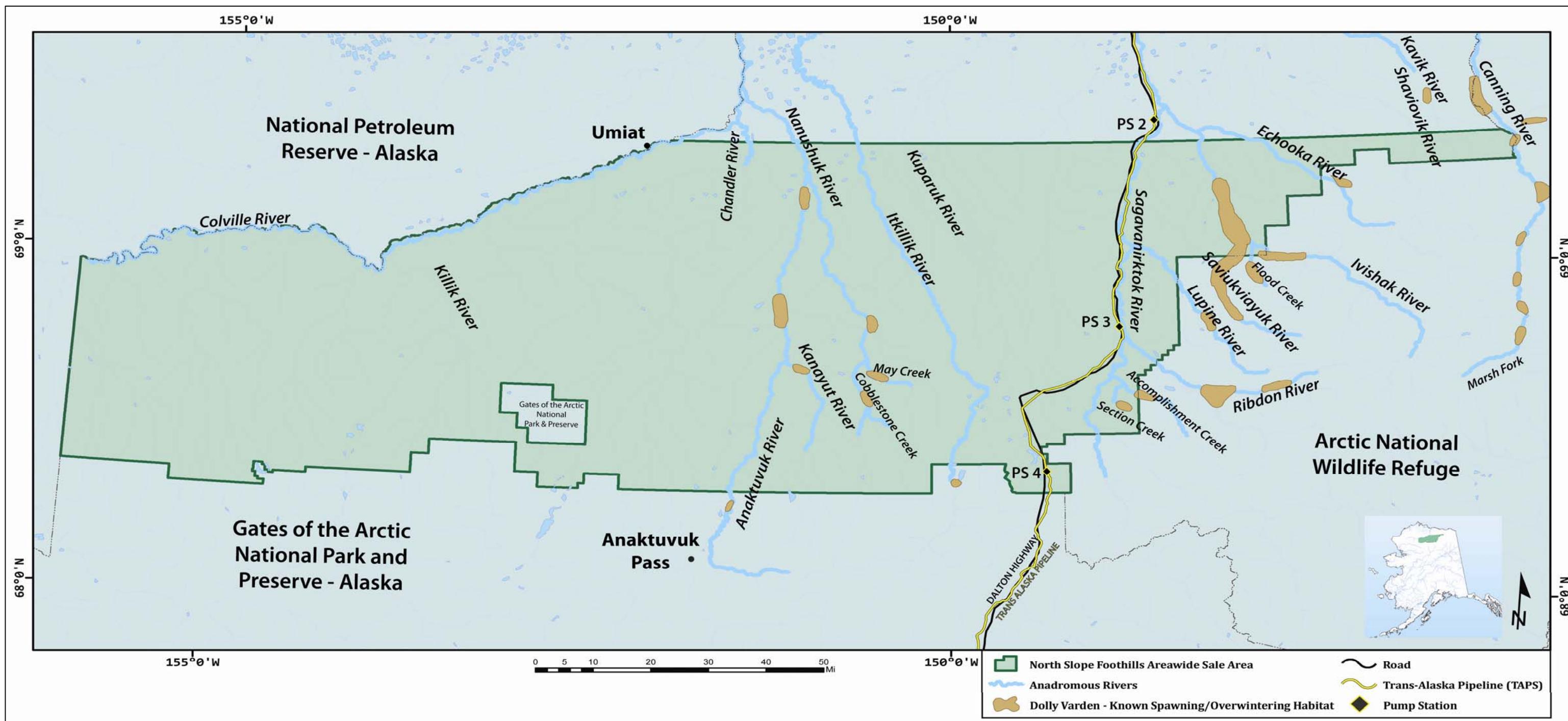




Source: Johnson and Klein 2009.

Map 4.7. Catalogued anadromous streams within the North Slope Foothills lease sale area.





Map 4.8. Known spawning or overwintering habitat of Dolly Varden in and near the North Slope Foothills lease sale area.



# Chapter Five: Current and Projected Uses in the North Slope Foothills Area

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# **Chapter Five: Current and Projected Uses in the North Slope Foothills Area**

AS 38.05.035(g) directs that best interest findings consider and discuss the current and projected uses in the area, including uses and value of fish and wildlife. The North Slope Foothills lease sale area provides important habitat for terrestrial mammals, many species of birds, and freshwater fishes. The wildlife, birds, fish and vegetation of the area provide the resource base for subsistence fishing and hunting, and for some sport fishing and sport hunting. There are no commercial fisheries reported in the lease sale area, although one previously existed downriver to the north along the Colville River (Hayes et al. 2008). The lease sale area is used to a small extent for recreation, tourism and Arctic research. The primary industrial use of the area is for oil and gas development. Some mining exploration has also been proposed.

## **A. Management**

Management authorities for fish and wildlife fall under the state ADF&G on state land. The proximity to federal and private owned land causes overlap of management and harvest activities throughout the North Slope region. Migratory birds are federally managed by the U.S. Fish and Wildlife Service. The North Slope Borough provides significant input regarding management of wildlife and habitat (Brower et al. 2000). Local residents serve on a number of advisory committees that provide input to state or federal management agencies, and local residents are also members of commissions that participate in co-management of migratory birds (Brower et al. 2000).

The reasonably foreseeable cumulative effects of the lease sale on subsistence activities are discussed in Chapter Eight. Mitigation Measures and Lessee Advisories designed to minimize impacts to subsistence resources are listed in Chapter Nine.

## **B. Uses and Value of Wildlife, Fish and Plants**

### **1. Subsistence Hunting**

The State defines subsistence uses as the noncommercial, customary and traditional uses of wild, renewable resources (AS 16.05.940[30]). Subsistence also refers to the production and distribution of wild resources for local use and small-scale exchanges in Alaska (Braund and Moorehead 2009, citing to Wolfe). The North Slope Foothills lease sale area encompasses lands traditionally and presently used for economic, cultural, and social purposes by residents of Anaktuvuk Pass, Nuiqsut, Barrow and Kaktovik (Pedersen 2009).

Community well-being depends on the continued use of subsistence resources because of their cultural and economical significance. The subsistence way of life, with its associated values of sharing food and its influence on the extended family and traditional knowledge, is considered an integral part of being Inupiat (Kruse et al. 1983). In addition to this cultural component, subsistence is the direct source of economic well being for NSB residents. Subsistence resources enter into household income as a food source that does not have to be purchased.

Subsistence activities in the lease sale area vary from season to season depending on the availability of food and the ability to travel (Brown 1979). In summer, the primary mode of transportation is by small skiff, which can navigate the shallow river channels, and by ATV for overland access. In winter, snow machines provide transportation to hunting and fishing camps. Historical subsistence access routes on the North Slope follow all major rivers and tributaries, and skirt the coast from the Canadian border to Wainwright and beyond.

Factors affecting subsistence harvests include the availability of fish and wildlife populations, weather, terrain, methods of harvest, availability of transportation, state and federal hunting and fishing regulations, local economic conditions, availability of cash for supplies and transportation, the changing condition of meat, hide or fur and community needs (Jacobson and Wentworth 1982; ISER and Scott Goldsmith 1991). Local subsistence users know the best time to harvest certain animals, fish, birds and vegetation. The seasons when the animals and fish are harvested depend upon many factors, but similar habitats serve as hunting and fishing areas for all of these communities.

The primary goal of Inupiat social structure is to extend and ensure cooperation to reduce individual risk. Important social relationships include hunting partnerships, food sharing, community education and social status (Spencer 1969). Subsistence food is the link that holds people together as members of a common social and economic community. Sharing is important in Inupiat society. A sense of community was essential in the past, when sharing was the best insurance against starvation. During times of shortage, food sharing maximized everyone's chances of survival (Brower and Opie 1996). The Inupiat make use of virtually all local plant and animal resources for food and raw materials.

Subsistence resources are utilized for much more than nutrition. Many non-edible parts of the animals harvested are used to make both functional items, and arts and crafts. Driftwood and willow brush are collected for firewood and building materials. Caribou hides are used for bedding, clothing, and masks. Ivory, caribou antler and bone, and whale bones are carved into miniature animals, umiaks, and hunting scenes or made into functional items, like knife or ulu handles and needle cases. Clothing is also made from sheep, moose, bear, wolf, wolverine, lynx, fox, Arctic hare, marmot and ground squirrels (Brown 1979). Jewelry is made out of many things, including ivory, antler, feathers and imported beads. Wolverine, wolf, polar bear, seal, and fox fur are used to make parkas, slippers, mukluks, and hats, and are used in making dolls, Eskimo yo-yo's, and caribou skin masks. Feathers and skins are used to make drums and many other craft items, such as spirit masks.

## **2. Communities Active in Subsistence Harvesting**

The communities in the North Slope region that use the lease sale area for subsistence hunting and fishing are Anaktuvuk Pass, Nuiqsut, Barrow and Kaktovik (Pedersen 2009). Caribou, brown bear, moose, furbearers, sheep, and waterfowl are harvested by subsistence users in and around the North Slope Foothills lease sale area (Map 5.1; Map 5.2; Map 5.3; Map 5.4; Map 5.5; Map 5.6).

Caribou is the primary subsistence resource for Anaktuvuk Pass residents (Brower and Opie 1996), and are also hunted year round by Nuiqsut residents along major rivers and where caribou migrate. Caribou are the main terrestrial animals harvested for subsistence in Barrow and Kaktovik, but sheep, muskoxen, and grizzly bears are also harvested. Dall sheep, wolves and moose are important subsistence resources, especially when caribou harvests are low. Other mammals harvested are the Arctic marmot, brown bear, ground squirrel, lynx, moose, red fox, snowshoe hare, weasel and wolverine (Bacon et al. *Unpublished*).

Subsistence users also fish in river habitats in the lease sale area. Arctic grayling, Arctic char, Dolly Varden, Arctic cisco, lake trout, whitefish, and burbot are common species that are harvested. The primary focus of subsistence hunting for the communities located closer to the Arctic marine environment is the harvest of marine mammals.

### **a. Sharing of the Harvests**

One of the most important traditions in the Inupiat culture is the sharing of subsistence resources. Harvests of marine mammals are used to trade with inland villages for caribou and terrestrial mammal, bird and fish harvests. For example inland village residents may exchange dried caribou



Subsistence activities at Anaktuvuk Pass.

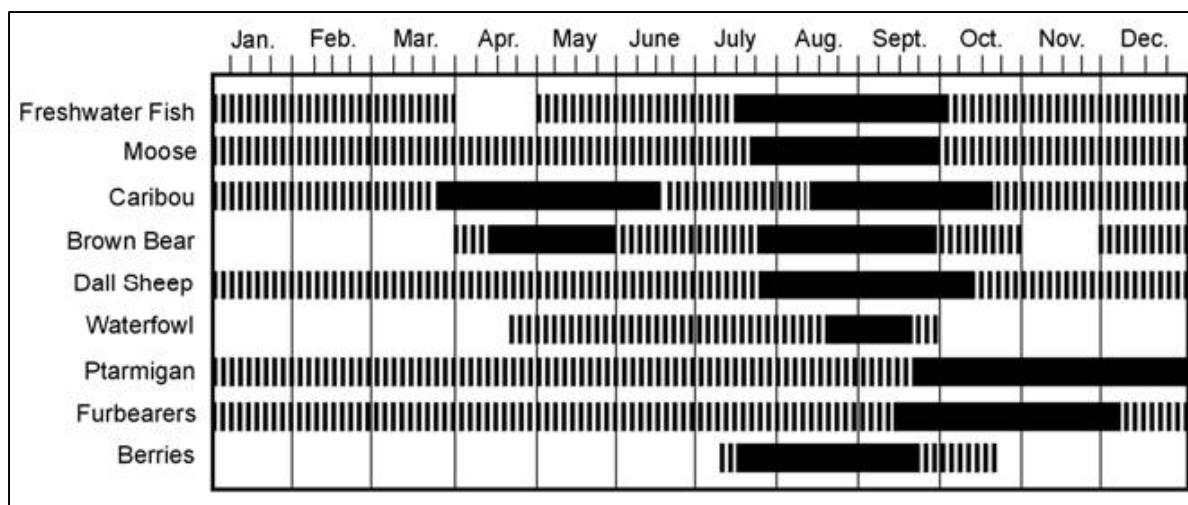
for whale skin and blubber (Bacon et al. *Unpublished*). In a study conducted by Brower and Opie (1996), for July, 1994 to June, 1995, they found that 75% of the harvests in Anaktuvuk Pass were shared. The hunters share with community members and guests, as well as during community feasts. The average percentage of Anaktuvuk Pass inhabitants involved in the sharing of the harvest from 1994 through 2003 was 63% (Bacon et al. *Unpublished*). In a subsistence harvest survey for Nuiqsut conducted by the North Slope Borough, researchers found that all subsistence hunters shared part of their harvest at least once, and that 87% of the harvest instances resulted in sharing (Brower and Hepa 1998).

### **b. Anaktuvuk Pass Subsistence Harvests**

The most intensive subsistence users of the lease sale area are those from Anaktuvuk Pass, (population 284, ADCRA 2009a) the closest community to the lease sale area (Map 5.7; Map 5.8). It is located south of the lease sale area in the central Brooks Range (Map 3.1). When the Killik and Tulgak people decided to come together and settle, they chose Anaktuvuk Pass because of nearby water sources, the abundance of willows, and the known fact that thousands of caribou migrated through the pass each year (Anaktuvuk 2000; Brown 1978). Anaktuvuk Pass residents mainly use the river corridors of the Colville, Itkillik, and Anaktuvuk rivers for subsistence activities within the lease sale area (Pedersen and Hugo 2005). They also use the Killik and Chandler River corridors (Anaktuvuk 2000; Pedersen and Hugo 2005).

Subsistence harvest levels in this community are high and reliance on locally harvested resources is strong. The Native Alaskans of Anaktuvuk Pass, also known as the Nunamuit, depend principally on caribou to support their lifestyle (Brown 1978). They primarily hunt terrestrial mammals such as caribou, Dall sheep, wolves and moose (Bacon et al. *Unpublished*, citing to Brower and Opie 1996). Other subsistence harvests are fish, birds and berries (Figure 5.1) (ADF&G 1986a). Hunting and trapping for the sale of skins, and making of traditional caribou skin masks or clothing provides income (ADCRA 2009a).

Information is unavailable as to how much of the subsistence hunting activities by Anaktuvuk Pass hunters occur in the lease sale area. Harvest estimates given below include plants, animals and fish that may have been harvested outside the lease sale area.



Notes: Solid lines indicate time when harvest usually takes place. Broken lines indicate occasional harvest effort.

Source: ADF&G 1986b.

**Figure 5.1. Seasonal use harvest activities by Anaktuvuk Pass residents.**

### i. Plant Resource Harvests

Berry picking is an important subsistence activity in Anaktuvuk Pass. Berries, such as salmonberries, cranberries, cloudbERRIES, and blueberries are gathered in July through October (Figure 5.1) (ADF&G 1986a). Berry picking may be done in conjunction with other subsistence activities like caribou hunting and fishing. Masu, or roots, are usually harvested in late summer (Bacon et al. *Unpublished*).

Subsistence harvest data from July 1, 1994 to June 30, 1995 in Anaktuvuk Pass reported that 7 gal of blueberries, 12 gal of salmonberries and 2 gal of cranberries were harvested by Anaktuvuk Pass residents (Brower and Opie 1996).

### ii. Terrestrial Mammal Resource Harvests

Caribou is the primary subsistence resource in Anaktuvuk Pass (Brower and Opie 1996). The annual subsistence cycle of Anaktuvuk Pass relies on factors such as the caribou migration patterns. Intensive caribou hunting occurs in April and May as animals move through the Brooks Range on spring migrations northward (Map 5.7). Caribou hunting intensifies again in the fall, during late August to early November, as the animals begin to move southward (Brower and Opie 1996). During the winter, caribou are occasionally hunted, but they are in less desirable condition at this time of year (ADF&G 1986b). The subsistence harvest of caribou for 2006 was reported to be 696 caribou (ADF&G 2006a). The previous estimated caribou harvest in 1990-1991 was 592 animals and in 1993-1994 was 574 animals. In a previous survey conducted for a one-year period in 1994-1995, 311 animals were harvested. These caribou accounted for 82.5% of the harvest in edible pounds for a one-year period (Brower and Opie 1996; Table 5.1).

Sheep, moose and brown bear are considered important supplemental meat sources when caribou are scarce (Brower and Opie 1996). Sheep are harvested mostly in the late summer through early winter, primarily in July and August, with occasional spring harvests (Figure 5.1). Few estimates of harvests by Anaktuvuk Pass residents are available. The most recent estimates are for harvests from 1994 through 2003, ranging from 5 to 26 sheep harvested per survey period (Table 5.1;

**Table 5.1. Estimated harvest by survey period for caribou, Dall sheep, Arctic grayling, and Dolly Varden, Anaktuvuk Pass.**

Survey Period	Caribou		Dall Sheep		Arctic Grayling		Dolly Varden (Char)	
	Est.	SE.	Est.	SE.	Est.	SE.	Est.	SE.
1990 <sup>a</sup>	592							
1991 <sup>a</sup>	545							
1993 <sup>a</sup>	574							
1994-1995 <sup>b</sup>	311		26		898		207	
1996-1997 <sup>b</sup>	210.2	16.8	6.7	1.1	885.1	103.6	188.1	32.1
1998-1999 <sup>b</sup>	500.0	0.0	10.0	0.0	1173.0	0.0	152.0	0.0
1999-2000 <sup>b</sup>	329.3	23.8	9.2	0.6	1152.2	52.1	277.8	46.6
2000-2001 <sup>b</sup>	732.2	225.3	5.0	0.0	1800.0	606.5	583.0	312.2
2002-2003 <sup>b</sup>	436.1	26.3	16.0	2.4	839.0	258.6	153.5	231.4
2006 <sup>c</sup>	696							

<sup>a</sup> Source: ADF&G 1990; ADF&G 1991; ADF&G 1993a.

<sup>b</sup> Source: Bacon et al. *Unpublished*.

<sup>c</sup> Source: ADF&G 2006a.

Bacon et al. *Unpublished*). Wolves were the most frequently harvested furbearer for the survey period, from 1994 through 2003.

### **iii. Bird Resource Harvests**

The harvest of Canada geese and greater white-fronted geese occurs annually in the spring. Anaktuvuk Pass is close to the inland nesting range of the Canada geese, and is more distant from the coastal nesting areas of the greater white-fronted geese. Ptarmigan are harvested, with populations of willow and rock ptarmigan as likely primary sources. Harvest occurs mainly in winter and early spring (Figure 5.1). Other birds harvested are the northern pintail, ducks, and eiders (Bacon et al. *Unpublished*). In a previous study in 1992 the birds harvested were snow geese, greater scaup, common eider, brant and Canada geese (Brower and Opie 1996, citing to George and Fuller in prep.).

### **iv. Fish Resource Harvests**

Fish are crucial during times of other resource scarcity. Important fish species include Arctic grayling, Arctic char, Dolly Varden, Arctic cisco, lake trout, whitefish, and burbot (Pedersen and Hugo 2005). Fish are primarily taken during the spring, summer and fall. Arctic grayling, Arctic char, lake trout and whitefish are harvested during July, August, and September. Between October and February fishing activity is minimal (Brower and Opie 1996; Pedersen and Hugo 2005).

Arctic grayling harvests were reported for several years from 1994 through 2003. The range of number of fish taken was from 898 fish in 1994-1995 to over 1000 fish in the years 1998 through 2001 (Table 5.1). In an assessment conducted from October 2001 through September 2003, the estimated fish harvest was 5,372 lb in the first year (October 2001 – October 2002), comprised of Arctic grayling (45%), Arctic char and Dolly Varden (28%), lake trout (26%), and burbot and Arctic cisco (less than 1%) (Pedersen and Hugo 2005).

In the second study year (October 2002 – September 2003), the estimated fish harvest was 4,284 lb, comprised of Arctic char and Dolly Varden (44%), Arctic grayling (27%), lake trout (27%), and burbot, Arctic cisco and other fish (1%) (Pedersen and Hugo 2005) (Map 5.8).

Some inhabitants travel to coastal villages to hunt marine mammals (Bacon et al. *Unpublished*). There is limited reliance on marine mammal hunting, with the exception of the sharing of the harvest among the North Slope villages and residents.

### **c. Other Communities Conducting Subsistence Hunting**

The three communities north of the lease sale area that also conduct subsistence hunting in the North Slope Foothills lease sale area are Nuiqsut, Barrow and Kaktovik (Map 3.2) (Pedersen 2009). The residents of these villages may harvest resources in the lease sale area, but information is unavailable as to how much of the subsistence hunting activities for these communities occur in the lease sale area.

Various types of plants provide subsistence foods to residents of the North Slope area. Root species are generally harvested in August, while late summer and early fall are important times for gathering berries. Residents often pick berries in conjunction with other subsistence activities such as caribou hunting and fishing (Bacon et al. *Unpublished*). Common berries harvested are salmonberries, blueberries and cranberries (Braund and ISER 1993). Berries and plants may be available for only a short time. They are found along raised banks of streams and rivers and in areas of wet tundra (EDAW/AECOM 2007). Table 4.1 lists some of the plants that may be found in the North Slope area.

Terrestrial mammals are important subsistence resources for the residents of these three villages. Caribou is the primary terrestrial mammal source of food and is hunted year round, but the migration patterns influence the most active hunting seasons. Subsistence species tend to be migratory and seasonally abundant. Successful hunts require knowing when and where to intercept these resources as they migrate. For species that migrate through the area over a relatively short period, adverse weather conditions or equipment problems may result in missing the entire migration (Braund and ISER 1993).

Moose are also hunted along the river system habitats, such as the Colville, Chandler and Itkillik rivers in August (EDAW/AECOM 2007). Other furbearers are harvested in winter. Nuiqsut residents may hunt for wolf and wolverine by snow machine in March and April, and may take them while hunting for other species during the winter as the opportunity arises (Bacon et al. *Unpublished*).

Birds and bird eggs are an important component of the subsistence harvests in the three communities (Table 5.2; Map 5.6). Hunting of other migratory birds is regulated under the Migratory Bird Treaty Act. Subsistence hunting of spectacled eiders is closed, and non-toxic lead shot must be used for all waterfowl hunting (USFWS 1999). Although they make up only a small proportion of total harvests by weight, they may be important seasonally, and participation in bird hunting is high (EDAW/AECOM 2007). Hunting corresponds to the spring migration and the molt and fall migration. Eiders, geese, and ptarmigan are particularly important (Bacon et al. *Unpublished*). Ptarmigan are important in the early spring because they are found in flocks and are one of the few sources of fresh meat available at that time (EDAW/AECOM 2007). In some communities, birds are an important component of whaling events, when it is not uncommon for 200 ducks and geese to be used.

Fish harvests are important food staples for residents of these communities. Whitefish species are particularly important and are used for dog food as well as for human consumption. Species such as broad whitefish, which are considered the preferred fish by many residents, are generally harvested in the summer and fall with gillnets. They are filleted and dried, or stored in ice cellars. Arctic

**Table 5.2. Estimated subsistence harvest and standard error (SE) of birds, by species, for Barrow, Nuiqsut, and Kaktovik.**

Species	Barrow 2003 <sup>a</sup>		Nuiqsut 2000-2001 <sup>b</sup>		Kaktovik 2002-2003 <sup>c</sup>
	Harvest	SE	Harvest	SE	Harvest
American Widgeon					2
Brant	88	30			277
Canada Goose	3	2			33
Common Eider	317	67			12
Duck spp.	505	130			8
Eider spp.	2,568	707	55	4	18
Eider Eggs					30
Goose spp.	220	85	319	79	
King Eider	937	325	30	3	8
Mallard	86	83			1
Long-tailed Duck	25	14			5
Northern Pintail	18	12			2
Ptarmigan spp.	426	139	23	3	370
Sandhill Crane	2	1			1
Snow Goose	3	2			20
Spruce Grouse	18	12			
Steller's Eider	14	9			
Tundra Swan	2	1			
White-fronted Goose	3,314	487	787	188	149
White-fronted Goose Eggs	44	19			
Yellow-billed Loon	18	8			

Source: Bacon et al. *Unpublished*.<sup>a</sup> Calendar year.<sup>b</sup> July 2000 - June 2001.<sup>c</sup> July 2002 through June 2003. No standard error (SE) because survey was a census.

grayling and Dolly Varden are also highly prized (Bacon et al. *Unpublished*). Subsistence harvests also occur through the ice on overwintering concentrations of whitefish and Arctic grayling (EDAW/AECOM 2007).

### i. Nuiqsut Subsistence Harvests

Nuiqsut (population 424, ADCRA 2009d) is located on the west bank of the Nechelik Channel in the Colville River delta. Although Nuiqsut is located approximately 60 miles north of the lease sale area, its residents use the foothills area to meet part of their subsistence needs. The Inupiat of Nuiqsut practice a traditional subsistence lifestyle where locally harvested foods and materials provide nourishment, clothes, tools and shelter (Brown 1979). Caribou, bowhead and beluga whale, seal, moose, and fish are staples of the diet. Polar bears are also hunted. Trapping and craft-making also provide some income (ADCRA 2009d). Caribou are the primary terrestrial mammal resources harvested by Nuiqsut residents and are hunted year round (Brower and Hepa 1998).

Nuiqsut hunters also harvest moose, wolves, wolverines, musk oxen, Arctic fox, cross fox, red fox, birds and other small animals (EDAW/AECOM 2007; Brown 1979). Hunting for birds includes Canadian and white-fronted geese, king eiders and common eiders. Spring hunts target geese, with spring and summer hunts harvesting eiders (Figure 5.2). Other birds harvested are other types of ducks and ptarmigan (Bacon et al. *Unpublished*). Fish harvests include thirteen types of fish,

including Arctic cisco, broad whitefish, humpback whitefish, Arctic grayling and burbot (Bacon et al. *Unpublished*). Whales are hunted in September, with some residents joining whaling teams in Barrow in the spring (Figure 5.2). Whale and marine mammal harvests are shared among other communities on the North Slope, such as Anaktuvuk Pass. Medicinal plants and greens are harvested when families are at camp hunting and fishing in late summer (EDAW/AECOM 2007). Blueberries, cloudberry, cranberries, wild potato, and wild rhubarb are also harvested (Jacobson and Wentworth 1982).

Few estimates of subsistence harvest are available. Previously in 1993, Nuiqsut subsistence residents harvested in 267,817 lb of locally obtained fish, game, birds and plants for local use. It is not known how much of the harvest came from the lease sale area. The mean household harvest was 2,943 lb of useable (dressed) food, or 742 lb per capita. Fish rank highest with an estimated community harvest of 90,490 lb, followed closely by terrestrial mammals and marine mammals at 87,390 lb and 85,216 lb, respectively. In 1993 caribou contributed 228 lb (94%), moose 12 lb (5%), and grizzly bear 2 lb (0.8%) to the per capita harvest. Subsistence harvested fish combined with terrestrial and marine mammals accounted for 98% of the community harvest, and birds/eggs and plants made up the remaining 2% of the community's harvest for 1993 (ADF&G 1993b). In July, 1994 through June, 1995, a Nuiqsut harvest subsistence survey by the North Slope Borough reported that the amount of edible pounds obtained were caribou (58%), fish (30%), moose (5%), birds (5%), and marine mammals (2%) (Brower and Hepa 1998).

Harvest information for caribou, whitefish, geese, eiders and bearded seals for the years of 1994-1995, 1995-1996, and 2000-2001 is presented in Table 5.3.

In 2003, subsistence resources made up at least half the food consumed for 81% of households in Nuiqsut (URS Corp. 2005c). Approximately 63% of the residents reported that at least half of their diet came from subsistence harvest activities. Nuiqsut households spent an average of \$6,700 on subsistence activities, and the community as a whole expended 20% of its gross income on subsistence activities (URS Corp. 2005c).

## ***ii. Barrow Subsistence Harvests***

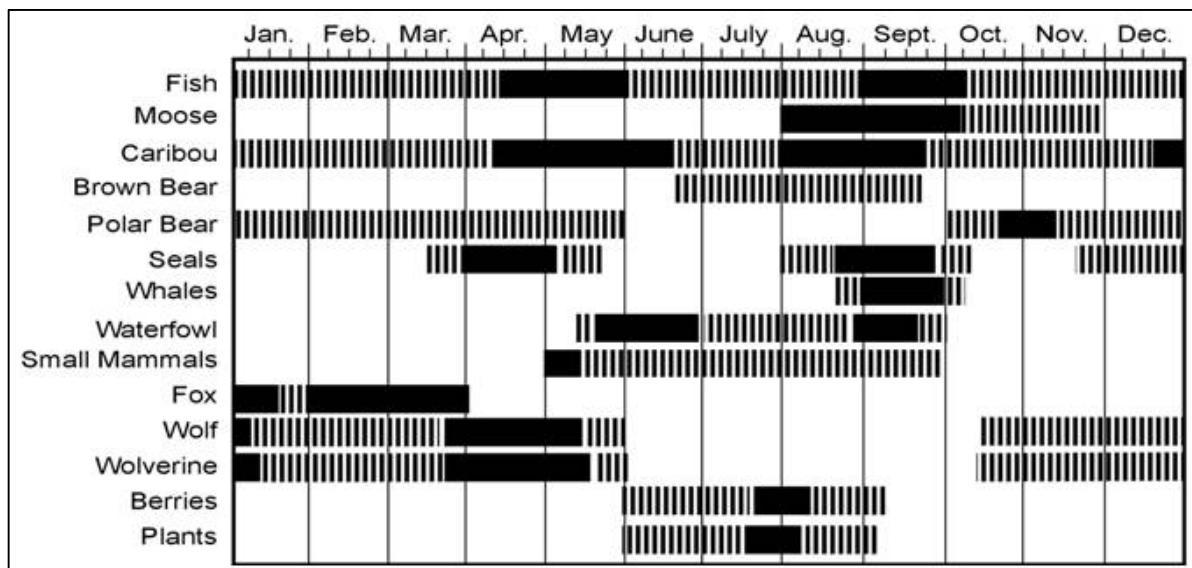
Barrow (population 4,054, ADCRA 2009b) is located on the Chukchi Sea coast, ten miles south of Point Barrow. Residents practice a traditional subsistence lifestyle dependent upon marine mammal hunting and supplemented by inland hunting and fishing. Barrow residents harvest marine and riverine fish year round from locales along the Colville River and beyond into the foothills of the Brooks Range. Although many residents from throughout the North Slope Borough have relocated to Barrow, many continue to hunt in the areas where they were raised (Braund and ISER 1993). For example, Barrow residents with ties to Nuiqsut may return there for subsistence activities because



Ice fishing.

they continue to share use rights to cabins, camps, and allotments in the area (EDAW/AECOM 2007).

Although bowhead whale harvests tend to make up the largest proportion of total subsistence harvests, other species are also seasonally important, more so than their actual proportions may imply (EDAW/AECOM 2007; URS Corp. 2005a). These other species become even more important in years when few or no whales are harvested.



Notes: Solid lines indicate time when harvest usually takes place. Broken lines indicate occasional harvest effort.

Source: ADF&G 1986b.

**Figure 5.2. Seasonal use harvest activities by Nuiqsut residents.**

**Table 5.3. Harvest of several species of wildlife and birds in the Nuiqsut area.**

12-mo Period	Caribou	Large Whitefish <sup>a</sup>	Geese <sup>b</sup>	Walrus	Eiders <sup>c</sup>	Bearded Seals
1994-1995	258	3,419	474	0	90	0
1995-1996	362	3,419	381	0	287	17
2000-2001	496	5,533	1,172	0	86	1

Source: Bacon et al. *Unpublished*.

<sup>a</sup> Includes broad whitefish, humpback whitefish, and unidentified whitefish.

<sup>b</sup> Includes greater white-fronted goose, Canada goose, snow goose and brant.

<sup>c</sup> Includes common eider, king eider, spectacled eider, and Steller's eider.



USFWS

Caribou harvest.

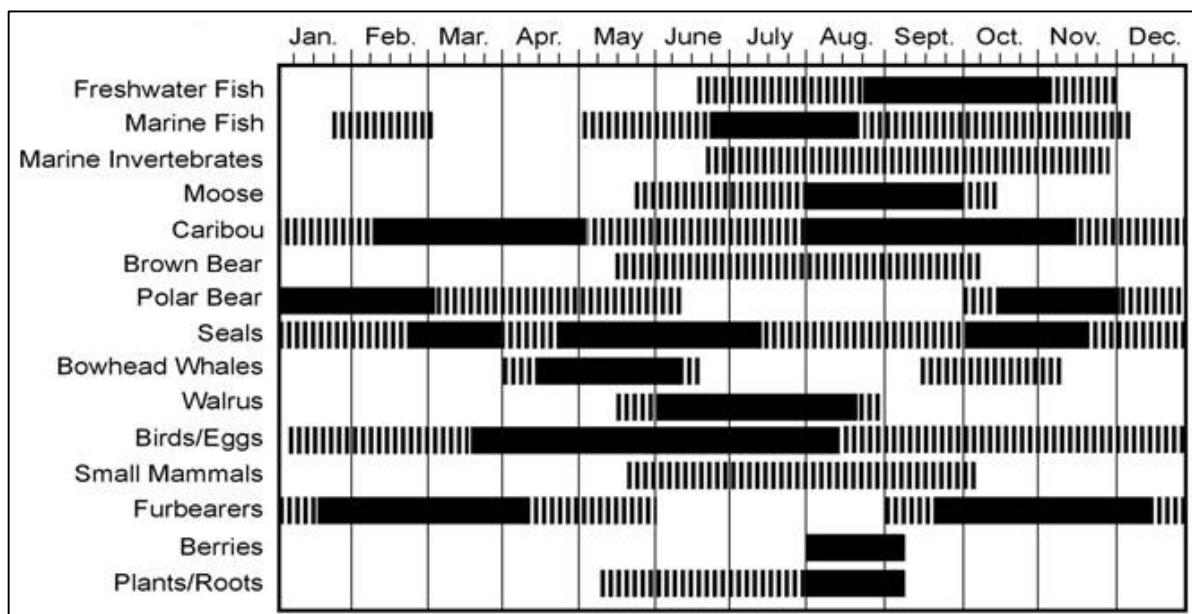
Caribou is the main terrestrial animal harvested for subsistence in Barrow, where harvest activities peak from February through early April, and from late June through late October (EDAW/AECOM 2007). Harvests fluctuate from year to year, depending on proximity of overwintering caribou to Barrow (Figure 5.3). In 2002-2003, 2,092 caribou were harvested by Barrow residents (Table 5.4). Barrow residents may hunt moose along the Colville River during the summer (EDAW/AECOM 2007). In Barrow, most moose hunting is conducted by non-Natives. During the winter hunters from Barrow harvest other furbearing animals (Bacon et al. *Unpublished*). In Barrow, eider harvests generally occur in July (Figure 5.3). Eiders, geese, and ptarmigan are particularly important (Bacon et al. *Unpublished*), with over 4,700 eiders and over 3,300 geese taken in Barrow in 2003 (Table 5.4). In 2003, over 91% of Alaska Native households in Barrow participated in local subsistence activities, and for 66% of the households, at least half of their diet consisted of local subsistence resources (EDAW/AECOM 2007 citing to Circumpolar Research Associates 2004). Harvest information for caribou, whitefish, geese, eiders and bearded seals for the years of 1994-1995, 1995-1996, and 2000-2001 is presented in Table 5.4.

### **iii. Kaktovik Subsistence Harvests**

Kaktovik (population 272, ADCRA 2009c) lies approximately 100 mi northeast of the lease sale area on Barter Island, off the coast of ANWR. Residents of Kaktovik have a unique set of natural resources available for subsistence. Because of Kaktovik's location, hunters have access to terrestrial, riparian, and marine resources. Subsistence activities, particularly those surrounding the bowhead whale hunt, are central to the structural organization and cultural identity of Kaktovik residents. Although the bowhead whale is the primary marine mammal subsistence species, seals and polar bears are also important. Whales are hunted in spring and fall, and seals are hunted year round (Figure 5.4). Residents harvest both marine and freshwater fishes. The species of fish harvested are Arctic cisco, Dolly Varden, sculpin, Arctic cod, Arctic flounder, Arctic grayling, and chum salmon (Brower et al. 2000). Caribou are the most important terrestrial subsistence resource, but sheep, muskoxen, and grizzly bears are also harvested (Galganaitis and Koski 2002). Bird species harvested include geese (Table 5.5) and ptarmigan (URS Corp. 2005b).

In 1998, subsistence resources made up at least half the food consumed for 83% of households; this decreased to 69% of households in 2003 (URS Corp. 2005b citing to Shepro et al. 2003). Residents

have noted that they are involved in a wider range of activities and responsibilities, and that they travel away from the village more often for a wide variety of reasons. These lifestyle changes may limit their subsistence activities and constrain the timing of subsistence activities. Some residents prefer seasonal work because it allows them to participate more fully in subsistence activities (EDAW/AECOM 2007).



Notes: Solid lines indicate time when harvest usually takes place. Broken lines indicate occasional harvest effort.

Source: ADF&G 1986b.

**Figure 5.3. Seasonal use harvest activities by Barrow residents.**

**Table 5.4. Harvest of several species of wildlife and birds in the Barrow area.**

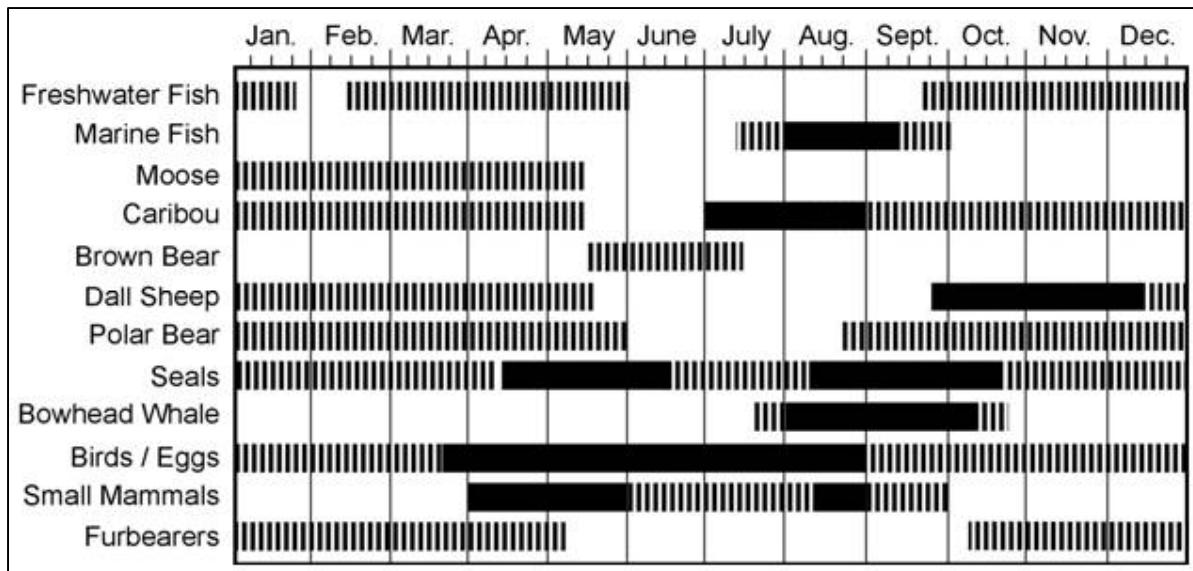
12-mo Period	Caribou	Large Whitefish <sup>a</sup>	Geese <sup>b</sup>	Walrus	Eiders <sup>c</sup>	Bearded Seals
1995-1996	2,155	12,084	2,599	74	12,114	431
1996-1997	1,158	7,657	1,856	78	2,572	192
1999-2000 <sup>d</sup>	3,359	23,213	7,550	115	2,572	729
2000-2001 <sup>d</sup>	1,820	2,177	4,893	123	2,201	327
2002-2003 <sup>d</sup>	2,092	8,899	3,321	313	4,773	776

Source: Bacon et al. *Unpublished*.

<sup>a</sup> Includes broad whitefish, humpback whitefish and unidentified whitefish.

<sup>b</sup> Includes greater white-fronted goose, Canada goose, snow goose and brant.

<sup>c</sup> Includes common eider, king eider, spectacled eider and Steller's eider.



Notes: Solid lines indicate time when harvest usually takes place. Broken lines indicate occasional harvest effort.

Source: ADF&G 1986b.

**Figure 5.4. Seasonal use harvest activities by Kaktovik residents.**

**Table 5.5. Harvest of several species of wildlife and birds in the Kaktovik area.**

12-mo Period	Caribou	Large Whitefish <sup>a</sup>	Geese <sup>b</sup>	Walrus	Eiders <sup>c</sup>	Bearded Seals
1994-1995 <sup>d</sup>	78	0	273	0	111	21
2002-2003	112	3	479	0	38	8

Source: Bacon et al. *Unpublished*.

<sup>a</sup> Includes broad whitefish, humpback whitefish, and unidentified whitefish.

<sup>b</sup> Includes greater white-fronted goose, Canada goose, snow goose and brant.

<sup>c</sup> Includes common eider, king eider, spectacled eider and Steller's eider.

### 3. Sport Fishing

Sport fishing traffic in the interior region of Alaska is lighter than in other regions of the state (ADF&G 2007d). Sport fishing in the lease sale area focuses on Dolly Varden and Arctic grayling, with smaller harvests of salmon, trout, whitefish, northern pike and burbot (NRC 2003, citing to Howe et al, 2001). Dolly Varden and Arctic char are grouped together for sport fishing regulatory purposes because of the difficulty in distinguishing the species based on external characteristics (Scanlon 2008). Dolly Varden and Arctic char populations can generally support only low rates of exploitation. The Sagavanirktok River is one of the primary rivers for sport fishing for these species. Anglers access the Sagavanirktok River by the Dalton Highway which parallels much of the river. The Sagavanirktok River is the only specific location for which sport effort and harvest estimates are available: effort averaged 1,232 angler-days, harvest of Dolly Varden averaged 272 fish, and harvest of Arctic grayling averaged 205 fish from 1998-2007 (Table 5.6). Although a



The Sagavanirktok River.

portion of the Sagavanirktok River runs through the lease sale area, harvest statistics are for the entire river.

Fishing effort and harvest of Arctic char, Dolly Varden, Arctic grayling, and lake trout were expected to increase when the entire Dalton Highway was opened to the public in 1994, and again when improvements were made to the road south of Atigun Pass in 2001 and 2002. However, effort and harvest statistics show that this has not occurred (Scanlon 2008). Increases in catch and harvest are expected from increased visitors floating rivers of the Alaska National Wildlife Refuge, particularly the Kongakut, Hulahula, and Canning rivers (Scanlon 2008).

#### 4. Sport Hunting and Trapping

Sport harvesting of big and small game in the lease sale area is managed by ADF&G, Division of Wildlife Conservation. The state is divided into 26 game management units (GMU). The lease sale area includes portions of GMUs 26A and 26B (Map 4.1). It is unknown exactly how many animals of each species are harvested within the lease sale area in any given year. Sport hunting harvest statistics collected by ADF&G are not specific to the lease sale area, but estimate the harvest of whole GMUs (ADF&G 1996). ADF&G reported that in 2006-2007, 1,050 caribou from the CAH, 19 moose, 77 sheep and 35 wolf were harvested in GMU 26 (Table 5.7). Management reports of documented harvest information is available in ADF&G publications (ADF&G 2008b moose; ADF&G 2007c caribou; ADF&G 2007b brown bear; ADF&G 2006b wolf; ADF&G 2008a Dall sheep; ADF&G 2007f muskox; ADF&G 2007e furbearers).

Hunting seasons and guidelines are determined by the Alaska Board of Game, and administered by ADF&G. The Dalton Highway corridor (extending 5 miles from each side of the highway) is closed to big and small game hunting, except with bow and arrow, and use of motorized vehicles is restricted in the corridor. Firearm possession by oil and gas industry employees is restricted and workers are not likely to sport hunt in the area during their active-duty shifts (ADF&G 1996). A hunting lodge is operated in Umiat, located in the northwest area of the lease sale area, and hunters and fishers charter aircraft for access (NSBCMP 2007).

**Chapter Five: Current and Projected Uses in the North Slope Foothills Area**

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**Table 5.6. Sport effort and harvest at the Sagavanirktok River, 1998-2007.**

Year	Anglers	Trips	Angler Days	Dolly Varden	Arctic Grayling	Burbot
1998	374	620	840	812	370	0
1999	367	1,844	2,055	330	181	0
2000	459	742	1,108	105	107	0
2001	359	1,615	2,537	757	206	7
2002	322	922	1,162	257	282	0
2003	242	375	423	0	163	22
2004	316	315	437	105	23	50
2005	614	535	1,042	51	354	0
2006 <sup>a</sup>						
2007	391	1,281	1,482	30	158	0
Average	383	917	1,232	272	205	9

<sup>a</sup> Too few surveys specific to the Sagavanirktok River were returned to make estimates in 2006.

Source: Jennings et al. 2004, 2006a, b, 2007; *In prep.-a, b, c.*

**Table 5.7. Sport harvest of big game in Game Management Unit 26, regulatory years 2002-2003 through 2006-2007.**

Regulatory Year	Species						
	Caribou Herd			Moose	Musko	Sheep	Wolf
	Brown Bear	Teshekpuk <sup>a</sup>	Central Arctic <sup>b</sup>				
2002-2003	28	2,700	760	12	7	58	8
2003-2004	30	2,700	311	5	3	75	19
2004-2005	32	4,642	625	6	8	93	10
2005-2006	19	4,460	687	14	4	92	16
2006-2007	30	4,050	1,050	19	0	77	35
Average	28	3,710	687	11	4	79	18

<sup>a</sup> Game Management Unit 26A. Harvest for this herd was estimated by the area management biologist.

<sup>b</sup> Game Management Units 26B and 26C. The 2006-2007 harvest was estimated by the area management biologist.

Source: ADF&G 2007a.

Notes: Most of these harvest totals do not include unreported harvest which may be substantial and can even exceed the reported harvest for certain caribou herds. In addition most harvest totals do not include harvest from federal hunts. Harvest estimates for the 2006-2007 regulatory year are considered preliminary.

## 5. Commercial Fishing

There are no commercial fishing operations within the lease sale area, but a commercial fishery interest was previously located downriver to the north on the Colville River (Hayes et al. 2008). Information about whether this commercial fishery could resume in the future is not available.

## C. Other Uses

### 1. Tourism and Recreation

Tourism in the North Slope area includes activities based upon packaged tours, back country adventures and sport fishing and hunting (NSBCMP 2007). Tour companies offer guided excursions by air and bus. Independent travelers can drive the Dalton Highway from Fairbanks to Deadhorse, but basic travel services are not generally available on the highway (NSBCMP 2007). There are no public services along the route except for Yukon Crossing, Five Mile, Coldfoot, Wiseman and Deadhorse, and some services are only available in summer (BLM 2007).

Recent information provided by the Alaska Visitor Statistics Program reported tourist visitor information for 2006. The survey conducted for visitor activities in the Far North region of Alaska showed that there were 49,000 summer visitors, with 11,000 to Nome and 41,000 visited the other areas of the Far North (McDowell Group 2007). The volume of visitors to the Far North was about 3% of the total summer visitors in 2006, with 1% to Nome and 2% to other areas of the Far North (McDowell Group 2007). The trip purposes for the Far North were reported as vacation/pleasure (76%), visiting friends and relatives (8%), business only (9%), and combined business and pleasure (7%). The primary tour package types taken were adventure tour (35%), wilderness lodge (20%), fishing lodge (1%) and other rail or motorbus based tours (19%) (McDowell Group 2007).

Recreational uses of the lease sale area include hiking, skiing, flight-seeing, boating and rafting. Each of these activities has its associated costs, which can be very high in the Arctic. Considering the remoteness and isolation of the lease sale area, most recreationists use a commercial outfitter to access the area, and nearly all must fly in. Back country and ecotourism adventures are offered. Most outfitters are based out of Fairbanks. In summer, visitors come to the region to camp, hike, float down the Canning River in a river raft, or watch and film whales, birds or caribou.

The Dalton Highway, running north south through the lease sale area, offers a road accessible Brooks Range experience for those seeking a rugged wilderness journey (NPS 2009a). In addition, those seeking recreation experiences can visit nearby public lands. The lease sale area abuts the boundaries of the Gates of the Arctic National Park and Preserve and a small portion of the Noatak National Preserve. The Gates of the Arctic Park offers the opportunity for extreme wilderness recreation activities such as backpacking, river running, mountaineering, and dog mushing. The remote location and extreme climate of the Brooks Range requires travelers to have exceptionally strong wilderness skills and flexibility to adjust plans. The Noatak National Preserve occupies a dramatic river basin ringed with mountains forming the western Brooks Range. The preserve is used for camping, backcountry hiking, fishing, wildlife observation and photography (NPS 2009b).

### 2. Mining

A proposed coal prospecting permit for the Nanushak project has been applied for within the lease area, and is being considered by the DMLW. Coal prospecting permits are issued rather than a mining lease where the Division of Geological and Geophysical Sciences (DGGS) has determined that the potential for mineable coal deposits is low. The proposed permitting area lies along the northern foothills of the Brooks Range, in an east-west belt extending from approximately 5 mi west of Toolik Lake to Banded Mountain, just west of the Anaktuvuk River (Map 5.9). The nearest community is Anaktuvuk Pass, approximately 36 mi south-southwest of the western end of the

proposed permitting area. The affected anadromous streams are the Anaktuvuk, Nanushuk, Kanayut, and Itkillik rivers, and May Creek. A coastal consistency determination and DMLW best interest finding was completed. The exact location of any coal deposits and the resulting mining operation cannot be predicted at the time of the writing of this DO&G final best interest finding.

### **3. Oil and Gas**

There has been limited oil and gas exploration and development in the lease sale area. The locations of previously drilled wells in and near the lease sale area are found in Map 5.9 and Map 5.10. Chapter Six provides a detailed description of the history of the oil and gas industry in the lease sale area as a comparison for potential future exploration and resource development uses of the North Slope Foothills area.

### **4. Transportation by Roads and Trails**

Many trails exist in the lease sale area, including a portion of the Hickel Highway. Construction of the Hickel Highway was begun in December, 1968, and was completed in March, 1969. It originates in Livengood, Alaska and continues about 547 mi north, ending at a landing airstrip at Sagwon, Alaska. It is a designated RST 450 trail that exists within the lease sale area along the Anaktuvuk River in sections 16, 17, 20, and 21, T9S, R4E UM. The Hickel Highway is a qualified RS 2477 route, and any oil and gas or other mineral prospecting activities will be subject to this right-of-way (ADNR 2009; ADEED 2009). Other trails or routes with an established history of use may exist in the lease sale area.

The James Dalton Highway is also known as the Haul Road. It was built in 1974, and is a 414 mi long road starting in Livengood, Alaska continuing north to Deadhorse and the oil fields on the North Slope. It is located in the eastern portion of the lease sale area. The Trans-Alaska pipeline parallels the road for much of the route. The road can be used by the general public, but few travel services are available (BLM 2007).



R. Cadigan, DOTPF

The Dalton Highway.

The North Slope Borough has about 107 mi of roads, excluding the Dalton Highway and the oil field roads: Anaktuvuk Pass has 58 mi of roads; Nuiqsut has 9.4 mi; Barrow has 51 mi; and Kaktovik has

9.9 mi of roads (NSBCMP 2007). Nuiqsut is connected to the Dalton Highway by an ice road through the oil field road infrastructure for 5 to 7 months each year (NSBCMP 2007).

A state of Alaska effort is underway to determine a preferred route for a future road from the Trans-Alaska pipeline to Umiat. The project is the foothills west transportation access project to construct a road from the Dalton Highway to Umiat. The road will provide access to estimated oil and gas resources in the northwestern foothills and the National Petroleum Reserve-Alaska (NPR-A). The project will be constructed in phases, with the initial planned phase extending from the Dalton Highway to the Gubik oil and gas field located north and outside of the northwest portion of the lease sale area (Map 5.9 and Map 5.10). A second planned phase will be to continue road construction from the Gubik oil and gas field to Umiat, including construction of a bridge across the Colville River and building an additional 15 mi of roadway (ADOT 2010).

Inter-village travel in the NSB is accomplished with the use of trails using snow machines in winter and All Terrain Vehicles (ATV) in summer. There is a trail between Nuiqsut and Anaktuvuk Pass that is reported to be about 140 mi long (NSBCMP 2007). “Cat-trains” that use inflated tires that do not damage the tundra are also used to transport freight. In addition the NSB maintains about 43 mi of ice roads each year (NSBCMP 2007).

## **5. Research Facilities**

The University of Alaska Fairbanks Institute of Arctic Biology Toolik Field Station is an active research facility located at Milepost 284 on the Dalton Highway within the lease sale area. It is about 158 mi north of the Arctic Circle.

Establishment of this research center was related to the construction of the Dalton Highway, also known as the Haul Road, that opened areas of northern Alaska to access and research (Shaver 2009, citing to Alexander and VanCleve 1983).



Toolik Research Station.

In 1975 an aquatic study was begun of the lakes and streams near Toolik Lake. A camp was located on an old airstrip near a former road construction camp with the objective of researching the aquatic

biomass, productivity and the cycles of organisms in Toolik Lake. By 1979 terrestrial ecosystem studies were being conducted on plant growth within the tundra environments and the effects of disturbance. A series of active research projects were conducted about ecosystem processes and Arctic lakes over the next several decades (Shaver 2009). Currently research based at Toolik Lake field station covers topics related to the Arctic. These include research in terrestrial and aquatic ecology, atmospheric science, physical sciences, physiology of arctic breeding birds, mammals and insects, and includes a broad range of temporal and spatial scales (UAF 2009).

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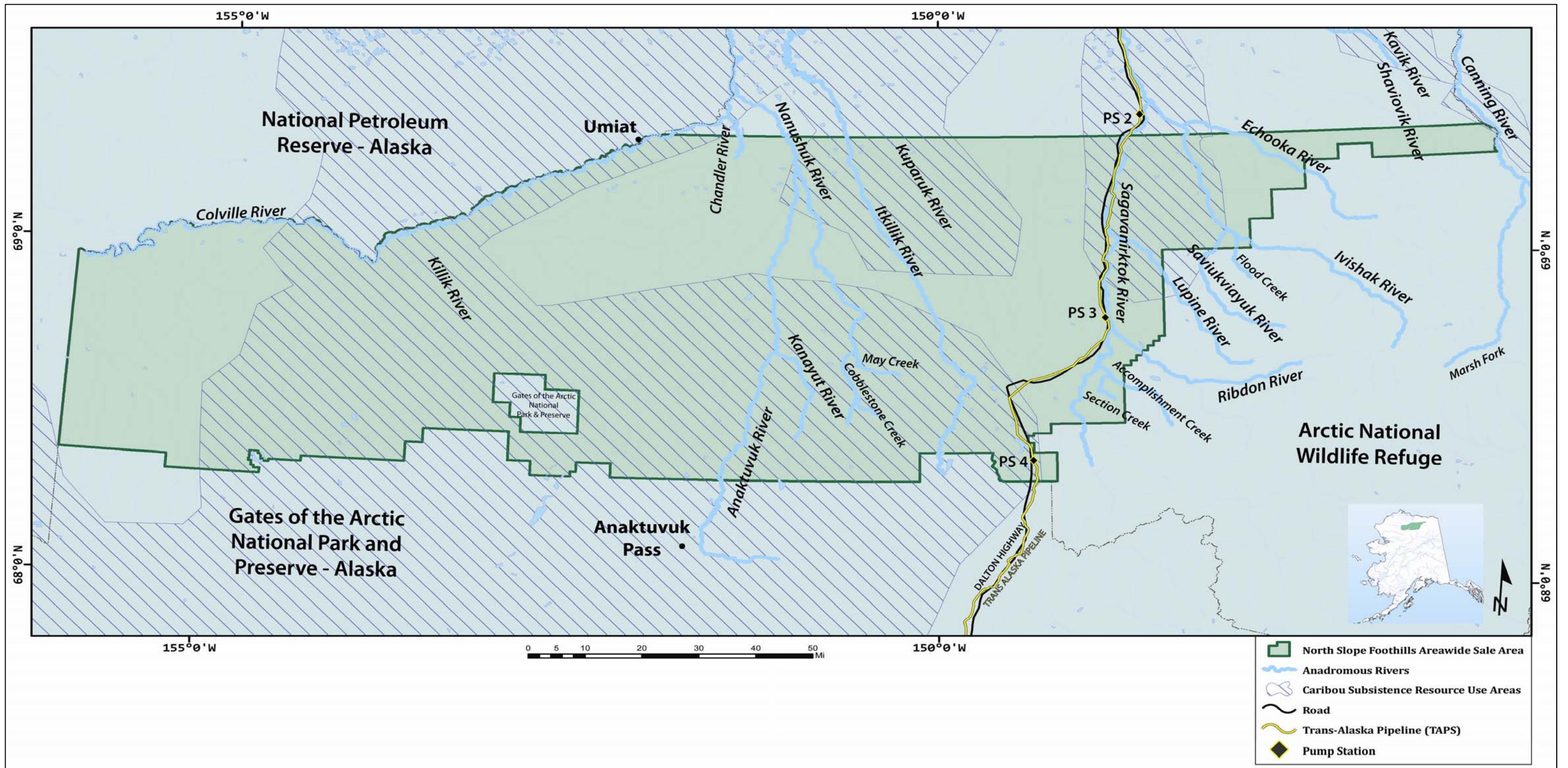
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## **E. Maps**

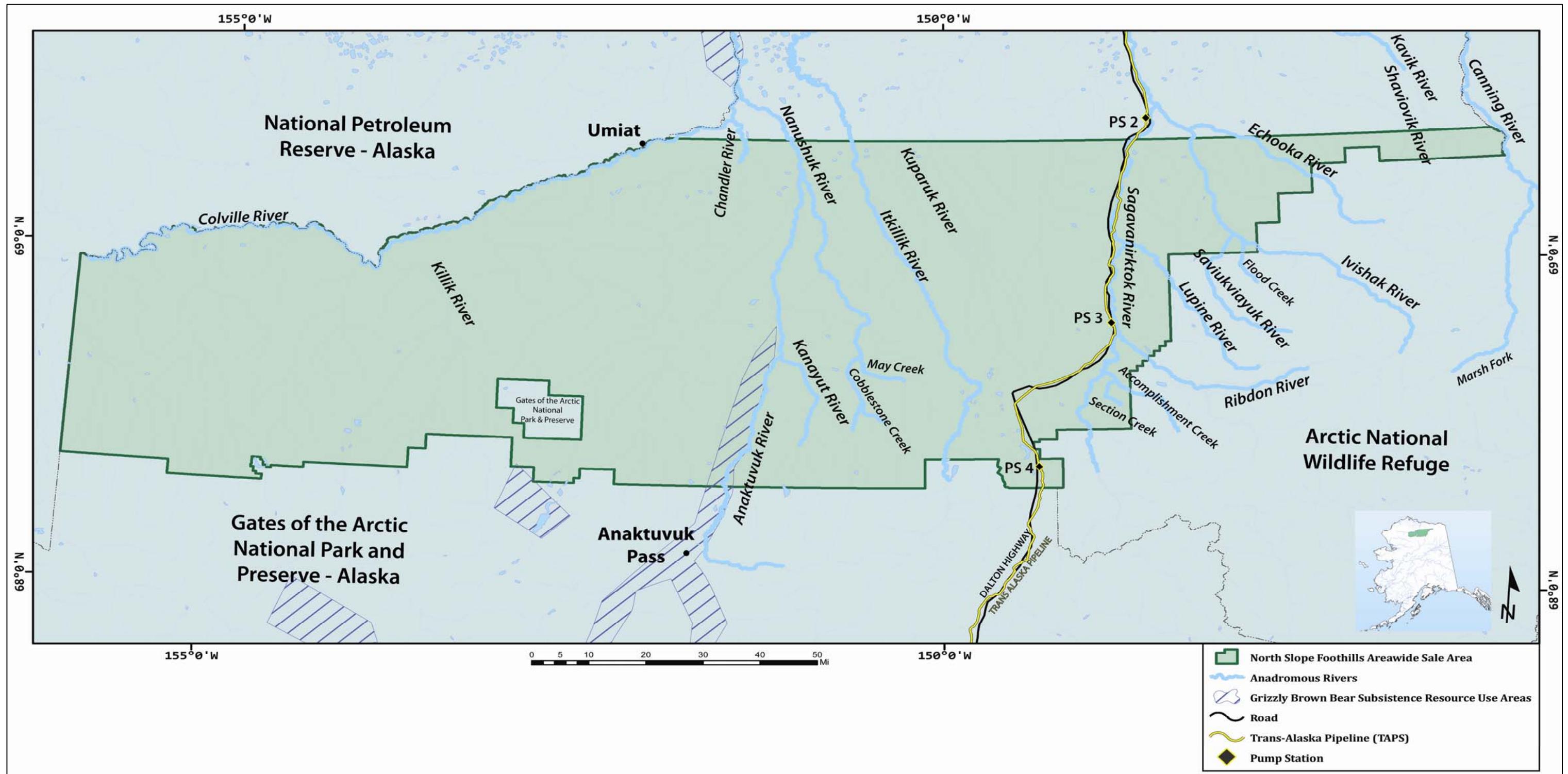




Source: Pedersen 1979.

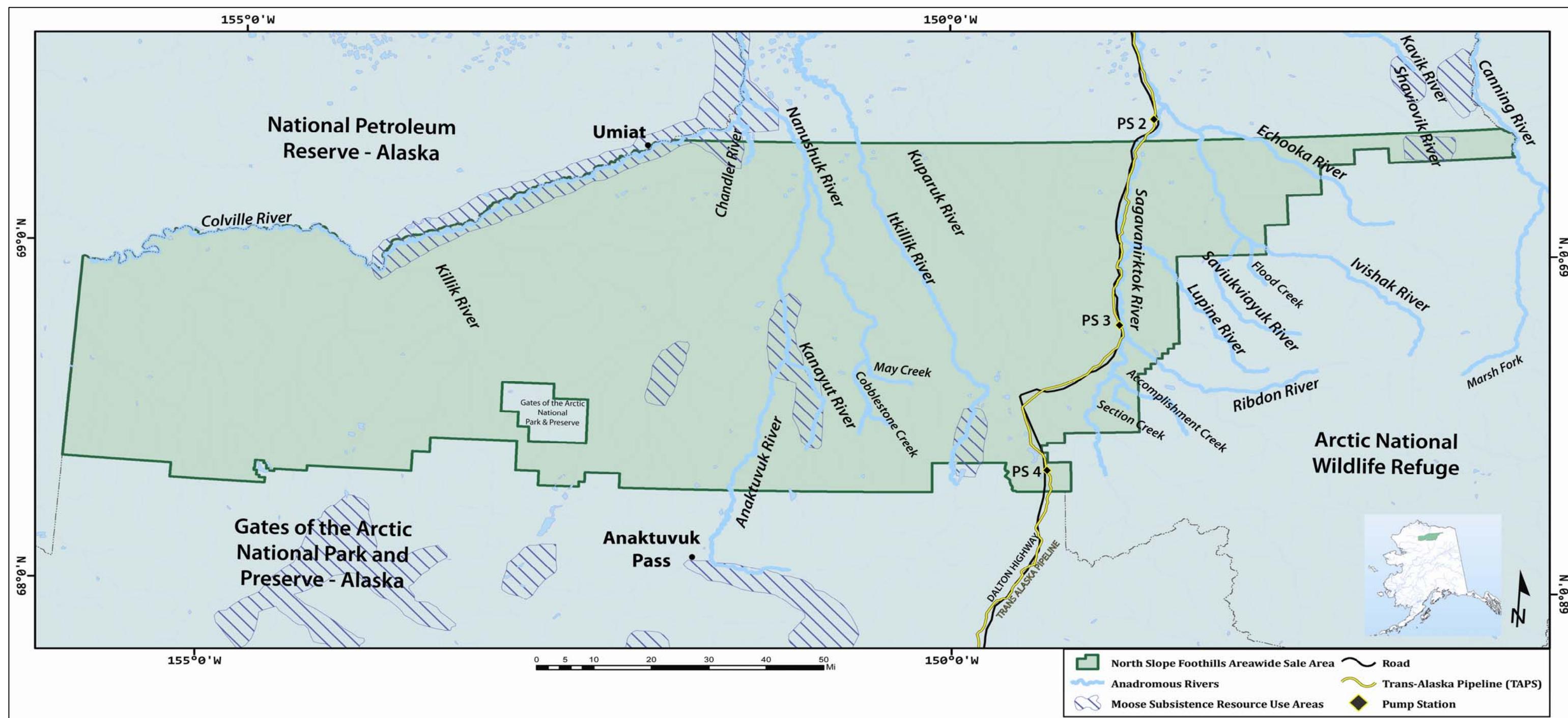
Map 5.1. Caribou subsistence resource use areas.





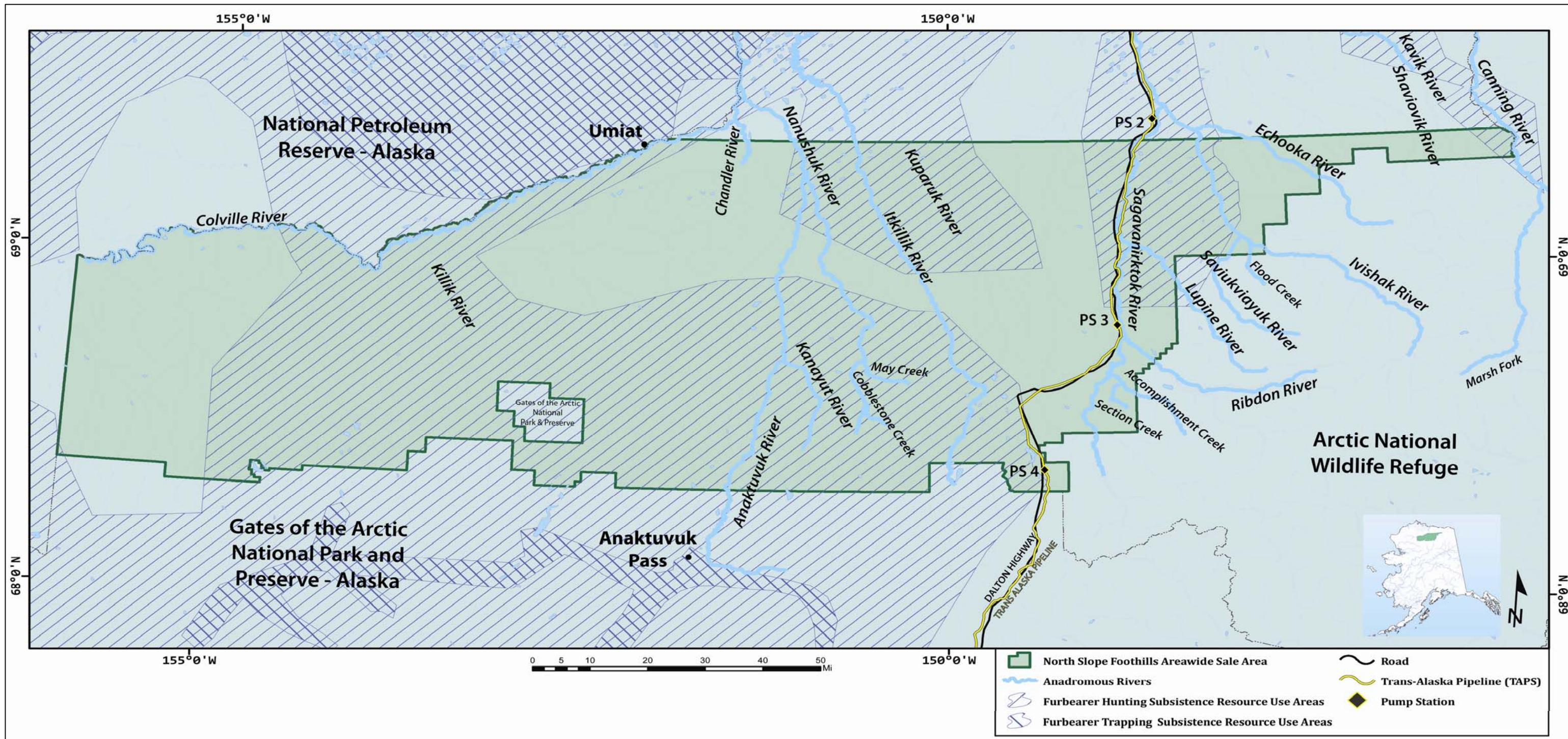
Map 5.2. Brown bear subsistence resource use area.





Map 5.3. Moose subsistence resource use areas.

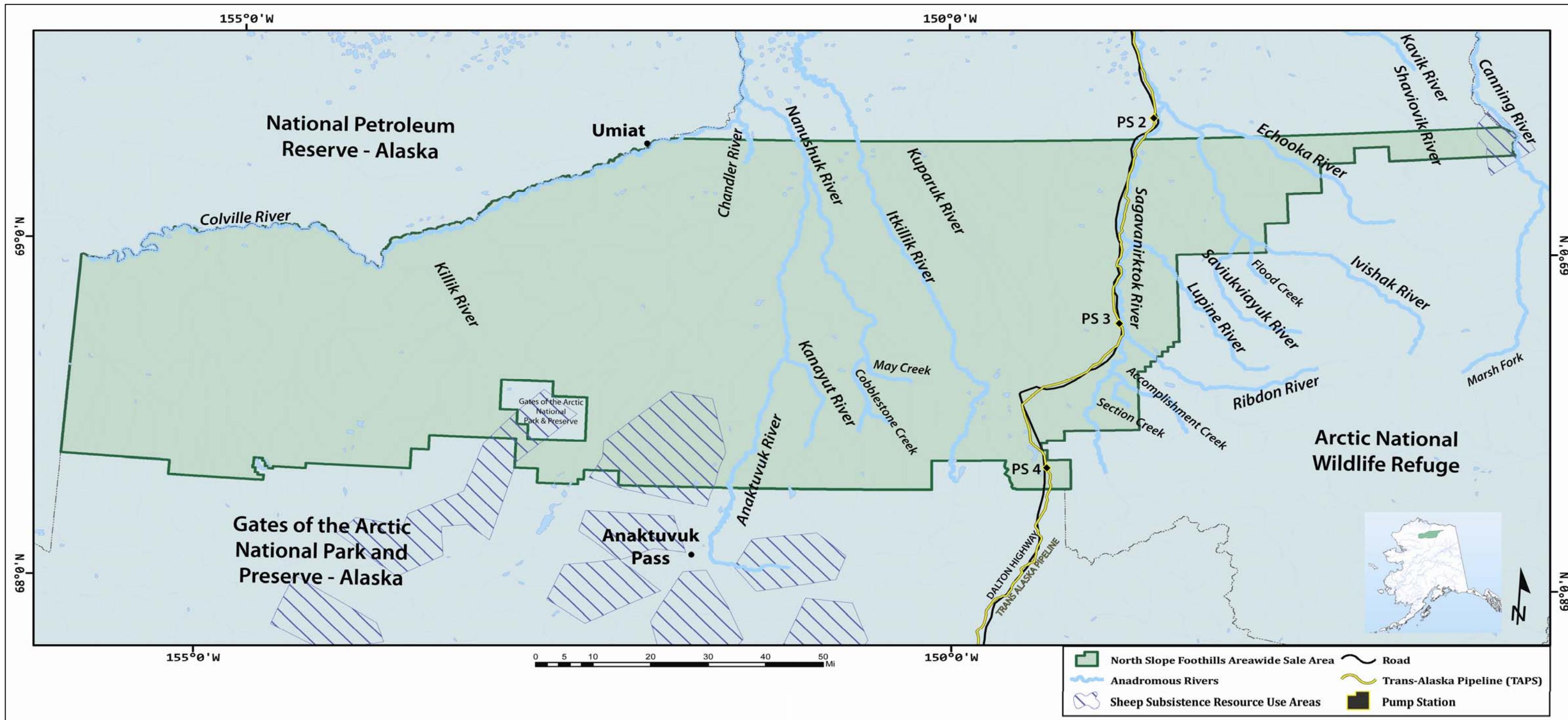




Source: Pedersen 1979.

Map 5.4. Furbearer hunting and trapping subsistence resource use areas.

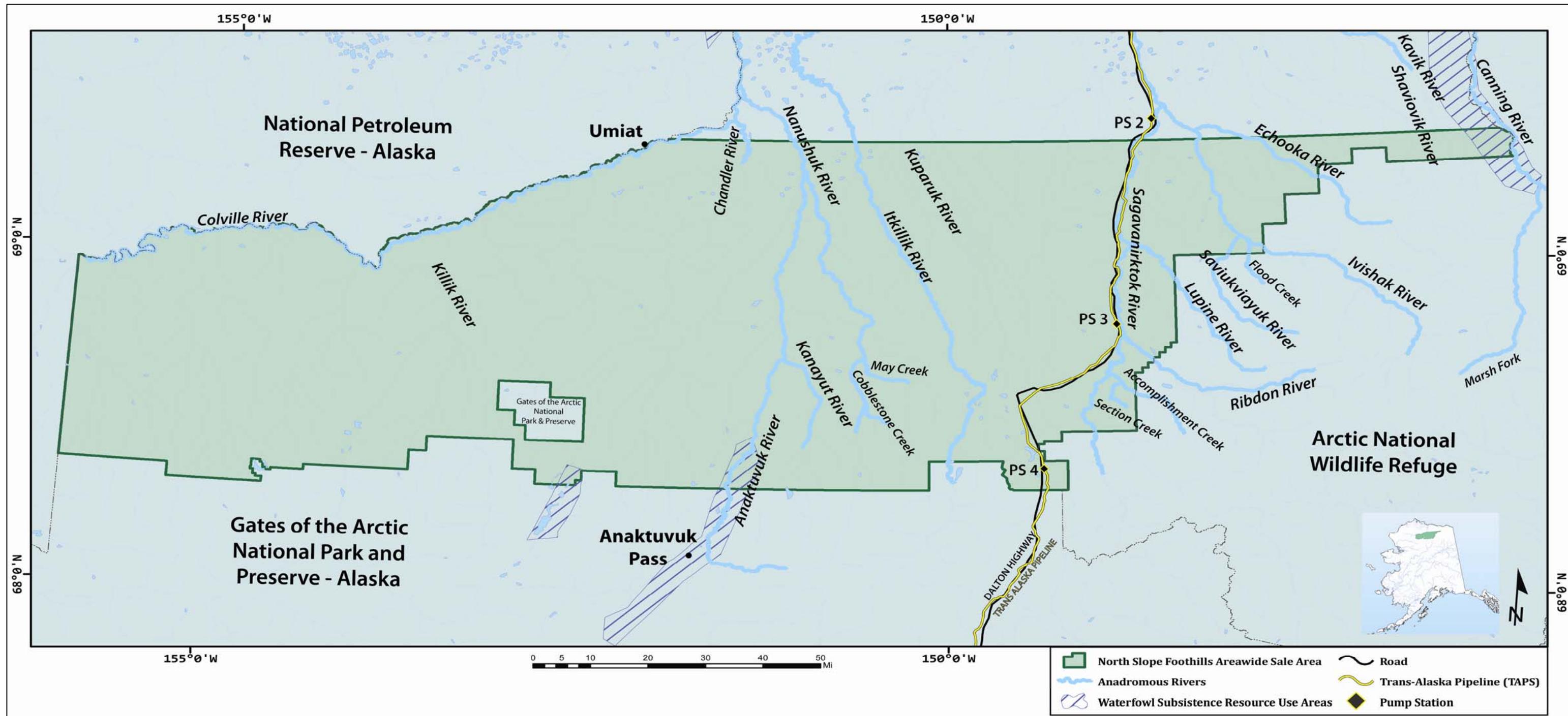




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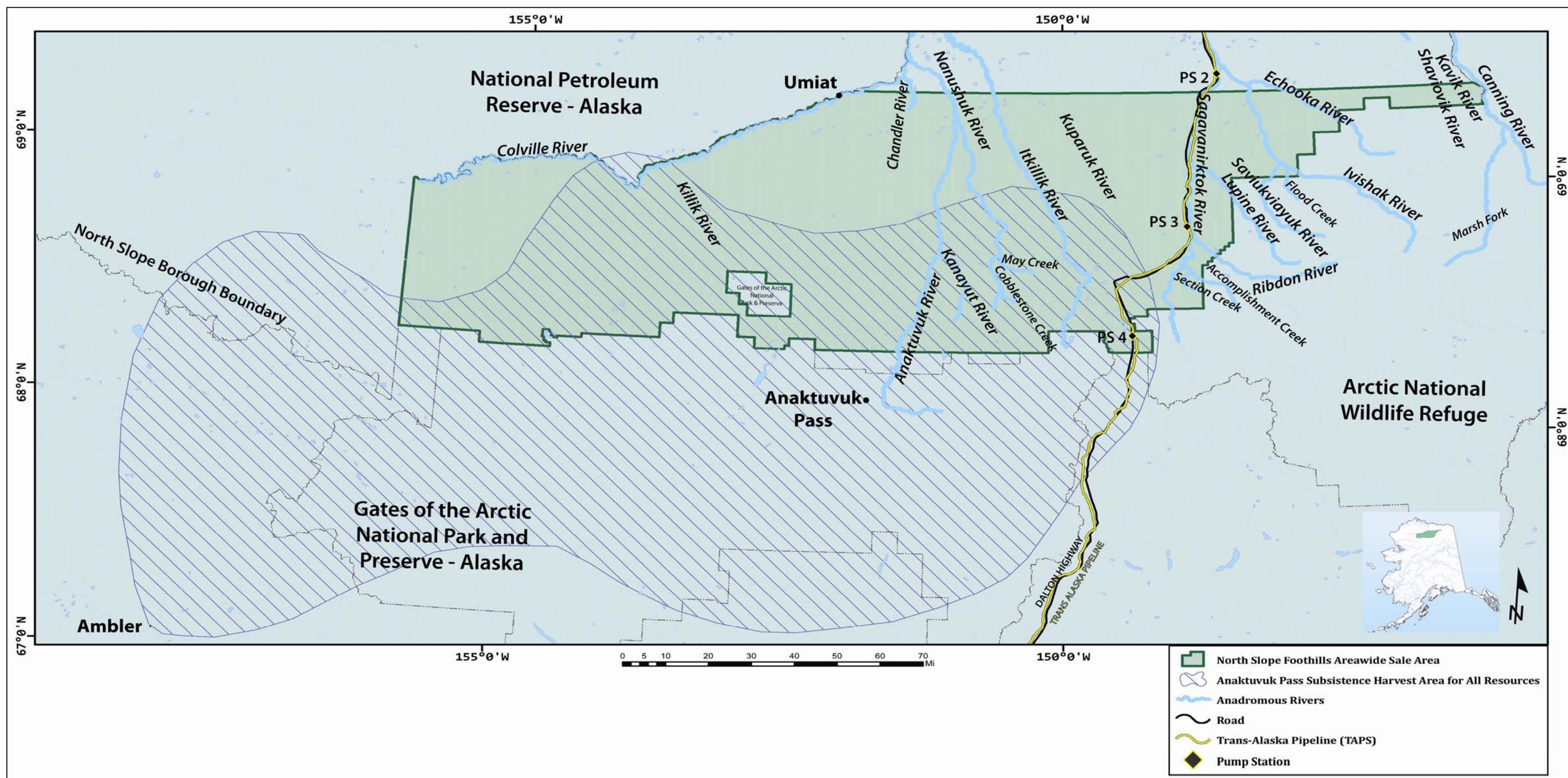
Map 5.5. Sheep subsistence resource use areas.





Map 5.6. Waterfowl subsistence resource use areas.

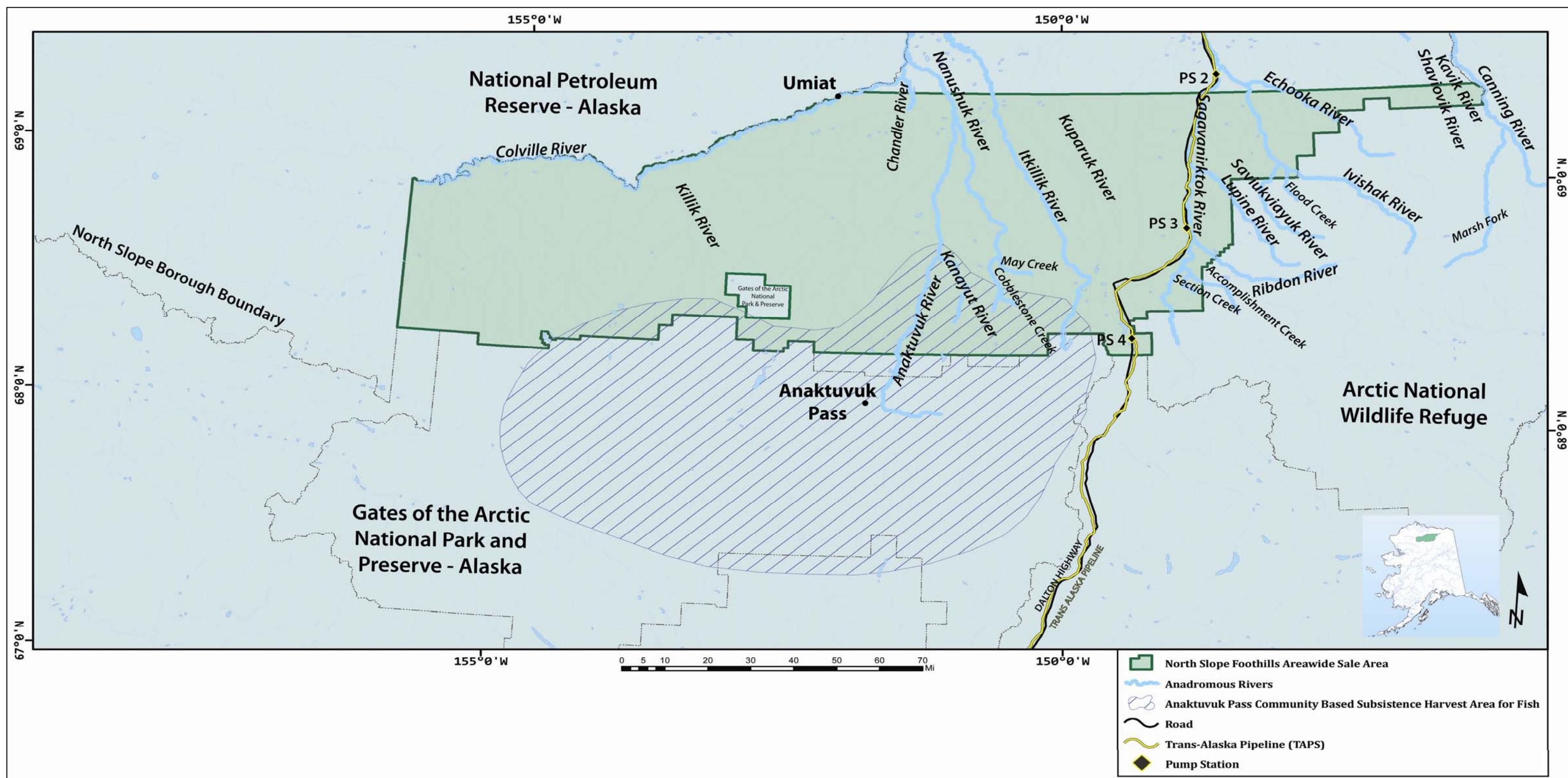




Source: Pedersen and Hugo 2005, citing to Pedersen 1979.

Map 5.7. Subsistence harvest area for all resources, Anaktuvuk Pass.

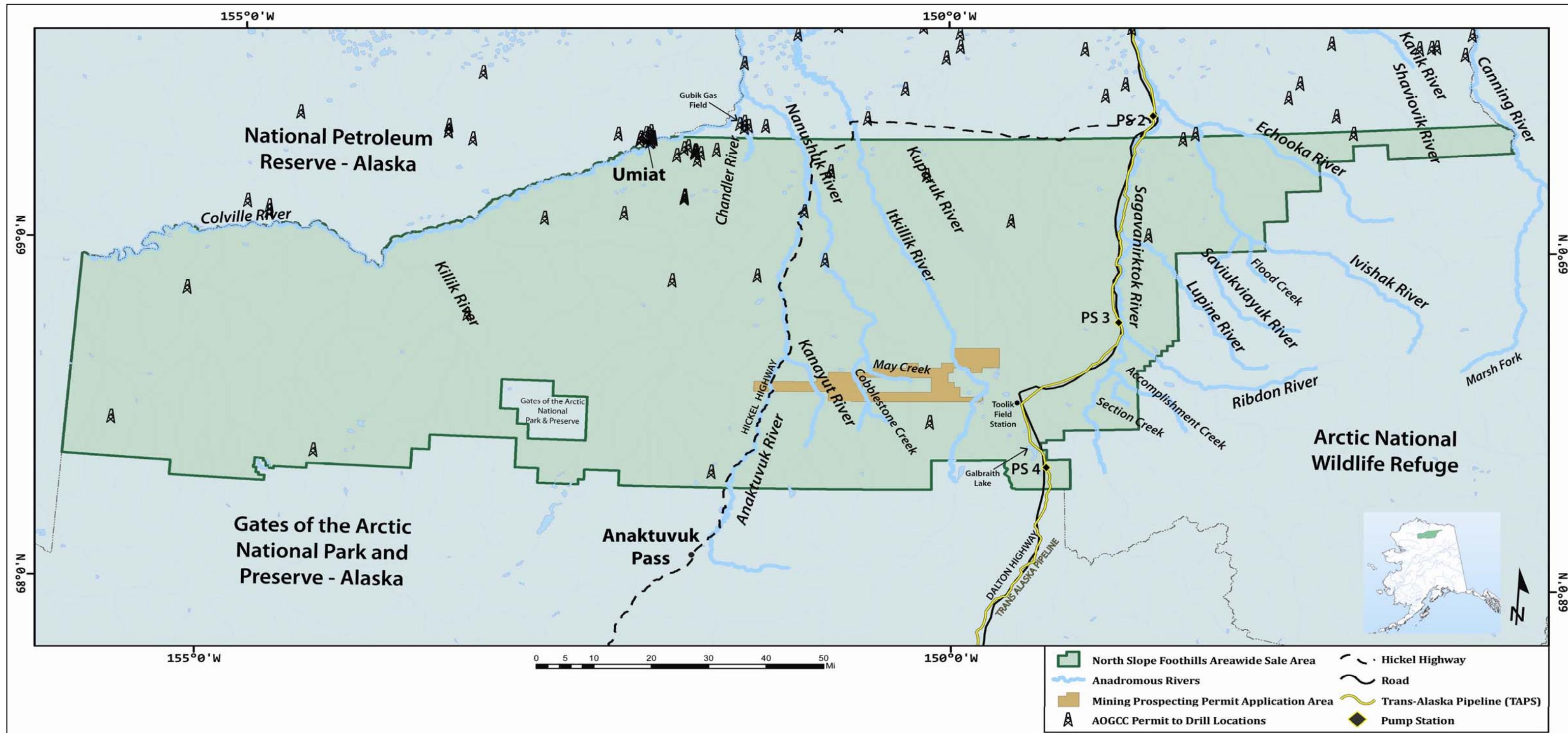




Source: Pedersen and Hugo 2005, citing to Pedersen 1979.

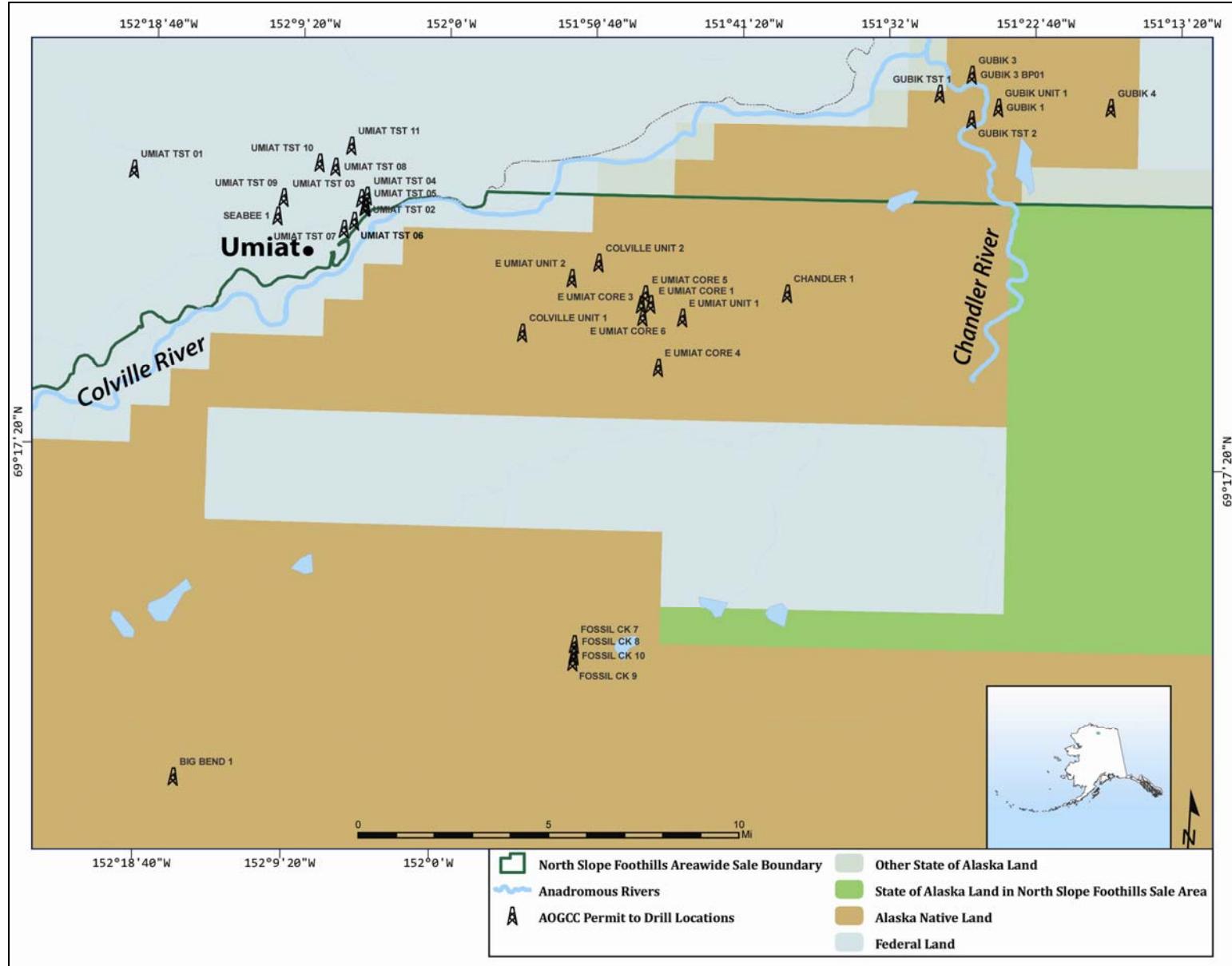
Map 5.8. Subsistence harvest area for fish, Anaktuvuk Pass.





Map 5.9. Oil, gas, and mining infrastructure and proposed mining permit application area in the North Slope Foothills area.





Source: AOGCC 2010.

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# Chapter Six: Oil and Gas in the North Slope Foothills Area

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# Chapter Six: Oil and Gas in the North Slope Foothills Area

## A. Geology

The North Slope Foothills lease sale area is distinct from and a subset of the North Slope Foothills Province (NSFP), which is a regional geologic feature that is part of Alaska's east-west trending North Slope Petroleum Province. The NSFP is nestled between the Brooks Range Province to the south and the Coastal Plain Province to the north. The NSFP encompasses more than 40,000 square miles, including the lease sale area lands, the southern part of the North Slope Areawide lands, greater than half the federally-managed NPR-A lands, the southern portion of ANWR 1002 area lands, various native corporation lands, and lands of mixed ownership on the far western North Slope. The NSFP regional depositional history is divided into four main sequences distinguished by sediment provenance, depositional style, and tectonics. These four sequences are listed (oldest to youngest) and discussed below.

The Franklinian sequence consists of fractured argillites, quartzites, carbonates, volcanics, and granitic rocks that once composed a stable continental platform prior to Devonian time 400 million years ago (Table 6.1). The Franklinian sequence includes the oldest sedimentary rocks in the NSFP and is considered effective basement for oil and gas potential (Figure 6.1). It is unlikely to contain any significant oil or gas accumulations in the foothills; however, if such accumulations are present they would likely be in the form of fractured reservoirs. During Late Devonian time, the Franklinian sequence was uplifted and deformed with coincident erosion of this uplifted sequence providing the dominant sediment source for the Ellesmerian sequence (Figure 6.2).

The Ellesmerian sequence consists of marine carbonates and clastic rocks rich in quartz and chert that were deposited on a subsiding foldbelt terrain for 150 million years during Mississippian to Early Jurassic time (Table 6.1). It is subdivided into a lower and upper section. The lower



Mississippian Lisburne Group carbonates north of the village of Anaktuvuk Pass,  
south of the North Slope Foothills lease sale area.

Ellesmerian section contains proven oil and gas accumulations in the Coastal Plain Province, such as the Endicott, Lisburne, and Liberty oil fields. The upper Ellesmerian section contains proven oil and gas accumulations such as the Prudhoe Bay, Northstar, and Raven oil fields and the Kemik, Kavik, and Sandpiper gas fields. The Shublik Formation and Sadlerochit Group are two of the most continuous rock units in this section (Figure 6.1). The Ellesmerian sequence thins to the south due to increasing distance from its source area and thins to the north due to the combined effects of onlap, subaerial uplift, and erosion prior to deposition of the Beaufortian Rift sequence (Figure 6.2; Moore et al. 1994).

**Table 6.1. Geologic time.**

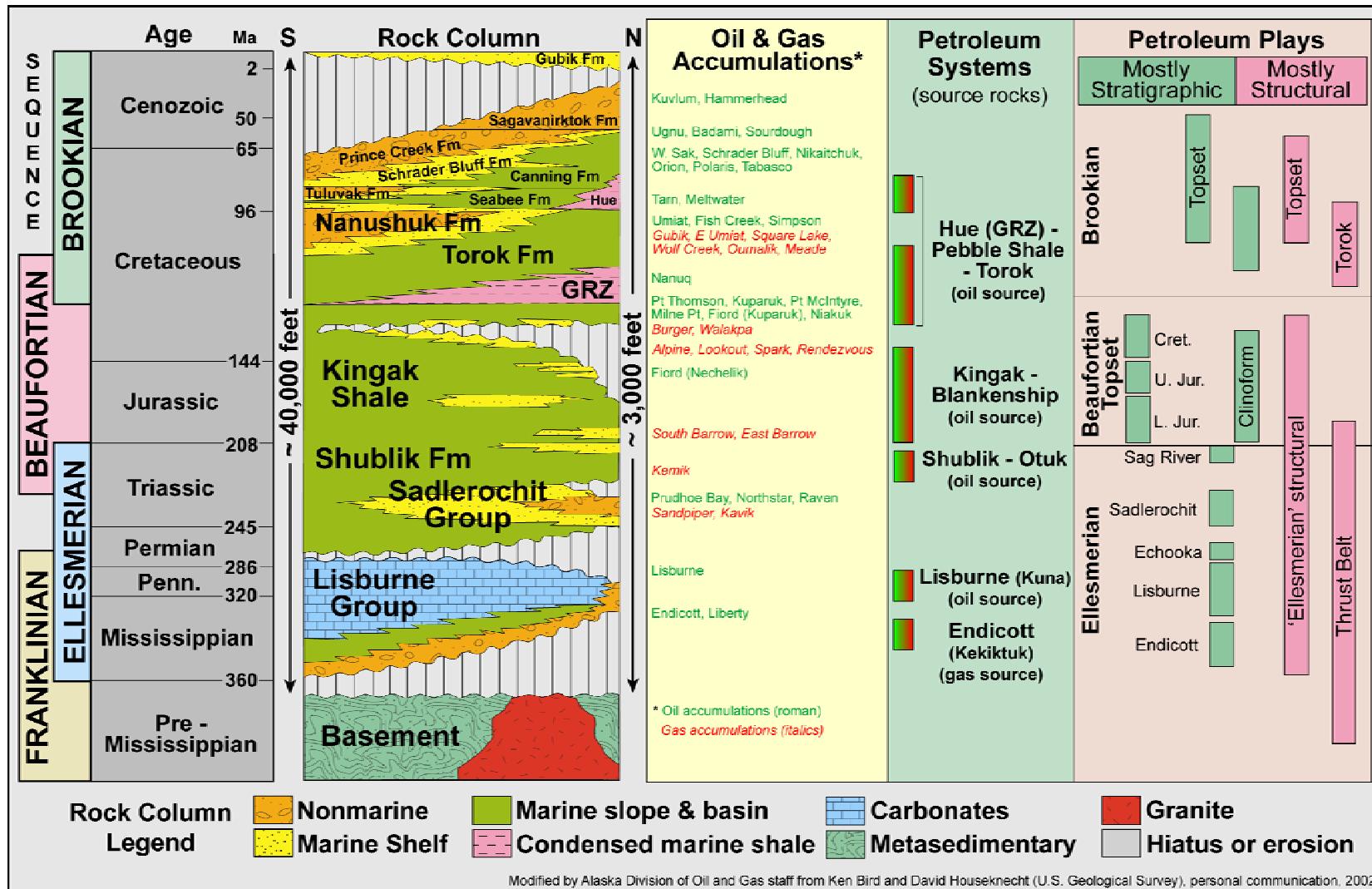
Era	Period	Epoch	Age (Millions of years)
Cenozoic	Quaternary	Holocene	0.01
		Pleistocene	1.8
	Tertiary	Pliocene	5.3
		Miocene	23.0
		Oligocene	33.9
		Eocene	55.8
		Paleocene	65.5
Mesozoic	Cretaceous	Early to Late	145.5
	Jurassic	Early to Late	199.6
	Triassic	Early to Late	251.0
Paleozoic	Permian	Early to Late	299.0
	Pennsylvanian	Early to Late	318.1
	Mississippian	Early to Late	359.2
	Devonian	Early to Late	416.0
	Silurian	Early to Late	443.7
	Ordovician	Early to Late	488.3
	Cambrian	Early to Late	542.0

Notes: Modified by DO&G staff from USGS 2007.

The Beaufortian sequence consists of marine shales, siltstones, and sandstones sourced from the Barrow Arch rift shoulder. Oil and gas accumulations adjacent to the Barrow Arch are contained in purely stratigraphic or combination structural/stratigraphic traps formed by associated rifting events; however, in the foothills proper, structural traps form the dominant play (Figure 6.2). The Beaufortian sequence contains proven oil and gas accumulations such as the Kuparuk, Point McIntyre, Milne Point, Fiord-Kuparuk, Niakuk, and Fiord-Nechelik oil fields and the East Barrow, South Barrow, and Walakpa gas fields. The Kingak Shale and pebble shale unit (informal name) are two of the most continuous rock units in this sequence (Figure 6.1).

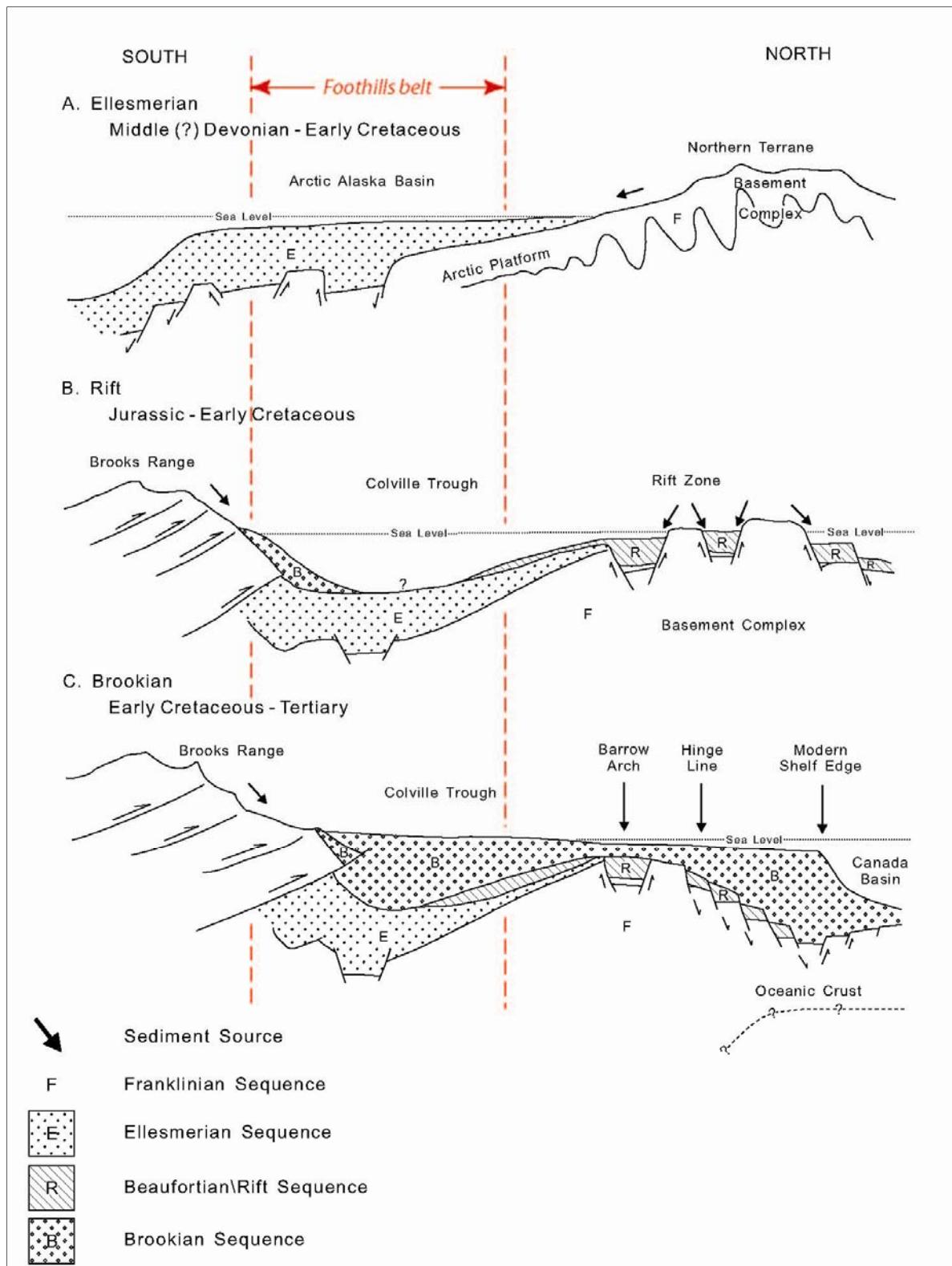
The Brookian sequence consists of sandstones that contain significantly less quartz and more ductile rock fragments than sandstones of the Ellesmerian sequence. Development of the Brookian sequence involved enormous amounts of sediment which were shed northward into the adjacent foredeep from the developing Brooks Range orogenic belt during Jurassic to Early Cretaceous time (Table 6.1). These sediments filled the Colville Basin to the north and then spread out over the Barrow Arch and onto the continental margin during Late Cretaceous to Tertiary time (Figure 6.2; Moore et al. 1994). The Brookian sequence contains proven oil and gas accumulations such as the West Sak, Schrader Bluff, Tabasco, Tarn, Meltwater, Umiat, Fish Creek, and Simpson oil fields and the East Umiat, Gubik, Square Lake, Wolf Creek, Oumalik, and Meade gas fields (Figure 6.1).

Refer to Map 5.9 and Map 5.10 for the location of the Gubik gas field, located north of and outside the lease sale area.



Source: USGS 2002.

Figure 6.1. Chronostratigraphic diagram for the central North Slope showing major sequences, discovered oil and gas accumulations, source rocks, and generalized plays.



Source: Craig et al. 1985.

**Figure 6.2. Schematic cross-sectional representation of North Slope basin evolution: Devonian time to present.**

Petroleum source rock facies of the Shublik Formation, Kingak Shale, pebble shale unit, and Hue Shale (gamma ray zone) and younger basinal shales of the Brookian sequence (Figure 6.1) are all likely to have generated gas and/or oil within the NSFP, based on organic richness, kerogen composition, and thermal maturity determined from well and outcrop samples. The data suggest these rocks currently reside principally within the gas window and partially within the oil window (Bird 1994; Bird 2001; Peters et al. 2006).

## B. Exploration History

The NSFP on the northern flanks of the Brooks Range was considered prospective for hydrocarbon exploration as early as the 1920s because of widespread discernable surface anticlinal structures in the area. The U.S. Geological Survey (USGS) spent the summers of 1923-1926 conducting reconnaissance surface-mapping in the NSFP.

From 1944-1953 the U.S. Navy, in conjunction with the USGS, conducted a widespread exploration drilling program in an area of the North Slope known at the time as the National Petroleum Reserve No. 4 (NPR-4) and known today as the National Petroleum Reserve-Alaska (NPR-A) (Bird 1994). The southern part of this area includes a region that today falls within the northern part of the North Slope Foothills lease sale boundary and NSFP area. As a result of the NPR-4 drilling program oil accumulations were discovered at Fish Creek, Cape Simpson, and Umiat and gas accumulations were discovered at South Barrow, Simpson, Meade, Wolf Creek, and Gubik (Figure 6.1). The Umiat oil and Gubik gas accumulations are located near the westward bend in the Colville River and adjacent to, but outside of, the north-central part of the lease sale area.

Building on the exploration drilling efforts of the U.S. Navy, private industry began exploratory drilling in the mid 1960s. In 1964, six wells were drilled by various companies within the lease sale area. Drilling was focused where surface expressions indicated anticlinal structure, following the pattern set by the U.S. Navy. Although hydrocarbon shows were present in each of the six wells drilled, no oil fields and only one sub-commercial gas field (East Umiat) were identified as a result of this work. The East Umiat gas field is located in topset (shallow water) sandstones of the Nanushuk Formation within the Cretaceous aged Brookian sequence (Figure 6.1). A second pulse of exploratory drilling occurred from 1969-1971. Four wells were completed within the lease sale area during this time, but none led to any further activity. Although it lies outside of the North Slope Foothills lease sale boundary, the undeveloped Kavik gas accumulation occupies an anticlinal trap similar to other foothills structures, and was discovered in 1969.



Meade River test well 1 derrick, April 17, 1950.

USGS (Reed, J.C. 883; fi00883)



P. Decker, DO&G 2007

Lower Cretaceous shelfal strata of the uppermost Torok Formation and nonmarine units of the Nanushuk Formation at Slope Mountain in the North Slope Foothills lease sale area.

From 1974-1982 eleven additional exploratory wells were drilled in the lease sale area. The East Kurupa Unit 1 well resulted in the discovery of the East Kurupa gas accumulation, which occurs near the base of the Brookian sequence in bottomset (deep water) sandstones assigned to the lower Torok Formation or the Fortress Mountain Formation (Figure 6.1). The undeveloped Kemik gas field, located east of the Dalton Highway near the Arctic National Wildlife Refuge in the foothills of the northeastern Brooks Range, is contained in fractured, low permeability rocks of the Triassic Shublik Formation belonging to the Ellesmerian sequence (Figure 6.1), the oldest stratigraphic series with commercial hydrocarbon significance in northern Alaska. The gas at Kemik is believed to have been sourced from organic rich shales and limestones of the Shublik Formation (Magoon et al. 2003), with minimal migration from kitchen to reservoir (refer to Section C, Petroleum Potential below for further discussion). The Lisburne 1 well, completed in 1980 by Husky, was drilled as part of the USGS-led NPR-A exploration program. The boundary of NPR-A was later adjusted in that area, and the Lisburne 1 well now lies just within the western boundary of the lease sale area. This well tested the hydrocarbon potential of the Lisburne carbonates on a closed anticlinal structure in the overthrust belt on the western edge of the NSFP and the lease sale area. Minor gas shows were encountered in poor reservoir-quality rocks throughout the well (Legg 1983). Chevron drilled three wells on Arctic Slope Regional Corporation (ASRC) land: the Tiglukpuk 1 well in 1978, the Killik 1 well in 1981, and the Cobblestone 1 well in 1981-1982.

The last wells drilled in the lease sale area were the Big Bend 1 well, drilled on ASRC land in 1993 by ARCO and the Chandler 1 well, drilled in 2008-2009 by Anadarko Petroleum Corporation. The Chandler 1 well targeted the flank of the East Umiat anticline and established the presence of a deeper bottomset (deep water) gas reservoir likely of the Torok Formation and/or Fortress Mountain Formation (Petroleum News 2009; OGJ 2009). The Gubik 3 and 4 wells were also drilled and completed in 2008-2009 by Anadarko Petroleum Corporation in the Gubik gas field north of the lease sale area (AOGCC 2010b).



P. Decker, DO&G 2005

The southerly equivalent to the Upper Triassic Shublik Formation in the southern foothills.

## C. Petroleum Potential

The potential for new discoveries of conventionally recoverable petroleum in the lease sale area, located in the NSFP is relatively high for gas, and relatively low for oil. Determining petroleum potential requires evaluation of the geology, geophysics, and exploration history of an area, which in this case requires analysis of data that are sparsely distributed and in many cases antiquated by today's standards, making it a difficult task.

With the exception of the Umiat oil accumulation, discoveries to date within the NSFP consist primarily of dry gas trapped in anticlinal fold closures, most of which were identified from early surface geologic mapping supported by two-dimensional reflection seismic surveys. This is strong evidence, corroborated by outcrop and well data, that many of the source rocks in the foothills have reached advanced thermal maturity due to deep sediment burial, and that major new oil finds are unlikely. On the basis of geochemical and stratigraphic evidence, the hydrocarbons in the accumulations west of the Dalton Highway are traced to Lower Cretaceous shale source rocks of the gamma ray zone and lower Torok Formation at the base of the Brookian sequence (Figure 6.1; Magoon et al. 2003). These western accumulations are reservoired in Brookian topset sandstones of the Nanushuk and Tuluvak Formations. These units are largely to entirely absent to the east of the Dalton Highway, though younger Brookian units are present that may have untapped potential.

A petroleum systems approach is useful for evaluating the undeveloped resource potential of areas such as the NSFP that have not yet reached an advanced stage of exploration. This methodology considers and quantifies each of the interdependent elements of the overall geologic framework that together create producible accumulations of oil and gas. There are three basic elements of functioning petroleum systems: *effective source rocks* to generate oil and gas in the thermally mature area of the basin (referred to as the petroleum “kitchen”), *effective reservoir rocks* with pore space to store them in, and *effective traps*, the sealed compartments that contain hydrocarbon fluids, preventing their escape. Each of these three components must be physically connected to the others at the *critical moment*, the brief episode during the system’s geologic history when hydrocarbons are generated, migrate out of their source rock, and in favorable outcomes, encounter reservoirs in trapping configurations.

An important distinction must be drawn between *resources* and *reserves*. In North America, and most other countries, the term “reserves” is restricted to discovered, well-quantified, technically recoverable volumes that are nearly certain to reach commercial production. All other oil and gas, whether discovered or yet-to-be found, belongs in one of the various “resource” categories (Society of Petroleum Engineers 2005). In keeping with these definitions, oil and gas volumes discovered to date in the NSFP are currently best described as “sub-commercial resources” whose development potential is contingent upon constantly fluctuating economic factors and connection to markets.

Wellhead proximity to existing oil or gas infrastructure directly affects the size of the resource required to make a project economic. Due to the remoteness of the lease sale area from existing oil and gas infrastructure, any discovered resource needs to be of sufficient size to economically justify production. To date, this has not been the case. The State of Alaska is currently deliberating construction of a transportation corridor, called the Foothills West Transportation Project, connecting the Umiat and Gubik area to the Dalton Highway. ADOT is currently considering corridor alternatives that maximize the benefits for hydrocarbon exploration and development (ADOT 2009). It is anticipated that such a road would dramatically improve the likelihood of economically justifiable hydrocarbon development in the lease sale area.

## **D. Phases of Oil and Gas Development**

Lease-related activities proceed in phases, moving from leasing, to exploration, development and production, transportation and storage, as needed. Each phase’s activities depend on the completion or initiation of the preceding phase. Table 6.2 lists some activities that may occur during the exploration, development, and production phases.

### **1. Lease Phase**

Oil and gas lease sales are the first step in developing the state’s oil and gas resources. Annually, DO&G prepares and presents a 5-year program of oil and gas lease sales to the legislature. DO&G conducts competitive annual areawide lease sales, offering for lease all available state acreage within five areas: North Slope; Beaufort Sea; Cook Inlet; North Slope Foothills; and the Alaska Peninsula. The lease sale area is divided into tracts, and interested parties that qualify may bid on one or more tracts.

Not later than 45 days before the lease sale, DO&G issues a notice describing the interests to be offered, the location and time of the sale, and the terms and conditions of the sale (AS 38.05.035(e)(6)(F)(ii)). The announcement includes a tract map showing generalized land status, estimated tract acreages, and instructions for submitting bids. The actual lease sale consists of opening and reading the sealed bids and awarding a lease to the highest bid per acre by a qualified bidder on a tract. DO&G verifies the state’s ownership interest only for the acreage within tracts that receive bids. Only those state-owned lands within the tracts that are determined to be free and clear of title conflicts are available to lease.

Alaska has several leasing method options designed to encourage oil and gas exploration and maximize state revenue. These methods include combinations of fixed and variable bonus bids, royalty shares, and net profit shares. Lease terms are set at 5, 7, or 10 years, depending on a number of factors, including geographical location. An oil and gas lease grants to the lessee the exclusive right to drill for, extract, remove, clean, process, and dispose of oil, gas, and associated substances. A lease plan of operations must be approved before most operations may be undertaken on or in the leased area.

Although beyond the scope of this best interest finding, exploration licensing supplements the state’s areawide oil and gas leasing program by targeting areas outside of known oil and gas provinces. The intent of licensing is to encourage exploration in areas far from existing infrastructure, with relatively

low or unknown hydrocarbon potential, where there is a higher investment risk to the operator. Because bonus payments are required to win a lease, lease sales held in some of these higher-risk areas tend to attract little participation. Exploration licensing gives an interested party the exclusive right to conduct oil and gas exploration without this initial expense. Through exploration licensing, the state receives valuable subsurface geologic information on these regions and, should development occur, additional revenue through royalties and taxes (AS 38.05.131-134).

**Table 6.2. Potential activities during exploration, development, and production phases**

Exploration	Development	Production
Permitting	Gravel pits, pads, and roads	Well work over (rigs)
Water usage	Dock and bridge construction	Gravel islands, pads, and roads
Environmental studies	Drilling rigs	Produced water
Seismic acquisition	Pipelines	Air emissions
Exploratory drilling rigs	Work camps	Pipeline maintenance
Drilling muds and discharges	Permitting	Work camps
Gravel or ice road beds	Monitoring	Trucking
Work camp	Well heads	
Increased air traffic	Injection wells	
Temporary ice or gravel pads	Seismic acquisition	
Research and analysis		

## **2. Exploration Phase**

During the exploration phase, information is gathered about the petroleum potential of an area by examining surface geology, researching data from existing wells, performing environmental assessments, conducting geophysical surveys, and drilling exploratory wells. The surface analysis includes the study of surface topography or the natural surface features, and near-surface structures revealed by examining and mapping near-by exposed rock layers. Geophysical exploration and exploration drilling are the primary activities that could result in potential effects to the North Slope Foothills lease sale area. Geophysical surveys, primarily seismic, help reveal the characteristics of the subsurface geology.

### **a. Geophysical Exploration**

Before proceeding with geophysical exploration, companies must acquire one or more permits from the state, depending on the timing and extent of the proposed activity. Geophysical exploration activities are regulated by 11 AAC 96. DO&G evaluates each permit and issues an authorization relating to the specifics of the proposed project. Restrictions on geophysical exploration permits depend on the duration, location, and intensity of the project. They also depend on the potential effects the activity may have on fish and wildlife resources or human use in the area. The extent of potential effects varies, depending on the survey method and the time of year the survey is conducted.

Seismic surveys are the most common type of geophysical exploration, and are typically conducted by geophysical companies under contract to leaseholders or as multi-client and speculative surveys run directly by the seismic contractors. At the survey location, energy is emitted into the subsurface and reflected seismic waves are recorded at the surface by geophones and/or hydrophones, vibration-sensitive devices. Different rock layers beneath the surface have different velocities and densities. This results in a unique seismic profile that can be analyzed by geophysicists to interpret subsurface



Courtesy PGS

Active seismic work on the North Slope.

structures and petroleum potential. Both 2-dimensional (2D) and 3-dimensional (3D) data are gathered from seismic surveys.

Seismic source and receiver locations are surveyed using GPS (Global Positioning Systems) and laid out or sailed in predesigned patterns. For land or ice 2D data, the receivers and sources lie in a straight line (as topographic and ice conditions permit), and can extend for many tens of miles. For 3D data, data is collected over a much wider swath, and can cover tens to hundreds of square miles. 2D seismic programs usually have fewer crew members and employ much less equipment than 3D programs.

Seismic data can be collected after the ground is well frozen and covered with a protective snow layer. Seismic in shallow water can be collected on the ice in winter, or by using bottom cables in the summer months. Ice based seismic programs are dependent on ice thickness and stability. Collecting data in the winter months may minimize effects to fish and wildlife habitats, and avoids conflicts with migrating marine mammals.

Multiple seismic sources can be used on land or ice surveys, but vibrator trucks are by far the most common. A vibrator truck is a low ground pressure vehicle with a heavy plate attached. The entire weight of the truck rests on the plate as it puts energy of continuously varying frequency into the ground. The vibration typically lasts 4 to 16 seconds. This energy source is less destructive than an impulsive explosive source, where all the energy is imparted in an instant. Less commonly, air guns can be lowered through holes drilled in the ice to provide the acoustic energy.

Additional geophysical techniques can be used to gather information specifically about very near surface geology, usually to identify drilling hazards. They include high-resolution shallow seismic, side-scan sonar, fathometer recordings and shallow coring programs. High-resolution shallow seismic surveys are specifically designed to image the bottom of the water body and very shallow geology. They employ a lower energy seismic source and a shorter cable than surveys targeting deeper oil and gas potential.

## b. **Exploration Drilling**

Exploratory drilling often occurs after seismic surveys are conducted, and when the interpretation of the seismic data incorporated with all available geologic data indicates possible oil and gas prospects. Exploration drilling, which proceeds only after obtaining the appropriate permits, is the only way to learn whether a prospect contains commercial quantities of oil or gas, and aids in determining whether to proceed to the development phase. Drilling operations collect well logs, core samples, cuttings, and a variety of other data. A well log is a record of one or more physical measurements as a function of depth in a borehole and is achieved by lowering measuring instruments into the well bore. Well logs can also be recorded while drilling. Cores may be cut at various intervals so that geologists and engineers can examine the sequences of rock that are being drilled.

The drilling process generally proceeds as follows:

- Large diameter steel pipe (conductor casing) is bored into the soil.
- A drill bit, connected to the end of the drill pipe, rotates and drills a hole through the rock formations below the surface.
- After a prescribed depth of drilling, the hole is cleaned up and surface casing, a smaller diameter steel pipe, is lowered into the hole and cemented in place. This keeps the hole from caving in; seals off rock formations; seals the well bore from groundwater; and provides a conduit from the bottom of the hole to the drilling rig.
- After surface casing is set, drilling continues until the objective formation is reached. In instances where subsurface pressures are extremely high, an intermediate casing string may be lowered into the hole and cemented in place.
- The well either: produces; is suspended; or is plugged and abandoned.

The drill site is selected to provide access to the prospect and, if possible, is located to minimize the surface area that may have to be cleared. Sometimes temporary roads must be built to the area. Non-permanent roads are constructed of ice, with permanent roads being constructed of sand and gravel placed on a liner above undisturbed ground. Construction of support facilities such as production pads, roads, and pipelines may be required. A typical drill pad is made of ice or sand and gravel placed over a liner and is about 300 ft by 400 ft. The pad supports the drill rig, which is brought in and assembled at the site, a fuel storage area if necessary, and a camp for workers. If possible, an operator will use nearby existing facilities for housing and feeding its crew. If facilities are not available, a temporary camp of trailers on skids may be placed on the pad. Enough fuel is stored on-site to satisfy the operation's short-term needs. The fuel storage area is a diked gravel pad lined with an 80 mil synthetic membrane. Additional amounts of fuel may be stored at the nearest existing facility for transport to the drilling area as needed (Chevron 1991).

Directional drilling is used to extend the length of the reservoir that is penetrated by the well (Dawe 2001). Exploration wells within the lease sale area may be directionally drilled because of a lack of suitable surface locations directly overlying exploration targets. The drilling technique used is controlled to direct the bore hole to reach a particular part of the reservoir. Directional drilling technology enables the driller to steer the drill stem and bit to a desired bottom hole location. Directional wells initially are drilled straight down to a predetermined depth and then gradually curved at one or more different points to penetrate one or more given target reservoirs (Van Dyke 1997). Directional drilling also allows multiple production and injection wells to be drilled from a single surface location such as a gravel pad or offshore production platform, thus minimizing cost and the surface impact of oil and gas drilling, production, and transportation facilities. It can be used to reach a target located beneath an environmentally sensitive area and may offer the most

economical way to develop offshore oil fields from onshore facilities. Extended reach drilling (ERD) is used to access reservoirs that are remote (up to 10 km) from the drilling location. These techniques allow for drilling into reservoirs where it is not possible to place the drilling rig over the reservoir (Dawe 2001).

An exploratory drilling operation generates drilling cuttings, that are fragments of rock cut by the drill bit. These fragments are carried up from the drill bit by the mud pumped into the well (Van Dyke 1997). Gas, formation water, fluids, and additives used in the drilling process are also produced from drilling operations. The fluids pumped down the well are called “mud” and are naturally occurring clays with small amounts of biologically inert products. Different formulations of mud are used to meet the various conditions encountered in the well. Chemicals may be added to maximize the effectiveness of drilling and casing. Drilling additives may include petroleum or other organic compounds to modify fluid characteristics during drilling (Lapham et al. 1997). Additives may be aromatic hydrocarbons, emulsifiers and metals (Woodward et al. 1988). Oil-based muds and synthetic-based muds may also be used, depending on the well depth, well diameter, and subsurface formations (NRC 1983; Veil et al. 1996). Muds are used to cool and lubricate the drilling bit, to prevent the drill pipe from sticking to the sides of the hole, to facilitate the drilling action, to carry cuttings within the well bore to the surface, to seal off cracks in down-hole formations to prevent the flow of drilling fluids into these formations, and to maintain reservoir pressure.

During drilling and after a well is in production, produced water comes to the surface mixed with oil and gas and must be separated before further refining. Drilling muds, fluids, and cuttings produced from the well are separated and disposed of, often by reinjection into an approved disposal well annulus or disposal well, or they may be shipped to a disposal facility out-of-state. Produced waters are reinjected either into the producing formation to enhance recovery, or into an injection well.

Disposal of mud, cuttings, and other effluent from the oil and gas industry is regulated by the National Pollutant Discharge Elimination System (NPDES) and the EPA’s Underground Injection Control program (UIC), administered by the Alaska Oil and Gas Conservation Commission under AS 31.05 and 20 AAC 25. During exploration well drilling, muds and cuttings are stored on-site, in holding tanks, or in a temporary reserve pit, and then hauled to an approved solid waste disposal site, or are reinjected into the subsurface at an approved injection well, in accordance with 20 AAC 25.080 and 20 AAC 25.252. The preferred method for disposal of drilling muds and cuttings is by underground injection, and production muds and cuttings on the North Slope are generally reinjected into a Class II injection well.

The state discourages the use of reserve pits, but if a reserve pit is necessary and approved, it is constructed off the drill pad and could be as large as 5 ft deep and 40 ft by 60 ft. It is lined with an 80-mil geotextile liner to prevent contamination of surrounding soils. Impermeable lining and diking, or equivalent measures, will be also required. With appropriate permits, solids may be left in place in a capped reserved pit. If necessary, a flare pit may be constructed off the drill pad to allow for the safe venting of natural gas that may be encountered in the well. New solid waste disposal sites will not be approved or located on state property during the exploration phase.

If oil or gas is discovered at the exploratory well, it is likely that the gravel pad used for the exploratory well will also be used for development and production operations. Gravel pads are semi-permanent structures and can be rehabilitated following field depletion.

### **3. Development and Production Phases**

#### **a. Overview**

The development and production phases are interrelated and overlap in time; therefore, this section discusses them together. Development and production phases can begin only after exploration has been completed and tests show that a discovery is economically viable (Van Dyke 1997). During the

development phase, operators evaluate the results of exploratory drilling and develop plans to bring the discovery into production. Production operations bring well fluids to the surface and prepare them for transport to the processing plant or refinery. The fluids undergo operations to purify, measure, test and transport. Pumping, storage, handling, and processing are typical processes in the production phase (Van Dyke 1997).

After designing the facilities and obtaining the necessary permits, the operator constructs permanent structures and drills production wells. The operator must build production structures that will last the life of the field and may have to design and add new facilities for enhanced recovery operations as production proceeds. Figure 6.3 depicts a typical wellbore. The development “footprint” has decreased in size in recent years as advances in drilling technology have led to smaller, more consolidated pad sizes. Directional drilling allows more wells to be drilled from a common location (drill pad). A single production pad and several directionally drilled wells can develop larger subsurface areas, as compared to the techniques of drilling multiple vertical wells to reach the same subsurface areas.

Development wells are often drilled at an angle through a formation to increase productivity and allow the oil and gas to be extracted from a larger subsurface area (by increasing the drainage area) than would be possible from a single straight wellbore. In addition, lateral bores may be drilled from one

“parent” well bore to penetrate separate sands within a reservoir and increase the area of reservoir exposed to production. Multiple laterals, up to five, have been drilled to improve drainage and productivity. This technique is especially effective in the heavier viscous oil accumulations.

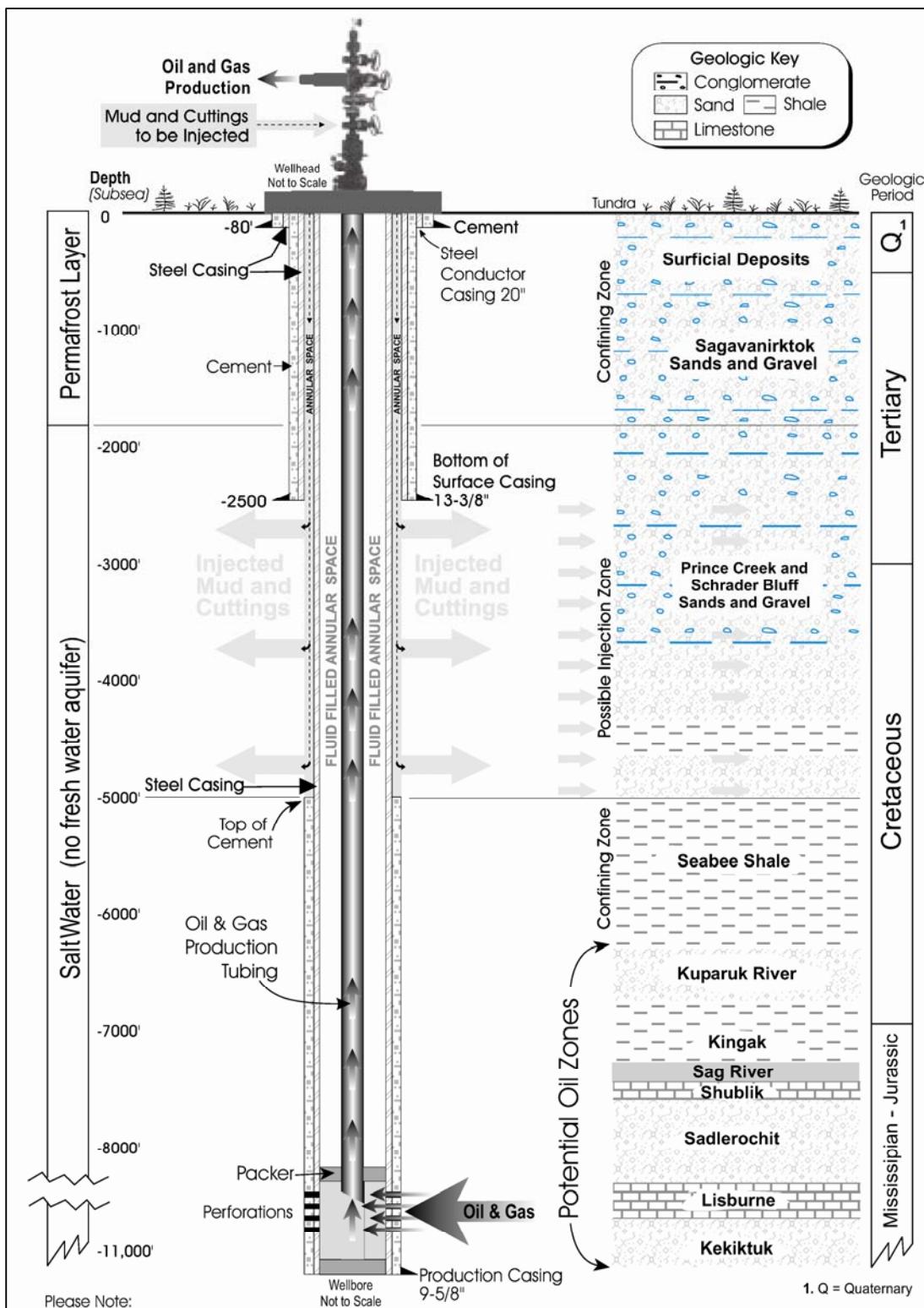
Production facilities will likely include several production wells, water injectors, gas injection wells, and a waste disposal well. Wellhead spacing may be as little as 10 ft. A separation facility removes water and gas from the produced crude, and pipelines carry the crude to storage and terminal facilities. Some of the natural gas produced is used to power equipment on the well pad or processing facility, but most is reinjected to maintain reservoir pressure in those reservoirs that have a surplus of produced gas. Produced water is also reinjected into an oil producing formation to maintain reservoir pressure. Often, seawater is treated and injected into the reservoir in addition to produced water in order to maintain pressure, improve recovery, and replace produced fluids.

Production muds and cuttings on the North Slope are reinjected into a Class II injection well. Produced waters are reinjected either into the producing formation to enhance recovery, or into an injection well. The preferred method for disposal of drilling muds and cuttings from oil and gas activities is by underground injection, as administered in the Underground Injection Control (UIC) program by AOGCC. When approved, impermeable lining and diking, or equivalent measures, will be required for reserve pits.



CD3 pipeline under construction at Prudhoe Bay.

DO&G Permitting Staff



Notes: When injection phase is completed, the 9-5/8" X 13-3/8" annular space is pumped full of cement and permanently sealed.

**Figure 6.3. Typical production/injection well, North Slope, Alaska.**

Oil and gas production facilities found on the well site may include gas and oil processing facilities to remove some of the water produced with the petroleum, water and sewage treatment equipment, power generators, a drilling rig, and support buildings and housing for workers. Support facilities include a production facility to receive and treat or transport the oil and gas to markets, refineries, or for shipment to other processing facilities in the lower 48 states and elsewhere. Other support facilities may include a supply base and a transportation system for cement, mud, water, food, and other necessary items.

Production operations for natural gas generally follow these steps:

- Natural gas flows through a high-pressure separator system where any liquids (water, condensate, etc.) are removed. Produced oil goes through a separator to remove the natural gas from the oil.
- The gas is compressed if necessary.
- The gas is dehydrated to lower its water content.
- Impurities are removed, if necessary.
- The gas is then metered, i.e. the amount of gas produced is measured.
- The gas is transported to an onshore facility where it passes through a water precipitator to remove any liquid.
- The gas may be conditioned or treated prior to transportation. An example is the conversion of gas to liquefied natural gas.

Production operations steps for oil are:

- Produced crude oil goes through a separator to remove water and gas from the oil stream.
- The oil moves to a processing facility via a pipeline.
- The gas removed from the oil may be used to power production facilities or compressed and reinjected to keep the pressure up in the producing formation to assist in oil production.

AOGCC through its statutory and regulatory mandate oversees drilling and production practices to maximize oil and gas recovery, prevent waste and ensure protection of correlative rights within the state (AS 31.05, 20 AAC 25). Correlative rights are legal rights to protect resource owners from excessive or wasteful withdrawal of hydrocarbons by adjoining properties overlying the same oil and gas reservoir (Answerscom 2010). The AOGCC is a quasi-judicial agency, which conducts hearings to review drilling and development to ensure regulatory compliance. The AOGCC may issue Conservation Orders (pool rules) to grant exceptions to regulations conditioned on prevention of waste, maximizing ultimate oil and gas recovery. Unless pool rules (oil or gas field rules governing well drilling, casing, and spacing that are designed to maximize recovery and minimize waste) have been adopted under 20 AAC 25.520, existing spacing rules stipulate that where oil has been discovered, not more than one well may be drilled to that pool on any governmental quarter section (20 AAC 25.055(a)). This would theoretically allow a maximum of four well sites per 640-acre section.

Where gas has been discovered, not more than one well per section may be drilled into the pool. An oil and gas producer may apply to change the spacing requirements if there is technical justification to support greater ultimate recovery by changing the spacing requirements. A Conservation Order will grant exception to regulations under 20 AAC 25 upon finding and concluding the spacing exception will not cause waste.

## **b. Proposed Development in the North Slope Foothills**

The last wells drilled in the NSFP were the Big Bend 1 well, drilled on ASRC land in 1993 by ARCO and the Chandler 1 well, drilled in 2008-2009 by Anadarko Petroleum Corporation. These wells targeted the flank of the East Umiat anticline and established the presence of a deeper bottomset (deep water) gas reservoir likely of Torok Formation and/or Fortress Mountain Formation (Petroleum News 2009; OGJ 2009; Figure 6.2).

The Gubik well 3 was also drilled by Anadarko Petroleum Corporation in the Gubik gas field to the north of the lease sale area, and was completed in April, 2008 (AOGCC 2010b). This well is located north of the northwest portion of the lease sale area on land owned by ASRC.

Existing oil fields on the North Slope also contain considerable amounts of gas that may be extracted and transported to market in the future. Tapping the North Slope's and the North Slope Foothill's gas reserves may require additional facilities, wells, and a new pipeline system.

At the best interest finding phase it is impossible to predict what a full development scenario will entail. The final project parameters will depend on the surface location, size, depth, and geology of a specific commercial discovery.

## **4. Subsurface Oil and Gas Storage Phase**

Under AS 38.05.180(u), the Commissioner of ADNR may authorize the subsurface storage of oil or gas to avoid waste or to promote conservation of natural resources. In Alaska, depleted reservoirs with established well control data are preferred storage zones. By memorandum dated September 2, 2004, the Commissioner approved a supplement to Department Order 003 and delegated the authority to authorize subsurface storage of oil or gas to the Division of Oil and Gas Director.

Subsurface storage of gas increases reliability of gas delivery to all sources of demand. The need for gas storage also depends upon access to transportation, pipeline infrastructure, existing production infrastructure, gas production sources, and delivery points. A subsurface storage authorization allows the storage of gas and associated substances in the portions of the gas storage formation, subject to the terms and applicable statutes and regulations, including mitigation measures and advisories incorporated by reference into the authorization. It does not matter whether the oil or gas is produced from state land, so long as storage occurs in land leased or subject to lease under AS 38.05.180. An oil and gas lease on which storage is authorized shall be extended at least for the period of storage and so long thereafter as oil or gas not previously produced is produced in paying quantities. The feasibility of subsurface storage depends on favorable geological and engineering properties of the storage reservoir, including its size and its cushion gas (or base gas requirements). Some unproduced native gas may remain in gas storage reservoirs as cushion gas to maintain reservoir pressures. Cushion gas is the volume of gas intended as permanent inventory in a storage reservoir to maintain adequate pressure and deliverability rates throughout the gas withdrawal season.

Subsurface storage must comply with all applicable local, state, and federal statutes and regulations, and with any terms imposed in the authorization or in any subsequent plan of operation approvals, or in the AOGCC Storage Injection Order. The plans of operation must identify the specific measures, design criteria, construction methods, and standards that will be employed to meet the provisions of the subsurface storage authorization. Plans of operation are subject to extensive technical agency review. They are also subject to consistency with the ACMP standards if the affected lands are within the coastal zone. The plans are available for public review upon submittal to the state. Oil and gas storage-related activities will be permitted only if proposed future operations comply with all borough, state, and federal laws and the provisions of the authorization.

A storage authorization is for only specified sand horizons and does not grant the right to drill, develop, produce, extract, remove, or market gas other than injected gas. A storage authorization allows the overlying oil and gas leases to continue as long as their original terms are met. Subsurface storage will be subject to terms and conditions identical to existing oil and gas lease permitting and bonding requirements. Storage operations may not interfere with existing oil and gas lease operations. Subsurface storage must comply with 20 AAC 25.252. Before any gas may be injected, approval of the Injection Order from AOGCC must be obtained.

Royalty on cushion gas may be paid from a percentage of each year's annual gas withdrawal as if it were originally produced from the overlying oil and gas lease, and allocated according to the unit agreement. Injected gas will mix with native gas in the reservoirs. Royalty on the native gas within the gas storage formation under the leased area is computed at the royalty rate and paid at the value as specified in the applicable oil and gas leases.

## **5. Activity Subsequent to Lease Sales**

Upon issuance of oil and gas leases, exploration drilling may occur on tracts leased in this sale within the initial term of the lease. However, whether or not exploration and eventual development will occur in areas of the North Slope Foothills depends on several factors, such as the subsurface geology of the area, a company's worldwide exploration strategy, the projected price of oil and gas and their market demand, and other economic, environmental and logistical factors. Geology dictates the extent of exploration. Several dry holes (no substantial hydrocarbons encountered) can discourage further exploration in an area. Whether a lessee proceeds with exploration of an area may depend on the area's priority when weighed against the lessee's other worldwide commitments. If extensive exploration does occur in an area, and an accumulation is discovered, development and production will only proceed if the lessee finds the risks acceptable, given the potential costs. This depends on the price of oil and gas, the lessee's development costs, and the cost of getting the oil and gas to market.

## **6. Oil and Gas Infrastructure**

The North Slope hosts an extensive network of petroleum production, development, and support facilities. The oil produced is transported to the TAPS gathering facility, into the pipeline, and, ultimately, to the TAPS terminal in Valdez. Prudhoe Bay continues to function as the hub of activity for the 14 active production units on the North Slope and in the Beaufort Sea, extending outward via roads, pipelines, production and processing facilities, gravel mines, and docks (ADNR 2010b). Deadhorse is comprised of an industry-support community that includes a post office and airport.

As exploration and development have continued, oil companies and regulatory agencies have capitalized on technological advances and existing infrastructure, thus minimizing environmental impacts on the North Slope.

If economically feasible quantities of natural gas are found and produced in the North Slope Foothills lease sale area, additional pipeline and processing infrastructure will probably need to be constructed.

## **7. Oil and Gas Lease Sales in the North Slope Foothills**

Many factors contribute to the outcome of oil and gas lease sales in Alaska. These include national and world economies, exploration budgets of oil and gas companies, oil and gas potential of the area, technological advances, the number of tracts available for lease, and the number of expired and relinquished tracts.

Since the first lease sale in the northern region (Sale 13) in December 1964, the state has held 10 oil and gas lease sales involving North Slope Foothills. As of September 23, 2010, there are 114 tracts

leased in the lease sale area, for a total of 577,754 acres (ADNR 2010a). There are no reports of recent exploration or developments drilled on these tracts since 2001. The most recent well drilled in the area was Gubik well 3 in early 2008 by Anadarko Petroleum Corporation, and was not drilled on state owned land.

## **E. Likely Methods of Oil and Gas Transportation**

AS 38.05.035(g) directs that best interest findings shall consider and discuss the method or methods most likely to be used to transport oil or gas from the lease sale area, and the advantages, disadvantages, and relative risks of each.

The location and nature of oil or gas deposits determine the type and extent of facilities necessary to develop and transport the resource. Strategies used to transport potential petroleum resources depend on many factors, most of which are unique to an individual discovery. ADNR and other state, federal, and local agencies will review the specific transportation system when it is actually proposed. Oil and gas produced in the lease sale area would most likely be transported by pipeline, depending on the type, size, and location of the discovery. The following is a general discussion of the components that might be in any transportation system.

### **1. Pipelines or Pipeline Facility**

A "pipeline" or "pipeline facility" means all the facilities of a total system of pipe, whether owned or operated under a contract, agreement, or lease, used by a carrier for transportation of crude oil, natural gas, or products for delivery, for storage, or for further transportation. This includes all pipe, pump or compressor stations, station equipment, tanks, valves, access roads, bridges, airfields, terminals and terminal facilities, including docks and tanker loading facilities, operations control center for both the upstream part of the pipeline and the terminal, tanker ballast treatment facilities, and fire protection system, communication system, and all other facilities used or necessary for an integral line of pipe, taken as a whole, to effectuate transportation, including an extension or enlargement of the line. (AS 38.35.230 (7)). The mode of transport from a natural gas discovery will be an important factor in determining whether future discoveries can be economically produced.

If commercial quantities of oil are found in the lease sale area, the oil will likely go to market via the Trans-Alaska Pipeline System (TAPS), a 798-mile pipeline from Prudhoe Bay to Valdez. In-field gathering lines bring the oil from individual well sites to processing facilities for injection into TAPS. From Valdez, the oil is transported to the U. S. West Coast, and the U. S. Gulf Coast via tanker.

If commercial quantities of natural gas are found there are currently at least six possible gas pipeline routes under consideration by the Federal Energy Regulatory Commission (FERC):

1. A pipeline from the Alaska North Slope (both the foothills of the Brooks Range and the Prudhoe Bay area) to the tidewater in Cook Inlet, along the Parks Highway;
2. A pipeline from the Alaska North Slope to tidewater in Cook Inlet, along the Richardson & Glenn Highways;
3. A spur-line off a main-line to Alberta, Canada, down the Parks Highway to Cook Inlet; and
4. A spur-line off a main-line to Alberta, Canada, down the Glenn and Richardson Highways to Cook Inlet (FERC 2009).
5. A TransCanada Alaska LLC, and partner Exxon Mobil, applied for approval of a pipeline system and gas treatment plant originating near Prudhoe Bay, Alaska, including a 48-inch diameter pipeline designed to carry 4.5 billion cubic feet of natural gas per day. The open season plan, dated January, 2010, offered a pipeline system originating from the Alaska North

Slope near Prudhoe Bay with a pipeline mainline route to the Alberta Hub in Canada, with a second routing option to transport gas to Valdez, Alaska, to connect to a liquefied natural gas facility operated by a third party, the Alaska Gasline Port Authority. FERC approved the plan on March 31, 2010, and TC Alaska commenced its open season April 29, 2010. Results of the open season have not yet been released to the public. The State of Alaska has issued a license under the Alaska Gasline Inducement Act (AGIA) to TransCanada Alaska LLC to pursue construction of a natural gas pipeline. (FERC 2010).

6. A Denali – the Alaska Gas Pipeline project has been applied for approval by partners BP and ConocoPhillips. This proposed pipeline system and gas treatment plant originate near Prudhoe Bay, Alaska, and include a pipeline designed to carry 4.5 billion cubic feet of natural gas per day. The open season plan, dated April 7, 2010, offered a configuration of two transmission lines, one originating from Point Thomson, and a second originating from the Prudhoe Bay Unit on the North Slope, both connecting to a gas treatment facility at Prudhoe Bay Unit. A mainline pipeline system will then transport gas along a 730-mile long, 48-inch diameter pipeline to the international border between Alaska and Canada, with five delivery points along the route. FERC approved the plan on June 7, 2010, and Denali commenced its open season on July 2, 2010. Results of the open season have not yet been released to the public (FERC 2010).

Although BLM has conducted oil and gas lease sales in NPR-A, it has imposed a 10-year deferral of leasing in the area north and east of Teshekpuk Lake. Securing permits for siting oil and gas facilities in NPR-A will require an EIS; siting facilities in ANWR is unlikely to be approved. The status of ANWR could change if Congress amends federal law to permit petroleum exploration and development or if the Secretary of Interior allows a pipeline right-of-way. However, this transportation discussion is based on the assumption that ANWR will not be available for onshore support of a transportation system.

Jurisdictional authority over pipelines depends on many factors such as design, pipe diameter, product transported, or whether it meets state or federal designation, e.g., transmission line, gathering line, or distribution line, and other attributes as specified in regulations. Generally, the design, maintenance, and preservation of transmission pipelines transporting hydrocarbon products are under the authority and jurisdiction of the Pipeline and Hazardous Materials Safety Administration (PHMSA) with specific federal regulations for natural gas (49 CFR 192) and hazardous liquids (49 CFR 195). Both regulations prescribe the minimum requirements that all operators must follow to ensure the safety of their pipelines and piping systems. The regulations not only set requirements, but also provide guidance on preventive and mitigation measures, establish time frames for upgrades and repairs, development of integrity management programs, and incorporate other relevant information such as standards, incorporated by reference, developed by various industry consensus organizations.

On December 29, 2006, the “Pipeline Inspection, Protection, Enforcement, and Safety Act of 2006” (PIPS Act H.R. 5782) was signed into law. The PIPES Act issued a final rule requiring hazardous liquid pipeline operators to develop integrity management programs for transmission pipelines.

Basic requirements for an Integrity Management Plan include:

- Periodic integrity assessment of pipelines that could affect high consequence areas (HCAs). Integrity assessments are performed by in-line inspection (also referred to as “smart pigging”), hydrostatic pressure testing, or direct assessment. Through these assessment methods, potentially injurious pipeline defects that could eventually weaken the pipe, or even cause it to fail, are identified early and can be repaired, thus improving the pipe’s integrity.
- Development and implementation of a set of safety management and analytical processes, collectively referred to as an integrity management program (IMP). The purpose of the



D. Houseknecht, USGS

Trans Alaska Pipeline in the northern Brooks Range.

program is to assure pipeline operators have systematic, rigorous, and documented processes in place to protect HCAs (PHMSA 2010a).

- Integrity management programs reflect significant improvements to pipeline safety and have unique aspects depending on service characteristics for natural gas and liquid hydrocarbons.
- For gas pipelines, the Gas Transmission IM Rule (49 CFR 192, Subpart O) the “Gas IM Rule,” as it is commonly referred to, became effective in February 2004, and represents a significant enhancement to PHMSA’s existing pipeline safety regulations. The Gas IM Rule specifies how pipeline operators must identify, prioritize, assess, evaluate, repair, and validate - through comprehensive analyses - the integrity of gas transmission pipelines that, in the event of a leak or failure, could affect High Consequence Areas (HCAs) within the United States. These HCAs include certain populated and occupied areas. The framework for an integrity management system are covered in Subpart O - Gas Transmission Pipeline Integrity Management (49 CFR 192.907) and integrity program elements are in 49 CFR 192.911, which invoke ASME/ANSI B31.8S by reference (PHMSA 2010a).
- For liquid hydrocarbon (oil and product) pipelines, the mandate is for Pipeline Integrity Management programs to establish High Consequence Areas (HCA) for Hazardous Liquid Operators (49 CFR 195.450 and .452). The “Liquid IM Rule,” as it is commonly referred to, represents a significant enhancement to PHMSA’s existing pipeline safety regulations. The Liquid IM Rule specifies how pipeline operators must identify, prioritize, assess, evaluate, repair, and validate-through comprehensive analyses—the integrity of hazardous liquid pipelines that, in the event of a leak or failure, could affect HCAs within the United States. These HCAs include population areas, drinking water and ecological resources that are unusually sensitive to environmental damage, and commercially navigable waterways.

## 2. Oil Transportation

Feeder pipelines may be constructed to TAPS for oil transport. These are either elevated or buried depending on several factors such as the substance being transported, the local soil and ice conditions and other considerations such as movement of wildlife. An individual pipeline may

alternate between buried and elevated, as is the case with TAPS. The advantages and disadvantages of the two options are set forth below. It is possible that a transportation system used for oil or gas from the lease sale area would be based upon both options. The mode of transport from a discovery will be an important factor in determining whether or not discoveries can be economically produced. Buried pipelines are more expensive to install and maintain than elevated pipelines. The more expensive a given transportation option, the larger a discovery will have to be for economic viability.

### **a. Elevated Pipelines for Oil Transport**

Elevated pipelines are essentially a series of support members or bridges that support a pipeline, and have the least potential to interfere with lateral fish movements or water circulation (USACOE 1984). Elevated pipelines allow visual monitoring for leaks and maintenance checks, are easy to maintain and visually inspect. Soil conditions are less of a limiting factor because pilings can be driven through problem soils; and heat transfer to thaw-unstable soils is minimized because the pipeline is not buried.

Elevated pipelines are typically used in North Slope oil field development to prevent heat transfer from the hot oil in the pipeline to frozen soils, since heat would degrade the permafrost. The pipeline is placed on crossbeams mounted between pairs of vertical support members (VSM). Heat pipes cool the ground to keep the soils stable (Van Dyke 1997). Above-ground pipelines can restrict caribou and other wildlife movements unless provisions are made to allow for their unimpeded passage. The current pipeline construction mitigation measures require that pipelines shall be elevated 7 ft except where the pipeline intersects a road, pad, or a ramp installed to facilitate wildlife passage; Refer to Mitigation Measure A(1)(g) (ADNR 2009b). There appears to be a cumulative effect of roads and adjacent pipelines that creates a barrier to caribou crossing (See Chapter Eight, "Foreseeable Effects"). Pipelines elevated at least 5 ft have been shown to be effective except when they were in proximity to roads with moderate to heavy traffic (15 or more vehicles/hour). Roads with low levels of traffic and no adjacent parallel pipeline are not significant barriers to movement of caribou. The Alaska Caribou Steering Committee concluded the most effective mitigation is



Caribou feeding under an elevated pipeline.

achieved when pipelines and roads are separated by at least 500 ft. Lessees are encouraged in planning and design activities to consider the recommendations for oil field design and operations contained in the final report of the Alaska Caribou Steering Committee, and the mitigation measures and lease advisories in Chapter Nine (Cronin et al. 1994).

### **b. Buried Pipelines for Oil Transport**

Buried pipelines are feasible in the Arctic provided that the integrity of the frozen soils is maintained. Such pipeline configurations have been used in the Milne Point area. There are some important considerations regarding long sections of buried pipe. First is cost, which depends on length, topography, soils, and distance from the gravel mine site to the pipeline. Second, buried pipe is more difficult to monitor and maintain than elevated pipelines. However, significant technological advances in leak detection systems have been made which increase the ease with which buried pipelines can be monitored. These systems are described under the oil spill prevention subsection in this chapter. Third, buried pipelines may involve increased loss of wetlands because of gravel fill. Finally, buried pipelines are sometimes not feasible from an engineering standpoint because of the thermal stability of fill and underlying substrate (Cronin et al. 1994).

## **3. Natural Gas Transportation**

There are various options for transporting natural gas to market. These include pipeline systems, LNG, CNG, gas to solids (GTS), such as hydrates, gas to power, such as electricity, and gas to liquids (GTL) (Mokhatab et al. 2006).

### **a. Pipelines for Natural Gas Transport**

The transportation of natural gas from producing regions to markets requires a transportation system. The gas may have to travel a great distance to reach its point of use. Transportation of natural gas is dependent upon demand and access to storage. Pipelines may follow elevated or buried routes, depending upon the engineering requirements needed and the soils found in the field.

There are three types of pipelines used: gathering system; intrastate and interstate pipelines; and distribution system. Natural gas may require treatment to remove impurities and to prepare it for transport. Treatment may include depressurization and dehydration. To keep the gas flowing along the pipeline route, the gas may also undergo pressurization by compressors, and liquid separation treatment.

During transport the gas is monitored. Pigging facilities and metering stations are constructed along the pipeline to monitor and manage the gas. Central control stations manage information along the pipeline to allow for quick prevention and necessary reaction to problems (Natural Gas Supply Association 2009).

Currently the Alyeska Pipeline company operates a natural gas fuel line from the North Slope fields to the fuel pump stations north of the Brooks Range (Pump Stations 1, 2, 3, and 4). This generally runs parallel to the mainline crude oil pipeline. The purpose of the natural gas is to fuel the pump stations for the Trans-Alaska pipeline (APSC 2009).

### **b. Liquid Natural Gas (LNG)**

There is also the potential for natural gas to be transported as LNG. The likelihood of LNG mode of transport will depend upon the remoteness and the costs and benefits of a particular project. If transport of liquid natural gas is a possibility, it may incorporate use of tankers and marine terminals.

Natural gas that is cooled liquefies. It is stored in refrigerated tanks after processing. Specially built refrigerated tankers transport the LNG to storage locations or to market. The LNG must be

processed to return it to the gas phase. Economies of scale are important to keep the cost per unit to commercially affordable rates (Mokhatab et al. 2006).

## **4. Natural Gas Storage**

The availability of subsurface storage horizons and gas storage facilities affect the technologies and preferred routes of transportation used for natural gas distribution. Under AS 38.05.180(u) the Commissioner of ADNR may authorize subsurface storage of oil or gas to avoid waste or to promote conservation of natural resources. Subsurface storage may be utilized by oil and natural gas developers if favorable geological and engineering properties of the storage reservoir are verified. Subsurface storage must comply with all applicable local, state, and federal statutes and regulations. Refer to Section B(4) above for more information relating to subsurface natural gas storage.

Facilities for gas storage may also serve as integral components of the natural gas transportation system. Cryogenic tanks are used to store LNG (Mokhatab et al. 2006). Gas condensate is stored between production and shipping in condensate storage tanks (Mokhatab et al. 2006). Distances to market and the need to allocate supply at prescribed times of demand may justify the construction and operation of storage facilities along the distribution system route.

## **5. Tankers and Marine Terminals**

In the ice-free ports of Southcentral Alaska, tankers are currently used to transport oil to and from Cook Inlet and from the Alyeska Terminal in Valdez, the terminus of TAPS. The US Coast Guard maintains a vessel traffic service in the Gulf of Alaska and Prince William Sound. Vessels are escorted through Prince William Sound. Two tug boats escort tankers from the Valdez terminal to Cape Hinchinbrook (Alyeska Pipeline Service Company 2009). Use of tankers reduces the risk of a large oil spill, such as the 1989 Exxon Valdez spill in Prince William Sound.

Liquid natural gas may also utilize tankers, if the project analysis deems it to be feasible and cost effective. There are no marine terminals on the north coast of Alaska at the present time due to shallow depths and the lack of ice-free ports.

## **6. Rehabilitation and Restoration Activities**

The lifecycle of an oil field includes another phase of activities for when production ceases and facilities are not active. After an oil field is abandoned, rehabilitation of the affected leased area may be required to restore areas impacted by oil and gas activities. This phase is often described as dismantlement, removal, and restoration (DR&R). The actual activities needed will be a function of the current configuration, and any future planned uses of the site.

Site appearance and function drive the efforts of this phase of the oil field. Revegetation includes reestablishing of a plant cover, and restoration implies returning a disturbed site to ecological conditions similar to those prior to oil and gas development (Linkins et al. 1984). Recovery of wetlands disturbed by gravel infilling may vary, depending on soil moisture content and amount of available soil organic matter (Kidd et al. 1997, citing to Jorgenson and Joyce, 1994). Removal of gravel from pads and roads may be the initial step in rehabilitation. At some sites on the North Slope where gravel fill has been removed, problems have emerged associated with ponding, thaw subsidence, and nutrient cycling. One method preferred by the state is to remove all gravel and create pond habitats that resemble pre-construction conditions. In some cases, full gravel removal may not be the optimum recovery option. In most cases, plant cultivation is desirable with the use of plant species identified as important for water bird habitat. The expected result will influence the techniques used on a case-by-case basis (Linkins et al. 1984). Several plant cultivation treatments have been used on the North Slope, including fertilizer only, native-grass cultivation, *Arctophila* transplantation, and sedge-plug transplantation. Optimum recovery of the tundra marsh would

include reestablishing vegetation, soil microbiota, phytoplankton, aquatic invertebrate, and wildlife communities at the impacted site (Kidd et al. 1997).

The rehabilitation of oil and gas sites must be accomplished to the satisfaction of the director of the DO&G, in consultation with the DMLW, ADF&G, ADEC, NSB and any non-state surface owner. The state is currently developing guidelines for site rehabilitation and DR&R, that will assist lessees in planning for site closures.

## **7. Mitigation Measures and Other Regulatory Protections**

Any product ultimately produced from the lease sale area will have to be transported to market; however, it is important to note that the decision to lease oil and gas resources does not authorize the transportation of any product. If and when oil or gas is found in commercial quantities and production is proposed, final decisions on transportation will be made through the local, state, and federal application and permitting processes. Those processes will consider any required changes in oil spill contingency planning and other environmental safeguards, and will involve public participation. The state has broad authority to withhold, restrict, and condition its approval of transportation facilities. In addition, boroughs, municipalities, and the federal government have jurisdiction over various aspects of any transportation alternative (see Chapter Seven). Measures are included in this best interest finding to mitigate potential negative effects of transporting oil and gas (see Chapter Nine). Additional site-specific and project-specific mitigation measures may be imposed as necessary.

## **F. Oil Spill Risk, Prevention and Response**

### **1. Oil Spill History and Risk**

The risk of a spill exists any time crude oil or petroleum products are handled. Oil spills associated with the exploration, development, production, storage, and transportation of crude oil may occur from well blowouts or pipeline or tanker accidents. Petroleum activities may also generate chronic low volume spills involving fuels and other petroleum products associated with normal operation of drilling rigs, vessels, and other facilities for gathering, processing, loading, and storing of crude oil. Spills may also be associated with the transportation of refined products to provide fuel for generators, marine vessels, and other vehicles used in exploration and development activities. A worst case oil discharge from an exploration facility, production facility, pipeline, or storage facility is restricted by the maximum tank or vessel storage capacity, or by a well's ability to produce oil. Companies do not store large volumes of crude at their facilities on the North Slope; rather, produced oil is processed and transported as quickly as possible. This reduces the possible size of a potential spill on the North Slope.

The oil and gas industry has been actively exploring and producing North Slope resources for more than three decades. The 2003 National Research Council report Cumulative Environmental Effects of Oil and Gas Activities on Alaska's North Slope, completed before the corrosion-caused spills in 2006, discussed in Section F(1)(b) below, concluded that, while small spills have occurred in the fields, the spills have not been large or frequent enough to have accumulated effects (NRC 2003).

The ADEC has reported that the primary causes of spills are line failure, equipment failure, human error, containment overflow and tank failure (ADEC 2009d). There were no large spills reported within the lease sale area. However, large spills of crude oil, produced water, seawater, halon and drilling muds have occurred on the North Slope (Table 6.3). Spill records from ADEC show that there have been 24 large spills reported in northern Alaska from October, 2007 to November, 2009, with three spills involving crude oil, 10 spills involving process or produced water, and the remaining involving drilling mud or other substance (Table 6.3). Two large spills of drilling mud

occurred nearby to the north at Gubik well 3 in 2008 (Table 6.3). A large spill is generally considered to be greater than 1,000 gal or lbs.

Large volume oil pipeline releases occurred on May 25, 2010 and January 8, 2011. The May 2010 release was at the Trans-Alaska Pipeline System (TAPS) Pump Station 9, about eight miles south of Delta, Alaska. About 208,950 gal of oil were released to secondary containment. The release was caused by a loss of power during a scheduled maintenance shutdown. Valves allowed the flow of oil into Tank 190, with oil overflow into a lined secondary containment area. About 56,000 gal of oil have been recovered, and spill clean-up is continuing (ADEC 2010a).

Another large volume pipeline release of oil occurred on January 8, 2011 at the TAPS Pump Station 1, located on the North Slope. An estimated 11,130 gal of oil has been recovered, and the cause of the release appears to be from part of the booster pumps' discharge piping in the building. Oil seeped into the booster pump building, but no oil was observed outside the building. This incident cleanup was finalized by the ADEC on January 20, 2011 (ADEC 2011).

**Table 6.3. Large spills in the Prudhoe Bay Kuparuk area on the North Slope, October 2007 through December 2009.**

Spill Date	Spill Name	Location	Product	Total Released
10/15/2007	Prudhoe Bay, Drill Site 16	Prudhoe Bay/Kuparuk	Produced Water	1,260 gal
10/15/2007	Prudhoe Bay, Drill Site 16	Prudhoe Bay/Kuparuk	Produced Water	1,260 gal
12/16/2007	Kuparuk Drill Site 2U	Prudhoe Bay/Kuparuk	Crude	4,284 gal
12/29/2007	Prudhoe Bay, Well Pad W	Prudhoe Bay/Kuparuk	Drilling Muds	1,470 gal
1/30/2008	Kuparuk Gubik #3	Prudhoe Bay/Kuparuk	Drilling Muds	2,226 gal
2/10/2008	Prudhoe Bay, Drill Site 13	Prudhoe Bay/Kuparuk	Produced Water	1,260 gal
2/30/2008	Oooguruk Development Project	Prudhoe Bay/Kuparuk	Drilling Muds	2,100 gal
3/17/2008	West North Slope Rendezvous 2	Prudhoe Bay/Kuparuk	Crude	2,100 gal
3/26/2008	Kuparuk Gubik #3	Prudhoe Bay/Kuparuk	Drilling Muds	10,920 gal
6/4/2008	Pump Station 1	Prudhoe Bay/Kuparuk	Halon	1,800 lbs
7/15/2008	Anadarko DS-2P Drill Mud Spill	Kuparuk	Drilling Muds	1,000 lbs
8/6/2008	D Pad Well 22 Diesel Release	Prudhoe Bay	Diesel	2,310 gal
9/7/2008	DS-18, Well Brine Spill	Prudhoe Bay	Process Water	5,544 gal
11/3/2008	DS-11, Wells 7, 8, & 38 Seawater Release	Prudhoe Bay/Kuparuk	Seawater	61,626 gal
12/4/2008	Oooguruk 6720 Drilling Mud Release	North Slope	Drilling Muds	6,720 gal
12/25/2008	Kuparuk DS 1L Well 22	Kuparuk	Produced Water	94,920 gal
1/2/2009	Pump Station 4	Pump Station 4	Halon	3,400 lbs
1/12/2009	Milne Point CFP Produced	Milne Point	Produced Water	24,444 gal
2/3/2009	Effluent Water Injection Leak	Kuparuk	Process Water	6,900 gal
2/18/2009	FS-2 Flow line 9A Crude/Gas Release	Prudhoe Bay	Natural gas, crude, produced water	1,890 gal
3/22/2009	DS-1L, Well 16 Produced Water Release	Kuparuk	Produced Water	9,450 gal
5/15/2009	Mud Cutting Containment Cell	North Slope	Drilling Muds	1,008 gal
6/23/2009	Pioneer Ice Damage to Dry Drill Products	Prudhoe Bay	Other	1,200 lbs
11/29/2009	Lisburne Common Line Release - Near DS L03	Prudhoe Bay	Produced Water	45,828 gal

Source: ADEC 2009a, b, c, d.

### **a. Exploration and Production**

Spills related to petroleum exploration and production must be distinguished from those related to transportation because the phases have different risk factors and spill histories. Exploration and production facilities in the lease sale area may include onshore gravel pads; drill rigs; pipelines; and facilities for gathering, processing, storing, and moving oil and gas. These facilities are discussed below. When spills occur at these facilities, they are usually related to everyday operations, such as fuel transfers. Large spills are rare at the exploration and production stages because spill sizes are limited by production rates and by the amount of crude oil stored at the exploration or production facility. A well can only spill as much oil as it can produce without assistance. Some wells cannot produce without mechanical assistance, and if an accident occurs, oil ceases to flow.

A spill of produced water, natural gas and crude occurred on December 29, 2009 in the 18-inch three-phase common carrier pipeline at a location about 1.5 miles from the Lisburne Production Center (LPC). The pipeline ruptured along the bottom, creating an opening of two ft in length, and released about 1,091 bbl of crude oil, produced water, and natural gas. The cleanup goals were achieved by response crew efforts that ended in January, 2010 (ADEC 2009b).

The most dramatic form of spill can occur during a well blowout, which can take place when high pressure gas is encountered in the well and sufficient precautions, such as increasing the weight of the drilling mud, are not effective. The result is that oil, gas, or mud is suddenly and violently expelled from the well bore, followed by uncontrolled flow from the well. Blowout preventers (BOP), which immediately close off the open well to prevent or minimize any discharges, are required for all drilling and work-over rigs and are routinely inspected by the AOGCC to prevent such occurrences.

Blowouts are extremely rare in Alaska and their numbers decline as technology, experience, and regulation impact drilling practices. A blowout that results in an oil spill has never occurred in Alaska, however natural gas blowouts have occurred. A gas blowout occurred at the Cirque No. 1 well in 1992. The accident occurred while ARCO workers were drilling an exploratory well and hit a shallow zone of natural gas. Drilling mud spewed from the well and natural gas escaped. It took 2 weeks to plug the well (Anchorage Times 1992). In 1994, a gas kick occurred at the Endicott field I-53 well. BP Exploration was forced to evacuate personnel and shut down most wells on the main production island. No oil was released to the surface, as the well had not yet reached an oil-bearing zone. There were no injuries, and the well was controlled and plugged 3 days later by pumping heavily weighted drilling muds into it (ADN 1994; Scagliotti 1994; AOGCC 2009).

On April 20-22, 2010, a blowout incident occurred in the Gulf of Mexico involving a semi-submersible rig, the Deepwater Horizon (Transocean 2010b; Transocean 2010d; Transocean 2010d). At the time of the incident, 126 crew members were onboard; 115 were evacuated and 11 died (Transocean 2010b; Transocean 2010d). Before the rig sank, the response team was not able to stop the flow of oil and gas (Transocean 2010d), the blowout preventer failed (BP 2010b), and a large release of hydrocarbons into the water occurred. The well was shut-in on July 15, 2010, a relief well successfully intercepted the annulus of the MC252 well on September 15, 2010, and cement was successfully pumped into the annulus on September 17, 2010 (BP 2010a). Although this incident did not occur in Alaskan waters, the State of Alaska is closely monitoring information available from the Deepwater Horizon incident, and may modify or issue new mitigation measures or lessees advisories as needed as more information becomes available.

### **b. Pipelines**

Both state and federal agencies have oversight of pipelines in Alaska. State agencies include the Petroleum Systems Integrity Office (PSIO) and DO&G within DNR; the State Pipeline Coordinator's Office (SPCO), the federal and state Joint Pipeline Office (JPO); and ADEC. Federal

agencies include PHMSA within the U.S. Department of Transportation; and the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE), formerly the U.S. Minerals Management Service (MMS).

The pipeline system that transports North Slope crude includes flow lines, gathering lines, and pipelines that carry the crude to processing facilities and to Pump Station 1, where the oil enters TAPS for transport to the port of Valdez. Pipelines vary in size, length, and amount of oil contained. A 14-inch pipeline can store about 1,000 bbl per mile of pipeline length. Under static conditions, if oil were lost from a 5-mile stretch of this pipeline (a hypothetical distance between emergency block valves), a maximum of 5,000 bbl of oil could be discharged if the entire volume of oil in the segment drained from the pipeline.

Oil spills in 2006 and 2009 have made the oil and gas industry, local, state, and federal regulators, and the public aware of potentially widespread pipeline corrosion issues on the North Slope. On March 2, 2006, 6,357 bbl (267,000 gal) from a transit line in Prudhoe Bay spilled over approximately 2 acres of tundra – the largest spill in Prudhoe Bay history (Loy 2006; ADEC 2009a, b). The cause of the leak was internal microbiological corrosion the pipeline (Bailey 2006). BP Exploration Alaska, the Prudhoe Bay operator, had not pigged the pipeline to test for internal corrosion since 1998 (Loy 2006). A one-quarter inch hole formed in the bottom of the pipeline in a section that had been buried under a caribou crossing. The snow covered the leak, delaying detection; ultimately, the odor exposed the leak to a worker. A report prepared by a team of BP and state investigators in April 2006 stated that spill alarms went off for at least 5 consecutive days in late February; however, the alarms were dismissed by operators monitoring the system as false. Crews recovered over 1,428 bbl (60,000 gal) of the spilled oil, and, after the \$6 million cleanup was completed, ADEC estimated the tundra suffered minimal environmental damage.

On March 9, 2006, spill responders found 12 bbl (500 gal) of crude oil and produced water that had leaked from a gathering line in the Kuparuk unit and another 4.8 bbl (200 gal) were collected in a catch basin (Loy 2006). The cause of the leak was also determined to be holes caused by internal corrosion.

On August 6, 2006, BP announced that it needed to shut down the Prudhoe Bay field in order to address pipeline corrosion issues (Nelson 2006). A corrosion test detected a small leak in a transit line and the entire eastern operating area was completely shut in. In response to the August 2006 shutdown, transit lines were pigged weekly and a continuous corrosion inhibitor was added to the transit lines.

Undertaking a multi-year, \$500 million project, BP replaced the 16-mile transit pipeline system in the Prudhoe Bay area (except for Lisburne), completing it in December, 2008 (Quinn 2009).

On December 19, 2006, 234,738 gal of produced water and 150 bbl (6,300 gal) of crude oil were spilled at Gathering Center 2 (ADEC 2010c). The loss was attributed to tank corrosion caused by mechanical failure. Misalignment of an agitation jet caused a hole to erode through the bottom of the tank. One to 2 gal of produced water flowed through a hole in the containment liner to the gravel pad. All of the oil was recovered.

Other spills occurred in 2009. On November 29, 2009, a rupture in an 18-inch pipeline released 45,828 gal of produced water. On December 21, 2009, a pipeline leak at a wellhead at Drill Site 6, Well 11 sprayed up to 700 gal of water and about 100 gal of crude on the well pad and surrounding tundra (ADEC 2009a, b). These spills have heightened the concern about risks relating to aging infrastructure on the North Slope.

Two large volume oil pipeline releases occurred on May 25, 2010 and January 8, 2011. These are discussed in more detail above in Section F(1).

After the 2006 spills and subsequent spill releases, the state made it a priority to address issues of corrosion and pipeline monitoring. Increased state and national awareness resulted in a number of changes in the public and private sectors. First, operators assert they are now monitoring corrosion more closely, including pigging transit and common carrier lines on a regular basis, and updating and strictly enforcing best industry standards for routine maintenance practices. The state has also examined pipeline corrosion issues closely and has expanded efforts to monitor and regulate both gathering and common carrier lines. ADEC promulgated new regulations regarding education, preparation for spills, and spill response; these regulations went into effect in December 2006. Updated regulations were issued on October 9, 2008 (18 AAC 75).

On December 29, 2006, the “Pipeline Inspection, Protection, Enforcement, and Safety Act of 2006” (PIPS Act H.R. 5782) was signed into federal law. Under the PIPES Act, hazardous liquid pipeline operators are required to develop integrity management programs for transmission pipelines.

### **c. Tankers**

Shallow nearshore waters and lack of ice free ports prevent the use of tankers for transporting oil from the North Slope. Alaska’s most catastrophic oil spill was the March 1989 *Exxon Valdez* tanker spill in Prince William Sound, the second largest recorded in U.S. waters. It spilled nearly 10.8 million gal of crude oil; contaminated fishing gear, fish, and shellfish; killed numerous marine birds and mammals; and led to the closure or disruption of many Prince William Sound, Cook Inlet, Kodiak, and Chignik fisheries (Graham 2003; Science Daily 2003; City of Valdez 2010; Alaska Office of the Governor 1989). Effects of oil spills on fish and other wildlife are discussed in Chapter Eight.

Other large tanker spills include the 1987 tanker Glacier Bay spill of 2,350-3,800 bbl of North Slope crude oil being transported into Cook Inlet for processing at the Nikiski Refinery (ADEC 1988). Less than 10% of the oil was recovered, and the spill interrupted commercial fishing activities in the vicinity of Kalgin Island during the peak of the sockeye salmon run.

Both incidents demonstrated that preventing catastrophic tanker spills is easier than cleaning them up, and focused public, agency, and legislative attention on the prevention and cleanup of oil spills. Numerous changes were effected on both the federal and state levels. At the state level, new statutes created the oil and hazardous substance spill response fund (AS 46.08.010), established the Spill Preparedness and Response (SPAR) Division of ADEC, (AS 46.08.100), and increased financial responsibility requirements for tankers or barges carrying crude oil up to a maximum of \$100 million (AS 46.04.040(c)(1)). Regulations and laws regarding oil spills are discussed in Chapter Seven.

### **d. Alaska Risk Assessment of Oil and Gas Infrastructure**

In May 2007, the Alaska Risk Assessment (ARA) project was launched by the ADEC. The purpose of the 3-year, \$5 million initiative is to evaluate Alaska’s oil and gas infrastructure for its ability to operate safely. Based upon Phase I of the investigation, the project scope was revised, and the investigation changed focus to North Slope pipeline spills that resulted in loss of integrity. A North Slope Spills Analysis (NSSA) for specific North Slope pipelines was issued in November 2010, and compiled and analyzed causal information associated with the North Slope pipeline spills. The spill analysis investigated risks to oil infrastructure using available spill data, information about causal factors, and included seven specific recommendations for reducing spills from Alaska infrastructure (ADEC 2010b).

A complementary report was issued, the Alaska Risk Assessment of Oil and Gas Infrastructure Oversight Report, that provided recommendations for future oversight activities for oil transportation (Cycla Corporation 2010). The report provided an overview of risk management and oversight systems used by other jurisdictions, and provided recommendations designed to enhance risk management practices of the ADEC and to strengthen risk management practice across Alaska

oversight agencies (Cycla Corporation 2010). Key findings from this report are that the primary job of regulators is to require practices that reinforce the operators' responsibility to ensure safe operation of their facilities; the State should not undertake a risk assessment without significant cooperation from the operators; the existing system should be refined rather than implementing radical changes; and operator reporting should be expanded to improve the understanding of the effectiveness of management systems (Cycla Corporation 2010). Specific recommendations were divided into two categories: recommended future Alaska oversight agency risk management activities, and recommended ADEC activities (Cycla Corporation 2010).

**e. Gulf of Mexico Incident:**

There was an oil release in the offshore region of the Gulf of Mexico in 2010. The Deepwater Horizon was a semi-submersible drilling unit (Transocean 2010a) operating on Mississippi Canyon Block 252 (MC252) (BP 2010a) in federal Outer Continental Shelf (OCS) waters located in the United States Gulf of Mexico, about 41 miles offshore of Louisiana (Transocean 2010c; Transocean 2010b; Transocean 2010d). BP Exploration & Production, Inc. was the lease operator (Transocean 2010d).

According to official reports, on April 20, 2010, approximately 10:00 p.m. Central Time, a fire and explosion were reported on the Deepwater Horizon (Transocean 2010b; Transocean 2010d). The oil drilling rig sank on April 22, 2010 (Transocean 2010d).

Several attempts to stop the flow of oil and gas, and to make the blow out preventer operational were attempted. The well was shut-in on July 15, 2010, a relief well was drilled, and the well was pumped with cement on September 17, 2010 (BP 2010a).

The U.S. Bureau of Ocean Energy Management, Regulation and Enforcement and the U.S. Coast Guard have joint jurisdiction over the incident, and are investigating the factors that caused the event (USCG and MMS 2010). The final report is scheduled to be issued in July 2011 (USCG and BOEMRE 2011).

The National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling (also called the Oil Spill Commission, or OSC) was established by presidential executive order in May 2010. Its objectives are to examine the relevant facts and circumstances concerning the root causes of the Deepwater Horizon explosion, fire, and oil spill and to develop options to guard against, and provide recommendations to mitigate the impact of, any oil spills associated with offshore drilling in the future (DOE 2010). The OSC report issued on January 11, 2011 concluded that several errors were made and that systematic failures in risk management are potential problems that may impact the oil and gas industry (OSC 2011).

The OSC report presents 31 specific recommendations for seven categories: improving the safety of offshore operations; safeguarding the environment; strengthening oil spill response, planning, and capacity; advancing well-containment capabilities; overcoming impacts of the Deepwater Horizon spill and restoring the Gulf of Mexico; ensuring financial responsibility; and promoting congressional engagement to ensure responsible offshore drilling (OSC 2011).

## **2. Oil Spill Prevention**

A number of measures contribute to the prevention of oil and natural gas related spills during the exploration, development, production, and transportation of crude oil and natural gas. Some of these prevention measures are presented as mitigation measures in Chapter Nine, and some are discussed in this chapter. Prevention measures are also described in the oil discharge prevention and contingency plans that the industry must prepare before beginning operations. Thorough training, well-maintained equipment, and routine surveillance are important components of oil spill

prevention. From 1949-2008, there were 18 blowouts in Alaska: 15 of those occurred before the 1990s, two occurred during the 1990s, and one occurred in 2008; all except one were gas blowouts (AOGCC 2009). Improvements in well control have come about because of better equipment and controls, redundancy in critical components, training, and frequent testing (AOGCC 2009).

Technical design of pipelines and other facilities also reduces the chance of oil spills. National industry standards and federal, state, and local codes and standards, help assure the safe design, construction, operation, maintenance, and repair of pipelines and other facilities. A quality assurance program promotes: adequate inspection of the pipelines to identify any safety or integrity concerns; regular maintenance, including installing improved cathodic protection, and using corrosion inhibitors; and continuing regular visual inspections to ensure safe and reliable operation.

If and when oil or gas is found in commercial quantities and production is proposed, final decisions on transportation will be made through the local, state, and federal application and permitting processes. Those processes will consider any required changes in oil spill contingency planning and other environmental safeguards, and will involve public participation.

The oil and gas industry employs, and is required to employ, many techniques and operating procedures to help reduce the possibility of spilling oil, including:

- Use of existing facilities and roads;
- Water body protection, including proper location of onshore oil storage and fuel transfer areas;
- Use of proper fuel transfer procedures;
- Use of secondary containment, such as impermeable liners and dikes;
- Proper management of oils, waste oils, and other hazardous materials to prevent ingestion by bears and other wildlife;
- Consolidation of facilities;
- Placement of facilities away from fishbearing streams and critical habitats;
- Siting pipelines to facilitate spilled oil containment and cleanup; and,
- Installation of pipeline leak detection and shutoff devices.

### **a. Blowout Prevention**

A blowout is the uncontrolled gushing of fluids from a formation that the hole has penetrated. Prevention of blowouts is a priority. In addition, operators must have plans for preventing and anticipating blowouts. Operators must train employees how to react safely in the case of a blowout (Van Dyke 1997).

Each well has a blowout prevention program that is developed before the well is drilled. Operators review bottom-hole pressure data from existing wells in the area and seismic data to learn what pressures might be expected in the well to be drilled. Engineers use this information to design a drilling mud program with sufficient hydrostatic head to overbalance the formation pressures from surface to the total depth of the well. They also design the casing strings to prevent various formation conditions from affecting well control performance. Blowout preventer (BOP) equipment is installed on the wellhead after the surface casing is set and before actual drilling begins. BOP stacks are routinely tested in accordance with government requirements. AOGCC regulates compliance with blowout prevention requirements (AOGCC 2010a).

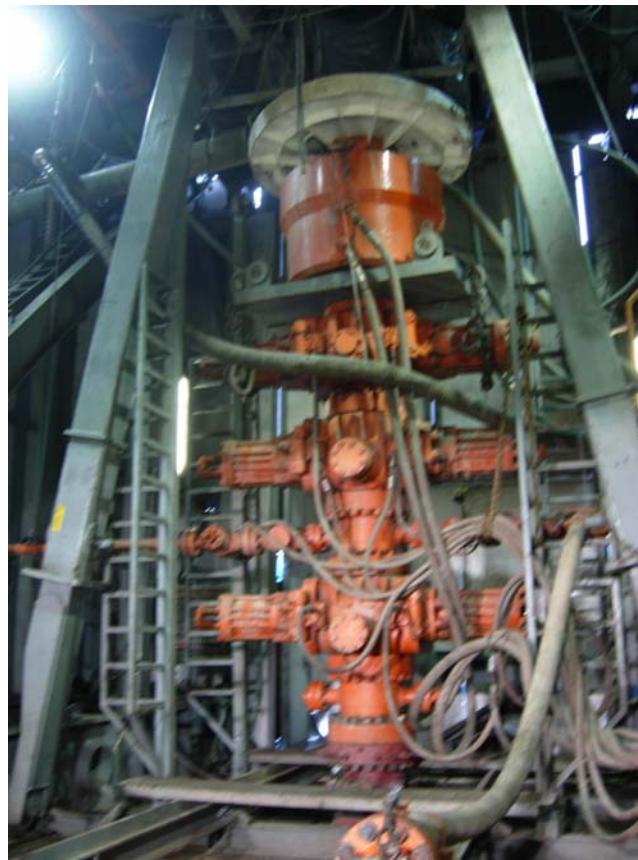
Wells are drilled according to the detailed plan. Drilling mud and well pressures are continuously monitored, and the mud is adjusted to meet the actual wellbore pressures. The weight of the mud is the primary well control system. If a kick (sudden increase in well pressure) occurs, the well is shut-in using the BOP equipment. This prevents further entry of formation fluids into the well borehole. The BOP closes off and contains fluids and pressures in the annulus and in the drill pipe. Technicians take pressure readings and adjust the weight and density of the drilling mud to compensate for the increased pressure (Van Dyke 1997).

Drilling of a relief well can address an over-pressured well. If a blowout occurs, another drilling rig is moved to the location, and a well borehole is drilled to intercept or pass within a few feet of the bottom of the “wild” well. The “wild” well is killed by circulating high density fluid down the relief well and up into the “wild” well (Van Dyke 1997). Conditions may require the construction of an ice or gravel pad and road for the relief well. The operator will look for the closest appropriate drill rig. If the rig is in use, industry practice dictates that, when requested, the operator will release the rig for emergency use. This can take weeks to implement.

### **b. Leak Detection**

Leak detection systems and effective emergency shut-down equipment and procedures are essential in preventing discharges of oil from any pipeline that might be constructed in the lease sale area. Once a leak is detected, valves at both ends of the pipeline, as well as intermediate block valves, can be manually or remotely closed to limit the amount of discharge. The number and spacing of the block valves along the pipeline will depend on the size of the pipeline and the expected throughput rate (Nessim and Jordan 1986). Industry on the North Slope has used the volume balancing method, which involves comparing input volume to output volume.

The technology for monitoring pipelines is continually improving. Leak detection methods may be categorized as hardware-based (optical fibers or acoustic, chemical, or electric sensors) or software-based (to detect discrepancies in flow rate, mass, and pressure) (Scott and Barrufet 2003). Leak detection methods include acoustic monitoring, pressure point analysis, ultrasound, radiographic testing, magnetic flux leakage, the use of coupons, regular ground and aerial inspections, and combinations of some or all of the different methods. The approximate location of a leak can be determined from the sensors along the pipeline. A computer network is used to monitor the sensors and signal any abnormal responses. In recent years, computer-based leak detection through a Real-Time Transient Model has come into use, to mathematically model the fluid flow within a pipe (Scott and Barrufet 2003). Modern pipeline systems are operated from control centers with



J. Easton, DO&G

Example of a blowout preventer (BOP) at Jacob's Ladder exploration well, North Slope.

computer connectivity with satellite and telecommunication links to strive for rapid response and constant monitoring of pipeline conditions (PHMSA 2010b).

Pressure Point Analysis (PPA) measures changes in the pressure and velocity of the fluid flowing in a pipeline to detect and locate leaks. PPA has successfully detected holes as small as 1/8-inch in diameter within a few seconds to a few minutes following a rupture (Farmer 1989). Automated leak detection systems such as PPA operate 24 hours per day and can be installed at remote sites. Information from the sensors can be transmitted by radio, microwave, or over a hardwire system.

Three systems can be employed that detect leaks down to 0.12% of rated capacity (100 bbl per hour). These include line volume balance, deviation alarms, and transient volume balance.

Line volume balance (LVB) checks the oil volume in the pipeline every 30 minutes. The system compares the volume entering the line with the volume leaving the line, adjusting for temperature, pressure, pump station tank-level changes, and slackline conditions.

There are three types of deviation alarms: pressure, flow, and flow rate balance. Pressure alarms are triggered if the pressure at the suction or discharge of any pump station deviates beyond a certain amount. Flow alarms are triggered if the amount of oil entering a pump station varies too much from one check time to the next. Flow rate balance alarms are triggered if the amount of oil leaving one pump station varies too much from the amount entering the next pump station downstream. This calculation is performed on each pipeline section about six times a minute.

Transient volume balance (TVB) can detect whether a leak may be occurring and identify the probable leak location by segment, especially with larger leaks. While the LVB leak detection system monitors the entire pipeline, the TVB system individually monitors each segment between pump stations. Because the TVB indicates in which area a leak may be occurring, focused reconnaissance, and earlier response mobilization are possible (APSC 2009).

There are several other leak detection systems. Leck Erkennung und Ortungs System (LEOS) is a leak detection and location system manufactured by Siemens AG. The system has been in use for 21 years and in over 30 applications. LEOS consists of a three-layer gas-sensor tube that is laid next to the pipeline. The inner layer is a perforated gas transport tube of modified PVC (polyvinyl chloride). A diffusion layer of EVA (ethylene vinyl acetate) surrounds and allows gasses to enter the inner tube. A protective layer of braided plastic strips forms the outer layer. The tube is filled with fresh air, and the air is evacuated through a leak detector at regular intervals. If a leak occurs, hydrocarbon gases associated with the leak enter the tube and are carried to the gas detector. The system is totally computer controlled, self-checking, and re-setting. Background gases are calibrated at setup and checked regularly. The system will pick up previous contamination and organic decomposition. The location of the leak is determined by monitoring the time that leaked gas arrives at the detection device. The sensor allows determination of the size and location of the leak (NRC 2003). The system is very low maintenance and will last the life of the pipeline. Special protective adaptations are made if the system will operate in cold temperatures and for the backfill installation method used to install the pipeline. The tube is placed in a protective cover, and the system is tested continuously as the segments are installed. LEOS is strapped to the oil pipeline next to the poly spacers that separate the gas line from the oil line. The system detects leaks from both lines, and operators are able to tell the difference between the two. Engineers estimate that it takes about 5 to 6 hours for leaked molecules to migrate to the LEOS tube. The air inside the tube is evacuated and tested every 24 hours (Scott and Barrufet 2003).

Design and use of “smart pigs,” data collection devices that are run through the pipeline while it is in operation, have greatly enhanced the ability of a pipeline operator to detect internal and external corrosion and differential pipe settlement in pipelines. Pigs can be sent through the pipeline on a regular schedule to detect changes over time and give advance warning of any potential problems.

The Trans-Alaska Pipeline System operation has pioneered this effort for Arctic pipelines. The technique is now available for use worldwide and represents a major tool for use in preventing pipeline failures. Although some older pipelines cannot facilitate smart pigs, the PIPES Act of 2006 requires the development of integrity management programs for pipelines in high consequence areas. Basic requirements for an Integrity Management Plan include periodic integrity assessment of pipelines that could affect high consequence areas (HCAs). Integrity assessments are performed by in-line inspection (also referred to as “smart pigging”), hydrostatic pressure testing, or direct assessment. Through these assessment methods, potentially injurious pipeline defects that could eventually weaken the pipe, or even cause it to fail, are identified early and can be repaired, thus improving the pipe’s integrity.

The Forward Looking InfraRed (FLIR) pipeline monitoring program assists in detecting pipeline leaks and corrosion in the Kuparuk oil field. Originally developed by the military (NRC 2003), FLIR uses infrared sensors to sense heat differentials. A leak shows up as a “hot spot” in an FLIR video, in both daytime and night time images (MMS 2008). In addition, water-soaked insulation surrounding a pipeline is visible because of the heat transfer from the hot oil to the water in the insulation and finally to the exterior surface of the pipeline. FLIR is also effective in discovering water-soaked insulation areas that have produced corrosion on the exterior wall of the pipeline (St Pierre 1999).

FLIR also has applications in spill response. Infrared photography can be used to quickly and accurately determine the area of the spill, distinguishing between oil and substances that might look like oil to human eyes (NRC 2003). This allows swift and accurate reporting of the spill parameters to the appropriate agencies. The incident command team is able to receive information near real-time, and can therefore make timely decisions.

ARCO studied the use of vertical loops at Alpine in lieu of block valves and concluded that, in conjunction with emergency pressure let down valves or direct valves, vertical loops are better than manual block valves for reducing catastrophic failures. A vertical loop is an artificial high point in a pipeline. If a pipe leaks, the vertical loop becomes the high point and the oil cascades from one vertical loop to the next, creating a vapor space and isolating the fluid on the uphill side from the leak (Cederquist 2000). BLM reported that vertical loops greatly reduce the environmental effects on tundra, provide for a safer line, and lessen the probability of spillage due to river induced pipeline damage. It also acknowledged that the placement of a pipeline at depth beneath a river could make detection and cleanup of a spill in the buried segment difficult (BLM 2008b).

The Pipeline and Hazardous Materials Safety Administration has jurisdiction over cross-country pipelines. The federal 49 CFR 192, Subpart O addresses the gas transmission pipeline integrity management regulations and requirements. Identification of High Consequence Areas (HCA) and the required integrity management program are components of what a gas transportation system operator must do to remain in compliance and to provide adequate planning, implementation and system maintenance. The technologies used for future gas transportation projects will determine the actual integrity management program components that must be implemented (PHMSA 2010a).

## **G. Oil Spill Response**

By law, the responsible party (RP) is responsible for preventing and responding to oil spills, including notifying federal, state, and local authorities. ADEC regulations (18 AAC 75.400) require that oil companies prepare Oil Discharge Prevention and Contingency Plans (C-plans). C-plans must set forth measures designed to prevent spills and must demonstrate sufficient resources are available to contain or control and clean up that occur. A key component of a plan is ready access to trained personnel and equipment. Spill preparedness and response practices are driven by the state’s Unified Plan, the North Slope Subarea Plan, and the practices developed by the North Slope’s oil spill

response cooperative. The North Slope Subarea Plan primarily serves the area within the North Slope Borough (ADEC 1999; ADEC 2007a).

Regardless of the nature or location of a spill, the North Slope Subarea Plan sets these objectives for all response actions:

- Ensure safety of responders and the public.
- Stop the source of the spill.
- Deploy equipment to contain and recover the spilled product.
- Protect sensitive areas (environmental, historic properties, and human use).
- Track the extent of the spill and identify affected areas.
- Clean up contaminated areas and properly dispose of wastes.
- Notify and update the public. Provide avenues for community involvement where appropriate (ADEC 1999; ADEC 2007a).

## **1. Response Teams**

The Alaska Regional Response Team (ARRT) monitors the actions of the RP. The Team is composed of representatives from 15 federal agencies and one representative agency from the state. The ARRT is co-chaired by the U.S. Coast Guard and EPA. ADEC represents the State of Alaska. The team provides coordinated federal and state response policies to guide the Federal On-Scene Coordinator in responding effectively to spill incidents and has developed a Unified Plan. The Statewide Oil and Hazardous Substance Incident Management System Workgroup, which consists of ADEC, industry, spill cooperatives, and federal agencies, published the Alaska Incident Management System (AIMS) for oil and hazardous substance response. The ARRT has developed guidelines regarding wildlife, in-situ burning, the use of dispersants, and the protection of cultural resources, which include archaeological and historic sites (ADEC 1999; ADEC 2007a). Each operator identifies a spill response team (SRT) for their facility, and each facility must have an approved



A Mutual Aid drill near TAPS pump station 3 in which the team is practicing deploying river boom, North Slope foothills area.

C-plan. Company teams provide on-site, immediate response to a spill event. The SRTs are integrated into the North Slope Spill Response Team (NSSRT), comprised of 115 field responders per day (ACS 2010b).

First, responders attempt to stop the flow of oil and may deploy booms to confine oil that has entered the water. The responders may deploy booms to protect major inlets, wash-over channels, and small inlets. Finally, deflection booming would be placed to enclose smaller bays and channels to protect sensitive environmental areas. If the nature of the event exceeds the facility's resources, the RP calls in its response organization. The SRT:

- identifies the threatened area;
- assesses the natural resources, i.e., environmentally sensitive areas such as major fishing areas, spawning or breeding grounds;
- identifies other high-risk areas such as offshore exploration and development sites and tank-vessel operations in the area;
- obtains information on local tides, currents, prevailing winds, and ice conditions; and,
- identifies the type, amount, and location of available equipment, supplies, and personnel.

The next action is containment. It is especially important to prevent oil spills spreading rapidly over a large area. Cleanup activities continue as long as necessary, without any time frame or deadline.

First responders to a natural gas leak would likely be associated with the pipeline operator. Operators on oil and gas leases are the primary persons responsible for planning for, implementing and completing an approved plan of operations, which includes provisions for operations, supplies, equipment, access, facilities and rehabilitation of the affected leased area (ADNR 2009a).

In addition, fire department personnel in nearby villages may be called to respond to fire incidents. Barrow and Nuiqsut have full time fire departments, and Anaktuvuk Pass and Kaktovik have volunteer fire departments. Others trained in fire response could be called to an oil and gas related fire event.

## **2. Training**

Individual members of the SRT train in basic spill response. Alaska Clean Seas (ACS), the North Slope's oil spill cleanup cooperative, offers dozens of classes in topics ranging from Incident Command to Fate and Behavior [of oil], Skimmer In Fast Tanks and Test Tanks, Winter Spill Response, Radio Communications, Tundra Cleanup Techniques, Staging Area Management, Behavior of Oil in Broken Ice, and others. Alaska Clean Seas provides spill response training each week in 2 to 4 hour sessions to each of the North Slope Spill Response Teams (ACS 2010b). ACS has five labor categories (ACS 2008). Entry level General Laborers may have minimal or no experience and perform tasks associated with mobilizing, deploying, and supporting cleanup. Over time, each General Laborer will receive additional training and be brought to at least the next training level, Skilled Technicians. Skilled Technicians receive specific training or experience in spill response; they operate skimmers and other equipment used to retrieve spilled oil. Team Leaders have additional responsibilities and may be charged with managing portions of a response. ACS's two remaining labor categories relate to Vessel Operation (ACS 2010b).

## **3. Response Organizations**

The response organizations for the lease sale area will be determined by the operators of the oil and gas exploration and development activities. There are organizations that currently provide response services for the North Slope area. The response organization for this lease sale area may provide response services that are similar to those described here for ACS.

ACS is an industry-sponsored, not-for-profit organization that provides the oil spill response function in support of petroleum-related activities on the North Slope, in the coastal and OCS waters off the coast of the North Slope of Alaska, and along the Trans-Alaska Pipeline from Pump Station One to Milepost 167 (ACS 2010a). The organization was originally established in Prudhoe Bay in 1979 under the name of ABSORB (Alaskan Beaufort Sea Oilspill Response Body) to support offshore exploration ventures in the Alaskan Beaufort Sea. In 1990, ACS owner companies expanded the mission to include response operations both offshore and onshore. Environmental support includes field environmental audits, storm water run off management, maintenance of water generator status, hazardous waste shipments, wildlife hazing, and reporting. Membership is optional, and member companies pay an initiation fee and annual fee, daily rig fees when engaging in drilling, and annual production fees for facilities in production (ACS 2010b).

Members of the ACS organization include Alyeska Pipeline Service Company, Anadarko Petroleum Corporation, BP Exploration (Alaska), Brooks Range Petroleum Corporation, ConocoPhillips Alaska Inc., Eni US Operating Company Inc., ExxonMobil Production Company, FEX L.P., Pioneer Natural Resources (USA), and Shell Offshore Inc. (ACS 2010a).

Any responses to oil spills in the lease sale area by ACS would be for ACS organization members. Exploration and development companies would need to join the Alaska Clean Seas organization to benefit from its spill response services provided to members.

Local fire departments and organizations with trained first responders may be called to action, depending upon the emergency incident circumstances.

#### **4. ACS Responders and Mutual Aid Agreements**

For an oil spill in the lease sale area, oil and gas operators who are members of ACS may call upon ACS for assistance with both spill planning and response. Members may also engage in Mutual Aid Agreements with other ACS members, providing each other with shared resources, both personnel and equipment, in the event of a spill. ACS provides manpower and equipment resources from its main base in Deadhorse and from within each of the operating oilfield units to assist in spill containment and recovery. ACS has 78 full time staff on the North Slope and in Anchorage; about half of ACS' employees and contractors are located on the North Slope and all are available for response operations. Including trained volunteers, ACS has available a minimum of 115 spill response personnel on the North Slope each day (ACS 2010b). ACS personnel are on call 7 days a week, 24 hours a day while they are on-shift. The time necessary to arrive at a spill site with the appropriate equipment depends on the spill situation.

North Slope operating companies coordinate with ACS to ensure a pool of trained personnel is available for an extended response. Over 500 trained employees, contractors, and ACS-trained Village Response Teams are available for response, with a minimum of 115 trained responders immediately available on a daily basis via mutual aid agreements. All on-shift members of the NSSRT are available for call-out. ACS also manages existing contracts with several spill response and service contractors. Contracted response services include labor and equipment, aviation support, telecommunications services, and computerized mapping (ACS 2008).

ACS trains North Slope village teams to support oil spill response capability. Intensive training courses for village team members include winter and summer oil spill operations, hazardous waste operations, oil spill post-emergency response, oil spill assessment, tracking and detection of oil, skimmer operations, incident command, and basic radio voice procedures. The teams take part in field exercises and the annual North Slope mutual aid response exercises. While ACS does not clean up spills in the villages, the village responders may have the training to do so.

## 5. Initiation of the Incident Management Team

Response actions vary greatly with the nature, location, and size of the spill. Upon direction of the Incident Command, the general response activities may include location and stop of the spill or release and estimation of the spill amount. The substance's chemistry and trajectory are determined, and the equipment needed to confine the spill or to protect sensitive areas is determined. Damage assessment is conducted of the oiled and impacted areas, and a cleanup plan is developed and implemented.

Response equipment might include earth-moving equipment, airplanes, helicopters, boats, boom, skimmers, sorbents, and in-situ burning equipment. The responsible party and its contractors usually perform response activities with assistance and monitoring by federal and state agencies.

ACS has purchased and maintains a spill response equipment inventory valued in excess of \$25 million and ACS members have built corresponding inventories capable of meeting the immediate response needs of their respective units, bringing the value of inventory to \$50 million. This equipment is designed to respond to spills within the defined area of operations, under all environmental conditions. Members share resources in the event of a significant spill within any of the North Slope operating units. To assist with this task, ACS manages the combined inventory of all dedicated North Slope spill response assets in a single, computerized maintenance and job order system (ACS 2008). Additional equipment and trained personnel are available through ACS' agreements with contractors or master services agreements.

There are emergency operation centers located in Deadhorse, at satellite areas in Alpine, Kuparuk, Milne Point fields and at the Prudhoe Bay Operations Center. With assistance from the ACS base operations center, field assigned ACS technicians support the operating area facilities and sites, while the Deadhorse locations are managed by ACS base personnel. Mobile facilities are also available (ACS 2010b).

ACS established a central Incident Command Post at Deadhorse as a control point for oil spill response radio and telephone systems for the entire North Slope area, extending into the Beaufort



P. Lhotka, ADEC

Spill response team removing contaminated water from the top of ice, Flow Station 2, Prudhoe Bay, 10/18/07.

Sea. This radio and telephone communications system is capable of being rapidly deployed by sea, land, or air to local and remote areas in support of onshore or offshore oil spill response actions. Remote control circuits for 14 permanent Very High Frequency (VHF) repeaters and marine coast stations, installed at strategic locations in the production area and pipeline corridor, are routed via private microwave circuits into the system (ACS 2008). Other High Frequency (HF) and Ultra High Frequency (UHF) radios are also connected to the system. Communication is then possible among all users, whether marine-based radios, company headquarters or supply depots, ICP, hand held portable radios, or aircraft radios. This gives each member company access to all of the radio systems, regardless of the type of radio it is using. ACS also has mobile VHF and UHF radios, base and mobile stations, satellite telephones with data capabilities, and portable repeaters for field use in its oil spill response program (ACS 2008).

Other spill response organizations operate in the state. Alyeska Pipeline's SERVS (Ship Escort Response Vessel System) operates in Prince William Sound. Other operational equipment includes INMARSAT satellite telephone systems, operating independently of wires and separate from the VHF, UHF, and other radio systems, at Deadhorse on the North Slope. The name INMARSAT is derived from "international, marine, satellite." The system can reach anywhere in the world via satellite. An INMARSAT system can be mounted on a boat, in such a way that, regardless of heavy seas or other disturbance, the antenna beam cannot be shaken off the satellite and communication disconnected. Ships, barges, aircraft, oil spill response agencies, ground personnel, and anyone with a telephone can be reached via this system.

## **6. Spill Response**

ACS and the North Slope operators employ a tiered system for responding to spills. Small, non-emergency spills are cleaned up by the operator or ACS personnel. Spills requiring the resources of ACS and the responsible party's SRT are considered Tier I spills. If a spill requires more than the resources of ACS and the RP, it is considered a Tier II spill. Other North Slope operators share their resources, both personnel and equipment. Mutual aid is a system that utilizes SRTs from companies other than that of the responsible party. Such spills usually require some longer-term cleanup.

An extremely large spill or an incident lasting several months may require resources unavailable on the North Slope and is classified as a Tier III spill. ACS may enlist assistance from spill responders from Cook Inlet (CISPRI) and Prince William Sound (SERVS) or from its Auxiliary Contract Response Team (ACRT) subcontractors: CCI, Penco, and Trident (ACS 2010b), as well from across the U.S. and other countries (ACS 2008). Response strategies are set forth in ACS' Technical Manual, providing specific scenarios for environmental and seasonal conditions found on the North Slope.

## **7. Research and Development**

Building on studies addressing Arctic oil spill response, ACS developed a technical manual for spill response on the North Slope and Beaufort Sea (ACS 2008). The three-volume manual was revised in 2008. The manual and the background documents supporting it are a compilation of the latest research and best available technology regarding oil spill response in the Arctic. The response tactics in the manual are designed to be used as building blocks for operators to prepare facility-specific response scenarios in their C-plans. The manual describes key response planning parameters for a variety of climatic and environmental conditions that may be encountered. It is intended to provide direction and consistency in developing generic scenarios for a variety of receiving environments, and eliminate the need for individual plans to repeat technical details. The manual consists of three volumes: Tactics Descriptions, Map Atlas, and North Slope Incident Management System and will augment the C-plans that each operator must prepare before beginning operations. The manual represents a major advance in the organization and coordination of spill

response planning and preparedness on the North Slope. The reader is referred to the Technical Manual for a thorough description of response activities.

ACS acts as a facilitator for much of the research and development related to responding to spills in the Arctic. Research focuses on recovery techniques in, on, and under ice, and during various broken ice conditions, as well as detecting and tracking oil under ice, tundra treatment, high volume skimmers, ground penetrating radar and alternative response options (ACS 2010b). ACS also manages research and development projects for BP Exploration, Inc., and ConocoPhillips Alaska, Inc., to meet the requirements to the Charter for Development of the Alaskan North Slope commitment to the State of Alaska. ACS is working with BOEMRE on improving methods for recovering residues of in-situ burning techniques of marine oil spills (ACS 2010b).

## **8. Cleanup and Remediation**

The state's priorities for oil spill responses are as follows:

- Safety of all persons involved in the spill;
- Protecting public health from contamination of drinking water, air, and food;
- Protecting the environment, natural and cultural resources, and biota from direct and indirect effects of contamination;
- Ensuring adequate containment, control, cleanup, and disposal by the responsible party, leading to the state assuming control of the incident, if necessary;
- Assessing contamination and damage and restoration of property, natural resources, and the environment; and
- Recovering costs and penalties (ADEC 1999; ADEC 2007a)

Cleanup plans, regardless of the location and nature of the spill, must balance the objectives of maximizing recovery and minimizing ecological damage. All oils are not the same, and knowledge of the chemistry, fate, and toxicity of the spilled oil can help identify cleanup techniques that can reduce the ecological impacts of an oil spill. Hundreds of laboratory and field experiments have investigated the fate, uptake, toxicity, behavioral responses, and population and community responses to crude oil.

Plans must also address the complications of working in Arctic conditions including extreme cold, ice, and darkness. The North Slope and North Slope Foothills areas can present extremes that might make it difficult to effectively contain and clean up a major spill. Cold weather, in particular, can challenge both personnel and machinery. Conversely, ice and snow can act as natural barriers and facilitate clean up (ADEC 1999, ADEC 2007a). However, spills that occur during the summertime risk impacting the diverse species that use North Slope Foothills habitats. Plans address specific steps to accommodate these conditions. The effects on the sensitive environments of the region could be severe if they are not mitigated.

## **9. Fate and Behavior of Spilled Oil**

Quick response and recovery greatly affect the efficacy of any spill cleanup. After a spill, the physical and chemical properties of the individual constituents in the oil begin to be altered by the physical, chemical, and biological characteristics of the environment. These are called weathering, spreading, evaporation, dispersion, dissolution, and emulsification (BLM 2008a). Evaporation allows lighter components of oil to evaporate; evaporation increases as oil spreads and in rougher seas and higher temperatures. Dispersion on water occurs when waves and turbulence break up the oil slick into droplets and smaller slicks. Droplets may remain in the water column or rise to the surface and combine with other droplets to form a new slick. Dissolution is the process wherein

water soluble compounds dissolve into water. The passage of time before the start of recovery allows oil to spread, expanding the affected area and thus requiring more response resources. The longer the oil remains exposed to the elements the more weathered it becomes, making it more viscous and more likely to form water in oil emulsions that can limit the effectiveness of skimmers, increase storage requirements on water, and negatively impact the oil's ability to burn (MMS 2008).

Oil on water spreads and quick intervention is critical. The fate and behavior of oil spilled in Arctic waters could be affected by the presence or developing presence of ice. Evaporation is the only significant weathering process at the time of freeze-up. Oil under ice may be trapped, or encapsulated, and will not evaporate; as ice melts in the spring, the oil rises to the surface and, if the ice moves, oil will appear at a different location than the spill (NRC 2003). Broken ice promotes emulsification more rapidly than open water (NRC 2003).

Upland spills follow topography; oil flows downhill. If released to tundra, summertime spills penetrate soil and foul tundra. Wintertime spills may be constrained, or facilitated, by snow and ice. Ice can also prevent oil from spreading.

The factors that are most important during the initial stages of cleanup are the evaporation, solubility, and movement of the spilled oil. As much as 40% of most crude oils may evaporate within a week after a spill. Over the long term, microscopic organisms (bacteria and fungi) break down oil (Jorgenson and Cater 1996). Understanding these processes is critical to decisions about cleaning spilled oil.

## **10. Cleanup Techniques**

The best cleanup techniques are those that quickly remove volatile aromatic hydrocarbons. This is the portion of oil that causes the most concern regarding the physical fouling of birds and mammals. To limit the most serious effects, it is desirable to remove the maximum amount of oil as soon as possible after a spill. The objective is to promote ecological recovery and not allow the ecological effects of cleanup to exceed those caused by the spill itself. Table 6.4 lists cleanup objectives and techniques that may be applicable to each objective. Table 6.5 compares the advantages and disadvantages of cleanup techniques for crude oil in terrestrial and wetland ecosystems (Jorgenson and Cater 1996).

Cleanup phases include initial response, remediation, and restoration. During initial response, the responsible party: gains control of the source of the spilling oil; contains the spilled oil; protects the natural and cultural resource; removes, stores and disposes of collected oil; and assesses the condition of the impacted areas. During remediation, the responsible party performs site and risk assessments; develops a remediation plan; and removes, stores, and disposes of more collected oil. Restoration attempts to reestablish the ecological conditions that preceded the spill and usually includes a monitoring program to access the results of the restoration activities (Jorgenson and Cater 1996).

Spill recovery techniques are generally considered mechanical (e.g., boom and skimmers) or nonmechanical (in-situ burning and dispersants); one or more techniques may be used together. The location of the spill (open water, protected water, on land, wetlands, broken ice) and weather are critical factors determining the techniques employed (ACS 2008).

Containment booms used in conjunction with skimmers are the most commonly used mechanical method for removing oil from water. Booms float on water and corral the oil and then skimmers are used to remove the concentrated oil. Some booms have been adapted for use in icy waters (NRC 2003). Skimmers of choice for Arctic waters are oleophilic brush, rope mop, or drum/disc skimmers that collect oil when it adheres to the surface of the brush or rope (MMS 2008). Oil is then scraped off into a sump and pumped to a storage tank. These skimmers efficiently recover oil while limiting

the amount of water collected, extending storage on water, but containment and recovery may be slow and may not remove all the oil.

Dispersants and in-situ burning are nonmechanical techniques. Dispersants chemically treat oil while it floats on the water surface. Dispersants do not remove the oil, but break it into very small droplets that mix into the upper water column, promoting rapid degradation. In Alaska dispersants are only used to clean up spills on water and are not used on broken or solid ice (ADEC 2007a). Use of dispersants must be approved in advance in certain coastal areas, by the Unified Command and by the EPA. Choosing dispersants as a recovery technique is influenced by water depth and distance from the shoreline; its use usually is not permitted in areas where the water depth is less than 10 meters (MMS 2008).

In-situ burning involves collecting or concentrating oil, performing a controlled burn, and then removing the residue. It is most effective when used early in the cleanup process, before oil has emulsified. On open water, this technique may involve special booms, igniting agents, and methods to deliver them. Burning can be effective in the Arctic, where ice may help contain a spill. ADEC's revised burning guidelines function as ARRT's policy on in-situ burning and present the required Federal and State On-Scene Coordinators approval process (ADEC 2008). MMS considered in-situ burning the preferred method of non-mechanical response for icy waters (MMS 2008).

**Table 6.4. Objectives and techniques for cleaning up crude oil and terrestrial and wetland ecosystems.**

Objectives	Cleanup Techniques
<b>Minimize:</b>	
Movement of oil	Absorbent booms Sand bagging Sheet piling
Surface-water contamination	Same as above
Soil infiltration	Flood surface
Soil and vegetation contact and oil adhesion	Flood surface Use surfactants to reduce adhesion
Vegetation damage	Use boardwalks to reduce trampling Use flushing instead of mechanical techniques Perform work when vegetation is dormant
Thawing of Permafrost	Avoid vegetation and surface disturbance
Wildlife contact with oil	Fencing to prevent wildlife from entering site Plastic sheeting to prevent birds from landing on site Guards to haze wildlife Devices to haze wildlife
Acute and chronic toxicity of oil to humans, fish, and wildlife	Removal of oil Enhance biodegradation of remaining oil
Waste disposal	Use flushing Avoid absorbents and swabbing
Cost	Remove oil as fast as possible Achieve acceptable cleanup level quickly to minimize monitoring
Liability	Achieve acceptable cleanup level
<b>Maximize:</b>	
Recovery potential of tundra ecosystems	All of the above Add nutrients to aid recovery of plants
Worker safety	Air testing, training, clothing

Source: Jorgenson and Cater 1996.

**Table 6.5. Advantages and disadvantages of techniques for cleaning up crude oil in terrestrial and wetland ecosystems.**

Technique	Advantage	Disadvantage	Recommended
<b>Wildlife</b>			
Fencing	Keeps out large mammals	Does not keep out birds	Yes
Plastic sheeting	Keeps out both birds and mammals	Can no longer work area	Sometimes
Wildlife guard	Flexibility to respond	Higher cost	Sometimes
Devices	Lower cost	Animals become habituated	No
<b>Containment</b>			
Absorbent booms	Contains floating oil, quickly deployed	Misses water soluble oil	Yes
Sand bags	Contains both floating and soluble fractions, follows tundra contours	Slower to mobilize, some leakage	Yes
Sheet piling	Maximum containment	Slow to install, doesn't fit contours well	Sometimes
Earthen berms	Can easily be adapted to terrain, heavy equipment rapidly can create berms	Destroys existing vegetation and soil	No
Snow/ice berms	Can be used during winter cleanup or to prevent runoff during breakup	Can only be used during freezing periods	Yes
<b>Contact</b>			
Flooding	Keeps heavy oil suspended	Spreads out oil	Yes
Surfactants	Reduces stickiness, aids removal, and reduces volatilization	Reduces effectiveness of rope mop skimmer	Yes
Thickening agents	Untried, aids physical removal	Must be well drained, physical removal more difficult	No
<b>Access</b>			
Boardwalks	Reduces trampling	None	Yes
<b>Removal</b>			
Complete excavation	Eliminates long-term liability	Eliminates natural recovery, disposal costs	Sometimes
Partial excavation	Quickly reduces oil levels, less waste to dispose of than complete excavation	Causes partial ecological damage, disposal costs, still long-term liability	Sometimes
Burning	Low cost, high removal rate	Little testing, ecological damage	Sometimes
Flushing, pressure	high High removal rate	High ecological damage	No
Flushing, pressure, cold	low Moderate removal rate, little damage, easy waste disposal	Spreads oil, not as effective as warm water	No
Flushing, pressure, warm	low High removal rate, little vegetation damage, easy disposal of waste	Spreads oil	Yes
Aeration	Accelerates volatilization	Volatiles lost to air, may pose risk to humans	Yes
Raking	Can target hot spots	Partial vegetation damage	Sometimes
Cutting and trimming	Targets hot spots, reduces stickiness	Partial vegetation damage	Sometimes
Swabbing	Targets hot spots	Not very effective, adds to waste disposal, adds to trampling	No
Oil skimmers and rope mops	Removes heavier oil, works well with flooding, lowers disposal costs	Requires personnel to push oil to skimmer, adds to trampling	Yes
Vacuum pumping	Removes surface and miscible oil, works well with flooding, lowers disposal cost	None	Yes
Biodegradation	Removes low levels of hydrocarbons, non-destructive, lowers disposal costs	Long-term monitoring, maintenance, may require site protection	Yes

Source: Jorgenson and Cater 1996.

Burning rapidly removes oil from the environment, particularly when compared to water shoreline cleanup activities that may take months or even years. The principle disadvantages of using in-situ burning are smoke plumes and the narrow timeline associated with it. Oil is most volatile before it evaporates or emulsifies, so waiting too long makes in-situ burning ineffective. Burning may also leave toxic residues. If they sink, they may be ingested by the species that use the waters. However, residue cools slowly, allowing time to recover it (ADEC et al. 2008). Samples collected after the

Newfoundland Offshore Burn Experiment were tested for toxicity to three aquatic species. Neither the residue nor the oil was toxic and the burn residue was no more toxic than the oil itself (ADEC et al. 2008). ADEC's guidelines require that approved burns have a plan for residue collection.

State regulations require that operators be able to mechanically entrain and recover, within 72 hours, a response planning standard (RPS) volume of oil (18 AAC 75.434). For exploration facilities, the RPS is a minimum of 16,500 bbl plus 5,500 bbl for each of 12 days beyond 72 hours. For production facilities, the RPS is, at a minimum, 3 times the annual average daily production for the maximum producing well at the facility. If well data demonstrate a lower RPS is appropriate, it may be adjusted accordingly. Conventional booms and skimmers have difficulty working efficiently among the broken ice (ADEC 2007b).

The federal, state and local statutes and regulations that apply to the regulation of oil spill prevention and response are included in Chapter Seven, Governmental Powers.

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# Chapter Seven: Governmental Powers to Regulate Oil and Gas

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# **Chapter Seven: Governmental Powers to Regulate Oil and Gas**

An oil and gas lease grants to the lessee the exclusive right to drill for, extract, remove, clean, process, and dispose of oil, gas, and associated substances. However, an oil and gas lease does not authorize any activities on the lease. A plan of operations or unit plan of operations must be approved before any operations may be undertaken on or in the leased area. In addition, oil and gas activities (exploration, development, production, and transportation) are subject to numerous federal, state, and local laws, regulations, policies, and ordinances, with which the lessee is obligated to comply (Appendix B). Regulatory agencies (state, federal, and local) have different roles in the oversight and regulation of oil and gas activities, although some agencies may have overlapping authorities.

Although there is no “typical” project, some of the various permits and approvals that may be required are discussed below. This chapter does not provide a comprehensive description of the multitude of laws and regulations that may be applicable to oil and gas activities. Rather, its purpose is to illustrate the broad spectrum of authority various government agencies have to prohibit, regulate, and condition activities related to oil and gas. Actual processes, terms, and conditions will vary with time certain, site-specific operations. Lessees are responsible for knowing and complying with all applicable state, federal, and local laws, regulations, policies, and ordinances.

## **A. Alaska Department of Natural Resources**

The ADNR, through the DO&G, the DMLW, the DCOM, the Office of Project Management and Permitting, and the Office of History and Archaeology, and the SPCO review, coordinate, condition, and approve plans of operations or development and other permits as required before on-site activities can take place. The department monitors activities through field inspection once they have begun. Each plan of operations is site-specific and must be tailored to the activity requiring the permit. A plan of operations is required to identify the specific measures, design criteria, and construction methods and standards to be employed so as to comply with the terms of the lease. Applications for other state or federal agency authorizations or permits must be submitted with the plan of operations.

### **1. Alaska Coastal Management Program (ACMP) Review**

The Alaska Coastal Management Program is administered by the DCOM. The North Slope Foothills Areawide lease sale area encompasses habitat in the North Slope Borough’s coastal zone. Therefore, lease related activities are subject to review under the 12 statewide standards of the Alaska Coastal Management Program (ACMP; AS 46.40, 11 AAC 110, 11 AAC 112) and the local coastal district plan. Currently, there is no district plan in effect for the NSB. Future exploration, development, and production activities requiring additional authorizations will undergo separate coastal zone consistency analyses if and when they are actually proposed. Future activities must comply with the ACMP and, once its plan is in effect, the enforceable policies of the North Slope Borough Coastal Management Program (ACMP 2010).

Permit applications for activities under the lease must be as detailed as necessary for a comprehensive agency review. If a project affects or occurs within the coastal zone, a review of the permit application will be conducted to determine whether the proposed activity is consistent with the standards of the ACMP. Following the review, each agency will approve or deny the permit application and determine whether any alternative measures (changes in the project description) or permit conditions are required before approval.

Most permits needed for exploration well drilling require public notice. The ACMP permitting process goes through a 30- or 50-day review and, if other agencies or offices within ADNR require approval, the review is coordinated by DCOM. This process provides for coordinated agency reviews and public input and ensures that proposed activities are consistent with the ACMP and local coastal plans.

The 50-day ACMP review process is initiated when the applicant applies for a state and/or federal permit(s). State authorizations subject to the ACMP are listed on the “C” list discussed below. Federal authorizations subject to the ACMP are listed at 11 AAC 110. The various agencies initiate their internal consistency reviews and must send any requests for additional information to the coordinating agency within 25 days. Public and agency review comments are due on or before Day 30, and a proposed consistency finding is issued on or before Day 44. A request for additional time to complete the review must be received on or before Day 49, and the final consistency determination is issued on Day 50. However, if a reviewing agency objects to the proposed determination, it may elevate the decision to the Commissioner. If the determination is elevated, the Commissioner or delegatee will issue a written decision with findings of fact within 45 days after the request for elevation. The 30-day review process has shorter time periods between action points.

The consistency determination process has been streamlined through the development of A, B, and C list activities.

“A list” activities are considered “categorically consistent,” do not result in significant impacts to coastal resources, and do not require a consistency review. On-pad placement of light poles, railings, electrical towers/poles, modules, and associated oil and gas buildings are examples of A list activities.

“B list” reviews are classified as General Concurrences, and the activities are considered routine with standard alternative measures. Examples are exploration sampling, and North Slope ice road construction, storage of construction materials on existing gravel pads, and North Slope installation of permanent snow fences and power transmission lines. B list activities are consistent with the ACMP and are conditioned with standard pre-set mitigation measures. Individual ACMP consistency reviews are not necessary for activities on the B list.

The resource agency(s) will check the CPQ and plan of operations to ensure that the project qualifies for the A or B list. The coordinating agency will also review the standard alternative measures and any applicable procedures against the plan of operations submitted.

“C list” activities are activities not covered by the A or B lists, and reviews are classified as Individual Project Reviews. C list activities are subject to the 30- or 50-day review process described in this section.

## **2. Plan of Operations Approval (Division of Oil and Gas)**

The operations on State of Alaska oil and gas leases are administered by the DO&G. Land use activities within oil and gas leases are regulated under 11 AAC 83.158, 11 AAC 83.346 and paragraphs 9 and 10 of the lease. These require the lessee to prepare plans of operations and development that must be approved by DO&G and by any other interest holder, if ownership is shared, before the lessee may commence any activities within the leased area. Except for uses and activities appearing on the list in 11 AAC 96.020, the lessee must prepare a plan of operations and obtain all required approvals and permits for each phase of exploration, development, or production before implementation of that activity. All permit applications and plans are available for public review, and public notices will be conducted.

An application for approval of a plan of operation must contain sufficient information, based on data reasonably available at the time the plan is submitted for approval, for the Commissioner to

determine the surface use requirements and impacts directly associated with the proposed operations. An application must include statements and maps or drawings setting out the following:

- (1) the sequence and schedule of the operations to be conducted on or in the leased area, including the date operations are proposed to begin and their proposed duration;
- (2) projected use requirements directly associated with the proposed operations, including the location and design of well sites, material sites, water supplies, solid waste sites, buildings, roads, utilities, airstrips, and all other facilities and equipment necessary to conduct the proposed operations;
- (3) plans for rehabilitation of the affected leased area after completion of operations or phases of those operations; and
- (4) a description of operating procedures designed to prevent or minimize adverse effects on other natural resources and other uses of the leased area and adjacent areas, including fish and wildlife habitats, historic and archeological sites, and public use areas (11 AAC 83.158(d)).

When it considers a plan of operations, DO&G often requires stipulations, in addition to the mitigation measures developed through the best interest finding. These additional stipulations address site-specific concerns directly associated with the proposed project. The lease stipulations and the terms and conditions of the lease are attached to the plan of operations approval and are binding on the lessee. The lease also requires that the lessee keep the lease area open for inspection by authorized state officials. Activities are monitored in the field by ADNR, ADEC, ADF&G, and AOGCC to ensure compliance with each agency's respective permit terms. In addition, each permittee must post a bond before beginning operations (11 AAC 83.160). Lease operation approvals are generally granted for three years.

The Commissioner of ADNR may authorize the subsurface storage of gas to avoid waste or to promote conservation of natural resources. Subsurface storage of gas increases reliability of gas delivery to all sources of demand. The Commissioner has delegated the authority to authorize subsurface storage of oil or gas to the Director of DO&G. Subsurface gas storage must comply with all applicable local, state, and federal statutes and regulations, and with any terms imposed in the authorization or in any subsequent plan of operation approvals, or in the AOGCC Storage Injection Order.

### **3. Geophysical Exploration Permit (Division of Oil and Gas)**

Geophysical surveys conducted on State of Alaska oil and gas leases are administered by DO&G. The geophysical exploration permit is a specific type of land use permit issued by DO&G under 11 AAC 96.010. Seismic surveys are the most common activity authorized by this permit and are related to oil and gas development. The purpose of the permit is to minimize adverse effects on the land and its resources while making important geological information available to the state (11 AAC 96.210). Under AS 38.05.035(a)(8)(C), the geological and geophysical data that are made available to the state are held confidential at the request of the permittee. If the seismic survey is part of an exploration well program, the permit will be reviewed as part of the exploration well permit package. The application must contain the following information in sufficient detail to allow evaluation of the planned activities' effects on the land:

- (1) a map at a sufficient scale showing the general location of all activities and routes of travel of all equipment for which a permit is required;
- (2) a description of the proposed activity, any associated structures, and the type of equipment that will be used. (11 AAC 96.030(a)).

Maps showing the precise location of the survey lines must also be provided, though this information is usually held confidential. A \$100,000 bond is required to conduct seismic work. The bond amount for other geophysical surveys is determined when the activity is proposed.

A geophysical exploration permit is usually issued for a single survey season, but may be extended. If the permit is extended, the Director may modify existing terms or add new ones. The permit is revocable for cause for violation of a permit provision or of 11 AAC 96, and is revocable at will if the department determines that revocation is in the state's interest. A permit remains in effect for the term issued, unless revoked sooner. The department will give 30 days notice before revoking a permit at will. A revocation for cause is effective immediately (11 AAC 96.040(a)).

## **4. Alaska State Pipeline Rights-of-Way**

The Alaska Right-of-Way Leasing Act (AS 38.35) is administered by the SPCO. This office is within the Alaska JPO. Most oil and gas transportation facilities within the lease area or beyond the boundaries of the lease area must be authorized by SPCO. These activities include right-of-way applications, drafting leases for Commissioner approval, implementing the public review process, issuance of project specific authorizations, and monitoring compliance with lease conditions. SPCO oversees 21 pipelines in Alaska from the North Slope to the Kenai Peninsula (SPCO 2010).

## **5. Alaska Petroleum Systems Integrity Office**

The Alaska Petroleum Systems Integrity Office (PSIO) is the lead state agency in exercising oversight of the maintenance of facilities, equipment, and infrastructure for the sustained production and transportation of oil and natural gas resources in this state, including such facilities, equipment, and infrastructure not currently within the jurisdiction of another state or federal agency. Through designated agency liaisons, PSIO leads interagency efforts to evaluate industry oversight. Designated agencies, to the extent authorized through legal authorities, require oil and gas producers and operators to provide a comprehensive description of current practices that includes the quality control, quality assurance, monitoring, inspection, and other practices used to ensure the integrity and reliability of oil and natural gas facilities, equipment, infrastructure and activities. The PSIO shall make recommendations to the Commissioner of ADNR regarding ADNR enforcement actions and cases to be referred to other state, local, or federal agencies for appropriate civil or criminal penalties available under the law.

## **6. Temporary Water Use Authorization (Division of Mining, Land and Water)**

Exploration activities may require a temporary water use authorization issued by DMLW. A temporary water use authorization is administered by the DMLW, and is required under 11 AAC 93.035 before the temporary use of a significant amount of water, if the use continues for less than five consecutive years and the water applied for is not otherwise appropriated. The volume of water to be used and permitted depends upon whether it is to be used for consumption or non-consumptive uses, and the duration of use. The authorization may be extended one time for good cause for a period of time not to exceed five years.

An application must include: (1) the application fee; (2) a map indicating the section, township, range, and meridian, the location of the property, the point of withdrawal, diversion, or impoundment, and the point of use; (3) the quantity of water to be used; (4) the nature of the water use; (5) the time period during which the water is to be used; and (6) the type and size of equipment used to withdraw the water. DMLW may issue an authorization for the temporary use of water subject to conditions, including suspension or termination, considered necessary to protect the water rights of other persons or the public interest. Information on lake bathymetry, fish presence, and fish

species may be required when winter water withdrawal is proposed to calculate the appropriate withdrawal limits.

## **7. Permit and Certificate to Appropriate Water (Division of Mining, Land and Water)**

The DMLW also administers authorizations for water use. Industrial or commercial use of water requires a Permit to Appropriate Water under 11 AAC 93.120. The permit is issued for a period of time consistent with the public interest and adequate to finish construction and establish full use of water. The maximum time period for which a permit will be issued for industrial or commercial use is five years, unless the applicant proves or the Commissioner independently determines that a longer period is required. The Commissioner may issue a permit subject to terms, conditions, restrictions, and limitations necessary to protect the rights of others, and the public interest. Under 11 AAC 93.120(e), permits are subject to conditions such as requirements: that no certificate will be issued until evidence is presented of adequate easements or other means necessary to complete the appropriation; that the permittee measure the water use and report water use information to ADNR; and that the permittee maintain, or restrict from withdrawing, a specific quantity, rate of flow or volume of water to protect fish and wildlife habitat, recreation purposes, navigation, sanitation or water quality, prior appropriators, or any other purpose the department determines is in the public interest.

A Certificate of Appropriation will be issued under 11 AAC 93.130 if the permit holder: (1) submits a statement of beneficial use stating that the means necessary for the taking of water have been developed and the permit holder is beneficially using the quantity of water to be certified, along with the required fee; and (2) has substantially complied with all permit conditions. Again, the Commissioner will, in his or her discretion, issue a certificate subject to conditions necessary to protect the public interest. For example, conditions to maintain a specific quantity of water at a given point on a stream or water body, or in a specified stretch of stream, throughout the year or for specified times of the year for the following purposes: to protect fish and wildlife habitat; recreation; navigation; sanitation and water quality; and prior appropriators; or any other purpose the Commissioner determines is in the public's interest (11 AAC 93.130(c)(1)).

## **8. Land Use Permits (Division of Mining, Land and Water)**

Land use permits are issued by DMLW and may be required for exploration, development, and production activities. Land use permits can be issued for periods up to five years depending on the activity, but DMLW anticipates permits issued in conjunction with the lease will likely be for a period of one year.

In accordance with 11 AAC 96.025, a generally allowed use listed in 11 AAC 96.020 is subject to the following conditions:

- (1) activities employing wheeled or tracked vehicles must be conducted in a manner that minimizes surface damage;
- (2) vehicles must use existing roads and trails whenever possible;
- (3) activities must be conducted in a manner that minimizes
  - (A) disturbance of vegetation, soil stability, or drainage systems;
  - (B) changing the character of, polluting, or introducing silt and sediment into streams, lakes, ponds, water holes, seeps, and marshes; and
  - (C) disturbance of fish and wildlife resources;

- (4) cuts, fills, and other activities causing a disturbance listed in (3)(A) - (C) of this section must be repaired immediately, and corrective action must be undertaken as may be required by the department;
- (5) trails and campsites must be kept clean; garbage and foreign debris must be removed; combustibles may be burned on site unless the department has closed the area to fires during the fire season;
- (6) survey monuments, witness corners, reference monuments, mining location posts, homestead entry corner posts, and bearing trees must be protected against destruction, obliteration, and damage; any damaged or obliterated markers must be reestablished as required by the department under AS 34.65.020 and AS 34.65.040;
- (7) every reasonable effort must be made to prevent, control, and suppress any fire in the operating area; uncontrolled fires must be immediately reported;
- (8) holes, pits, and excavations must be repaired as soon as possible; holes, pits, and excavations necessary to verify discovery on prospecting sites, mining claims, or mining leasehold locations may be left open but must be maintained in a manner that protects public safety;
- (9) on lands subject to a mineral or land estate property interest, entry by a person other than the holder of a property interest, or the holder's authorized representative, must be made in a manner that prevents unnecessary or unreasonable interference with the rights of the holder of the property interest.

## **9. Material Sale Contract (Division of Mining, Land and Water)**

If the operator proposes to use state-owned gravel or other materials for construction of pads and roads, an DMLW material sale contract is required. The contract must include a description of the sale area, the volume of material to be removed from the sale area, the method of payment by the purchaser, the method of removal of the material, the bonds and deposits required of the purchaser, the method of scaling to be used by the purchaser, the purchaser's liability under the contract, the improvements to and occupancy of the sale area required of the purchaser, and the reservation of material within the sale area to DMLW. A material sale contract must also include the purchaser's site-specific operating requirements, including requirements relating to boundary markers and survey monument protection; erosion control and protection of water; fire prevention and control; roads; sale area supervision; protection of fish, wildlife, and recreational values; sale area access; and public safety. A contract must state the date upon which the severance or extraction of material under the contract is to be completed. A contract may be extended before its expiration if the director determines that the delay in completing the contract is due to unforeseen events beyond the purchaser's control, or the extension is in the best interests of the state.

In connection with a material sale, the DMLW director may require the purchaser to provide a performance bond that guarantees performance of the terms of the contract. If the director requires a performance bond, the bond amount will be based on the total value of the sale. The performance bond must remain in effect for the duration of the contract unless released in writing by the director.

## **10. Alaska Office of History and Archaeology**

The Alaska Office of History and Archaeology performs the functions of the State Historic Preservation Office (SHPO) (Office of History and Archaeology 2010). In accordance with the state's Historic Preservation Plan, they maintain the Alaska Heritage Resources Survey (AHRS), an inventory of all reported historic and prehistoric sites within the state. This inventory of cultural resources includes objects, structures, buildings, sites, districts, and travel ways, with a general provision that they are over 50 years old. To date, over 39,000 sites have been reported within

Alaska. However, this is probably only a small percentage of the sites that may actually exist but are as yet unreported. The fundamental use of the AHRS is to protect cultural resource sites from unwanted destruction. Before beginning a project, information regarding important cultural and historic sites should be obtained by contacting the Office of History and Archaeology. The AHRS data sets are comprised of “restricted access documents” and specific site location data should not appear in final reports or distributed to others.

AS 41.35.010, the Alaska Historic Preservation Act says that “It is the policy of the state to preserve and protect the historic, prehistoric, and archaeological resources of Alaska from loss, desecration, and destruction so that the scientific, historic, and cultural heritage embodied in those resources may pass undiminished to future generations.” Existing statutes, which apply to both known sites and newly discovered sites, include:

AS 41.35.200. Unlawful acts. A person may not appropriate, excavate, remove, injure, or destroy, without a permit from the Commissioner, any historic, prehistoric, or archaeological resources of the state. “Historic, prehistoric, or archaeological resources” includes deposits, structures, ruins, sites, buildings, graves, artifacts, fossils, or other objects of antiquity which provide information pertaining to the historical or prehistorical culture of people in the state as well as to the natural history of the state (AS 41.35.230(2)).

AS 11.46.482. Criminal mischief in the third degree occurs when a “person knowingly (A) defaces, damages, or desecrates a cemetery or the contents of a cemetery or a tomb, grave or memorial regardless of whether the tomb, grave, or memorial is in a cemetery or whether the cemetery, tomb, grave, or memorial appears to be abandoned, lost, or neglected; (B) removes human remains or associated burial artifacts from a cemetery, tomb, grave, or memorial regardless of whether the cemetery, tomb, grave, or memorial appears to abandoned, lost, or neglected.”

AS 41.35.210. Criminal penalties. A person who is convicted of violating a provision of AS 41-35.010 – 41.35.240 is guilty of a class A misdemeanor.

AS 41.35.215. Civil penalties. In addition to other penalties and remedies provided by law, a person who violates a provision of AS 41.35.010 – 41.35.240 is subject to a maximum civil penalty of \$100,000 for each violation.

## **B. Alaska Department of Environmental Conservation**

The Alaska Department of Environmental Conservation (ADEC) has statutory responsibility to conserve, improve, and protect Alaska’s natural resources and environment, by controlling air, land, and water pollution, and oil spill prevention and response. ADEC implements and coordinates several federal regulatory programs in addition to state laws (ADEC 2010e).

### **1. Air Quality Permits**

ADEC administers the Clean Air Act and the state’s air quality program under a federally-approved State Implementation Plan (AS 46.14; 18 AAC 50) (EPA 2010b). Through this plan, federal requirements of the Clean Air Act are met including National Ambient Air Quality Standards, New Source Review (NSR), New Source Performance Standards, National Emission Standards for Hazardous Air Pollutants (NESHAP), and Prevention of Significant Deterioration. ADEC also monitors air quality and compliance.

The National Ambient Air Quality Standards set limits on pollutants considered harmful to public health and the environment (EPA 2008a). Limits have been defined for principal pollutants, or criteria pollutants: carbon monoxide, lead, nitrogen dioxide, particulate matter (PM10), particulate matter (PM2.5), ozone, and sulfur dioxide. NSR, a permitting program required for new construction projects, ensures that air quality is not degraded by the new project, and that large new or modified

industrial sources will be as clean as possible (EPA 2010f). New Source Performance Standards are intended to promote use of the best air pollution control technologies available, and they take into account the cost of the technology and any other non-air quality, health, and environmental impact and energy requirements (EPA 2010e). The National Emissions Standards for Hazardous Air Pollutants are set for air pollutants that are not covered by National Ambient Air Quality Standards, but that may be harmful (EPA 2010d). The standards are categorized by type of source, and require the maximum degree of reduction in emissions that is achievable, as determined by the EPA. The purpose of the Prevention of Significant Deterioration program is:

...to protect public health and welfare; preserve, protect, and enhance the air quality in national parks, national wilderness areas, national monuments, national seashores, and other areas of special national or regional natural, recreational, scenic, or historic value; insure that economic growth will occur in a manner consistent with the preservation of existing clean air resources; and assure that any decision to permit increased air pollution...is made only after careful evaluation of all the consequences of such a decision and after adequate procedural opportunities for informed public participation in the decision making process (EPA 2010i).

The two primary types of permits issued to meet these requirements are Title I Construction Permits and Title V Operation Permits (ADEC 2010a). Permits are legal documents that the applicant must follow. Permits specify what activities are allowed, what emission limits must be met, and may specify how the facility must be operated. Permits may contain monitoring, recordkeeping, and reporting requirements to ensure that the applicant meets the permit requirements (ADEC 2010a).

### **a. Title I (NSR) Construction Permits**

#### ***i. Permit Description***

Title I permits incorporate air quality requirements for the Prevention of Significant Deterioration as well as other requirements of the Clean Air Act. This permit must be obtained before onsite construction can begin. Title I permits are required for projects that are new major sources for pollutants, or major modifications at existing sources. Prevention of Significant Deterioration requires installation of the "Best Available Control Technology (BACT)"; an air quality analysis; an additional impacts analysis; and public involvement (EPA 2010i).

BACT is determined on a case-by-case basis and takes into account energy, environmental, and economic impacts. BACT includes add-on control equipment, or modifications to production processes or methods. Examples include fuel cleaning or treatment, innovative fuel combustion techniques; and design, equipment, work practice, or operational standards (EPA 2010i).

An air quality analysis is required to show that new emissions will not violate air quality standards. In general, an assessment of existing air quality and predictions of future air quality that will result from the project are required (EPA 2010i).

#### ***ii. Review Process***

The permitting process includes a pre-application meeting between the applicant and ADEC, several ADEC reviews and a Technical Analysis Report, and a 30-day public comment period, after which ADEC may issue a final permit. The final permit includes a final Technical Analysis Report and response to comments. The process for a Title I process can take up to three years, depending on the amount of meteorological data collection required. The permit must be obtained before construction may begin.

## **b. Title V Operation Permits**

### ***i. Permit Description***

The federal Clean Air Act of 1970, and its subsequent 1990 revision and expansions (42 USC §§7401-7661), give EPA the authority to limit emissions from point sources (EPA 2010h). EPA regulations require facilities that emit certain pollutants or hazardous substances to obtain a permit to operate the facility, known as a Title V permit. In Alaska, ADEC is responsible for issuing Title V permits and making compliance inspections (ADEC 2010a; 18 AAC 50, and AS 46.14). Permits are legally binding and include enforceable conditions with which the operator must comply. The permit establishes limits on the type and amount of emissions allowed, requirements for pollution control devices and prevention activities, and monitoring and record keeping requirements (ADEC 2010a).

### ***ii. Review Process***

Operators have 12 months to submit their completed Title V permit application after commencing their operations, which can continue while ADEC processes the application. However, significant revisions to an existing permitted facility cannot be made until the permit revision is approved by ADEC. Processing time for permit revisions can be up to 6 months. Title V permits and revisions can be processed concurrently with Title I permits.

## **2. Solid Waste Disposal Permit**

ADEC regulates solid waste storage, treatment, transportation, and disposal under 18 AAC 60. EPA administers the Resource Conservation and Recovery Act (RCRA) relating to hazardous wastes and UIC Class I injection wells. A different state agency, the AOGCC, regulates UIC Class II oil and gas waste management wells.

For all solid waste disposal facilities regulated by ADEC, a comprehensive disposal plan is required, which must include engineering design criteria and drawings, specifications, calculations, and a discussion demonstrating how the various design features (liners, berms, dikes) will ensure compliance with regulations. Before approval, solid waste disposal permit applications are reviewed for compliance with air and water quality standards, wastewater disposal, and drinking water standards, as well as for their consistency with the Alaska Historic Preservation Act. The application for a waste disposal permit must include a map or aerial photograph (indicating relevant topographical, geological, hydrological, biological, and archaeological features) with a cover letter describing type, estimated quantity, and source of the waste, as well as the type of facility proposed. Roads, drinking water systems, and airports within a two-mile radius of the site must be identified, along with all residential drinking water wells within one-half mile. There must also be a site plan with cross-sectional drawings that indicate the location of existing and proposed containment structures, material storage areas, monitoring devices, area improvements, and on-site equipment. An evaluation of the potential for generating leachate must be presented as well. For above-grade disposal options, baseline water quality data may be needed to establish the physical and chemical characteristics of the site before installing a containment cell.

Non-drilling related solid waste must be disposed of in an approved municipal solid waste landfill (MSWLF). MSWLFs are regulated under 18 AAC 60.300-.398. All other solid waste (except for hazardous materials) must be disposed of in an approved monofill (18 AAC 60.400-.495). A monofill is a landfill or drilling waste disposal facility that receives primarily one type of solid waste and that is not an inactive reserve pit (18 AAC 60.990(80)). An inactive reserve pit is a drilling waste disposal area, containment structure, or group of containment structures where drilling waste has not been disposed of after January 26, 1996, and at which the owner or operator does not plan to continue disposing of drilling waste (18 AAC 60.990(62)). Closure of inactive reserve pits is regulated under 18 AAC 60.440.

Drilling waste disposal is specifically regulated under 18 AAC 60.430. Design and monitoring requirements for drilling waste disposal facilities are identified in 18 AAC 60.430(c) and (d), respectively. Under 18 AAC 60.430(c)(1), the design must take into account the location of the seasonal high groundwater table, surface water, and continuous permafrost, as well as proximity to human population and to public water systems, with the goal of avoiding any adverse effect on these resources. The facility must be designed to prevent the escape of drilling waste and leachate; be of the minimum volume necessary for drilling waste disposal and emergency relief volume; prevent overflow from, or damage to, containment structures or other waste management areas, from operations, annual average precipitation, wind or wave action; ensure that drilling waste, leachate, or eroded soil from the facility does not cause a violation of applicable water quality standards at the surface water point of compliance or at the uppermost aquifer at the groundwater point of compliance. The plans for the proposed design and construction of the drilling waste disposal facility and the fluid management plan must be approved, signed, and sealed by a registered engineer per 18 AAC 60.430(c)(5).

Presently, the preferred practice is to dispose of drilling fluids by reinjection deep into the ground; however, EPA and ADEC may authorize limited discharge of waste streams under the NPDES permit system. All produced waters must be reinjected or treated to meet Alaska Water Quality Standards before discharge. Before a well may be permitted under 20 AAC 25.005, a proper and appropriate reserve pit, also known as a solid waste disposal cell, must be constructed or appropriate tankage installed for the reception and confinement of drilling fluids and cuttings, to facilitate the safety of the drilling operation, and to prevent contamination of freshwater and damage to the surface environment (20 AAC 25.047).

Typically, a reserve pit is a containment cell lined with an impermeable barrier compatible with both hydrocarbons and drilling mud. Average dimensions are approximately 130 feet wide by 150 feet long by 12 feet deep, although specific configurations vary by site. The cell may receive only drilling and production wastes associated with the exploration, development, or production of crude oil, natural gas or hydrocarbon contaminated solids. The disposal of hazardous or other waste in a containment cell is prohibited. After the well is deepened, the residue in the reserve pit is often dewatered and the fluids are injected into the well annulus. An inventory of injection operations including volume, date, type, and source of material injected is maintained by requirement. Following completion of well activities, the material remaining in the pit is permanently encapsulated in the impermeable liner. Fill and organic soil is placed over it and proper drainage is re-established. Surface impoundments within 1,500 feet are sampled on a periodic basis and analyzed. In addition, groundwater monitoring wells are drilled and sampled on a regular basis. If there are uncontained releases during operations, or if water samples indicate an increase in the compounds being monitored, additional observation may be required. Closure of reserve pits is administered under 18 AAC 60.200.

Substances proposed for disposal that are classified as “hazardous” undergo a more rigorous and thorough permitting and review process by both ADEC, per 18 AAC 62 and 63, and the EPA.

### **3. Wastewater Disposal Permit**

Domestic graywater must be disposed of properly at the surface and requires a Wastewater Disposal Permit per 18 AAC 72. Typically, waste is processed through an on-site plant and disinfected before discharge. ADEC sets fluid volume limitations and threshold concentrations for biochemical oxygen demand (BOD), suspended solids, pH, oil and grease, fecal coliform, and chlorine residual. Monitoring records must be available for inspection, and a written report may be required upon completion of operations.

## 4. NPDES Discharge Permits and Certification

### a. Permit Description

ADEC participates in the federal National Pollution Discharge Elimination System (NPDES) program that is administered by EPA (see Section E.3. below). This program regulates discharges of pollutants into U.S. waters by “point sources,” such as industrial and municipal facilities. Permits are designed to maximize treatment and minimize harmful effects of discharges. EPA administered the NPDES program in Alaska until it began transitioning the administration to ADEC in 2008. On October 31, 2008, EPA approved the state’s application to assume issuing and enforcing permits for wastewater discharges issued under the Clean Water Act. Transfer of authority for the program will be phased in over three years, from November 2008 through November 2011 (ADEC 2010g).

Authority to administer the Alaska Pollution Discharge Elimination System (APDES) permitting will transfer to ADEC in four phases. Phase I included program components of domestic discharges, log storage and transfer facilities, seafood processing and hatcheries. Phase II included federal facilities, storm water, pretreatment and miscellaneous non-domestic discharges. Phase III transferred mining discharges. Phase IV includes administration of discharges for the oil and gas industry, cooling water intakes and munitions, and is scheduled for transfer on October 31, 2011 (ADEC 2010g).

NPDES covers a broad range of pollutants, which are defined as “any type of industrial, municipal, and agricultural waste discharged into water” (EPA 2008c). Examples of oil and gas industry effluents regulated by NPDES include drilling muds, cuttings and wash water, deck drainage, sanitary and domestic wastes, desalination unit waste, blow-out preventer fluids, boiler blowdown, fire control system test water, non-contact cooling water, uncontaminated ballast and bilge waters, excess cement slurry, water flooding discharges, produced waters, well treatment fluids, and produced solids.

There are two basic types of NPDES permits: general permits and individual permits. General permits cover multiple facilities that are similar, for example, oil and gas facilities on the North Slope. General permits are efficient and cost effective because they eliminate redundancy of multiple permits for the same type of facility and discharges (EPA 2008c). They also ensure consistency among similar facilities. Individual permits apply to a specific facility and are tailored to that facility’s characteristics. Individual permits are issued for a defined time period, not exceeding five years, and the facility must reapply for the permit before it expires (EPA 2008c).

For those permits that will continue to be administered by EPA, the ADEC certifies that discharges permitted under NPDES meet state and federal water quality standards. When an application for an NPDES permit is made to EPA, a duplicate must also be filed with ADEC for certification. The permit may impose stipulations and conditions on the facility and operations, such as monitoring and/or mixing zone requirements. Once operations begin, both EPA and ADEC have the responsibility to monitor the project for compliance with the terms of the permit.

### b. Review Process

The process for issuing a general permit begins when it is determined that there is a group of facilities in an area that share similar characteristics and discharges. The permitting authority develops a draft permit and fact sheet, which documents the decision-making process for developing effluent limits (EPA 2008c). The permitting authority then issues a public notice, providing opportunity for interested parties to submit comments on the draft permit. Both EPA and ADEC require opportunities for public participation (40 CFR 124.10 - .14; 18 AAC 15.140; 18 AAC 15.150). After considering public input, the permitting authority issues the final permit. The process for an individual permit is similar.

After a general permit is issued, facilities wishing to be included under the general permit submit a “Notice of Intent” to the permitting authority. Additional information describing the facility may be required. The facility may be notified that it is covered by the general permit or the facility may be required to apply for an individual permit (EPA 2008c).

## **5. Industry Oil Discharge Prevention and Contingency Plans**

The ADEC regulates the planning and implementation of spill prevention and response under AS 46.04.030. This authority was delegated to ADEC from EPA per 40 CFR 112. In 2006, ADEC adopted new regulations (18 AAC 75) for oilfield flowlines, new construction, and maintenance standards that apply to oil tanks and pipeline facilities. Additionally, ADEC is placing increased emphasis on oil spill prevention training (ADEC 2010f).

ADF&G and ADNR support ADEC in these efforts by providing expertise and information. The industry must file C-plans with ADEC before operations commence. ADNR reviews and comments to ADEC regarding the adequacy of these C-plans (ADEC 2010d).

Lessees must comply with the requirements of AS 46.04.010 - .900, Oil and Hazardous Substance Pollution Control. This requirement includes the preparation and approval by ADEC of a C-plan (AS 46.04.030; 18 AAC 75.445). C-plans for exploration facilities must include a description of methods for responding to and controlling blowouts, the location and identification of oil spill cleanup equipment, the location and availability of suitable drilling equipment, and an operations plan to mobilize and drill a relief well. Parties with approved plans are required to have sufficient oil discharge containment, storage, transfer, cleanup equipment, personnel, and resources to meet the response planning standards for the particular type of facility, pipeline, tank vessel, or oil barge (AS 46.04.030(k)). If development and production should occur, additional contingency plans must be filed for each facility before commencement of activity.

Discharges of oil or hazardous substances must be reported to ADEC on a time schedule depending on the volume released, whether the release is to land or to water, and whether the release has been contained by a secondary containment or structure. The discharge must be cleaned up to the satisfaction of ADEC, using methods approved by ADEC. ADEC will modify cleanup techniques or require additional cleanup techniques for the site as ADEC determines to be necessary to protect human health, safety, and welfare, and the environment (18 AAC 75.335(d)).

A C-plan must describe the existing and proposed means of oil discharge detection, including surveillance schedules, leak detection, observation wells, monitoring systems, and spill-detection instrumentation (AS 46.04.030; 18 AAC 75.425(e)(2)(E)). The C-plan must include: a Response Action Plan; a Prevention Plan; and Supplemental Information to support the response plan, including a Best Available Technology Section (18 AAC 75.425). Operators must also provide proof of financial ability to respond in damages (AS 46.04.040).

The Response Action Plan (18 AAC 75.425(e)(1)) must include, but is not limited to, an emergency action checklist of immediate steps to be taken if a discharge occurs. The checklist must include contact information, response strategies, safety measures, communication planning and long term plans for oil collection, storage, recovery, disposal and site rehabilitation.

The Prevention Plan (18 AAC 75.425(e)(2)) must provide, but is not limited to: an analysis of the potential oil discharges that might occur; a description and schedule of regular pollution inspection and maintenance programs; prevention and mitigation measures using historical information about known discharges, and descriptions of leak detection systems; surveillance schedules; observation wells; monitoring systems; and spill-detection instrumentation.

The Supplemental Information Section (18 AAC 75.425(e)(3)) must include, but is not limited to: a facility description and operational overview, describing oil storage, transfer, exploration, or

production activities; the number and type of oil storage containers and the type and amount of oil stored; procedures for loading or transferring oil; and a description of flow and gathering lines and processing facilities. The supplemental information must show: the response command system; the realistic maximum response operation limitations; the logistical support, including identification of aircraft, vehicle, and vessels; and other transport equipment and personnel. The plan also must address the best available technologies and the justification for the proposed technologies selected (18 AAC 75.425(e)(4)).

The current statute allows the sharing of oil spill response equipment, materials, and personnel among plan holders. ADEC determines the maximum amount of material, equipment, and personnel that can be transferred, and the time allowed for the return of those resources to the original plan holder (AS 46.04.030(o)). The statute also requires the plan holders to “successfully demonstrate the ability to carry out the plan when required by [ADEC]” (AS 46.04.030(r)(2)(E)). ADEC regulations require that exercises (announced or unannounced) be conducted to test the adequacy and execution of the contingency plan. ADEC may, at its discretion, consider regularly scheduled training exercises as discharge exercises (18 AAC 75.485(a) and (d)).

In accordance with AS 46.04.200, ADEC must prepare, annually review, and revise as necessary, the statewide master oil and hazardous substance discharge prevention and contingency Unified Plan (ADEC 2010c). The plan must identify and specify the responsibilities of state and federal agencies, municipalities, facility operators, and private parties whose property may be affected by an oil or hazardous substance discharge, as well as other parties with an interest in cleanup. The plan must incorporate the incident command system, identify actions to be taken to reduce the likelihood of a discharge of oil or a hazardous substance. Revisions are submitted for public and agency review.

ADEC must also prepare and annually review and revise, as necessary, regional master oil and hazardous substance discharge prevention and contingency plans (AS 46.04.210). The regional master plans must contain the same elements and conditions as the state master plan, but are applicable to a specific geographic area. The North Slope subarea plan was revised in April of 2007, and encompasses the entire North Slope Borough (ADEC 2007).

## **C. Alaska Department of Fish and Game**

ADF&G manages most fish and wildlife populations, their habitats, and activities that may affect those resources. For activities in the lease sale area Fish Habitat and hazing permits may be required; however, a public notice is not required.

### **1. Fish Habitat Permit**

Under 16.05.871(b) a Fish Habitat permit is required prior to using, diverting, obstructing, polluting, or changing the natural flow or bed of a specified anadromous fish river, lake, or stream, or to operate vehicles or equipment in the bed of given waterbodies. Under 16.05.841, a permit is required if a stream frequented by any fish is obstructed to ensure efficient passage of migrant fish. In some parts of the lease sale area, a Fish Habitat permit may be subject to ACMP consistency review.

### **2. Hazing Permit**

Under 16.05.920, a permit to haze that may include the actual taking of some species may be issued for public safety and/or spill response. Such permits may not be required if the lessee is a member of Alaska Clean Seas (ACS).

## D. Alaska Oil and Gas Conservation Commission

AS 31.05, the Alaska Oil and Gas Conservation Act, created the Alaska Oil and Gas Conservation Commission (AOGCC). Its regulatory authority is outlined in Alaska Title 20, Chapter 25 of the administrative code (20 AAC 25). It acts to prevent waste, protect the correlative rights and improve ultimate recovery, and protect underground freshwater.

AOGCC oversees oil and gas drilling, development and production, reservoir depletion and metering operations on all lands subject to the state's police powers. It administers the Underground Injection Control (UIC) Program for the State of Alaska, as delegated authority of the federal Safe Drinking Water Act (SDWA). It serves as an adjudicatory forum for resolving certain oil and gas disputes between owners, including the state. The Commission carries forth statutory mandates consistent with the protection of health, safety and the environment. It strives for cooperation with industry, while maintaining well-defined and essential regulatory requirements. AOGCC holds hearings and adjudicates decisions, which require the combined expertise of petroleum geology and petroleum engineering (AOGCC 2010b).

### 1. Permit to Drill

#### a. Permit Description

In order to drill a well for oil or gas in Alaska, a person must obtain a Permit to Drill from AOGCC. This requirement applies not only to exploratory, stratigraphic test, and development wells, but also to injection and other service wells related to oil and gas activities. AOGCC does not manage or decide whether to develop state owned resources. Rather, it regulates certain oil and gas operations anywhere in Alaska, whether on state, federal, or private land.

AOGCC's oversight of drilling operations focuses on ensuring that appropriate equipment is used and appropriate practices are followed to maintain well control, protect groundwater, avoid waste of oil or gas, and promote efficient reservoir development. AOGCC is not authorized to deny a Permit to Drill on the basis of land use concerns or conflicts between surface and subsurface interests.

AOGCC is one of several state agencies that have roles in reviewing and approving oil and gas activities. AOGCC's issuance of a Permit to Drill does not relieve the applicant of any obligations to comply with the permit or regulatory requirements of other state, local, or federal agencies before drilling (AOGCC 2010a).

#### b. Review Process

A Permit to Drill from AOGCC is often the last step in the overall approval process, and usually all of the other concerned agencies have given their approval. The application must be accompanied by the items set out in 20 AAC 25.005(c). A geologist and a drilling engineer review the entire application in detail using a multi-question checklist to ensure the application is complete, accurate, and conforms to all applicable regulations.

AOGCC will notify the operator if there are any deficiencies in the application. The operator will either supplement the original application with revised or additional information, or, in the event that substantive changes are needed, resubmit the entire application. If unanticipated exceptions to regulations or AOGCC orders are needed, such as a well spacing exception, the operator will be notified. Usually such exceptions are handled through a public notice process, with an opportunity for a hearing. If the permit is approved, it will include any operational or environmental safety stipulations identified by AOGCC (AOGCC 2010a).

## **2. Underground Injection Control Program (UIC)**

The AOGCC has primacy for Class II wells in Alaska through a Memorandum of Understanding with the EPA. The goal of the UIC program is to protect underground sources of drinking water from contamination by oil and gas (Class II) injection activities. The three types of Class II wells include oilfield waste disposal wells, enhanced oil recovery (EOR) wells, and hydrocarbon storage wells. AOGCC reviews and takes appropriate action on proposals for the underground disposal of Class II oil field wastes (20 AAC 25.252). Before receiving an approval, an operator must demonstrate that the movement of injected fluids into freshwater sources will not occur. Disposal or storage wells must be cased and the casing cemented in a manner that will isolate the disposal or storage zone and protect oil, gas, and freshwater sources (AOGCC 2010a).

Along with a plat showing the location of other wells within one-quarter mile, the disposal injection order application must include information about surface owners located within one-quarter mile of the injection well(s). The disposal injection order application must also contain the name, description, depth, thickness, lithologic description, and geological data of the disposal formation and adjacent confining zones. A description of the fluid to be injected, including composition, source, daily amount, and disposal pressures, and sufficient information and analysis, must be presented demonstrating that the disposal well will not initiate or propagate fractures through the confining zones that allow fluids to migrate. Under certain circumstances a freshwater aquifer exemption may be granted (20 AAC 25.440).

Following approval, liquid waste from drilling operations may be injected through a dedicated tubing string into the approved subsurface zone. The pumping of drilling wastes through the annular space of a well is an operation incidental to drilling of the well, and is not a disposal operation subject to regulation as a Class II well. AOGCC approval of annular disposal operations is required before commencing pumping operations (20 AAC 25.080) (AOGCC 2010a).

## **3. Annular Disposal of Drilling Waste**

An AOGCC permit is required if waste fluid is to be injected into a well annulus. The material must be incidental to the drilling of a well (muds and cuttings). AOGCC may take all actions necessary to allow the state to acquire the primary enforcement responsibility for the control of underground disposal related to the recovery and production of oil and natural gas. ADEC considers the volume, depth, and other physical and chemical characteristics of the formation designated to receive the waste. Annular disposal is not permitted into water bearing zones where dissolved solids or salinity concentrations fall below predetermined threshold limits. Waste not generated from a hydrocarbon reservoir cannot be injected into a reservoir (AOGCC 2010a).

## **4. Disposal Injection Orders**

Operators may apply for disposal injection orders to allow disposal activity in individual wells. After the public review process and Commission analysis, an order may be issued that approves the proposed disposal project (AOGCC 2010a).

## **5. Area Injection Orders**

Injection orders may be issued on an area basis rather than for individual wells in areas where greater activity is anticipated. The area injection orders describe, evaluate, and approve subsurface injection on an area wide basis for enhanced oil recovery and disposal purposes (AOGCC 2010a).

## **6. Other Oversight Activities**

The AOGCC has oversight authority for reservoir plans of operation and development, conservation orders, flaring, inspections and prevention of waste of hydrocarbon resources, and hydraulic fracturing procedures (AOGCC 2010a).

## **7. Review Process**

AOGCC actions that have statewide application, such as adopting regulations, are conducted in accordance with the Administrative Procedures Act. Major actions that result in conservation orders that apply to a single well or field receive public notice by publication in a newspaper and a public hearing may be held (20 AAC 25.540). In addition, a public mailing list is maintained for the purpose of sending appropriate notices, orders, and publications to persons who request to be put on these lists (20 AAC 25.545) (AOGCC 2010a).

## **E. U.S. Environmental Protection Agency**

The U.S. Environmental Protection Agency (EPA) protects human health and the environment by implementing, administering, or overseeing programs and regulations promulgated in federal environmental legislation. These programs, some of which are delegated to the states, safeguard the air, land, and water environments.

### **1. Air Quality Permits**

The federal Clean Air Act includes a number of air quality standards and requirements, including National Ambient Air Quality Standards, New Source Review (NSR), New Source Performance Standards, National Emission Standards for Hazardous Air Pollutants, and Prevention of Significant Deterioration. The two primary types of permits are issued to meet these requirements: Title I Construction Permits, which must be obtained before onsite construction can begin, and Title V Operation Permits, which regulate facilities that emit certain pollutants or hazardous substances (EPA 2010a).

The ADEC administers the Clean Air Act and the air quality program for the State of Alaska under a federally approved State Implementation Plan that applies these standards. See Section B(1) for further details.

### **2. Hazardous Waste (RCRA) Permits**

The federal Resource Conservation and Recovery Act (RCRA) established a program for managing hazardous wastes to ensure the protection of human health and the environment, with the EPA as the regulatory authority. Regulations established by the EPA direct procedures for transporting, storing, and disposing of hazardous wastes, and for designing and operating treatment, storage, and disposal facilities safely. A corrective action program guides investigations and cleanups of contaminated air, groundwater, surface water, or soil. Regulations are enforced through inspections, monitoring of waste handlers, taking legal action for noncompliance, and providing compliance incentives and assistance (EPA 2010c).

States may receive authorization to implement the program, which requires that the state standards be at least as strict as the federal standards. Alaska is not authorized for this program, and therefore it is implemented by the EPA in Alaska.

### **3. NPDES Discharge Permit**

ADEC has begun to take over authority for administering this program, now titled APDES. EPA is scheduled to transfer authority for the program in phases over three years, from November 2008

through November 2011. Phase IV of the transfer, administration of discharges for the oil and gas industry, is scheduled for October 31, 2011 (ADEC 2010g).

Effluents discharged by the oil and gas industry into waters and wetlands are regulated through EPA's NPDES program as required by the federal Clean Water Act. The NPDES program, which covers other industries and waters as well, ensures that state and federal clean water quality standards are maintained by requiring a permit to discharge wastes into the nation's waters (EPA 2008c). NPDES permits specify the type and amount of pollutant, and include monitoring and reporting requirements, to ensure that discharges are not harmful to water quality and human health (EPA 2010g). Some permits may be subject to procedures of the National Environmental Policy Act (EPA 2010g).

## **4. Underground Injection Control (UIC) Class I and II Injection Well Permits**

EPA is responsible for regulating injection wells, which are used to dispose of fluid wastes by injecting the waste underground (EPA 2008b). Authorized as part of the federal Safe Drinking Water Act of 1974, EPA's Underground Injection Control (UIC) program protects underground sources of drinking water from contamination by injection wells. Injection wells are categorized into five classes; Class I and II are most common in the oil and gas industry. EPA may delegate authority for implementing the program to states that meet federal standards. EPA implements the program for Class I wells in Alaska, and authority for Class II oil and gas wells has been delegated to AOGCC (see Section D.2.).

All injections falling into Class I must be authorized through EPA's UIC Class I program. Class I wells must operate under a permit that is valid for up to 10 years. Permits stipulate requirements such as siting, construction, operation, monitoring and testing, reporting and record keeping, and closure. Requirements differ for wells depending on whether they accept hazardous or non-hazardous wastes (EPA 2008b).

## **F. U.S. Army Corps of Engineers**

### **1. Section 10 and Section 404 Permits**

#### **a. Permit Description**

The U.S. Army Corps of Engineers (Corps) has regulatory authority over construction, excavation, or deposition of materials in, over, or under navigable waters of the United States, or any work which would affect the course, location, condition, or capacity of those waters (Rivers and Harbors Acts of 1890 [superseded] and 1899 [33 USC 401, et seq.; Section 10 [33 USC 403]; USACOE 2010b]). These Section 10 permits cover oil and gas activities, including exploration drilling from jack-up drill rigs and installation of production platforms.

Section 404 of the Clean Water Act established a program to regulate the discharge of dredged and fill material into waters and wetlands of the United States. This program is administered by the Corps, which is authorized to issue Section 404 permits for discharging dredge and fill materials.

Individual permits (issued for specific projects) are the basic type of permit issued. General permits (including programmatic, nationwide, and regional general permits) authorize activities that are minor and will result in minimal individual and cumulative adverse effects. General permits carry a standard set of stipulations and mitigation measures. Letters of permission, another type of project authorization, are used when the proposed project is minor, will not have significant individual or cumulative environmental impact, and appreciable opposition is not expected (USACOE 2010a; USACOE 2010b).

### **b. Review Process**

Section 404 and Section 10 permits follow a similar three-step review process: pre-application consultation (for major projects); formal project review; and decision making.

During the pre-application consultation, the applicant meets with Corps staff from the local district, interested resource agencies (federal, state, or local), and at times, interested public. These meetings provide informal discussions about the proposal before the applicant commits resources such as funds and detailed designs to the project; provide the applicant with possible alternatives and measures for reducing project impacts; and provide the applicant with information about factors the Corps considers in the permitting process (USACOE 2010a; USACOE 2010b).

After receiving a formal application, the first step in the Corps' project review is to obtain public input, which is central to the permitting process. The project is public noticed, and comments and information are requested that will assist with evaluating the positive and negative effects on the public interest. Public hearings may be held if substantial issues are raised that warrant additional public input. USFWS, NMFS, ADNR, and ADF&G may also submit comments to the Corps (USACOE 2010a; USACOE 2010b).

Next, the Corps evaluates the project's impacts, considers all comments received, negotiates changes to the project as required, and drafts documentation supporting a recommended permit decision including environmental impacts of the project, findings of public input, and other special evaluations depending on the type of project (USACOE 2010a; USACOE 2010b).

In making a final decision on whether to issue a permit, the Corps weighs all relevant factors, which can include conservation, economics, aesthetics, wetlands, cultural values, navigation, fish and wildlife values, water supply, water quality, and other factors judged important to the needs and welfare of the people (USACOE 2010a; USACOE 2010b).

The process for letters of permission is abbreviated. In this situation, the proposal is coordinated with fish and wildlife agencies and adjacent property owners who might be affected by the project, but the public at large is not notified (USACOE 2010a; USACOE 2010b).

ADEC participates in the Section 404 and 10 permit review processes by reviewing the permit application to ensure that the proposed project will comply with Alaska water quality standards. ADEC then approves of the permit through a Clean Water Act Section 401 Certification.

Permits may also receive review by other agencies, such as the USFWS and NMFS, to ensure compliance with other laws such as the Endangered Species Act, the National Environmental Policy Act, and Essential Fish Habitat Provisions of the Magnuson-Stevens Act.

## **G. U.S. Pipeline and Hazardous Materials Safety Administration**

The federal Office of Pipeline Safety (OPS) in the Pipeline and Hazardous Materials Safety Administration (PHMSA), an agency of the U.S. Department of Transportation, is responsible for regulating movement of hazardous materials by pipeline (PHMSA 2010b). OPS develops regulations and other approaches to risk management to assure safety in design, construction, testing, operation, maintenance, and emergency response of pipeline facilities (PHMSA 2010a; PHMSA 2010b). The Pipeline Safety Improvement Act of 2002 advances planning, inspection and maintenance of pipeline transportation systems, with requirements for integrity management and active inspection programs (PHMSA 2010a). There are two federal PHMSA inspectors to review technical issues on hazardous liquid pipelines in Alaska (PHMSA 2010a). Under the PIPES Act of 2006, hazardous liquid pipeline operators are required to develop integrity management programs for transmission pipelines.

## H. U.S. Fish and Wildlife Service

The U.S. Fish and Wildlife Service (USFWS), is a part of the Department of the Interior and is dedicated to the conservation of natural resources. In Alaska, the USFWS focuses on working with others to conserve, protect and enhance fish, wildlife, plants and their habitats for the continuing benefit of the American people (USFWS 2010b). They have management authority for migratory birds, and threatened and endangered species, the national wildlife refuge system, and on lands under their jurisdiction, landscape conservation and aquatic resources. USFWS issues permits related to migratory birds, endangered species, with the intent to manage risks and benefits of projects by using best available science and expertise. Permits can authorize activities consistent with conservation, protection and enhancement of wildlife, plants, and their habitats (USFWS 2010a).

## I. Regulation of Oil Spill Prevention and Response

### 1. Federal Statutes and Regulations

Section 105 of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) (42 USC §9605), and §311(c)(2) of the Clean Water Act, as amended (33 USC §1321(c)(2)) require environmental protection from oil spills. CERCLA and the Clean Water Act require a National Oil and Hazardous Substances Pollution Contingency Plan (40 CFR §300; 33 USC §1321(d)). See also Section B(5) above concerning delegation of authority to ADEC. Under these regulations, the spiller must plan to prevent and immediately respond to oil and hazardous substance spills and be financially liable for any spill cleanup. If the pre-designated Federal On-Scene Coordinator (FOSC) determines that neither timely nor adequate response actions are being implemented, the federal government will respond to the spill, and then seek to recover cleanup costs from the responsible party.

The Oil Pollution Act of 1990 (OPA 1990) requires the development of facility and tank vessel response plans and an area-level planning and coordination structure to coordinate federal, regional, and local government planning efforts with the industry. OPA 1990 amended the Clean Water Act (§311(j)(4); 33 USC §1231(j)) and established area committees and area contingency plans as the primary components of the national response planning structure. In addition to human health and safety, these area committees have three primary responsibilities:

- Prepare an area contingency plan;
- Work with state and local officials on contingency planning and preplanning of joint response efforts, including procedures for mechanical recovery, dispersal, shoreline cleanup, protection of sensitive areas, and protection, rescue and rehabilitation of fisheries and wildlife; and,
- Work with state and local officials to expedite decisions for the use of dispersants and other mitigating substances and devices.

In Alaska, the Alaska Regional Response Team (ARRT) is an advisory board to the FOSC. It provides processes for participation by federal, state and local governmental agencies to participate in response to pollution incidents (ADEC 2010b). The area contingency plan for the State of Alaska is the Unified Plan. Since Alaska is so large and geographically diverse, the federal agencies have found it necessary to prepare subarea contingency plans. The North Slope Subarea Contingency Plan was revised in April 2007, and encompasses the entire NSB (ADEC 2007).

## J. North Slope Borough

The NSB has adopted a comprehensive plan and land management regulations under Title 29 of the Alaska Statutes (AS 29.40.020-040). These regulations are Title 19 of the NSB Municipal Code and require borough approval for certain activities necessary for exploration and development of oil and

gas leases. These activities include construction of facilities, placement of gravel pads, use of explosive devices and tundra travel. The NSB may assert its land management powers to the fullest extent permissible under law to address any outstanding concerns regarding impacts to the area's fish and wildlife species, habitat, and subsistence activities.

The NSB also established a Traditional Land Use Inventory (TLUI). The TLUI data sets are restricted access documents and specific site location data should not appear in final reports or distributed to others (NSB 2011, Dale 2011). The NSB also advises that for any earth-moving activity, ice road, or seismic survey that a Certificate of Inupiat History, Language and Culture /Traditional Land Use Inventory (IHLC/TLUI) Clearance from the NSB Planning Department may be required.

## **K. Other Requirements**

### **1. Native Allotments**

Lessees must comply with applicable federal law concerning Native allotments. Activities proposed in a plan of operations must not unreasonably diminish the use and enjoyment of lands within a Native allotment. Before entering onto lands subject to a pending or approved Native allotment, lessees must contact the Bureau of Indian Affairs (BIA) and the Bureau of Land Management (BLM) and obtain approval to enter.

### **2. U.S. Coast Guard**

The U.S. Coast Guard has authority to regulate offshore oil pollution under 33 CFR §§153-157 and to make a determination of a hazard to navigation under 33 CFR §64.31.

### **3. Alaska Department of Labor and Workforce Development**

The Alaska Department of Labor and Workforce Development administers the Alaska Employment Security Act under AS 23.30 and 8 AAC 85. They promote employment security by increasing opportunities for placement, and provide eligible workers with compensation while unemployed (ADLWD 2010).

The Department also administers some delegated authorities of the Occupational Safety and Health Administration (OSHA), PL-91-596, 1970. Under Section 18 of the law, State Jurisdiction and State Plans, it allows states to obtain approval to assume responsibility for development and enforcement of federal occupational safety and health standards. The Department has obtained approval from OSHA for administration of some of the federal OSHA standards (OSHA 2010; ADLWD 2010).

### **4. Applicable Laws and Regulations**

In addition to existing laws and regulations applicable to oil and gas activities, DO&G requires, under paragraph 26 of the state's standard lease contract, that leases be subject to all applicable state and federal statutes and regulations in effect on the effective date of the lease. Leases will also be subject to all future laws and regulations placed in effect after the effective date of the leases to the full extent constitutionally permissible and will be affected by any changes to the responsibilities of oversight agencies.

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# Chapter Eight: Reasonably Foreseeable Effects of Leasing and Subsequent Activity

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# Chapter Eight: Reasonably Foreseeable Effects of Leasing and Subsequent Activity

Until leases are sold and discoveries are made, DO&G cannot predict when any oil and gas activity might occur or the type, location, duration, or level of those potential activities. In addition, methods to explore for, develop, produce, and transport petroleum resources will vary depending on the area, lessee, operator, and discovery. Best interest findings are not required to speculate about such possible future effects (AS 38.05.035).

However, AS 38.05.035(g) specifies that the following shall be considered and discussed in a best interest finding: reasonably foreseeable cumulative effects of exploration, development, production, and transportation for oil and gas on the lease sale area, including effects on subsistence uses, fish and wildlife habitats and populations and their uses, and historic and cultural resources; reasonably foreseeable fiscal effects of the lease sale on the state and affected municipalities and communities; and reasonably foreseeable effects of exploration, development, production, and transportation for oil and gas on municipalities and communities within or adjacent to the lease sale area. This chapter discusses these potential effects.

Potential effects of oil and gas lease sales can be both positive and negative. Most potentially negative effects on fish and wildlife species, habitats, and their uses, on subsistence uses, and on local communities and residents can be avoided, minimized, or mitigated. DO&G mitigation measures can be found in Chapter Nine.

This best interest finding does not speculate about possible future effects subject to future permitting that cannot reasonably be determined until the project or proposed use is more specifically defined (AS 38.05.035). The effects of future exploration, development, or production will be considered at each subsequent phase, when various government agencies and the public review permit applications and other authorizations for the specific activities proposed at specific locations in the lease sale area.

It is important to note that in addition to the mitigation measures in Chapter Nine, all post-lease activities are subject to local, state, and federal statutes, regulations, and ordinances, some of which are listed as other regulatory requirements (lessee advisories) in Chapter Nine (see also Chapter Seven and Appendix B). Additional project-specific and site-specific mitigation measures may be required by permitting agencies, including DO&G, in response to public comments received during review of the proposed activity or as deemed necessary. Mitigation measures of Chapter Nine may also be changed or removed, and additional measures may be added, through the Call for New Information and supplement process described in Section E(2) of Chapter Two.

Leasing activities alone are not expected to have any effects, other than to provide initial revenue to the state. Post-lease activities could affect the terrestrial and freshwater habitats and wildlife, birds and fish of the lease sale area and uses of these resources. These activities could include seismic surveys related to exploration and development; environmental and other studies; excavation of gravel material sites; construction and use of support facilities such as gravel pads, staging areas, roads, airstrips, pipelines, and housing; transportation of machinery and labor to the site; and construction of drill sites and ongoing production activities. Unintended occurrences such as oil spills could also have effects.

## A. Effects on Terrestrial Habitats, Wildlife, and Birds

In Arctic environments, the largest effects of oil and gas activities are from physical disturbances (Huntington 2007). Activities such as seismic surveys, road and other construction activities, and ongoing vehicle and human movements may alter landscapes and habitat. These can disturb the environment and contribute to behavior changes in wildlife, birds and fish. Below is a discussion of potential effects from activities such as surface land disturbances, seismic surveys, road and pad construction, and similar activities on terrestrial habitats, wildlife, birds in and near the lease sale area.

### 1. Potential Cumulative Effects on Terrestrial Habitats

During oil and gas exploration, development and production, various activities could impact vegetation and habitats in the lease sale area.

#### a. Effects of Disturbances

During the initial exploration phases, disturbances caused by cross-country travel and construction are the most significant (Hanley et al. 1983). Other activities that may induce impacts are installation of pile foundations in permafrost areas, construction of gravel roads, ice roads, ice pads and ice bridges, and general terrain disturbance (Hanley et al. 1981). Potential impacts can occur at all phases, but most are likely to occur during development and production. Disturbances related to construction for oil field development and pipeline construction may be the most significant disturbances (Hanley et al. 1983). Potential ecological effects of roads include physical disturbance, habitat loss, reduction in population of species in close proximity to the road, dispersal of wildlife, and mortality of wildlife. Habitat fragmentation may be a result, which may impact biological diversity (Spellerberg and Morrison 1998). Mitigation of negative impacts can be accomplished with appropriate measures, such as road edge management, containment of water run-off, and planning of roads to minimize habitat fragmentation and loss (Spellerberg and Morrison 1998).

Land surface disturbances may change and destroy vegetation, and can alter soils characteristics. Types of land surface disturbances may include vegetation clearing, slash disposal, altered soil



Alpine field ice road.

characteristics, hydraulic erosion, altered surface hydrology, above ground obstructions and filled areas (Hanley et al. 1983). Disruption of the tundra surface may result in thermokarst in Arctic environments (Truett 2000, citing to MacKay 1970). Construction activities relating to petroleum extraction can cause impacts from the following: off-road transportation; road, pad and airstrip construction techniques; pile foundations in permafrost; below-ground pipelines and impacts to permafrost; ice roads; and terrain disturbance (Hanley et al. 1981).

Human activities can damage or remove the vegetative cover, leading to soil erosion (Hanley et al. 1981). The effects can alter the terrestrial habitat, and cause siltation of nearby freshwater habitats. Disturbance to permafrost areas removes the natural insulation, inducing thermal and hydraulic erosion, particularly in poorly drained, fine grain sediments. Disturbance can cause melting, erosion, heaving, slumping and subsidence (Hanley et al. 1981). The active layer of soil can undergo changes that cause settling, and can cause draining of areas previously frozen. Growth of depressions can cause more thawing and further subsidence, and potential deepening of Arctic lakes. (Hinzman et al. 1997, citing to Lawson 1986 and Waelbroeck 1993). Searching for adequate construction materials can also cause removal of gravel and disturbance of habitats (Hanley et al. 1983).

### **b. Effects of Construction Activities**

Effects of constructing production pads, roads, and pipelines include direct loss of habitat acreage due to gravel infilling, and loss of dry tundra habitat due to entrainment and diversion of water. Construction of roads and gravel pads can interrupt surface water sheet flow and stream flows (NRC 2003). Prior identification of sensitive areas can support the construction of infrastructure away from sensitive habitats. In a study of the impacts to habitats from the construction of the Trans-Alaska Pipeline System, it was found that the greatest percent loss of habitat was from gravel material sites used for construction materials, with the work pad areas and road causing the next greatest habitat loss percentages (Pamplin 1979). A secondary effect of construction activities includes dust deposition, which may reduce photosynthesis and plant growth (McKendrick 2000, Truett and Johnson 2000).

Construction activity involving vehicular passage (see below, Effects of Seismic Surveys), such as a rolligon, may upset the thermal balance of the permafrost beneath the tundra, especially in non-winter months. Based upon research by Jorgenson et al. (2002), differing vegetation types respond differently to the surface use of rolligon vehicles. The amount of time that is predicted for full surface revegetation after rolligon use ranged from 3 to 10 years, with differences attributed to type of vegetation, soil moisture characteristics, and level of disturbance. Dwarf shrub tundra generally showed a higher level of disturbance from rolligons than the moist wet sedge tundra vegetation (Jorgenson et al. 2002). The effects upon the ecosystems impacted by roads include potential chemical input from roads to water bodies and to the airshed, and bioaccumulation in soils. Roads can impact fluvial dynamics, sediment transport and floodplain ecology. When roads alter habitats, plant species can be changed



Trench remediation, NE Pad L3, North Slope.

DOI&G Permitting Staff

or removed, and nonnative plants can be introduced. Additional wildlife habitat impacts from roads can change the density, composition of animal species and populations (NRC 2003). The effects of roads can also include physical disturbance, habitat loss or fragmentation, and threatening or extinction of populations and species near the road edge, mortality of wildlife on roads, the use of road edges as habitat and dispersal of wildlife along road networks (Spellerberg and Morrison 1998).

The use of all-terrain vehicles (ATVs) on moist and wet tundra can disturb ground relief, vegetation and habitats. The impacts to tundra are dependent upon the amount of ATV use, the water content, the resulting impacts to tussocks, shrubs and lichens, and the effects of thermokarsting (Racine and Johnson 1988). Thermokarsting is a result of heat absorption by the tundra soils (McKendrick 2000, citing to McKendrick 1987; and Walker et al. 1987). It causes irregular land formation due to the uneven melting of permafrost.

Road construction, vehicular passage, and oil spills can alter surface albedo (reflectivity of sunlight off the earth's surface) or water drainage patterns, resulting in thaw and subsidence or inundation. Such changes can affect regeneration and revegetation of certain plant species, and species composition may also change after disturbance from construction activities (Linkins et al. 1984).

### **c. Effects of Seismic Surveys**

Winter seismic surveys can affect tundra vegetation, depending on snow depth, vehicle type, traffic pattern, and vegetation type. Soil-water content, and the freezing and thawing cycles impact soil strength. Water that freezes in the soils impedes the movement of soil particles. In contrast, low soil-water content does not increase soil strength upon (Lilly et al. 2008). A study by Lilly et al. showed that while freezing, the soil temperatures colder than -2°C did not cause an appreciable increase in frozen soil water, and found that the difference in frozen soil-water content between -2° C and -5°C in early spring was less than autumn freezing conditions (Lilly et al. 2008).

Effects from seismic surveys during any season could be substantial if operations are conducted improperly. Vehicles can leave visible tracks in the tundra, but they should disappear with the recovery of the vegetation within a few years, especially in moist or wet vegetation areas. Vehicles using tight turning radii have sheared off upper layers of vegetation, but left rhizomes intact, so those plants would probably recover. Dry, snowless ridges and vegetated sand dunes are at higher risk of damage. Damage was observed to shrubs, forbs and tussocks in research conducted by Guyer and Keating in 2001 and 2002. More significant impacts were observed on higher, drier sites, with little to no evidence of damage observed in wetlands (Guyer and Keating 2005).

The moving of equipment over land and the conducting of seismic surveys could alter the thermal balance, and increase the risk of thermokarsting. Studies of tundra disturbance from seismic surveys showed full or partial recovery over several years duration (Jorgenson and Cater 1996). Tundra plots were evaluated for vegetation, trail compression, visibility from the air, and exposed soil. Use of narrow trails and disturbance caused by camp moves showed partial recovery after ten years time, while other trails experienced almost full to full recovery. Impacts that persisted were trail subsidence, changes to wetter conditions, ruts, invasion of grasses, and decreases in shrubs. Use of 3D seismic methods may increase the surface footprint of the surveys, as a denser grid of trails is used than in the 2D surveys previously conducted (Jorgenson and Cater 1996).

### **d. Effects on Caribou Populations and Habitats**

Direct habitat loss results from construction of well pads, pipelines, roads, airfields, processing facilities, housing, and other infrastructure. Effects of constructing pads, roads, and pipelines on caribou habitats include direct loss of acreage due to gravel infilling, and loss of dry tundra habitat due to entrainment and diversion of water. The long term avoidance of human activities in oil fields by caribou constitutes a form of habitat loss, as well (Ballard et al. 2000, citing to Cameron 1995).

In comparison, other research showed that caribou are attracted to oil field infrastructure for insect relief (Ballard et al. 2000, citing to Ballard et al. 2000; Murphy and Lawhead 2000). Joly et al. (2006) support that oil development on Alaska's North Slope has not adversely affected caribou. Effects to individual animals may or may not represent net impacts to the caribou herd population overall, and those impacts may be positive or negative.

***i. Effects on Caribou Calving and Post-calving***

Cronin et al. (1994) found that caribou cow and calf groups are most sensitive to human disturbance just before calving and post-calving, but Haskell et al. (2006) found that caribou with or without calves became habituated to development after the calving period. Cameron et al. (2005) reported that caribou shifted calving inland, away from Milne Point, as infrastructure density increased. Ground vehicle traffic, aircraft, and human presence near cows with newborn calves also affect individuals as they migrate. If caribou are displaced from calving in a certain area due to construction, they are likely to calve in an area where construction is not taking place. The use of specific calving sites within the broad calving area varies from year to year. If calving caribou are displaced from high nutrition forage near a drill site or facility, they are likely to seek any protective area regardless of the forage. The cumulative effect of displacement from higher value calving habitat could be lower calf survival or calves with smaller mass and size (Arthur and DeVecchio 2009). On the other hand, high populations would force the caribou into lower nutrition areas anyway.

As discussed in Section 1(b), secondary effect of construction activities includes dust deposition, which may reduce photosynthesis and plant growth. Plants eliminated by dust along roads include sphagnum, acidophilus mosses and willow. If dust accumulation persists, all vascular plants may be eliminated. Caribou may be impacted by dust accumulation due to reduction in foraging plants, such as willow (McKendrick 2000, citing to Walker and Everett 1987; Ballard et al. 2000, citing to White et al. 1975 and White and Trudell 1980). In comparison, it has also been suggested that this dust shadow along roads allows for early melting of snow, increasing the earlier availability of forage vegetation to caribou in these locations (Cronin et al. 1994, citing to Lawhead and Cameron 1988).

***ii. Effects of Roads***

The use of roads has varying impacts on caribou. Caribou habituate to oil field structures, and habituate more slowly to vehicular traffic (Cronin et al. 1994). The observed density of caribou adjacent to roads showed that there was a significant decline in caribou in the zone of up to 0.6 mi from the road (Cronin et al. 1994). Caribou density increased at distances further than 0.6 mi, with an observed tripling of density in areas 2.5 to 3.7 mi from the road (Cronin et al. 1994).

During road construction in the Milne Point oil field, the estimated number of caribou within 2 km of the road declined by more than two-thirds during 1982-1987 (Nellemann and Cameron 1996). In contrast, Valkenburge and Davis (1986) reported that the Fortymile caribou herd moved to a new calving area, and chose a new area for several years duration (Valkenburg and Davis 1986). Although human activity may affect choice of calving areas, there is considerable natural variation in where calving occurs without human intervention (Valkenburg and Davis 1986).

Although aerial surveys of radio-collared females conducted between 1978 and 1987 indicate that parturient females ready to birth calves can be displaced by road systems (Cameron et al. 1992), more recent analysis suggests that calving and adult caribou distribution is not strongly influenced by the presence of the Milne Point Road (Noel et al. 2004). In the 1992 study, after construction of the Milne Point road, caribou were significantly less numerous within 1 km of roads and significantly more numerous 5 to 6 km from roads. A Noel et al. (2004) study of recent post-road calf densities reported that densities within 1 km of the Milne Point Road were higher than intervals farther from the road. In addition, the densities of all caribou were not lower closer to the road than at greater

distances, as reported by other researchers. Roads without adjacent pipelines with heavy levels of vehicle traffic appear to impede caribou movement (Cronin et al. 1994).

Extensive research on the response of caribou to development has shown that for many situations it is possible to design facilities so that caribou movements are not significantly impeded. For example, in the Kuparuk development area, elevating pipelines and separating pipelines from roads with traffic have allowed caribou to move with ease through the oil field.

### ***iii. Effects of Pipelines***

Cronin et al. (1994) have found that caribou readily cross under elevated pipelines under most conditions. Elevated pipelines with adjacent roads with less than 5 vehicles per hour showed similar movement by caribou as areas with no vehicle traffic. Elevated pipelines and adjacent roads with moderate to heavy levels of vehicle traffic have been shown to impede caribou movements. Buried pipelines allow free passage of caribou. Noel et al. (2004) found that pipelines do not delay caribou travel to the coast.

Above-ground pipelines can restrict caribou movement and deter them from seeking preferred habitat unless provisions are made to allow for their free passage. It was found that pipelines elevated at least 5 ft allow for effective crossing by caribou, except when they were in proximity to roads with moderate to heavy traffic (15 or more vehicles per hour) (Cronin et al. 1994). Facilities and pipelines built earlier in the development of the Arctic oil fields and the Trans-Alaska Pipeline System likely created impediments to caribou movements (Shideler 1986). Group size of caribou affects the success of crossing linear structures, with larger groups showing lower success in crossings than do smaller groups (Shideler 1986). Flow and gathering pipelines were elevated only 1 to 4 ft above the ground, effectively barring caribou from crossing. However, extensive research on the response of caribou to development has now shown that for many situations it is possible to design facilities so that caribou movements are not significantly impeded. For example, in the Kuparuk development area, where elevating pipelines to a minimum of 5 ft above ground, and separating pipelines from roads with traffic, have allowed caribou to move freely through the oil field.



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Caribou under pipeline.

**iv. Caribou Behavior for Insect Relief**

The movements and behavior of caribou are strongly influenced by mosquitoes and flies. Caribou are harassed by mosquitoes (*Aedes spp.*) from late June to late July, and by oestrid flies (*Hypoderma tarandi* and *Cephenomyia trompel*) from mid-July through August (Ballard et al. 2000, Truett and Johnson 2000, citing to Dau 1986; Pollard et al. 1996). To escape mosquitoes, caribou move from inland feeding areas to windswept, vegetation free coastal areas, where they rely on various coastal habitats for relief from insect pests (White et al. 1975; Dau and Cameron 1986).

A variety of natural land features are used by caribou for insect relief (Roby 1978; Dau and Cameron 1986; Pollard et al. 1996, Ballard et al. 2000, citing to Pollard et al. 1996). Flies are less tolerant of shade, so when oestrid flies dominate, caribou favor shade created by industrial buildings and pipelines (Ballard et al. 2000; Murphy and Lawhead 2000). Gravel pads are also favored habitat for relief from both mosquitoes and flies (Ballard et al. 2000; Murphy and Lawhead 2000). Researchers found that ambient air temperatures were lower, wind speeds higher, and poor insect cover habitat likely made mosquitoes less abundant on gravel pads than on the tundra (Pollard et al. 1996).

**v. Effects of Seismic Activities and Wells**

A study in Alberta, Canada found that seismic lines did not act as barriers to caribou, and that roads were semi-barriers to animal movements. Maximum animal avoidance distances from well sites were reported to be 1,000 m, and avoidance distances from seismic lines and roads were 250 m (Dyer 1999).

**vi. Effects of Aircraft Traffic**

Caribou can be briefly disturbed by low flying aircraft, which can result in disruption of habitat use, with highly variable animal reactions, ranging from none to violent escape. Reactions depend upon distance from human activity; speed of approaching disturbance source; altitude of aircraft; frequency of disturbance; sex, age, and physical condition of the animals; size of caribou group; and season, terrain, and weather. Caribou in some herds appear to be habituated to aircraft; other herds respond with panicked running. Flights greater than 2,000 ft above sea level (asl) during calving, and flights greater than 1,000 ft asl at other times appears to cause little or no caribou reaction (Shideler 1986). In contrast, Calef et al. (1976), stated that during the spring and fall migrations, caribou react to aircraft flying less than 200 ft in altitude, and that above this height, disturbances were observed in less than 20% of all groups observed. They also found that during calving, there were strong panic and escape animal behaviors during overflights of less than 500 ft height (Calef et al. 1976). Panic reactions can cause animals to collide and injure themselves, with young calves being particularly susceptible to injury (Calef et al. 1976).

**vii. Summary of Effects on Caribou**

The Central Arctic and other herds found in the lease sale area have grown considerably during the period of oil field development, but researchers disagree about the impact of industry activity on caribou populations. Still, research indicates that caribou can accommodate and habituate to most oil field activities, although questions remain regarding the impact of high intensity or frequent disturbances (Murphy and Lawhead 2000, citing to Curatolo and Murphy 1986, 1987). Based upon comparisons with other herds, there have been no apparent effects of oil field development on the growth of the Central Arctic herd. This does not suggest that there may not be effects in the future, or that other herds under different ecological conditions may not be affected (Cronin et al. 1994).

**e. Effects on Other Terrestrial Wildlife Habitats**

Other terrestrial mammals that may experience cumulative effects of oil and gas development are the brown bear, muskoxen, moose, and other furbearers. Primary sources of disturbance include seismic activity, vehicle traffic, and aircraft.

Human activity may initially cause bears to avoid an area and can displace bears in the area. Seismic activity that occurs in winter may disturb denning bears. Studies have found that radio-collared bears in their dens were affected by seismic activities within 1.2 mi of their dens, demonstrated by an increased heart rate and greater movement within the den. However, no negative effect, such as den abandonment, was documented (Reynolds et al. 1986).

A study of the effects of roads on brown bears in British Columbia and Montana found that bears used areas within 100 m of roads significantly less than areas farther from the roads, but this behavior change did not translate into a demonstrable effect on the population (McLellan and Shackleton 1988). However, of greater concern to wildlife managers in the lease sale area is the potential for increased bear-human interactions and potential subsequent high nonhunting mortality of bears resulting from those interactions (ADF&G 2007; Suring and Del Frate 2002).

The ADF&G manages the GMUs where brown bears are found in and near the lease sale area, and have implemented management actions to reduce impacts on bears. Actions include closure of developed areas to big game hunting, prohibition of firearms within oil fields, and implementing bear safety and proper hazing techniques to reduce bear/human encounters. The proper management of wastes and landfills also reduce availability of anthropogenic foods to the bear population (Shideler and Hechtel 2000). If food is present, human activity serves as an attractive nuisance, attracting foraging bears, especially to refuse disposal areas. This may pose a threat to human safety and the potential need to remove “problem” animals. In 2001, five brown bears were shot in the Prudhoe Bay fields (NRC 2003).

Muskoxen have a high fidelity to particular habitat areas because of factors favorable to herd productivity and survival, such as food availability, snow conditions, or absence of predators. Therefore, displacement from preferred habitat could have a negative effect on muskoxen



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Muskoxen in front of a production site, Prudhoe Bay.

populations. Muskoxen conserve energy and remain relatively sedentary in the winter and calving, to conserve energy to compensate for reduced forage (Reynolds et al. 2002). Mixed groups of muskoxen showed a greater sensitivity to fixed-wing aircraft in winter and during calving than in summer, fall, or during rut. Helicopters and low-flying aircraft have sometimes caused muskoxen to stampede and abandon their calves (NRC 2003). Muskoxen also may react to seismic survey

equipment operating within 2 mi from the herd, and move away from the equipment and sounds emitted. Research has shown that the animals return from 1 to 4 weeks after the disturbance (Russell 1977). Muskoxen may react to visual stimulus rather than the noise of the disturbance source. On level land the disturbance was much less than in more rolling terrain, where more sudden appearance of a vehicle caused a disturbance. Aircraft and snow machines caused a disturbance at greater distances than Nodwell vehicles (Beak Consultants Ltd. 1976).

The presence of linear pipelines may affect moose habitats, causing disruption in migration movements. A study of the effect of the Trans-Alaska pipeline on moose habitats suggested that moose are physically prevented from crossing under pipe structures that are less than 4 ft above ground level (Van Ballenberghe 1978). During shallow snow conditions about 60% of all moose crossings occurred when distances were between 6 to 8 ft high. Three-quarters of all crossings occurred where the pipe was 8 ft or less above ground, and more than 90% used crossing locations that were less than 10 ft high. Open ditches of 10 ft or more in depth deflected moose migration (Van Ballenberghe 1978).

Wolves and foxes are found in the lease sale area. Foxes readily habituate to human activity, and this can lead to human-animal encounters, the foxes' use of human structures, and attraction to anthropogenic food sources. Foxes are especially attracted to human activity because of potential scavenging sources (Burgess 2000, citing to Wrigley and Hatch 1976; Eberhardt 1977). Animal disturbance can be caused by aircraft traffic. Human use of land with denning sites can force animals to move (Eberhardt 1977). Ice roads connecting well sites and supply areas provide a source of disturbance from vehicles, and access to animals that may be perceived as a nuisance (USFWS 1987). Foxes have been attracted to camps where workers provided food handouts (Eberhardt 1977). During construction of the Dalton Highway and TAPS, wolves readily accepted handouts from construction workers (McNay 2002). When wolves approached humans, they were sometimes shot (McNay 2002). Foxes and wolves are also noted for rabies outbreaks, which increase when population densities are high and which add risks to human health. Oil and gas activity may attract foraging foxes and wolves, especially to refuse disposal areas.

Wolverines are primarily scavengers and are cautious and wary of humans (Krott 1960). Wolverines apparently are not attracted to garbage (USFWS 1986). Van Zyll de Jong (1975) reported that evidence of declining wolverine populations in Canada were found in areas of relatively dense human populations. The human hunting and exploitation of wolverines were thought to be the direct or indirect causes of decline of the wolverine population in those areas (Van Zyll de Jong 1975). Habitat destruction can also affect wolverine populations (Magoun 1985).

#### **f. Effects on Bird Populations and Habitats**

The numerous migratory birds that are found in the North Slope Foothills use the area for important breeding, nesting, rearing, staging, refugia, and overwintering habitat. Some bird habitats located north of the foothills on the North Slope's Arctic coastal plain have been impacted by oil and gas infrastructure, such as pads, pipelines, roads, and gravel pits, and community development, such as residences, schools, airports, roads, and landfills (MMS 2008). Disturbance and habitat loss of birds may occur as facilities are developed, on tundra habitats used by birds for nesting, foraging, brood rearing, and molting. For example, regular vehicle traffic on roads could permanently displace nesting birds near the development. Secondary effects, including changes in drainage patterns, thermokarst, deposition of dust, and disturbance associated with activity on roads, can displace additional individuals. Collision of birds with manmade objects may occur.

Studies conducted about the human effects of the habitats of the Pacific loon in or near oil fields report that disturbances are caused by construction of gravel roads and pad and human activity. Disturbance of nest sites, reduced availability of food sources, and abundance of predators may affect the bird populations (Kertell 2000, citing to Kertell 1996, 1997). The common eider and

Lapland longspurs sometime select gravel fill for nesting sites (McKendrick 2000). Changing the water regime with impoundments and limiting movement among wetlands may compromise access to birds' food supply (Kertell 2000, citing to Walker et al. 1987).

The tundra swan habitats in or near oil fields have experienced some human impacts and habitat loss due to the construction of gravel roads, pads, material sites and other permanent infrastructure (Ritchie and King 2000). The selection of nesting habitat has been more important than oil field facility avoidance (Ritchie and King 2000). Road noise and human presence, including pedestrians, on roads have caused some swans to nest farther from the road than they had previously (>100 to 200 m) (Ritchie and King 2000, citing to Murphy and Anderson 1993).

Disturbance is most likely to have an impact to bird habitat during those periods when birds have difficulty in meeting their daily energy requirements, especially when food intake needs to be high to enable birds to build up nutrient reserves in advance of periods of high demand (MMS 2008).

Effects of aircraft traffic on birds have been studied for several species, locations, and types of aircraft with varying results. Studies regarding the impact of low altitude overflights by helicopter or other aircraft traffic can adversely affect birds by causing stress and the flushing of habitats and nests (Rojek et al. 2007). Research relating to aircraft disturbances of common murres along the California coast showed that aircraft noise and the presence of aircraft flying below 1000 ft altitude caused head-bobbing behavior or flushing of part or all of a bird colony (Rojek et al. 2007). Helicopters can cause more disturbance due to their low altitude capabilities (Rojek et al. 2007). Flushing and displacing adults and/or broods from preferred habitats during prenesting, nesting, and brood rearing and migration can cause disruption of courtship, chick loss, egg breakage, and predation by predators (Rojek et al. 2007).

Research by Ward and Sharp (1974) evaluated the impacts of helicopters to moulting sea ducks on Herschel Island, Canada. They found that helicopter disturbances at 100 m height had an immediate impact, but that bird behavior showed no lasting effects. Helicopter disturbances did not drive birds from the habitat, and helicopter overflights at 300 m did not affect bird behavior (Ward and Sharp 1974).

In a 4-year study by Ward et al. (1999), they observed the effects of aircraft overflights on Pacific brant and Canada geese in Izembek Lagoon, located in Southcentral Alaska. The findings showed that 75% of the Pacific brant and 9% of the Canada geese flew in response to overflights. The Pacific brant were more reactive to helicopter rotary wing aircraft (51%) and louder aircraft (49%), as compared to fixed-wing (33%) and low-noise aircraft (40%) (Ward et al. 1999). The Canada geese were more reactive to helicopter rotary wing aircraft (41%) and louder aircraft (43%), as compared to fixed-wing (20%) and low-noise aircraft (31%) (Ward et al. 1999). The greatest response was to flights at intermediate altitudes of about 1000 to 2300 ft. Lateral distance from the



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Swan in front of a production facility, Prudhoe Bay.

birds was also a critical factor in determining the amount of disturbance to the birds (Ward et al. 1999).

Finally, Larned et al. (1997) found contrasting results about bird impacts from helicopters compared to fixed wing aircraft. They found that eiders tolerated close passes by helicopters at 150 m with mild alarm responses, while fixed wing aircraft caused the entire flock to leave with approaches within 150 to 200 m (Larned et al. 1997).

In research by Rojek, boat vessel approaches to common murre colonies along the coast also caused disturbances, with large disturbances causing some birds to fly away leaving the habitat, and allowing other bird species to replace them (Rojek et al. 2007).

### **g. Effects on Terrestrial Habitats from Discharges from Gas Blowouts, Oil Spill Releases, and Drilling Waste Releases**

#### ***i. Gas Blowouts***

During drilling, shallow gas pockets of natural gas may be encountered. Gas can get trapped in soils, water, and ice in permafrost environments. Sediments in which gas has accumulated are potential hazards for drilling that penetrates them in Arctic environments (Natural Resources Canada 2010, citing to Hyndman and Dallimore 2001).

If a natural gas blowout occurs, the explosion and resultant fire would impact the immediate area, and gas vapors may migrate downwind. Natural gases, hydrogen sulfide, and gas condensates may impact any humans, plants, insects and other organisms in the immediate vicinity. If a natural gas blowout occurs, the initial explosion and possibility of fire are immediate hazards. Blowouts can also cause a toxic cloud of hydrogen sulfide to accumulate close to the ground (Van Dyke 1997). Natural gas and condensates that did not burn in the blowout would be hazardous to any organisms exposed to high concentrations.

#### ***ii. Oil Spills***

The release of hydrocarbons can have toxic effects on vegetation, soils, wildlife, birds and fish. Effects of spilled oil on the tundra would depend on time of year, vegetation, and terrain. Oil spilled on the tundra would migrate both horizontally and vertically. The characteristics of the soil, such as porosity, permeability, texture, degree of water saturation and organic matter content, would affect oil movement (Jorgenson and Cater 1996). Oil flow would depend on many factors, including the volume spilled, type of cover (plant or snow), slope, presence of cracks or troughs, moisture content of soil, temperature, wind direction and velocity, thickness of the oil, discharge point, and ability of the ground to absorb the oil (Linkins et al. 1984). The principal means of oil transport are gravity, water flow, and diffusion in water or air (Jorgenson and Cater 1996). The spread of oil is less when it is thicker, cooler, or is exposed to chemical weathering. If the ground temperature is less than the pour point of the oil, it would pool and be easier to contain. If the oil is spilled on snow, it may be absorbed by the snow. Spilled oil that is warmer than snow may melt the snow and flow along the ground under the snow (Linkins et al. 1984, citing to MacKay 1975).

Absorption of the oil by the tundra itself would also limit flow and reduce the area contaminated. Experiments in Canada revealed that mosses have high absorption capacity (Linkins et al. 1984, citing to MacKay 1974). Moss-covered tundra can absorb more than 13 gal of oil per m<sup>2</sup>, compared to less than a gallon for tundra not covered by moss (Linkins et al. 1984, citing to MacKay 1974). If there is a vertical crack through different soil horizons, oil would migrate down to the permafrost. If no cracks are present in the soil layers beneath the tundra, oil moves laterally in the organic material, does not penetrate the silty clay loam mineral soils beneath, and oil contamination would be restricted to the top few centimeters of the soil layer. Dry soils have greater porosity and the potential for vertical movement is greater (Linkins et al. 1984, citing to Everett 1978). If oil

penetrates the soil layers and remains in the plant root zone, longer-term effects, such as mortality or reduced regeneration, would occur in following seasons (Linkins et al. 1984). Hydrogen degrading bacteria and fungi can act as decomposers of organic material, and under the right conditions can assist in the breakdown of hydrocarbons in soils. Natural or induced bioremediation using microorganisms can also occur (Linkins et al. 1984; Jorgenson and Cater 1996). Tundra recovery from a crude oil spill in Prudhoe Bay showed complete vegetation recovery within 20 years without any cleanup (McKendrick 2000, citing to McKendrick et al. 1981). Natural recovery in wet habitats may occur in time durations of 10 years or less, if aided by cleanup activities and additions of fertilizer (McKendrick 2000).

Oil may cause harm to wildlife through physical contact, ingestion, inhalation and absorption. Oil toxicity can be related to the content of light aromatic hydrocarbons in the oil (Jorgenson and Cater 1996). As food sources are impacted by oil, larger animals, fish, mammals and humans can in turn be affected (USFWS 2004). Impacts to birds from oil releases may foul plumage and destroy insulation value, and resultant loss of buoyancy or hypothermia can kill birds (Burger and Fry 1993). While cleaning plumage, birds can ingest or inhale the oil, causing damage to lungs, liver, kidneys and death. Non-lethal effects to birds can include impaired reproduction or suppression of the immune system (USFWS 2004). Individual animals in the immediate vicinity and the associated nearby habitat and food sources may be impacted. Wildlife species may be disturbed or displaced. Additional efforts may need to divert wildlife from access to the impacted area.

Impacts to the terrestrial habitat could also result from disturbances associated with spill cleanup activities. These disturbances may cause positive effects by minimizing animals' and birds' direct contact with oil. The amount of damage to tundra by oil spills and the length of time that the oil persists decline with the site moistness, and increase with oil concentration at the site (McKendrick 2000, citing to Walker et al. 1978). Observations of a wet-sedge meadow affected by a crude oil spill showed that complete vegetation recovery occurred in 20 years without cleanup. In contrast, a dry habitat effected by a crude oil spill recovered to only 5% of the vegetation cover after 24 years (McKendrick 2000, citing to McKendrick 1999). Burning as part of oil spill cleanup immediately after the spill is a very effective cleanup method. Heat from a fire will not penetrate deeply into the soil, and tundra recovery will occur naturally (McKendrick 2000).

The action of removal of oil may be more damaging than allowing some residual oil to remain in place, in some cases. Oil weathers over time, and organisms may be able to tolerate the presence of oil while it is naturally degrading (Jorgenson and Cater 1996). The long term effects of oil may persist in the sediments for many years. Shifting of population structure, species abundance, diversity and distribution can be long term effects, especially in areas that are sheltered from weathering processes (USFWS 2004). Active clean-up measures must be planned to avoid additional adverse impacts, such as inducing thermal degradation, use of tundra damaging equipment and manpower activities, and further oil movement during thawing conditions. Passive measures may be the best means to facilitating natural recovery, as in the case of small or contained spills to minimize adverse effects to habitats (Linkins et al. 1984).

During the construction of the Trans-Alaska Pipeline from January through December, 1975, the most oil spills occurred due to equipment repair, refueling, or vehicular accidents (Kavanagh and Townsend 1977). It was determined that many small spills of less than 50 gallons could have been prevented by good maintenance procedures and consistent, careful handling techniques. The large spills of over 50 gallons were related to vehicular accidents or faulty fuel facilities in camps. Education of managers and employees that prevention due to good maintenance procedures and proper handling were recommended as the preferred policies and practices (Kavanagh and Townsend 1977).

### ***iii. Releases of Drilling Muds and Produced Water***

During exploration well drilling muds and cuttings are stored on-site, in holding tanks, or in a temporary reserve pit, and then hauled to an approved solid waste disposal site, or are reinjected into the subsurface at an approved injection well. Common drilling fluids contain water, clay, and chemical foam polymers. Drilling additives may include petroleum or other organic compounds to modify fluid characteristics during drilling (National Driller 2010). The down-hole injection of drilling muds and cuttings are unimportant if they are not placed into the subsurface into a drinking water aquifer (NRC 2003). This injection technique for mud and cutting disposal has greatly reduced the potential adverse impacts caused by releases of drilling muds and reserve pit materials (NRC 2003).

## **2. Mitigation Measures and Other Regulatory Protections**

Mitigation measures minimize negative cumulative effects by planning and implementing exploration and development activities, along with associated infrastructure and roads, that minimize negative impacts. DO&G mitigation measures in this best interest finding, along with regulations imposed by other state, federal and local agencies, are expected to avoid, minimize, and mitigate those potential effects. For example, DO&G mitigation measures require that impacts to important wetlands must be minimized. Exploration facilities, including exploration roads and pads, must be temporary and must be constructed of ice. Siting of material sites and roads must consider impacts to habitats to minimize adverse impacts to wildlife habitats. Exploration facilities, including exploration roads and pads, must be temporary and must be constructed of ice unless the director determines that no practicable alternative exists.

Technologies have been developed that may reduce the potential for impacting the tundra during seismic investigations (Jorgenson and Cater 1996). DMLW regulates use of tundra on the North Slope to prevent significant damage to the tundra. Each year, DMLW determines the date when North Slope tundra is open for use, and also determines the date for closure of tundra use. DMLW has determined that damage to vegetation can be avoided by limiting travel to areas with at least 6 inches of snow cover in wet sedge vegetation environments and 9 inches in tussock tundra, by monitoring soil temperature, and avoiding minimum radius turns (DMLW 2006). In areas where damage is extensive and natural recovery not expected, restoration may be required of operators. Use of non-native plants may be discouraged in certain habitats.

Conducting inventories to assist in site selection may prevent habitat degradation and reduction. Pollution prevention, habitat enhancement and management prior to, during and after construction are recommended (Spellerberg and Morrison 1998). In addition, DO&G mitigation measures in this best interest finding specifically address prevention of impacts to caribou and wildlife. Specifically, pipelines shall be designed and constructed to avoid significant alteration of movement and migration patterns of caribou and other large ungulates, and pipelines must generally be elevated at least 7 ft. The Alaska Caribou Steering Committee provides additional recommendations, such as that pipelines and roads should be separated by at least 500 ft (Cronin et al. 1994).

Disturbance caused by aircraft use is addressed by DO&G mitigation measures in this best interest finding. Aircraft travel shall remain one-half mile horizontal or 1,000 ft vertical from Dall sheep lambing areas between May 5 and June 20, and mineral licks from May 20 to June 30. Human safety will take precedence over flight restrictions. Lessee advisories in this best interest finding provide that seasonal restrictions may be imposed on activities located in, or requiring travel through or overflight of important calving or wintering areas for wildlife.

For projects near areas frequented by bears, mitigation measures in this written finding require that lessees prepare and implement a human-bear interaction plan designed to minimize conflicts between humans and bears, including reduction of attraction to garbage and food waste. Proper

disposal of garbage and putrescible waste is addressed, and before commencement of any activities, lessees must consult with ADF&G to identify the locations of known brown bear den sites.

Oil and gas activities may have cumulative effects on bird habitats. Specific mitigation measures in this best interest finding require permanent, staffed facilities to be sited outside specified identified bird nesting and brood rearing areas. Lessees must also comply with USFWS and NMFS requirements regarding the Endangered Species Act, Migratory Bird Treaty Act and Appendix B of the “Yellow-billed Loon Conservation Agreement.”

DO&G mitigation measures for this lease sale area are found in Chapter Nine.

## **B. Effects on Freshwater Habitats and Fish**

### **1. Potential Cumulative Effects on Freshwater Habitats**

Major anadromous rivers and streams within the lease sale area include the Colville, Sagavanirktok, Ivishak, Nanushuk, Echooka, Saviukviayak, Itkillik, Anaktuvuk, Kanayut, Lupine, Ribdon and Canning rivers, portions of the Chandler River, and Accomplishment, Upper Section and Lower Section, Flood, Cobblestone, and May creeks (Johnson and Klein 2009; Map 4.7 Anadromous rivers). These are the primary freshwater habitats in the lease sale area. Numerous other rivers and streams that flow through the sale area also support anadromous and sensitive overwintering fish populations. Several species of anadromous fish spawn and overwinter in these rivers and during summer migrate to nearshore coastal waters to feed. Migration patterns vary by species and within species by life stage (see Chapter Four). Potential effects include degradation of stream banks and erosion; reduction of or damage to overwintering areas; habitat loss due to gravel removal; high impact facility siting; effects due to water removal; siltation; impediments to fish passage and migration; and fish kills due to oil spills or freshwater habitat contamination. Excavation of gravel construction materials can cause disturb floodplains and habitats. Construction activities can also cause erosion of river banks, siltation, bottom substrate disturbance, reduced water volumes, altered water quality, barriers to fish passage, and elimination of habitat (Hanley et al. 1983).



Alpine CD3 flowline over a side channel of the Colville River.

Erosion is a potential impact of all phases of exploration and development. Erosion results in siltation and sedimentation, which in turn may reduce or alter stream flow, affecting overwintering habitat availability and the ability of fish to migrate upstream. Protecting the integrity of stream bank vegetation and minimizing erosion are important elements in preserving fish habitat. Vegetated stream banks significantly reduce erosion of habitats (Muhlberg and Moore 1998). Streambeds could be affected if stream banks are altered, such as in cases of damage from equipment crossings.

A potentially limiting factor for fish populations in the Arctic is overwintering habitat. Removal of water from lakes, ponds and rivers where fish overwinter may affect the viability of overwintering fish, and longer-term effects of lake drawdown may impede the ability of fish to return to the lake in subsequent years. Removal of snow from lakes may increase the freeze depth of the ice, kill overwintering and resident fish, and adversely affect the ability of fish to utilize the lake in future years. Water depths of 7 ft or more are considered the minimum for supporting overwintering freshwater fish (ConocoPhillips Alaska Inc. 2010). Oxygen depletion, caused by overcrowding or over-demand by biological and chemical processes, can result in fish mortality (Schmidt et al. 1989; Reynolds 1997). The Ivishak River is known to provide consistently available overwintering habitat for anadromous fish in the lease sale area (Viavant 2007; Viavant 2008). Removal of snow from lakes may increase the freeze depth of the ice, kill overwintering and resident fish, and adversely affect the ability of fish to utilize the lake in future years.

The construction of roads across rivers and streams may also affect the ability of fish to reach habitat and overwintering areas by blocking movement and causing direct loss of overwintering habitat. Blockage of movement could also occur from the improper installation of culverts and fish crossings in streams for permanent roads. The blockage of passage, siltation of streams and destruction of spawning habitat were the main problems associated with construction of fish passage crossings along the Trans-Alaska Pipeline System (Gustafson 1977).

Unapproved gravel removal from fish bearing streams during development could adversely impact anadromous fish. Gravel removal could increase sediment loads, change the streambed course, cause instability upstream, destroy spawning habitat, and create obstacles to fish migration. Gravel removal from streambeds could also cause potential damage to overwintering fish populations. Any gravel structure that obstructs the natural migratory corridor near river or creek mouths has the potential to adversely affect anadromous fish. Alternatively, gravel mine sites can be restored as overwintering habitat and thus add to total available fish habitat.

### **a. Seismic Surveys**

The principle impacts to freshwater habitats attributed to seismic surveys involve the acoustic energy pulses emitted by airguns. Seismic surveys typically cover a relatively small area and only stay in a particular area for hours, thereby posing transient disturbances. The airgun firing overpressures the water, and the fish react to the airgun, where fish immediately swim in an intense effort to flee from the sound.

In a study conducted in the Sagavanirktoq River, when an airgun was fired in close proximity, after 2 minutes, the broad whitefish then slowed their swimming speed once again, and were observed to school as a group back at the original water location (Morris and Winters 2005). Repeated firing of the airgun revealed that this pattern was consistent, and fish returned to a sedentary posture at the original water location each time. The author's interpretation of this study concluded that there was little evidence that energy from the airguns harmed the fish observed (Morris and Winters 2005). In a related study, the internal conditions of the fish were assessed after airgun firing to observe any organ damage that may have occurred from the disturbance. Airguns were fired in close proximity of Arctic char within a flooded gravel pit at Duck Island mine site on the North Slope. Results showed that no fish deaths occurred as a direct result of airgun noise, no bleeding of the gills was noted, but that internal injuries were observed in some fish. No swim bladder damage was observed.

Eye injuries were noted at rates ranging from 0.009 to 0.07, and body tissue injuries were noted at rates ranging from 0.06 to 0.12 in the fish. Fish eye injury was the injury with the highest frequency occurrence (Morris and Winters 2005).

Popper et al. (2005) measured the effects of seismic airgun firing on broad whitefish and found that the firing of airguns had no apparent effect on hearing. The results also showed that the lake chub species experienced only temporary hearing loss, and the northern pike hearing returned after 18 hours.

In a study of a rocky reef off Scotland, fish response from seismic airguns showed minor behavioral responses to airgun emissions. The researchers found there were no permanent changes in behavior, and no fish appeared to leave the reef habitat. There were no indications of observed damage to the reef animals (Popper and Hastings 2009, citing to Wardle et al. 2001).

Vessel traffic in rivers may disturb some fish resources and their habitat during operations. However, vessel noise is expected to be chiefly transient. Fish in the immediate vicinity of such vessels are believed likely to avoid such noise perhaps by as much as several hundred meters. Adverse effects from seismic activities to the migration, spawning, and hatchling survival of fish most likely would be temporary and localized (MMS 2007).

**b. Effects on Freshwater Habitats from Discharges from Gas Blowouts, Oil Spill Releases, and Releases of Drilling Muds and Produced Water**

**i. Gas Blowouts**

If a natural gas blowout occurs the initial explosion and possibility of fire are real hazards, and vapors may migrate downwind. Blowouts can also cause a toxic cloud of hydrogen sulfide that accumulates close to the ground (Van Dyke 1997). Natural gas and condensates that did not burn in the blowout would be hazardous to any organisms exposed to high concentrations.

**ii. Oil Spills**

Oil spills could range from small chronic leaks from equipment or facilities to catastrophic pipeline failures or, however unlikely, a blowout. The effects of oil spills on fish habitats would depend on many factors, including the time of year, size of the spill, and water body affected.

Fish can be impacted by oil uptake by the gills, ingestion of oil or oiled prey, and disruption of access to and changes to habitats (USFWS 2004). The impacts of the toxins in oil to freshwater invertebrates and fish are of concern (Jorgenson and Cater 1996). Potential adverse effects include direct uptake of oil by the gills, ingestion of oil, ingestion of oiled plankton or prey, effects on survival of eggs and larvae, and ecosystem changes in freshwater habitats. Adult fish may be affected by reduced growth, enlarged livers, heart and respiration rate changes and effects to reproduction. Due to toxic compounds in oil, spawning success may be reduced, and mortality of eggs and larvae could occur in spawning or nursery areas. Floating oil can also affect plankton, such as algae, fish eggs and invertebrate larvae (USFWS 2004). Sublethal effects may also reduce fitness and impair an individual's ability to endure environmental stress. The long term effects to ecosystems impacted by oil spills due to persistence of toxic substances and chronic exposures may continue to affect wildlife (Peterson et al. 2003).

The freshwater habitats that were affected by the *Exxon Valdez* oil spill in 1989 were evaluated relating to the adverse effects of oil on embryos in the streams impacted by the spill. Bue et al. (1998) found that there was a significant embryo mortality rate from 1989 to 1993, but this elevated mortality rate was not repeated in 1994.

Research about the effects of oil to embryos in freshwater habitats demonstrated that water borne oil can kill pink salmon embryos downstream from oil sources. It was also found that the effects were

varied, and that there was a potential for sublethal effects due to exposure to oil to impact fish later in their lifecycle (Heintz et al. 1999). The findings of a study to assess the delayed effects of crude oil in freshwater environments on pink salmon showed that there may be a relationship between impacts experienced by embryos exposed to crude oil and the long term survival rate of fish in the marine environment. Pink salmon exposed to crude oil as embryos had a 15% decrease in marine survival as compared to unexposed salmon (Heintz et al. 2000).

### ***iii. Releases of Drilling Muds and Produced Water***

Drilling muds, cuttings, produced waters, and other effluents from oil and gas exploration, development, and production can have short- and long-term negative effects on aquatic life, including fish and benthic organisms (Olsgard and Gray 1995). Lethal or sub-lethal effects may subtly reduce or impair physiological and reproductive fitness (Davis et al. 1984). Type and extent of effects depends on a myriad of factors including habitat involved, species, life history stage, migration patterns, nursery areas, season, type of chemical, amount and rate of release, time of release, duration of exposure, measures used for retaining of the chemical, and use of counteracting or dispersing agents (Davis et al. 1984).

Common drilling fluids contain water, clay, and chemical foam polymers. Drilling additives may include petroleum or other organic compounds to modify fluid characteristics during drilling (National Driller 2010). Releases to water environments that have concentrations above the concentration considered acceptable for aquatic life could cause toxic conditions (Woodward et al. 1988). Significant accumulation of drilling mud in wetlands can potentially impact benthic habitats and can blanket fish spawning grounds (Schmidt et al. 1999, citing to Falk and Lawrence 1973; and citing to Friedheim; Sprague and Logan 1979). Some research shows that bentonite mud may increase and improve the water holding capacity of soil (Schmidt et al. 1999, citing to Luginbuhl 1995). Suspended solids in aquatic habitat can have adverse effects on egg and larval development of amphibians (Schmidt et al. 1999, citing to Richter 1995). Produced waters may contain hydrocarbon and chemical constituents in volumes that may be toxic to microorganisms and mysid shrimp (*Mysidopsis bahia*) (Brown et al. 1992).

## **2. Mitigation Measures and Other Regulatory Protections**

Although oil and gas activities subsequent to leasing could potentially have cumulative effects on freshwater habitats, mitigation measures in this best interest finding, along with laws and regulations imposed by other state, federal and local agencies, are expected to avoid, minimize, and mitigate any potential effects.

Prevention of impacts from pads and roads includes containing waters and sediment load from flow into surface waters, using overpass and fish crossing structures, and compensating for loss of habitat (Spellerberg and Morrison 1998). The main fisheries problems associated with fish crossings are blockage of fish passage, siltation of streams and destruction of spawning habitat (Gustafson 1977). The primary failure mechanisms for fish crossings include poor materials, heavy traffic, thermal erosion, poor pad and low water crossings, scour and fluvial action. Pre-construction surveys should be done to find the natural low point of the stream crossing. Maintenance of the crossings is needed all year (Gustafson 1977). DO&G mitigation measures in this best interest finding address protection of fish and eggs from an oil spill, specifically, siting facilities away from fishbearing streams and lakes; development of oil spill contingency plans; and providing adequate spill response equipment staging and training.

Adverse impacts to overwintering habitat from oil releases can be damaging to fish. Because of the many variables involved, it is not clear prior to a spill what the impacts would be that would affect the long term survival rate of fish and the fish population. Exploration and development must take these overwintering habitat locations into consideration in planning, and should implement

mitigation activities that prevent any adverse impacts to these freshwater habitats. The crossing of fish habitat waters, and the use of water for exploration and development are regulated by the ADF&G and ADNR. Please refer to Chapter Seven for details about the governmental powers related to management of freshwater habitats.

To protect fish eggs, DO&G considers mitigation measures on a case-by-case basis as a condition for obtaining a geophysical exploration permit. Mitigation measures for geophysical exploration permits may include limiting the timing of seismic work and requiring that seismic activities be set back from freshwater fish spawning areas so that shock waves are reduced to safe levels before reaching incubating eggs during sensitive stages of development.

DO&G mitigation measures for this lease sale area are found in Chapter Nine.

## **C. Effects on Water Resources**

### **1. Potential Cumulative Effects on Water**

Potential cumulative effects on water quality would probably be due primarily to three factors: discharges of drilling muds, cuttings, and produced waters; increased turbidity from construction of gravel structures, roads and pipelines; and oil spills. Water use from lakes, ponds or groundwater wells may be required for the construction and maintenance of ice roads and pads, for blending drilling muds in drilling activities, and for potable and domestic water uses at drilling camps (NRC 2003; Van Dyke 1997).

Turbidity, which is related to suspended particles in the water column, could increase if pipeline construction or repairs, or gravel structure construction were performed improperly or without following regulations and industry protocols. Water quality characteristics that could potentially be affected by oil and gas activities include: pH, total suspended solids, organic matter, calcium, magnesium, sodium, iron, nitrates, chlorine, and fluoride. Potential activities that might affect surface water quality parameters include accidental spills of fuel, lubricants, or chemicals; increases in erosion and sedimentation causing elevated turbidity and suspended solids concentrations; and oil spills.

Geophysical exploration with tracked seismic vehicles is not expected to alter water quality because seismic surveys are conducted in winter and permit conditions mitigate potential damage. Under standard ADNR permit conditions for winter seismic exploration, the use of ground-contact vehicles for off-road travel is limited to areas where adequate ground frost and snow cover prevent damage to the ground surface.

The extent and duration of water quality degradation resulting from accidental spills would depend on the type of product, the location, volume, season, and duration of the spill or leak, and the effectiveness of the cleanup response. Heavy equipment, such as trucks, tracked vehicles, aircraft, and tank trucks, commonly use diesel fuel, gasoline, jet fuel, motor oil, hydraulic fluid, antifreeze, and other lubricants. Spills or leaks could result from accidents, during refueling, or from corrosion of lines (ADEC 2007).

### **2. Potential Effects of Releases of Drilling Muds and Produced Water**

Byproducts of drilling and production activities include muds and cuttings, produced water, and associated wastes. Improper disposal or accidental releases of drilling muds, cuttings, produced waters, and other effluents from oil and gas exploration, development, and production could have short- and long-term negative effects on fresh water habitats, as discussed in Section B above. Cumulative impacts from exploration and development activities may affect water quality.

Technological advances in drilling mud systems have developed mud systems less toxic to the environment. Newer synthetic-based muds are formulated from synthetic organics base fluids. They produce even less waste, improve drilling efficiency, are reusable, and have advantages in environmental protection over oil or water-based muds. Synthetic muds can be reconditioned instead of discharged as waste (Wojtanowicz 2008).

Produced water contains naturally occurring substances such as clay, sand, oil, water, metals, and gas. These substances are found in the subterranean strata. Produced waters are usually saline with some level of hydrocarbons and naturally occurring solids and bacteria. They may also contain chemicals added to inhibit corrosion, as well as emulsifiers, coagulants, flocculants, clarifiers and solvents. Produced waters from gas production also can include condensed water, dehydration chemicals, hydrogen sulfide removal agents and chemicals that inhibit formation of hydrates (Veil et al. 2004). Produced waters may contain hydrocarbon and chemical constituents in volumes that may be toxic to microorganisms and mysid shrimp (*Mysidopsis bahia*) (Brown et al. 1992).

Associated wastes are other production fluids such as tank bottom sludge, well work-overs, gas dehydration processes, tank wastewater, and other residues that are considered non-hazardous (low-toxicity) by the EPA.

Most drilling wastes from onshore operations are disposed of under ADEC's solid waste disposal program. ADEC administers the oil and gas reserve pit closure program (18 AAC 60.200), for sites that previously used an on-site holding pit for drilling waste fluids. Re-injection is the preferred method for disposal of drilling fluids. Disposal of drilling muds and cuttings requires permit approval. Most oil field wastes are considered non-hazardous and waste fluids are recycled, filtered, and treated before reinjection or disposal. Cuttings and waste fluids must be made non-hazardous before injection. Produced water is treated using heat, gravity settling, and gas flotation devices to remove hydrocarbons. After treatment, produced water is reinjected into either the oil-bearing formation to maintain pressure and enhance recovery or into an approved disposal well. Cuttings disposal is done through grinding and injecting on-site, or cuttings are transported to an approved disposal site. Cuttings disposal can cost more than the total cost to drill a well. Wastewater, including sanitary and domestic graywater, is also treated to meet effluent guidelines before discharge. All disposal wells inject fluids deep beneath any drinking water aquifers.

The AOGCC functions as the regulatory agency overseeing the underground operation of the Alaska oil industry on private and public lands and waters, and ensures proper and safe handling and disposal of drilling wastes. AOGCC administers the Underground Injection Control (UIC) Program for oil and gas Class II wells, acts to prevent waste of oil and gas resources and ensures maximum recovery, and protects subsurface property rights.

### **3. Mitigation Measures and Other Regulatory Protections**

Although oil and gas activities subsequent to leasing could potentially have cumulative effects on water resources, mitigation measures in this best interest finding, along with laws and regulations imposed by other state, federal and local agencies, are expected to avoid, minimize, and mitigate any potential effects.

Under the standard ADNR permit conditions for off-road activity, fuel and hazardous substances must have secondary containment apparatus. An appropriately sized secondary containment or surface liner must be placed under all container or vehicle fuel tank inlet and outlet points. Appropriate spill response equipment must be on hand during any transfer or handling of fuel or hazardous substances. Vehicle refueling is prohibited within annual floodplains (DCOM 2004). Impacts and cleanup of crude oil spills are discussed in Chapter Six.

Other standard ADNR land use permit conditions serve to protect water quality from facility construction and operation. Work areas must be kept clean. Trash, survey markers, and other debris

that may accumulate in camps or along seismic lines and travel routes that are not recovered during the initial cleanup must be picked up and properly disposed. All solid wastes, including incinerator residue, must be backhauled to an approved solid waste disposal site. Vehicle maintenance, campsites, and the storage or stockpiling of material on the surface of lakes, ponds, or rivers is prohibited (DCOM 2004).

Effluents discharged by the oil and gas industry are regulated through EPA's NPDES program. The administration of the program for oil and gas discharges is transitioning to ADEC in 2011, under the Alaska Pollution Discharge Elimination System (see Chapter Seven). Therefore fish and other aquatic organisms are not expected to be impacted by drilling muds, cuttings, produced waters, and other effluents associated with oil and gas exploration, development, and production.

Permits may contain stipulations on water use and quantity drawn in order to meet standards related to protection of recreation activities, navigation, water rights, or any other substantial public interest. Water use permits may also be subject to conditions, including suspension and termination of exploration activities, in order to protect fish and wildlife habitat, public health or the water rights of other persons. Before a permit to appropriate water is issued, ADNR considers local demand and may require applicants to conduct aquifer yield studies. Generally, water table declines associated with the upper unconfined aquifer can be best mitigated by industrial users tapping confined (lower) layers or searching for alternate water sources.

DO&G mitigation measures included in this best interest finding that address water quality include: protection of wetlands, riparian, and freshwater habitats; prohibition of discharges into waters; turbidity reduction; water quality monitoring; stream buffers; and water conservation.

DO&G mitigation measures for this lease sale area are found in Chapter Nine.

## **D. Air Quality**

### **1. Potential Cumulative Effects on Air Quality**

#### **a. Current Air Quality Conditions**

Oil and gas exploration, development, and production activities may produce emissions that potentially affect air quality. Gases are emitted to the air from power generation, flaring, venting, well testing, leakage of volatile petroleum components, supply activities and shuttle transportation (Arctic Council 2009).

Greenhouse gas emissions ( $\text{CO}^2$  and  $\text{CH}^4$ ) are another potential source of air pollution. These emissions come primarily from the burning fossil fuels in generators, vehicles, heavy construction equipment, aircraft, and camp operations, as well as the flaring and venting of natural gas. Fugitive sources account for a significant percentage of  $\text{CH}^4$  emissions from oil and gas operations.

Air quality throughout the lease sale area is good. Concentrations of regulated pollutants are below the maximum allowed under the National Ambient Air Quality Standards (NAAQS).

#### **b. Possible Effects to Air Quality**

On-road and off-road vehicles, heavy construction equipment, and earth-moving equipment could produce emissions from engine exhaust and dust. Sources of air emissions during drilling operations include rig engines, camp generator engines, steam generators, waste oil burners, hot-air heaters, incinerators, and well test flaring equipment. Emissions could be generated during installation of pipelines and utility lines, excavation and transportation of gravel, mobilization and demobilization of drill rigs, and during construction of gravel pads, roads, and support facilities. Emissions could also be produced by engines, turbines, and heaters used for oil/gas production, processing, and transport. In addition, aircraft, supply boats, personnel carriers, mobile support modules, as well as

intermittent operations such as mud degassing and well testing, could produce emissions (MMS 2008).

Other sources of air pollution include evaporative losses of volatile organic compounds from oil/water separators, tanks, pump, compressor seals, and valves. Venting and flaring could be an intermittent source of volatile organic compounds and sulfur dioxide (MMS 2008). Gas blowouts, evaporation of spilled oil, and burning of spilled oil may also affect air quality. Gas or oil blowouts may ignite. A fire could deposit a light, short-term coating of particulates over a localized area. In-situ burning of spilled oil must be pre-approved by ADEC and EPA and/or the U.S. Coast Guard (ADEC et al. 2008). Controlled in-situ burning of spilled oil is only allowed if it is located a safe distance from populated areas. Approved burn plans require removal of particulates. Other effects of reduced air quality include possible damage to vegetation, acidification of nearby areas, and atmospheric visibility impacts (BLM 2005).

### **c. Known Effects to Air Quality**

An ambient Air Quality Monitoring Station has operated at Nuiqsut since 1999, originally as a State of Alaska permit condition for the Alpine field. Data collected indicate that air quality information from 2002 through 2005 showed Nuiqsut and Kuparuk field in compliance with both NAAQS and Alaska Ambient Air Quality Standards for all pollutants and averaging periods (BLM 2008, citing to Phillips Alaska and SECOR International Inc.).

The volume of 2002 emissions from the large stationary sources within the oil and gas industry in Alaska was 15.26 million metric tons of gross carbon dioxide equivalent. This is estimated as 7% of the total Title V large source emissions reported, and about 29% of all reported emissions in Alaska (ADEC 2008). The Alaskan overall oil and natural gas industry historical trend projection for emissions was an estimated 3.0 million metric tons of greenhouse gases statewide in 2005, contributing about 6% of the state's total greenhouse gas emissions (Roe et al. 2007). This is a projected decrease from 1990 and 2000, and continued decreases are expected through 2020. There are significant uncertainties with these estimates. These estimates are for fugitive emissions, which are released during the production, processing, transmission, and distribution of oil and gas. Fugitive emissions include methane and carbon dioxide released from leakage and venting at oil and gas fields, processing facilities, and pipelines. Estimates of emissions resulting from fuel combustion are only available for residential, commercial, and all industries combined, and are not available for the oil and gas industry separately (Roe et al. 2007).

The presence of an Arctic haze at higher elevations and from locally produced emissions is common among Arctic climates. It is reportedly primarily formed from fugitive emissions from temperate zone sources that are transported long distances. There is no definitive research about the interaction between local emissions and pollutants from distant sources (NRC 2003).

## **2. Mitigation Measures and Other Regulatory Protections**

Although oil and gas activities subsequent to leasing could potentially affect air quality, federal and state air quality regulations, particularly the Clean Air Act (42 USC §§ 7401-7671), 18 AAC 50, AS 46.03, and AS 46.14, are expected to avoid, minimize, and mitigate those potential effects. Therefore, additional DO&G mitigation measures are not included in this best interest finding because air quality regulations are under the jurisdiction of ADEC.

Because industrial emissions such as those listed above can have negative environmental effects, the federal Clean Air Act of 1970 and subsequent amendments regulate air quality across the U.S., including in Alaska (EPA 2010). Although the EPA is the primary federal agency responsible for controlling air pollution, monitoring air quality, and inspecting facilities (EPA 2010), many of these authorities in Alaska have been delegated to ADEC under a federally-approved State Implementation Plan (ADEC 2010b). State and federal regulations require facilities that emit certain pollutants or

hazardous substances to obtain a permit: new facilities are required to obtain a permit before construction (Title I, NSR permit); existing facilities must have an operating (Title V) permit (ADEC 2010a). Permits are legally binding and include enforceable conditions. The permit limits the type and amount of emissions and requires pollution control devices, prevention activities, monitoring, and record keeping.

ADEC also operates ambient air quality monitoring networks under the provisions of the Prevention of Significant Deterioration Program to assess compliance with the NAAQS for: carbon monoxide, particulates, nitrogen dioxide, sulfur oxide, and lead; assesses ambient air quality for ambient air toxics level; provides technical assistance in developing monitoring plans for air monitoring projects; and issues air advisories to inform the public of hazardous air conditions (ADEC 2010b).

Operators in Alaska are required to minimize the volume of gas released, burned, or permitted to escape into the air (20 AAC 25.235(c)). Operators must report monthly to AOGCC any flaring event lasting over an hour. AOGCC investigates these incidents to determine if there was unnecessary waste (AOGCC 2004).

Additional information about air quality regulations and permits is found in Chapter Seven.

## **E. Wildlife and Fish Uses**

### **1. Subsistence Uses**

#### **a. Potential Cumulative Effects on Subsistence Uses**

Subsistence uses of the North Slope Foothills area are dependent upon the area's terrestrial and freshwater habitats. For centuries survival in the Arctic has centered upon the pursuit of subsistence foods and materials as well as the knowledge needed to find, harvest, process, store, and distribute the harvest. The development of Inupiat culture depended upon handing down traditional knowledge and beliefs about subsistence resources. For the Inupiat, subsistence and culture continue to be inextricably intertwined.

Subsistence uses of the North Slope Foothills area depend on the area's wildlife, fish and their habitats. Traditional subsistence activities include: hunting and fishing for caribou, muskoxen, brown bear, moose and other furbearers; hunting for migratory waterfowl and collecting their eggs; fishing for Dolly Varden, Arctic char, whitefish, salmon, Arctic grayling, rainbow trout, and burbot; collecting berries, edible plants, and wood; and producing crafts, clothing, and tools made from these wild resources. Equally important, subsistence activities also include social activities of consuming, sharing, trading and giving, cooperating, teaching, and celebration among members of the community. Potential cumulative effects to wildlife, fish, birds and fish, and their respective terrestrial and freshwater habitats are discussed in the preceding sections. Other potential effects on subsistence uses are discussed below.

Potential post-lease activities that could have cumulative effects on subsistence uses of the lease sale area include seismic surveys, discharges from well drilling and production, construction of roads and support facilities, and ongoing disturbances from production activities such as pipeline activities, vehicle, boat, and aircraft traffic. In addition, gas blowouts and oil spills could potentially occur during development and production. Potential effects on subsistence uses may also include: increased or decreased access to hunting and fishing areas; concerns about safety of subsistence foods; and increased competition for nearby subsistence resources. For example, roads built by oil companies during exploration and development recently and over the last 50 years are important for access to subsistence resources for the Cook Inlet area (Braund 2007). Increased access to hunting, fishing, and trapping areas, due to construction of new roads, could make access to subsistence areas easier and faster, but could also increase competition between user groups for subsistence resources.

Although the oil and gas industry has the potential to provide jobs and income to subsistence users, work in the oil and gas industry may reduce the time available for subsistence activities (Stanek et al. 2007; EDAW/AECOM 2007). Some studies have found that “higher levels of household cash income were directly correlated with peoples’ commitment to, and their returns from, natural resource harvesting” (EDAW/AECOM 2007, citing to Kruse 1986, and to National Research Council 1999). Other studies have shown that young men in Inupiaq communities balance wage employment with seasonal subsistence activities, even when there are large numbers of high paying job opportunities (EDAW/AECOM 2007, citing to Kleinfeld et al. 1983). The availability of time-saving technologies, such as ATVs, snow machines, and outboard motors, has counter-balanced decreased availability of time, and “cash derived from wage employment did not replace subsistence but underwrote it” (EDAW/AECOM 2007, citing to Lonner 1986).

A major oil spill could decrease resource availability and accessibility, and create or increase concerns about food safety which could result in significant effects on subsistence users that could linger for many years. Subsistence harvests of fish and wildlife by residents of fifteen predominately Alaska Native communities, as well as by residents in larger rural communities, declined by as much as 77% after the 1989 *Exxon Valdez* oil spill (Fall 1999). The primary reason for the decline was the perception or fear that oil contamination had rendered the food sources unsafe to eat.

Within two years of the spill, subsistence harvests and participation had returned to pre-spill levels, although communities closest to the spill lagged behind. However, concerns remained about food safety, availability of many species was reduced, efficiency was reduced, and opportunities to teach subsistence skills to young people were lost (Fall 1999). By 2003, harvest levels were higher than pre-spill levels, or were within the range of other rural communities. However, harvest composition remained different from the pre-spill composition, and concerns about the safety of some shellfish species remained (Fall 1999). Additional complex factors may confound effects of an oil spill, including demographic changes in communities, and increased competition for fish and wildlife resources by other user groups and predators (Fall 1999). Because many subsistence resources affected by the spill had not fully recovered, subsistence in areas affected by the *Exxon Valdez* oil spill was still not considered to have fully recovered in 2006 (EVOSTC 2006).

It should be noted that publically available, quantitative, controlled studies that document cumulative effects of an oil spill on land or in freshwater are lacking. There is limited information available on whether spatial redistribution of a species, such as caribou, affects harvest and the time required to for a successful hunt (NRC 2003).

### **b. Mitigation Measures and Other Regulatory Protections**

Although oil and gas activities subsequent to leasing could potentially affect subsistence uses, primarily as secondary effects from effects on habitat, wildlife, or fish, DO&G measures in this best interest finding, along with regulations imposed by other state, federal and local agencies, are expected to avoid, minimize, and mitigate those potential effects. In addition to the DO&G mitigation measures addressing wildlife, fish, and habitat discussed in Section A(2) and B(2), other DO&G mitigation measures in this best interest finding specifically address harvest interference avoidance, public access, road construction, and oil spill prevention. In addition, a plan of operations must include a training program to inform the persons working on the project of environmental, social, cultural, health, and safety concerns.

DO&G mitigation measures for this lease sale area are found in Chapter Nine.

## F. Sport Fishing and Hunting

### 1. Potential Cumulative Effects on Sport Fishing and Hunting

In addition to subsistence hunting and fishing, other important uses of fish and wildlife populations in the lease sale area include sport hunting and fishing. Potential post-lease activities that could have cumulative effects on these uses of the lease sale area include seismic surveys, discharges from well drilling and production, construction of road and support facilities, and ongoing disturbances from production activities such as pipeline activities, vehicle, boat, and aircraft traffic. In addition, gas blowouts and oil spills could potentially occur during development and production.

Sport hunting and fishing in the North Slope Foothills area depend on the area's habitats for wildlife and fish. Therefore, potential cumulative effects from oil and gas exploration, development and production on the area's terrestrial and freshwater habitats could also affect these uses. Potential effects to the area's habitats are discussed in the preceding sections.

Oil and gas exploration, development, and production could result in increased access to hunting and fishing areas. For example, roads built by oil companies during exploration and development recently and over the last 50 years are important for access to subsistence resources for the Cook Inlet area (Braund 2007), which would likely be true for user groups in other areas in Alaska, as well. However, increased public access to hunting and fishing areas due to construction of new roads could also increase competition between user groups for wildlife and fish resources.

### 2. Mitigation Measures and Other Regulatory Protections

Oil and gas activities subsequent to leasing could potentially have cumulative effects on uses of wildlife and fish populations, such as sport hunting and fishing. Most of these potential effects would likely occur as secondary effects from effects on habitats, wildlife or fish. DO&G measures in this best interest finding, along with regulations imposed by other state, federal and local agencies, are expected to avoid, minimize, and mitigate those potential effects. In addition to DO&G mitigation measures addressing habitats, wildlife, and fish, other DO&G mitigation measures specifically address harvest interference avoidance.

DO&G mitigation measures for this lease sale area are found in Chapter Nine.

## G. Historic and Cultural Resources

### 1. Potential Cumulative Effects

The lease sale area has documented occurrence of historical and cultural resources found throughout the area (Dale 2009). The potential impacts to these resources may be from accidental oil spills, erosion and vandalism (Dekin et al. 1993). The expected effects on archaeological resources from an oil spill are uncertain. However, during the *Exxon Valdez* oil spill and subsequent cleanup activities, the greatest effects to cultural resources came from vandalism and direct disturbance during cleanup activities (Bittner 1996).

If development occurs, impacts and disturbance to historic and cultural resources could be associated with installation and operation of oil and gas facilities, including drill pads, roads, airstrips, pipelines, processing facilities, and any other ground disturbing activities. Damage to archaeological sites may include: direct breakage of cultural objects; damage to vegetation and the thermal regime, leading to erosion and deterioration of organic sites; shifting or mixing of components in sites resulting in loss of association between objects; and damage or destruction of archeological or historic sites by oil spill cleanup crews collecting artifacts (USFWS 1986).

In the event that an increased amount of ground disturbing activity is planned for historically and culturally rich areas, state and federal laws and regulations can mitigate effects to archaeological resources. The Alaska Office of History and Archaeology requires that any cultural resources found be reported to their office. Please see Chapter Seven, for more information about the Alaska Office of History and Archaeology.

**a. Gas Blowouts or Explosion**

Disturbance to historical and archaeological sites might occur as a result of activity associated with incidents such as an oil or gas well blowout, or explosion. Archaeological resources in the immediate vicinity of the blowout might be destroyed, and cleanup activities could result in disturbance by workers near the accident site, as discussed above.

**b. Oil Spills**

Oil spills can have an indirect effect on archaeological sites by contaminating organic material, which would eliminate the possibility of using carbon C-14 dating methods (USFWS 1986). Subsequent to the *Exxon Valdez* oil spill, the detrimental effects of cleanup activity on these resources were minor because the work plan for cleanup was constantly reviewed, and cleanup techniques were changed as needed to protect archaeological and cultural resources (Bittner 1996).

**2. Mitigation Measures and Other Regulatory Protections**

Historic and cultural resources could be affected by oil and gas exploration, development, and production activities. For example, historic and cultural resources may be encountered during field based activities, and these resources could be affected by disturbance, or accidents, such as an oil spill. Various mitigation measures used to protect archaeological sites during oil spill cleanups include avoidance (preferred), site consultation and inspection, onsite monitoring, site mapping, artifact collection, and cultural resource awareness programs (Bittner 1996).

Although oil and gas activities subsequent to leasing could potentially have cumulative effects on historic and cultural resources, DO&G measures in this best interest finding, along with regulations imposed by other state, federal and local agencies, are expected to avoid, minimize, and mitigate those potential effects.

Because historic and cultural resources are irreplaceable, caution is necessary in order to not disturb or impact them. AS 41.35.200 addresses unlawful acts concerning cultural and historical resources. It prohibits the appropriation, excavation, removal, injury or destruction of any state owned cultural site. In addition, all field based response workers are required to adhere to historic properties protection policies that reinforce these statutory requirements, and to immediately report any historic property that they see or encounter (AHRS 2010).

Under MSB municipal code, proposed development may not impact any historic, prehistoric, or archaeological resource before the assessment of that resource by a professional archaeologist (NSBMC 19.50.030(F)). MSB municipal code 19.70.050(F) states, “Development shall not significantly interfere with traditional activities at cultural or historic sites identified in the Coastal Management Program” (NSB 2010b). These provisions give the NSB authority to protect cultural and historic resources and current subsistence uses of these sites.

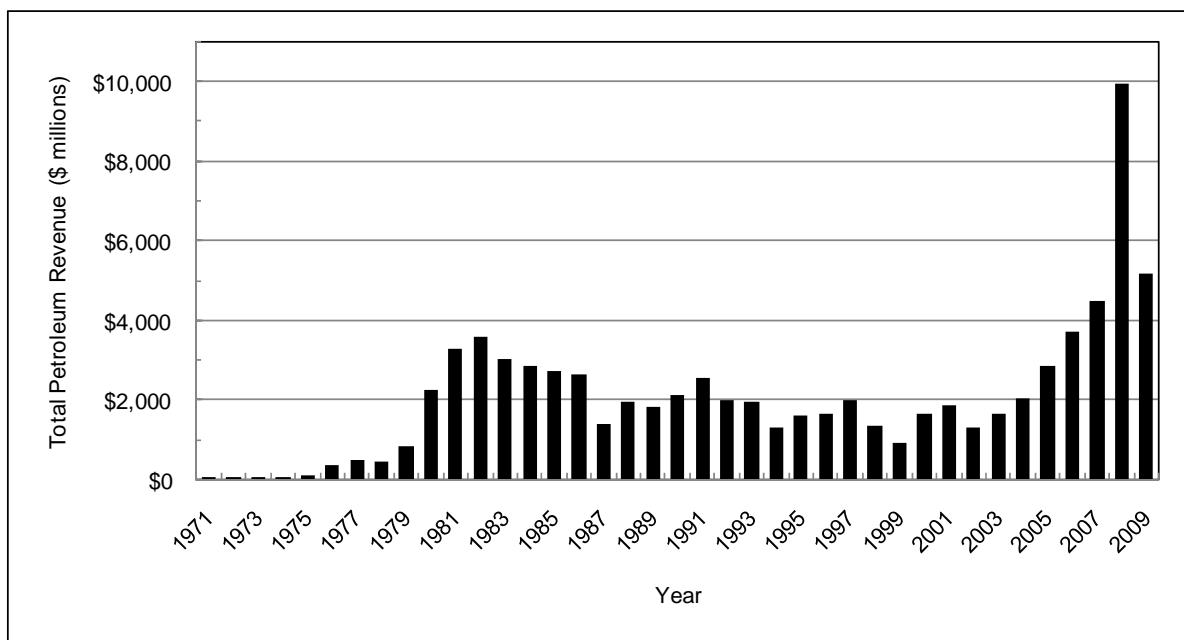
DO&G mitigation measures in this best interest finding address education and protection of historic and archeological sites. DO&G mitigation measures for this lease sale area are found in Chapter Nine.

## H. Potential Cumulative Fiscal Effects on the State

Alaska's economy depends heavily on revenues related to oil and gas production and government spending resulting from those revenues. Oil and gas lease sales generate income to state government through royalties (including bonuses, rents, and interest), production taxes, petroleum corporate income taxes, and petroleum property taxes. Total oil revenue for FY 2009 was about \$5.18 billion (Figure 8.1). Total projected oil revenue is \$5.03 billion for fiscal FY 2010, and the projected oil revenue in FY 2011 is \$4.66 billion (ADOR 2010). In addition, Alaska's oil resources are important to the nation, with about 17% of US oil production is from Alaska (Goldsmith 2008).

**Bonus bid payments** are the amounts paid by winning bidders for the individual tracts leased. Since 1959 through 2008, 6,954 tracts have been leased, generating more than \$2.1 billion in bonus income and interest to the state (ADNR 2010a, ADNR 2010c)

Each lease requires an annual **rental payment**. The first year rent is \$1 per acre or fraction of an acre, and the rent increases in 50-cent increments to \$3 per acre or fraction of an acre in the fifth and all subsequent years of the lease. The lessee must pay the rent in advance and receives a credit on



Source: ADOR 1979; ADOR 2004; ADOR 2007b; ADOR 2009b.

Notes: Includes petroleum corporate income tax; production tax; petroleum property tax; oil and gas royalties (net); bonuses, rents and interest (net); and petroleum special settlements. Does not include Permanent Fund contributions and Constitutional Budget Reserve Fund.

**Figure 8.1. Historical petroleum revenue to the State of Alaska, 1971-2009.**

the royalty due under the lease for that year equal to the rental amount. Rental income from state leases for FY 2010 (July 2009 through June 2010) was approximately \$8.7 million. In FY 2010, rental revenues received from federal leases were approximately \$243,000 (ADNR 2010b).

**Royalties** represent the state's share of the production as the mineral owner. Royalties provided more than \$1.4656 billion in revenue to the state in FY 2009 (ADOR 2010). The projected royalty revenue in FY 2010 is \$1.5943 billion, and projected royalty revenue for FY 2011 is \$1.562 billion (ADOR 2010). Royalty rates can vary depending on tracts. For the most recent North Slope

Foothills Areawide Oil and Gas Lease Sale held October 28, 2009, the royalty rate was 12.5% (ADNR 2010c).

**Production taxes** are the biggest source of state revenue. In 2007, the state replaced the Petroleum Profits Tax with the Alaska's Clear and Equitable Share. The revision increased overall rates and narrowed allowances for cost deductions and investment credits. For FY 2009 production tax revenue was \$3.112 billion; for FY 2010 it is forecast to be \$2.9433 billion, and \$2.4922 billion for FY 2011 (ADOR 2010).

**Corporate income taxes** must be paid by all corporations in the state for all taxable income derived from sources within the state. Special provisions apply to apportioning total income worldwide for corporations involved in producing or transporting oil and gas. Most, if not all, producers and transporters of oil and gas in Alaska are corporations. For FY 2009, oil and gas corporation taxes were \$492.2 million, and are forecast to be \$390.0 million for FY 2010, and \$500.0 million for FY 2011 (ADOR 2010).

**Petroleum property taxes** are annual taxes levied each year on the full and true value of property taxable under AS 43.56. This includes exploration property, production property, and pipeline transportation property. Property tax revenue amounted to \$111.2 million in FY 2009, and is anticipated to be \$106.4 million for FY 2010, and \$104.1 for FY 2011 (ADOR 2010).

In addition, tax settlements to the Constitutional Budget Reserve Fund for FY 2009 amounted to approximately \$202.6 million and NPR-A royalties, rents, and bonuses amounted to \$14.8 million. Projected NPR-A revenues are projected to be \$16.0 million for FY 2010, and \$4.8 million for FY 2011 (ADOR 2010).

The oil conservation surcharge revenue to the state in FY 2009 was \$11 million. This surcharge is applied to each taxable barrel of oil produced in the state (ADOR 2010). The purpose of the surcharge is to fund the oil and hazardous substance release prevention and response fund (AS 43.55.201; AS 43.55.300).

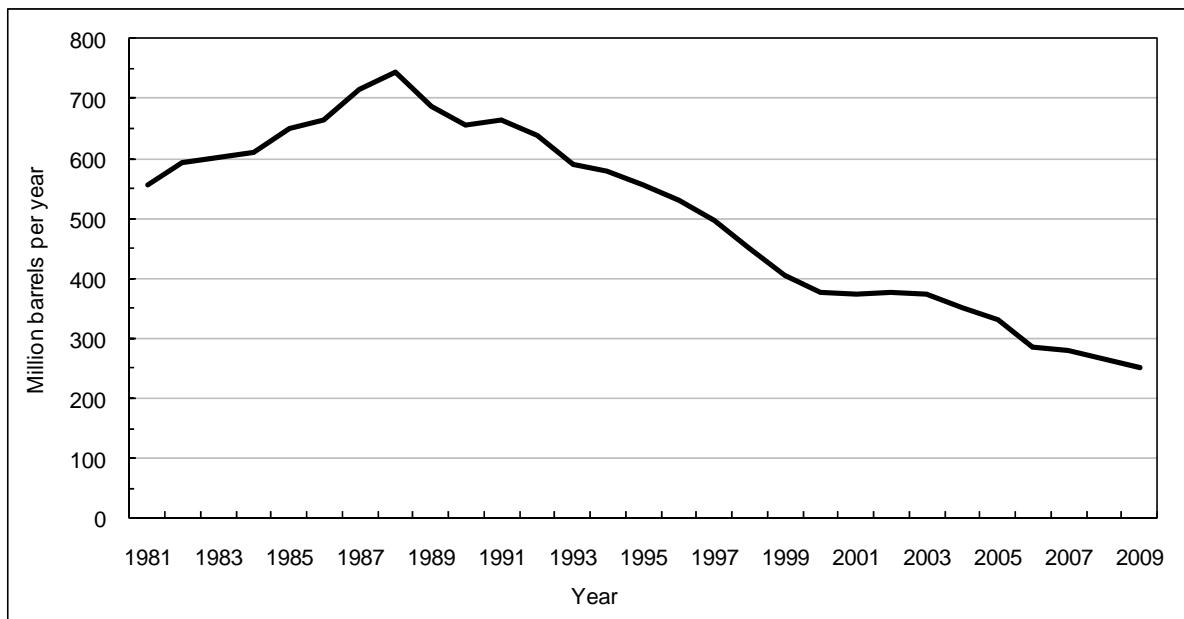
Unrestricted oil revenue comprised approximately 89% of the state's general fund unrestricted revenue in FY 2009 (ADOR 2010). Such revenues finance the state's education funding, operating budget, and capital budget.

Alaska North Slope production peaked at 2.006 million bbls per day in FY 1988 and has declined steadily since then (Figure 8.2). The oil production on the North Slope in FY 2009 was about 0.693 million bbls per day. The Alaska Department of Revenue (ADOR) anticipates production will decline by 6.6% in FY 2010 to about 0.650 million bbls per day, and projects 0.619 bbls per day for FY 2011. ADOR expects oil prices to average \$76.13 per bbl in FY 2010, and \$80.15 per bbl in FY 2011 (ADOR 2010).

Production of natural gas on the North Slope has increased since 1969 (ADNR 2009). Production of gas increased significantly beginning in 1981, and production levels continue to increase (Figure 8.3). In some locations on the North Slope natural gas is injected back into the subsurface to maintain necessary pressures. Specific future production levels of gas are unknown at this time.

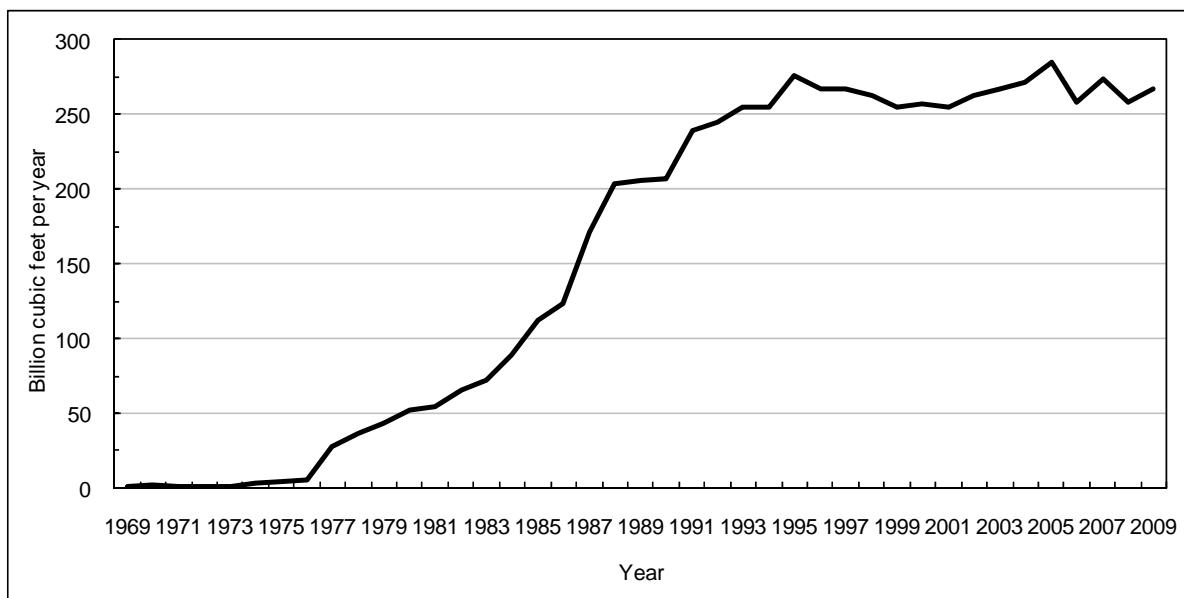
Oil and gas royalties and revenues also contribute to the Alaska Permanent Fund, which pays significant dividends each year to eligible state residents. The Alaska Permanent Fund, established by ballot proposition in 1976, is also funded with oil and gas revenues. Twenty-five percent of all revenue generated by oil and gas activities is placed in the fund, which reported a value of \$35.2 billion in the end of the quarter on August 6, 2010 (APFC 2010). All eligible Alaskans who apply receive an annual PFD from the earnings of the fund. The PFD for 2010 was \$1,281 per person; 641,595 dividends were paid, totaling \$821.8 million (SOA 2010; Figure 8.4). The PFD is an equitable benefit transfer because it reaches every eligible Alaskan regardless of income or socio-

economic status. The PFD, with its large annual infusion of cash, contributes to the growth of the state economy, like any other basic industry.



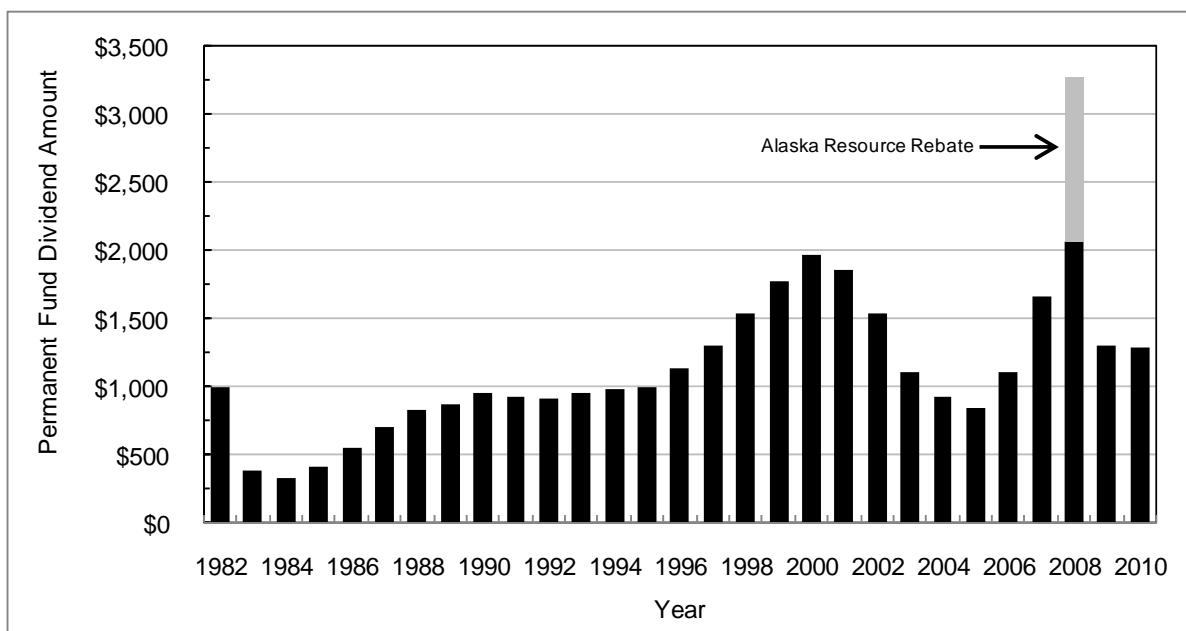
Source: ADNR 2009.

**Figure 8.2. Alaska North Slope oil production, 1981-2009.**



Source: ADNR 2009.

**Figure 8.3. Alaska North Slope natural gas production, 1969-2009.**



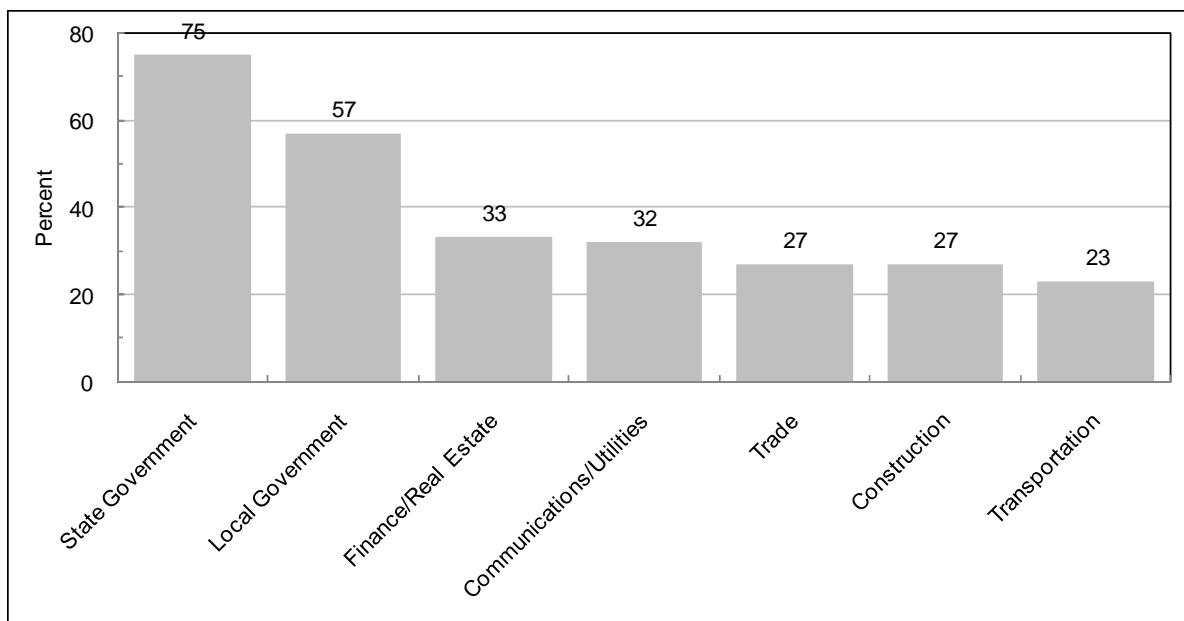
Sources: ADOR 2007a; ADOR 2008; ADOR 2009a; SOA 2010

**Figure 8.4. Alaska Permanent Fund Dividend amounts, 1982-2010; includes Alaska Resource Rebate in 2008.**

Jobs in the oil and natural gas industry comprise about 9.8% of Alaska's total workforce, with 3.8% direct employment, and 6% indirect and induced impacts on other industries (PriceWaterhouseCoopers 2009). This represents about 13.5% of the state's labor income in dollars, with 8.4% from direct employment, and 5.1% from indirect and induced impacts on other industries (NES 2009). The petroleum sector supports 75% of state government jobs, and more than half of local government jobs (Goldsmith 2008; Figure 8.5). The petroleum sector supports more than 100,000 jobs in Alaska, with about 5,000 jobs directly supporting oil and gas. More than a quarter in finance, utilities, retail and wholesale trade, and construction can be traced to the petroleum sector. The petroleum industry creates jobs in oilfield support, construction and other industries (Goldsmith 2008). State funding for the NSB School District (derived primarily from oil and gas revenues) was \$11.66 million in FY 2009 for a student enrollment of 1,544 students (Table 8.1).

When state and local governments spend oil and gas revenues, Alaska's petroleum industry exercises significant indirect impacts on local communities. Money is spent throughout the state on capital projects, to support basic government operations (including payroll for state government employees), for revenue sharing and municipal assistance, to fund education, and to pay the annual PFD (Information Insights and McDowell Group 2001).

Furthermore, the total economic effects of any spending, including state government spending and salaries paid to private oil and gas industry employees, are always greater than the direct effect. When money is re-spent in the economy, its original value multiplies. For example, this "income multiplier" is calculated at 1.35 for state spending. This means that for every dollar of income Alaskans receive directly from state spending, an additional 35 cents of income is generated when that dollar is re-spent in the local economy (Goldsmith 1991).



Source: Goldsmith 2008.

**Figure 8.5. Percent of Alaskan jobs that depend on petroleum.**

Alaska's oil and gas industry is important to employment outside Alaska, as well. In 2006, nonresidents accounted for 30.8% of the statewide oil industry's workforce (major oil companies and oilfield services), an increase of 1.2 percentage points over 2005 (ADOL 2010a). Earnings paid to nonresidents working in the oil industry increased from \$364.7 million in 2007 to \$421.6 million in 2008. The nonresident share of earnings in the oil industry was 28% in 2008, a figure much higher than the statewide private sector average of 12.8%. By comparison, Alaska's seafood processing industry employed the highest percentage of nonresident workers of any industry sector in 2008; 74.4% of workers were nonresidents (ADOL 2010a).

The mitigation measures encourage lessees to employ local Alaska residents and contractors, to the extent they are available and qualified. Lessees must submit, as part of the plan of operations, a proposal detailing the means by which the lessee will comply with the mitigation measures. The plan must include a proposal with a description of the operator's plans for partnering with local communities to recruit, hire, and train local and Alaska residents and contractors, per the lease Section 31. communities to recruit, hire, and train local and Alaska residents and contractors, per the lease Section 31.

**Table 8.1. State aid and enrollment for the North Slope Borough School District, fiscal year 2000-2009.**

	Fiscal Year									
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Aid in millions	\$8.96	\$9.75	\$8.94	\$8.47	\$8.70	\$9.28	\$11.60	\$12.24	\$10.22	\$11.66
Enrollment	1,936	2,187	2,165	2,115	2,065	1,938	1,941	1,859	1,864	1,544

Source: ADEED 2010a; ADEED 2010b.

## I. Effects on Municipalities and Communities

### 1. Fiscal Effects on Municipalities and Communities

The North Slope Borough (NSB) is host to the production center for the state's oil industry and is influenced by the oil and gas industry. Although the borough relies on oil revenues as its primary source of income, most local residents pursue a traditional and community-based economic lifestyle (NRC 2003). The finances of the NSB government depend predominately on tax revenues from oil properties. Approximately 98% of all local property tax collections come from oil producers (ADOL 2010b). The revenue from these property taxes is about 88% of all NSB revenue (NSB 2010a).

Oil and gas property is exempt from local municipal taxation, but the state levies a 20-mill tax against this property. Each municipality with oil and gas property within its boundaries is reimbursed an amount equal to the taxes which would have been levied on the oil and gas property, up to the 20-mill limit. The 2009 property tax rate for the NSB was 18.5-mill (ADOL 2010b).

A critical issue facing the NSB is the potential for shortfall in revenues consequent to reductions in the assessed value of oil facilities as they depreciate. The oil and gas property tax revenue for the NSB in 2009 was \$235 million, of the total property tax revenue of \$239 million. For fiscal year 2010-2011, property tax receipts are anticipated to be \$278 million (NSB 2010a).

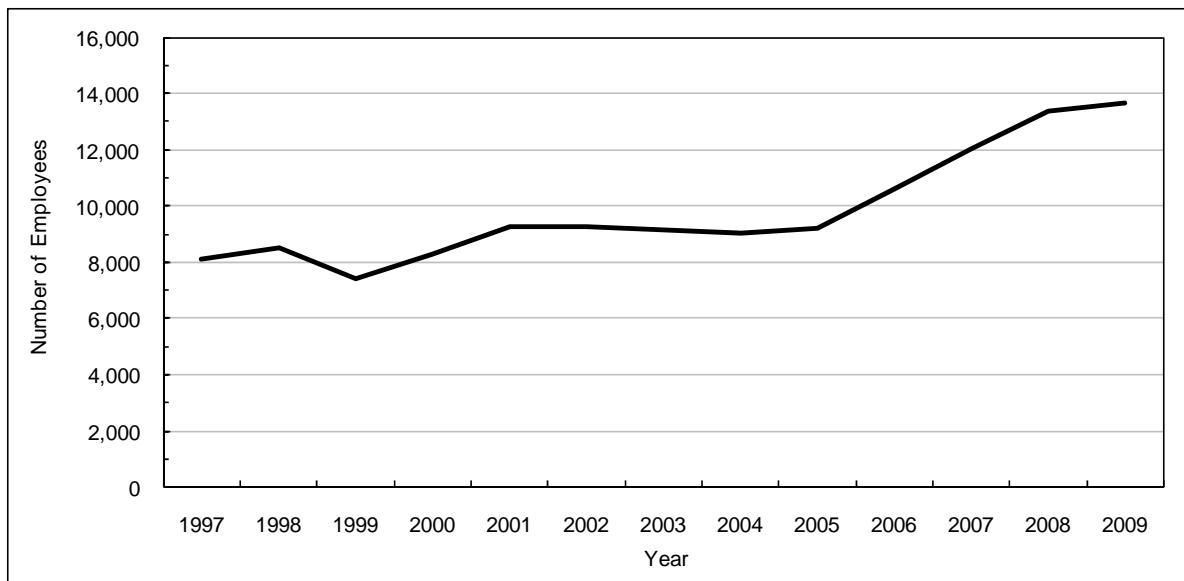
One of the NSB's main goals is to create employment for Native residents and it has successfully hired many Natives for NSB construction projects and operations. The NSB has been less successful facilitating employment of Native people in the oil industry at Prudhoe Bay. Reasons cited were that residents were not motivated to move for employment from their current residence location, that training of related skills to work in oil and gas development was needed, and that recruiting employees was done using methods common to western industry (MMS 2008, citing to Nageak 1998).

The NSB employs many permanent residents directly and finances construction projects under its Capital Improvement Program. The NSB pay scales have been equal to, or better than, those in the oil and gas industry, while working conditions and the flexibility offered by the NSB are considered by Alaska Native employees to be superior to those in the oil and gas industry. In addition, NSB employment policies permit employees to take time off, particularly for subsistence hunting (BLM 2007).

### 2. Fiscal Effects of the Oil and Gas Industry on Expenditures and Employment

The accumulated beneficial effects of oil and gas industry activity can be measured by net assets (public and private) per capita (NRC 2003). Regions that have a substantial tax base, such as the NSB, collect property taxes that provide many social services and reduce tax liability for private citizens. The NSB has used income generated from taxes, most of which comes from oil and gas sources, to create net public assets that were worth \$1.8 billion in 2000. The combined income with all public and private assets totaled \$13.4 billion, which was more than \$1.77 million per capita. For small towns of Washington state with populations about the size of the NSB, the private per capita taxable net asset values for individuals, corporations, and other taxable sources average about \$74,000 per capita; this compares to \$1.53 million private per capita average for the NSB (NRC 2003).

Local government is the largest employer of NSB residents and the median household income in the Borough is \$63,173 (ADCRA 2009b). In 2000, Borough, state, and federal agencies provided 61%



Source: ADOLWD 2009.

**Figure 8.6. Average monthly employment for all industries in the North Slope Borough, 1997-2009.**

of the total employment for the NSB. In 2009, four residents held commercial fishing permits. Figure 8.6 represents the average monthly number of employees for all industries in the NSB from 1997-2009. The estimated number of resident jobs by sector in the North Slope Borough communities in 2003 is shown in Table 8.2.

**Table 8.2. Estimated number of resident jobs by sector for North Slope Borough communities, 2003.**

Sector	Anaktuvuk					Point Hope	Point Lay	Wainwright
	Pass	Atqasuk	Barrow	Kaktovik	Nuiqsut			
Federal Government	1	0	45	1	0	10	2	2
State Government	2	0	22	0	1	0	1	0
City Government	12	1	21	3	5	14	2	8
NSB Government	51	20	464	27	29	44	24	48
NSB School District	30	20	194	21	27	62	29	44
NSB CIP	0	0	4	0	2	0	1	3
Oil industry	3	0	14	1	3	2	0	0
Private Construction	4	0	23	5	3	1	4	4
ASRC	3	0	69	5	3	1	4	3
Village Corporation	19	27	87	18	37	60	9	38
Finance	0	0	5	0	0	0	1	0
Transportation	0	0	48	0	1	3	1	1
Communications	0	0	8	0	0	0	0	0
Trade	0	1	27	0	0	2	0	1
Service	4	0	103	0	0	0	1	0
Ilisagvik College	0	0	58	0	0	2	1	1
Other	2	3	132	3	10	25	5	18

Source: BLM 2008.

Barrow is a hub and economic center of the NSB. The US Census 2000 reported Barrow's per capita income at \$22,902 and median household income at \$67,097 (ADCRA 2009a). The number of people employed in Barrow increased from 2,194 in 1998 to 2,377 in 2003.

Employment opportunities are limited in Anakatuvuk Pass. The primary employers are the NSB and the school district, followed by city government and the Nunamiat Inupiat Corporation (URS Corp. 2005a, citing to Shepro and Maas 2003).

In Nuiqsut, education and other government services provide the majority of full-time employment. The Kuukpik Native Corporation and the North Slope Borough, including its school district, are the largest employers. In 2003, per capita income was \$13,633 and household income was \$59,907 (URS Corp. 2005c, citing to Shepro and Maas 2003).

The primary employers in Kaktovik are the NSB, NSB School District, and the Kaktovik Inupiat Corporation (URS Corp. 2005b). Craft sales are also part of Kaktovik's economy.

Very few Alaska Native residents of the North Slope have been employed in oil production facilities and associated work in and near Prudhoe Bay since production started in the late 1970s. In response to concerns about accommodating cultural and subsistence needs, BP Exploration initiated the Itqanaiyagvik Program, a training partnership with Arctic Slope Regional Corporation (ASRC), Ilisagvik College, and the NSB School District to provide education and training for oil industry professional and craft jobs (BLM 2008). ConocoPhillips has also worked closely with Kuukpik Corporation, ASRC, and other companies to hire and train Alaska Natives. ConocoPhillips, in cooperation with Kuukpik Corporation, sponsors mentoring and training at the Alpine field for North Slope residents. As a result of current development of the Alpine field, Nuiqsut has received a number of economic benefits and employment opportunities, including construction, catering, seismic, surveying, trucking, and security (BLM 2008). Nanook Incorporated, a subsidiary of Kuukpik Corporation, based in Nuiqsut, has a training program that could be used in the future to train Alaska Natives for positions in the North Slope Foothills in the oil industry, such as technicians and other long-term jobs (MMS 2008).

If exploration and development activities occur in the lease sale area, jobs could be added to the local economy. These jobs would not be limited to the petroleum industry, but would be spread throughout the government, trade, service, and construction industries. The number of jobs produced would depend on whether commercial quantities of oil and gas are discovered and developed. Discovery and development of commercial quantities of petroleum or natural gas in the lease sale area would probably bring direct economic benefits to the local and regional economy.

The standard of living of North Slope communities depends largely on a steady flow of money related to oil and gas activities. The current economies of these communities will be difficult to maintain unless significant revenues continue to come into these communities from oil and gas revenues; the prospects of other sources of revenue appear to be modest. Adjustments can and probably will be postponed for as long as oil and gas are being extracted, but eventual adjustment may be unavoidable. The nature and extent of these adjustments will be determined by the adaptations North Slope residents have made to the cash economy made possible by oil and gas and other activities (NRC 2003).

### **3. Public Health for Municipalities and Communities**

Health status on the North Slope is determined by a wide array of factors, including genetic susceptibility, behavioral change, environmental factors, diet, and socio-cultural impacts. The scope of review for this best interest finding is to present current health related information, and is intended to consider and discuss the effects of exploration, development, production, and transportation involving oil and gas or gas only, as can be determined from the literature (AS 38.05.035(g)(B)(x)).

The causes of illness and resultant mortality rates of North Slope residents and workers have not been definitively correlated to specific natural or anthropogenic causes. However, changes in general health indicators on the North Slope have been documented. There have been investigations relating to disease and mortality rates for cancer, occurrence of social and psychological problems, suicide, diabetes, obesity and related metabolic disorders, cardiovascular and pulmonary diseases, and their rates of occurrence (BLM 2007).

As an example, several studies have presented information about the cancer mortality rates for Alaska Natives in the North Slope region, where the mortality rate from cancer was measured at 303/1,000, as compared with 163/100,000 in the US population (BLM 2007). The MMS (2008) reports that lung cancer is the most common variety of cancer in Alaskan Natives, and may be related to tobacco smoke. Chronic pulmonary disease mortality rates in the North Slope are the highest in the state, and are estimated at about three times that of the US population, 130/100,000 compared to 45/100,000, respectively (BLM 2007, citing to Day et al 2006). These health risk factors may be associated with rates of smoking documented on the North Slope.

Social and psychological problems on the North Slope have increased, including rates of alcohol and drug abuse, injury, assault, domestic violence and depression (BLM 2007). Overall suicide rates have increased since 1960 (BLM 2007, citing to Kraus and Buffler 1976 and Hicks and Bjerregaard 2006). The suicide rate on the North Slope has been estimated at about 45/100,000, about four times the rate estimated in the US population (BLM 2007, citing to Alaska Department of Vital Statistics 2006). In the young Inupiat male population, the suicide rate has been reported to be as high as 185/100,000, about 16 times the US population rate of suicide (BLM 2007, citing to Wexler 2006). To date, MMS (2008) reports that no research has been conducted to directly examine the impact of oil and gas operations on social and psychological health in the North Slope. Research suggests that in global Inuit societies, rapid socio-cultural changes have impacted the social and health related problems now being observed (BLM 2007, citing to Bjerregaad and Young 2004 and to Curtis and Kvernmo 2005, and to Goldsmith 2004).

There are observed reduced rates of diabetes and cardiovascular disease in the North Slope population, as compared to the US population, but rates are showing trends of increase. Public health researchers have noted that the lower mortality rates for these disease types may be attributed to subsistence diets (BLM 2007, citing to ANMC Diabetes Program 2006, and to Day et al 2006).

The state is currently developing a policy regarding Health Impact Assessments (HIA) for large resource extraction projects. HIA is a tool that seeks to identify potential lasting or significant changes, both positive and negative, of different actions on the health and social well-being of a defined population as a result of a program, project, or policy.

The Alaska Inter-Tribal Council received a grant from the Robert Wood Johnson Foundation to integrate an HIA into the federal environmental impact study process. In 2007, the NSB was awarded a \$1.67 million NPR-A impact grant to perform an HIA. The goal of the HIA is to aid the NSB in analyzing and understanding potential impacts of proposed development on the health of communities and to design appropriate mitigation measures.

The NSB's HIA contractor, Northern Health Resource Impact Group (NHIRG), has conducted meetings in North Slope communities to present information to various stakeholder and community groups on the HIA program and the baseline community health analysis project. In collaboration with the state-tribal-federal HIA working group, NHIRG drafted guidelines for scoping and public health intervention strategies (DCCED 2009). These HIA efforts are still under review and are ongoing.

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# Chapter Nine: Mitigation Measures and Other Regulatory Requirements (Lessee Advisories)

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# **Chapter Nine: Mitigation Measures and Other Regulatory Requirements (Lessee Advisories)**

AS 38.05.035(e) and the departmental delegation of authority provide the Director of DO&G (“Director”), with the authority to impose conditions or limitations, in addition to those imposed by statute or regulations, to ensure that a resource disposal is in the state’s best interests. Consequently, to mitigate the potential adverse social and environmental effects of specific lease-related activities, DO&G has developed mitigation measures and will condition plans of operation, exploration, or development and other permits based on these mitigation measures. Mitigation measures are not intended to duplicate or replace an agency’s regulatory authority.

Lessees must obtain approval of a detailed plan of operations from the Director before conducting exploration, development, or production activities. A plan of operations must identify the sites for planned activities and the specific measures, design criteria, construction methods, and operational standards to be employed to comply with the restrictions listed below. It must also address any potential geophysical hazards that may exist at the site.

These measures were developed after considering terms imposed in earlier competitive lease sales and comments and information submitted by the public, local governments, environmental organizations, and other federal, state, and local agencies. Additional measures will likely be imposed when lessees submit a proposed plan of operations.

Lessees must comply with all applicable local, state, and federal codes, statutes, and regulations, as amended, as well as all current or future ADNR area plans and recreation rivers plans; and ADF&G game refuge plans, critical habitat area plans, and sanctuary area plans within which a lease area is located. Lease activities must be consistent with the enforceable policies of the Alaska Coastal Management Program (ACMP), including statewide standards and the enforceable policies of an affected coastal district with a plan in effect.

The Director may grant exceptions to these mitigation measures. Exceptions will only be granted upon a showing by the lessee that compliance with the mitigation measure is not practicable and that the lessee will undertake an alternative to satisfy the intent of the mitigation measure. Requests and justifications for exceptions must be included in the plan of operations. The decision whether to grant an exception will be made during the public review of the plan of operations.

Except as indicated, the mitigation measures do not apply to geophysical exploration on state lands; geophysical exploration activities are governed by 11 AAC 96.

Abbreviations used are:

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**Agencies**

ADF&G	Alaska Department of Fish and Game
ADEC	Alaska Department of Environmental Conservation
ADNR	Alaska Department of Natural Resources
DMLW	Division of Mining, Land, and Water (ADNR)
DO&G	Division of Oil and Gas (ADNR)
DPOR	Division of Parks and Recreation
NMFS	National Marine Fisheries Service
NSB	North Slope Borough
USFWS	U.S. Fish and Wildlife Service

**Measurements**

ft	feet
mi	miles
in	inches
mm	millimeters
gal	gallons

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## **A. Mitigation Measures**

### **1. Facilities and Operations**

- a. A plan of operations must be submitted and approved before conducting exploration, development, or production activities, and must describe the lessee's plans to avoid or minimize impacts on residential, commercial, and recreational areas, Native allotments and subsistence use areas. At the time of application, lessee must submit a copy of the proposed plan of operations to all surface owners whose property will be entered.
- b. Facilities must be designed and operated to avoid or minimize sight and sound impacts in areas of high residential, commercial, recreational, and subsistence use and important wildlife habitat. Methods may include providing natural buffers and screening to conceal facilities, sound insulation of facilities, or by using alternative means approved by the Director, in consultation with ADF&G and the NSB.
- c. The siting of facilities, other than docks, roads, utility, and pipeline crossings will be prohibited within 500 ft of all fish bearing streams and water bodies and 1,500 ft from all current surface drinking water sources; additionally, the siting of facilities will be prohibited within one-half mile of the banks of the main channel of the Colville, Canning, Sagavanirktok, Shaviovik, Kadleroshilik, and Kuparuk rivers. Facilities may be sited within any of these

buffers if the lessee demonstrates to the satisfaction of the Director, in consultation with ADF&G, that a site location inside the buffer is environmentally preferred. Road, utility, and pipeline crossings must be consolidated and aligned perpendicular or near perpendicular to watercourses.

- d. Impacts to identified wetlands must be minimized to the satisfaction of the Director, in consultation with ADF&G and ADEC. The Director will consider whether facilities are sited in the least sensitive areas. Further, certain activities within wetlands require permission from the U.S. Army Corps of Engineers (see Lessee Advisories below).
  - e. Exploration facilities must be temporary and must be constructed of ice, unless the Director approves a proposed alternative. Use of gravel structures may be permitted on a case-by-case basis by the Director, after consultation with DMLW, and ADF&G. Approval for use of existing structures will depend on the extent and method of restoration needed to return these structures to a usable condition. Refer to A(5)(a) relating to access for exploration activities requirements.
  - f. Pipelines must utilize existing transportation corridors where conditions permit. Pipelines and gravel pads must be designed to facilitate the containment and cleanup of spilled fluids. Onshore pipelines must be located on the upslope side of roadways and construction pads unless an alternative site is environmentally acceptable, as determined by the Director, in consultation with DMLW. Wherever possible, onshore pipelines must be buried where soil and geophysical conditions permit. All pipelines, including flow and gathering lines, must be designed, constructed and, maintained to maximize integrity against climatic conditions, geophysical hazards, corrosion and other hazards as determined on a case-by-case basis.
  - g. Pipelines shall be designed and constructed to minimize alteration of caribou and other large ungulate movement and migration patterns. At a minimum, above-ground pipelines shall be elevated 7 ft, as measured from the ground to the bottom of the pipe, except where the pipeline intersects a road, pad, or a ramp installed to facilitate wildlife passage. Lessees shall consider increased snow depth in the sale area in relation to pipe elevation to ensure adequate clearance for wildlife. ADNR may, after consultation with ADF&G, require additional measures to mitigate impacts to wildlife movement and migration.
  - h. Dismantlement, Removal and Rehabilitation (DR&R): Upon abandonment of material sites, drilling sites, roads, buildings, or other facilities, such facilities must be removed and the site rehabilitated to the satisfaction of the Director, unless the Director, in consultation with DMLW, ADF&G, ADEC, NSB, and any non-state surface owner, determines that such removal and rehabilitation is not in the state's interest.
  - i. Gravel mining sites required for exploration and development activities will be restricted to the minimum necessary to develop the field efficiently and with minimal environmental damage. Where practicable, gravel sites must be designed and constructed to function as water reservoirs for future use, unless the Director approves a proposed alternative. Gravel mine sites required for exploration activities must not be located within an active floodplain of a watercourse unless DMLW, after consultation with ADF&G, approves a proposed alternative, or that a floodplain site would enhance fish and wildlife habitat after mining operations are completed and the site is closed.
- Mine site development and rehabilitation within floodplains must follow the procedures outlined in McLean, R. F. 1993, North Slope Gravel Pit Performance Guidelines, ADF&G Habitat and Restoration Division Technical Report 93-9, available from ADF&G.

## 2. Habitat, Fish and Wildlife

- a. Detonation of explosives will be prohibited in open water areas of fish bearing streams and lakes. Explosives must not be detonated beneath, or in proximity to fish bearing streams and lakes if the detonation of the explosive produces a pressure rise in the water body of greater than 2.7 pounds per square inch, or unless the water body, including its substrate, is solidly frozen. Detonation of explosives within or in close proximity to a fish spawning bed during the early stages of egg incubation must not produce a peak particle velocity greater than 0.5 in per second. Blasting criteria have been developed by ADF&G and are available upon request from ADF&G. The location of known fish bearing waters within the project area can also be obtained from ADF&G.

The lessee will consult with the NSB before proposing the use of explosives for seismic surveys. The Director may approve the use of explosives for seismic surveys after consultation with the NSB.

- b. Removal of water from fish bearing rivers, streams, and natural lakes shall be subject to prior written approval by DMLW and ADF&G. Water intake pipes used to remove water from fish bearing water bodies must be surrounded by a screened enclosure to prevent fish entrainment and impingement. Screen mesh size shall be no greater than 1 mm (0.04 in), unless another size has been approved by ADF&G. The maximum water velocity at the surface of the screen enclosure may be no greater than 0.1 ft per second, unless an alternative velocity has been approved by ADF&G.
  - c. Removal of snow from fish bearing rivers, streams, and natural lakes shall be subject to prior written approval by ADF&G. Compaction of snow cover overlying fish bearing water bodies is prohibited except for approved crossings. If ice thickness is not sufficient to facilitate a crossing, ice or snow bridges may be required.
  - d. No facilities will be sited within one-half mile of identified Dolly Varden and Arctic char overwintering and/or spawning areas on the Canning, Kavik, Shaviovik, Echooka, Ivishak, Saviukviayak, Anaktuvuk, Kanayut, and Nanushuk Rivers; and on May, Cobblestone, Upper Section, Lower Section, and Accomplishment Creeks without prior authorization. Road and pipeline crossings within these buffers, and for other anadromous streams, require an ADF&G Fish Habitat permit. Current data must indicate that the proposed crossing is not within an overwintering and/or spawning area, or that the crossing will have no significant adverse impact to Dolly Varden or Arctic char overwintering and/or spawning habitat.
- e. Bears:
- i. Lessees are required to prepare and implement a human-bear interaction plan designed to minimize conflicts between bears and humans. The plan should include measures to:
    - A. minimize attraction of bears to facility sites, including garbage and food waste;
    - B. organize layout of buildings and work areas to minimize interactions between humans and bears such as including the use of electric fencing;
    - C. warn personnel of bears near or on facilities and the proper actions to take;
    - D. if authorized, deter bears from the drill site;
    - E. provide contingencies in the event bears do not leave the site;
    - F. provide for proper storage and disposal of materials that may be toxic to bears; and
    - G. document and communicate the sighting of bears onsite or in the immediate area to all shift employees.

- ii. Before commencement of any activities, lessees shall consult with ADF&G to identify the locations of any known brown bear den sites that are occupied in the season of proposed activities. Exploration and development activities started between September 20 and May 15 may not be conducted within one-half mile of known occupied brown bear dens, unless alternative mitigation measures are approved by ADF&G. A lessee who encounters an occupied brown bear den not previously identified by ADF&G must report it to the Division of Wildlife Conservation, ADF&G, within 24 hours. Mobile activities shall avoid such discovered occupied dens by one-half mile unless alternative mitigation measures are approved by DO&G with concurrence from ADF&G. Non-mobile facilities will not be required to relocate.
- f. Permanent, staffed facilities must be sited outside identified brant, white-fronted goose, snow goose, tundra swan, king eider, common eider, Steller's eider, spectacled eider, and yellow-billed loon nesting and brood rearing areas, unless the Director approves a proposed alternative.
- g. Aircraft travel shall remain one-half mile horizontal or 1,000 ft vertical from Dall sheep lambing areas between May 5 and June 20, and mineral licks from May 20 to June 30. Human safety will take precedence over flight restrictions.
- h. Minor ground activity (e.g., surveying, geological hand sampling) and major activity (e.g., seismic testing, construction) shall remain  $\frac{1}{4}$  mi and 1 mi from Dall sheep lambing areas and mineral licks, respectively, during the same time periods as above.
- i. Major manned facilities (e.g., processing facilities, camps) shall be sited at least one mile from Dall sheep lambing areas and mineral licks.
- j. Known Dall sheep lambing areas and mineral licks shall be obtained from ADF&G, Division of Wildlife Conservation, Region 3 (Interior Alaska).

### **3. Subsistence and Sport Harvest Activities**

- a. Exploration, development and production operations shall be conducted in a manner that prevents unreasonable conflicts with subsistence activities. Lease-related use will be restricted when the Director determines it is necessary to prevent conflicts with local subsistence and sport harvest activities.
  - i. Before submitting a plan of operations for onshore activities that have the potential to disrupt subsistence activities, the lessee shall consult with the potentially affected subsistence communities and the NSB (collectively "parties") to discuss the siting, timing, and methods of proposed operations and safeguards or mitigating measures that could be implemented by the operator to prevent unreasonable conflicts. The parties shall also discuss the reasonably foreseeable effect on subsistence activities of any other operations in the area that they know will occur during the lessee's proposed operations. Through this consultation, the lessee shall make reasonable efforts to assure that exploration, development, and production activities are compatible with subsistence hunting and fishing activities and will not result in unreasonable interference with subsistence harvests. In order to avoid conflicts with subsistence and sport harvest activities, restrictions may include alternative site selection, requiring directional drilling, seasonal drilling restrictions, and other technologies deemed appropriate by DO&G.
  - ii. A discussion of resolutions reached or not reached during the consultation process and any plans for continued consultation shall be included in the plan of operations. The lessee shall identify who participated in the consultation and send copies of the plan to participating communities and the NSB when it is submitted to the division.

- iii. If the parties cannot agree, then any of them may request that the Commissioner of ADNR or his/her designee intercede. The Commissioner may assemble the parties or take other measures to resolve conflicts among the parties.
- iv. The lessee shall notify the Director of all concerns expressed by subsistence hunters during operations and of steps taken to address such concerns.
- b. Traditional and customary access to subsistence areas shall be maintained unless reasonable alternative access is provided to subsistence users. “Reasonable access” is access using means generally available to subsistence users. Lessees will consult the NSB, nearby communities, and native organizations for assistance in identifying and contacting local subsistence users.
- c. Exploratory drilling operations may be restricted during the fall caribou migration (August 1 through October 31) in the Chandler, Nanushuk, Itkillik, Kuparuk, and Anaktuvuk River valleys to allow for subsistence hunting.
- d. Exploration activities may be restricted during fall caribou migration (August 1 through October 31); and the siting of permanent facilities, except for roads or pipelines, will be prohibited in the Chandler, Anaktuvuk, Nanushuk, Itkillik, and Kuparuk River valleys, unless the lessee demonstrates to the satisfaction of the Director, in consultation with the NSB, that the development will not preclude reasonable subsistence user access to caribou.

Lease related use may be restricted when the Director determines it is necessary to prevent conflicts with subsistence and sport harvest activities. DO&G will consult with other agencies, the affected local borough(s) and the public to identify and avoid potential conflicts that are brought to the division’s attention both in the planning and operational phases of lease-related activities. In order to avoid conflicts with subsistence, commercial and sport harvest activities, restrictions may include alternative site selection, requiring directional drilling, seasonal drilling restrictions, and other technologies deemed appropriate by the Director.

## **4. Fuel, Hazardous Substances, and Waste**

- a. Secondary containment shall be provided for the storage of fuel or hazardous substances. Secondary containment means an impermeable diked area or portable impermeable containment structure capable of containing 110% of the volume of the largest independent container. Double walled tanks do not qualify as secondary containment unless an exception is granted for a particular tank.
- b. Containers with a storage capacity larger than 55 gal that contain fuel or hazardous substances shall not be stored within 100 ft of a water body, or within 1,500 ft of a current surface drinking water source.
- c. During equipment storage or maintenance, the site shall be protected from leaking or dripping fuel and hazardous substances by the placement of drip pans or other surface liners designed to catch and hold fluids under the equipment, or by creating an area for storage or maintenance using an impermeable liner or other suitable containment mechanism.
- d. During fuel or hazardous substance transfer, secondary containment or a surface liner must be placed under all container or vehicle fuel tank inlet and outlet points, hose connections, and hose ends. Appropriate spill response equipment, sufficient to respond to a spill of up to 5 gal, must be on hand during any transfer or handling of fuel or hazardous substances. Trained personnel shall attend transfer operations at all times.
- e. Vehicle refueling shall not occur within the annual floodplain, except as addressed and approved in the plan of operations. This measure does not apply to water-borne vessels.

- f. All independent fuel and hazardous substance containers shall be marked with the contents and the lessee's or contractor's name using paint or a permanent label.
- g. A fresh water aquifer monitoring well, and quarterly water quality monitoring, may be required down gradient of a permanent above-ground liquid hydrocarbon storage facility.
- h. Waste from operations must be reduced, reused, or recycled. Garbage and domestic combustibles must be incinerated or disposed of at an approved site in accordance with 18 AAC 60. (See also Section B(2), below.) Proper disposal of garbage and putrescible waste is essential to minimize attraction of wildlife. The lessee must use the most appropriate and efficient method to achieve this goal.

The primary method of garbage and putrescible waste disposal is prompt, on-site incineration in compliance with state air quality control regulations (18 AAC 50). The secondary method of disposal is on-site frozen storage in animal-proof containers with backhaul to an approved waste disposal facility. The tertiary method of disposal is on-site non-frozen storage in animal proof containers with backhaul to an approved waste disposal facility. Daily backhauling of non-frozen waste must be achieved unless safety considerations prevent it. Alternative methods of waste disposal must be approved by the Director.

- i. New solid waste disposal sites will not be approved or located on state property during the exploration phase. Exceptions may be provided for drilling waste if the facility will comply with the applicable provisions of 18 AAC 60.
- j. Wherever practicable, the preferred method for disposal of muds and cuttings from oil and gas activities is by underground injection, as regulated by AOGCC. Other methods of disposal shall be allowed only upon approval by the Director, in consultation with ADEC and ADF&G.

## **5. Access**

- a. Except for approved off-road travel, exploration activities must be supported only by ice roads, winter trails, existing road systems or air service. (Refer to A(1)(e) relating to exploration facilities). Wintertime off-road travel across tundra and wetlands may be approved in areas where snow and frost depths are sufficient to protect the ground surface. Summertime off-road travel across tundra and wetlands may be authorized subject to time periods and vehicle types approved by DMLW. Exceptions may be granted by DMLW and the Director if an emergency condition exists; or if it is determined after consulting with ADF&G that travel can be accomplished without damaging vegetation or the ground surface.
- b. Public access to, or use of, the lease area may not be restricted except within the immediate vicinity of drill sites, buildings, and other related facilities. Areas of restricted access must be identified in the plan of operations. Lease facilities and operations shall not be located so as to block access to or along navigable or public waters as defined in AS 38.05.965.

## **6. Prehistoric, Historic, and Archaeological Sites**

- a. Before the construction or placement of any gravel, or other structure, road, or facility resulting from exploration, development, or production activities, the lessee must conduct an inventory of prehistoric, historic, and archaeological sites within the area affected by an activity. The inventory must include consideration of literature provided by the NSB, nearby communities, Native organizations, and local residents; documentation of oral history regarding prehistoric and historic uses of such sites; evidence of consultation with the Alaska Heritage Resources Survey and the National Register of Historic Places; and site surveys. The inventory must also include a detailed analysis of the effects that might result from the activity.

- b. The inventory of prehistoric, historic, and archaeological sites must be submitted to the Director and to DPOR Office of History and Archaeology who will coordinate with the NSB for review and comment. If a prehistoric, historic, or archaeological site or area could be adversely affected by a lease activity, the Director, after consultation with DPOR Office of History and Archaeology and the NSB, will direct the lessee as to the course of action to take to avoid or minimize adverse effects.
- c. If a site, structure, or object of prehistoric, historic, or archaeological significance is discovered during lease operations, the lessee must report the discovery to the Director as soon as possible. The lessee must make reasonable efforts to preserve and protect the discovered site, structure, or object from damage until the Director, after consultation with DPOR Office of History and Archaeology and the NSB, has directed the lessee as to the course of action to take for its preservation.

## **7. Local Hire, Communication, and Training**

- a. Lessees are encouraged to employ local and Alaska residents and contractors, to the extent they are available and qualified, for work performed in the lease area. Lessees shall submit, as part of the plan of operations, a proposal detailing the means by which the lessee will comply with the measure. The proposal must include a description of the operator's plans for partnering with local communities to recruit, hire and train local and Alaska residents and contractors. The lessee is encouraged, in formulating this proposal, to coordinate with employment and training services offered by the State of Alaska and local communities to train and recruit employees from local communities.
- b. A plan of operations application must describe the lessee's past and prospective efforts to communicate information about the project with local communities and interested local community groups.
- c. A plan of operations application must include a training program for all personnel including contractors and subcontractors. The program must be designed to inform each person working on the project of environmental, social, cultural, health, and safety concerns that relate to that person's job. The program must use methods to ensure that personnel understand and use techniques necessary to preserve geological, archaeological, and biological resources. In addition, the program must be designed to help personnel increase their sensitivity and understanding of community values, customs, and lifestyles in areas where they will be operating. The program must include an explanation of the applicable laws protecting cultural and historic resources. The program shall address the importance of not disturbing archeological, cultural and historic resources and provide guidance on how to avoid disturbance.

## **8. Definitions**

**Facilities** means any structure, equipment, or improvement to the surface, whether temporary or permanent, including, but not limited to, roads, pads, pits, pipelines, power lines, generators, utilities, airstrips, wells, compressors, drill rigs, camps and buildings.

**Hazardous substance** means the following: (A) an element or compound that, when it enters into or on the surface or subsurface land or water of the state, presents an imminent and substantial danger to the public health or welfare, or to fish, animals, vegetation, or any part of the natural habitat in which fish, animals, or wildlife may be found; or (B) a substance defined as a hazardous substance under 42 USC 9601 - 9675 (Comprehensive Environmental Response, Compensation, and Liability Act of 1980); "hazardous substance" does not include uncontaminated crude oil or uncontaminated refined oil (AS 46.09.900).

**Identified wetlands** are those areas that have been identified as wetlands by the U. S. Army Corps of Engineers under Section 404 of the Clean Water Act.

**Minimize** means to reduce adverse impacts to the smallest amount, extent, duration, size, or degree reasonable in light of the environmental, social, or economic costs of further reduction.

**Plan of operations** means a lease plan of operations under 11 AAC 83.158 and a unit plan of operations under 11 AAC 83.346.

**Practicable** means feasible in light of overall project purposes after considering cost, existing technology, and logistics of compliance with the standard.

**Reasonable access** means access using means generally available to subsistence users.

**Temporary** means no more than 12 months.

## **B. Other Regulatory Requirements (Lessee Advisories)**

Lessees must comply with all applicable local, state, and federal codes, statutes, and regulations in place at the time of a given project or activity. ADNR provides the following Lessee Advisories to alert lessees to additional obligations and restrictions that government entities other than DO&G may impose on the lessee. These advisories are not intended to be exhaustive or as commentary on the jurisdiction of any government entity or propriety of any code, statute, or regulation. It is the lessee's responsibility to obtain all necessary state, federal or local authorizations or permits relating to lease activities.

### **1. Alaska Department of Natural Resources, Division of Coastal and Ocean Management**

- a. Pursuant to AS 46.40, projects are required to comply with all policies and enforceable standards of the Alaska Coastal Management Program, including the approved District Coastal Management Plans.

### **2. Alaska Department of Environmental Conservation**

- a. Pursuant to AS 46.04.030, lessees are required to have an approved oil discharge prevention and contingency plan (C-plan) before commencing operations. The plan must include a response action plan to describe how a spill response would occur, a prevention plan to describe the spill prevention measures taken at the facility, and supplemental information to provide background and verification information.
- b. Pursuant to state regulations administered by ADEC and the Clean Air Act administered by EPA, lessees are required to obtain air quality permits before construction and operation. The permits will include air quality monitoring, modeling, and emission control obligations.
- c. Unless authorized by an ADEC permit, surface discharge of reserve pit fluids and produced waters is prohibited.
- d. Unless authorized by National Pollutant Discharge Elimination System or state permits, disposal of wastewater into freshwater bodies is prohibited.

### **3. Alaska Department of Fish and Game**

- a. Under the provisions of Title 16 of the Alaska Statutes, the measures listed below may be imposed by ADF&G below the ordinary high water mark to protect designated anadromous water bodies and to ensure the free and efficient passage of fish in all fish bearing water bodies. However, exceptions may be authorized with a Fish Habitat permit. Specific information on the location of anadromous water bodies in and near the area may be obtained from ADF&G.
  - i. Alteration of riverbanks may be prohibited.
  - ii. The operation of equipment, excluding boats, in open water areas of rivers and streams may be prohibited. Except for approved stream crossings, equipment must not be operated within willow stands (*Salix spp.*).
  - iii. Bridges or non-bottom founded structures may be required for crossing fish spawning and important rearing habitats.
  - iv. Culverts or other stream crossing structures must be designed, installed, and maintained to provide free and efficient passage of fish.
- b. Removal of water from fish bearing water bodies is subject to the regulations for the Appropriation and Use of Water (11 AAC 93.035-.147) and Fish and Games statutes AS 16.05.841 and AS 16.05.871.
- c. The Director, in consultation with ADF&G, may impose seasonal restrictions on activities located in, or requiring travel through or overflight of, important caribou or other large ungulate calving and wintering areas during the plan of operations approval stage.
- d. The Director, in consultation with ADF&G, may impose seasonal restrictions on activities located in and adjacent to important waterfowl and shorebird habitat during the plan of operations approval stage.
- e. To minimize impacts on Dolly Varden, and Arctic char overwintering areas, permanent, staffed facilities must be sited to the extent practicable outside identified Dolly Varden or Arctic char overwintering areas.
- f. Lessees are encouraged in planning and design activities to consider the recommendations of oilfield design and operations in the final report to the Alaska Caribou Steering Committee: Cronin, M. et al., 1994. "Mitigation of the Effects of Oil Field Development and Transportation Corridors on Caribou." LGL Alaska Research Associates, Inc., July.
- g. Lessees must comply with the provision of Appendix B of the "Yellow-billed Loon Conservation Agreement," dated July 31, 2006, between ADF&G, ADNR, USFWS, Bureau of Land Management, and the National Park Service.

### **4. Alaska Department of Natural Resources, Office of History and Archaeology**

- a. Pursuant to AS 11.46.482, defacing, disturbing, or desecration of a cemetery or graves is prohibited in the State of Alaska. Removal of remains or artifacts is against statute mandates and may be punishable by law.
- b. The Alaska Heritage Resource Survey (AHRS) data set is comprised of "restricted access documents" and specific site location data should not appear in final reports or be distributed to others.

## 5. Alaska Department of Natural Resources

- a. The State of Alaska is in the process of reviewing and evaluating information from the Deepwater Horizon investigations and the Alaska Risk Assessment reports, and is determining which of the information and recommendations are applicable to Alaska, which recommendations to implement, and the next steps for implementing them. As this process develops, new or modified mitigation measures, lessee advisories, or other statutory or regulatory requirements addressing issues such as safety, environmental safeguards, risk management, and reporting standards may be forthcoming.

## 6. Alaska Department of Labor and Workforce Development

- a. The lessee shall facilitate Alaska resident hire monitoring by reporting project wages on a quarterly basis for each individual employed by the lessee in the lease area, through electronic unemployment insurance reporting, and by requiring the same of the lessee's contractors and subcontractors.

## 7. U.S. Army Corps of Engineers

- a. A U.S. Army Corps of Engineers permit is required when work is anticipated on, in, or affects navigable waters or involves wetland related dredge or fill activities. A Section 10 permit is required for construction, excavation, or deposition of material in, over, or under navigable waters, or for any work which would affect the course, location, condition, or capacity of navigable waters, or for any work which would affect the course, location, condition, of capacity of navigable waters (33 USC 403). A Section 404 permit (33 USC 404) authorizes the discharge of dredged and fill material into waters and wetlands of the United States. The process is similar for both permits and, at times, both may be required.

## 8. Pipeline and Hazardous Materials Safety Administration

- a. Lessees are advised that any pipeline used for transportation of gas or hazardous liquids may be subject to Federal Pipeline Safety Laws (49 USC 60101 et seq.) and regulations (49 CFR 190-195) under the jurisdiction of the U.S. DOT – Pipeline and Hazardous Materials Safety Administration.

## 9. U.S. Fish and Wildlife Service and National Marine Fisheries Service

- a. Lessees are advised that the Endangered Species Act of 1973 (ESA), as amended (16 USC 1531-1544) protects endangered and threatened species and candidate species for listing that may occur in the lease sale area. Lessees shall comply with the Recommended Protection Measures developed by the USFWS to ensure adequate protection for all endangered, threatened and candidate species. The following endangered or threatened species occur in or adjacent to the lease sale area:

Common Name	ESA Status
Spectacled eider	Threatened
Steller's eider (Alaska breeding population)	Threatened
Polar bear	Threatened

- b. Lessees are advised of the need to comply with the Migratory Bird Treaty Act (MBTA; 16 USC 703) which is administered by the USFWS. Under the MBTA, it is illegal to "take"

migratory birds, their eggs, feathers or nests. “Take” is defined (50 CFR 10.12) to include “pursuing, hunting, shooting, wounding, killing, trapping, capturing, or collecting.” The MBTA does not distinguish between “intentional” and “unintentional” take. Migratory birds include songbirds, waterfowl, shorebirds, and raptors. In Alaska, all native birds except grouse and ptarmigan (which are protected by the State of Alaska) are protected under the MBTA.

In order to ensure compliance with the MBTA, it is recommended that lessees survey the project area before construction, vegetation clearing, excavation, discharging fill or other activities which create disturbance, and confirm there are no active migratory bird nests. It is recommended lessees contact the USFWS for assistance and guidance on survey needs, and other compliance issues under the MBTA. While the USFWS can recommend methods (such as surveys and timing windows) to avoid unintentional take, responsibility for compliance with the MBTA rests with lessees.

- c. Lessees are advised that they must comply with the provisions of the Marine Mammal Protection Act of 1972, as amended (16 USC 1361-1407). USFWS shares authority for marine mammals with the NMFS.
- d. Peregrine falcon nesting sites are known to occur in the sale area. Lessees are advised that disturbing a peregrine falcon nest violates federal law. Lessees are required to comply with the federal resource recovery plan for the arctic peregrine falcon.
- e. Lessees are advised that the Magnuson-Stevens Fishery Conservation and Management Act requires identification of Essential Fish Habitat (EFH) for all species managed under a federal Fisheries Management Plan. Subsequent exploration and/or development activities associated with the lease sale may be subject to consultation under EFH. EFH information, consultation, guidance, and species life history information are available from the National Marine Fisheries Service (NMFS).

## **10. North Slope Borough**

- a. Lessees are advised that the NSB Assembly has adopted a comprehensive plan and land management regulations under Title 29 of the Alaska Statutes (AS 29.40.020-040). The NSB’s Title 19 for zoning, and other borough regulations, require borough approval for all proposed uses, development, and master plans. It is the lessee’s responsibility to obtain and comply all authorizations and permits relating to lease activities.
- b. Lessees are advised that restricting access to and use of fish camps and other subsistence use areas defined in the NSB Traditional Land Use Inventory, may violate subsistence harvest protection and land use regulations. Lessees are advised to consult with the NSB Planning Department and local communities during planning of operations.
- c. Lessees are encouraged to include residents of communities in the area of operations into their planning process. Local communities have a unique understanding of their environment and community activities. Involving local community residents in the earliest stages of the planning process for oil and gas activities can be beneficial to the industry and to the community. Community representation on management teams developing plans of operation, oil spill contingency plans, and other permit applications can help communities understand permitting obligations and help industry to understand community values and expectations for oil and gas operations being conducted in and around their area.
- d. In order to protect species that are sensitive to noise or movement, horizontal and vertical buffers will be required, consistent with aircraft, vehicle, and vessel operations regulated by

NSB Code §19.70.050(I)(1). Lessees are encouraged to apply the following provisions governing aircraft operations in and near the sale area:

- i. From June 1 to August 31, aircraft overflights must avoid identified brant, white fronted goose, tundra swan, king eider, common eider, and yellow-billed loon nesting and brood rearing habitat, and from August 15 to September 15, the fall staging areas for geese, tundra swans, and shorebirds, by an altitude of 1,500 ft, or a lateral distance of 1 mi.
  - ii. To the extent practicable, all aircraft should maintain an altitude greater than 1,500 ft or a lateral distance of 1 mi, excluding takeoffs and landings, from caribou and muskoxen concentrations. A concentration means numbers of animals in excess of the general density of those animals found in the area.
  - iii. Human safety will take precedence over flight restrictions.
- e. Lessees are advised that certain areas are especially valuable for: their concentrations of mammals, birds, fish, or other biological resources; cultural resources; and for their importance to subsistence harvest activities. The following areas must be considered when developing plans of operation.
    - i. Dolly Varden or Arctic char overwintering and/or spawning areas on the Canning, Kavik, Shaviovik, Echooka, Ivishak, Saviukviayak, Anaktuvuk, Kanayut, and Nanushuk Rivers; and, on May, Cobblestone, Upper Section, Lower Section, and Accomplishment creeks.
    - ii. The Chandler, Anaktuvuk, Nanushuk, Itkillik, and Kuparuk river drainages, from August 1<sup>st</sup> to October 15, for protection of subsistence caribou harvest opportunities.
  - f. No lease facilities or operations may be located so as to block access to, or along, navigable and public waters as defined by AS 38.05.965(13) and (18).
  - g. Lessees are advised that the NSB requires that permits be obtained prior to implementation for these activities:
    1. construction of facilities;
    2. placement of gravel pads;
    3. use of explosive devices; and
    4. tundra travel
  - h. Lessees are advised that prior to any earth-moving activity, ice road, or seismic survey activities the NSB may require a Certificate of Inupiat History, Language and Culture/Traditional Land Use Inventory (IHLC/TLUI) Clearance from the NSB Planning Department. The TLUI are comprised of “restricted access documents” and specific site location data should not appear in final reports or be distributed to others.



# Appendix A: Summary of Comments and Responses

AS 38.05.035(e)(7)(B) requires that final best interest findings include a summary of agency and public comments received and the department's responses to those comments. This appendix summarized public comments received in response to the Preliminary Finding of the Director for the North Slope Foothills Preliminary Best Interest Finding, issued on January 13, 2011.

## A. Comments Received

Three comments were received by the end of the public comment period on March 25, 2011. The Alaska Department of Natural Resources (ADNR) Office of History and Archaeology (OHA), the Alaska Department of Fish and Game (ADF&G), Division of Habitat, and the North Slope Borough provided comments.

### 1. ADNR Office of History and Archaeology

**Anchorage, AK, e-mail agency comment of February 24, 2011, Rachel Joan Dale, Archaeologist**

**Comment Summary:** The OHA recommended an addition to the Office of History and Archaeology text in the Final Finding about the Alaska Heritage Resource Survey (AHRS) and the NSB's Traditional Land Use Inventory (TLUI) data sets. The OHA stated that these are comprised of "restricted access documents" and specific site location data should not appear in final reports or be distributed to others.

**ADNR Response:** This additional information about the state AHRS was incorporated into the Final Finding in Chapter Seven, Governmental Powers, Section 10, and into Chapter Nine, Lessee Advisories, Section B(4)(b).

Reference to the AHRS and the NSB's TLUI was included in Chapter Three, Section D of the Final Finding. Both data sets were described as "restricted access documents".

### 2. ADF&G Division of Habitat

**Fairbanks, AK, e-mail agency comment of March 7, 2011, Todd "Nik" Nichols, Biologist**

**Comment Summary:** ADF&G Division of Habitat provided technical edits to Chapter Four in Section A, Section B, and Section B(1)(b), and also provided additional references as supporting information.

**ADNR Response:** Many of the technical suggestions, an additional reference, and some of the style suggestions were incorporated into Chapter Four of the Final Finding.

### **3. North Slope Borough (NSB)**

**Barrow, Alaska, e-mail with attachment borough comment of March 25, 2011, Mayor Edward S. Itta**

**Scope of Review Comment Summary:** The North Slope Borough (NSB) stated that the scope of review is overly narrow.

**ADNR Response:** AS 38.05.035(g) sets forth the specific scope of review of the written finding. The statute requires ADNR to consider the reasonably foreseeable cumulative effects of oil and gas exploration, development, production, and transportation on the sale area, including effects on subsistence uses, fish and wildlife habitats and populations and their uses, historic and cultural resources, the reasonably foreseeable fiscal and economic effects of the lease sale, and the subsequent activities, on the state and affected municipalities and communities.

The Final Finding does not speculate about possible future effects subject to future permitting that cannot reasonably be determined until the project or proposed use is more specifically defined (AS 38.05.035 (h)), but it does consider and discuss current research and information about foreseeable cumulative impacts due to oil and gas activities in the 45 pages of Chapter Eight, citing to 142 sources. In addition, each year ADNR issues a Call for New Information, to request any substantial new information that has been made publically available, including information about effects on subsistence uses, fish and wildlife habitats and populations and their uses, historic and cultural resources, and the reasonably foreseeable fiscal and economic effects of the lease sale.

Also refer to the ADNR response below about phasing.

**Phasing Comment Summary:** The NSB stated that the use of phasing avoided consideration of potential future environmental, sociological, or economic effects, such as health, climate change, and cumulative impacts. The NSB requested that ADNR consider these concerns to ensure that impacts are adequately considered. The NSB referenced and attached their public comments submitted to ADNR for the Beaufort Sea preliminary best interest finding, as submitted November 30, 2009.

**ADNR Response:** Phasing the review of lease sales does not avoid consideration of potential future effects. In fact, the Final Finding devotes a whole chapter (Chapter Eight), consisting of 45 pages and citing to 142 sources, to the consideration and discussion of foreseeable cumulative impacts due to oil and gas activities, and current research and information about those potential impacts. Mitigation measures found in Chapter Nine, many of which were developed with input from the NSB, ADF&G and other resource agencies, address these impacts to ensure that potential effects from oil and gas lease sales are avoided, minimized or mitigated.

Phased review is statutorily authorized by AS 38.05.035(e)(1)(C). As discussed in detail in Chapter Two, Section D, the statutory criteria for phasing have been met for the North Slope Foothills oil and gas lease sales. In addition, ADNR will comply with the decision of the court in REDOIL v. Sullivan.

Applications for permits and plans of operation generally require public notice and opportunity for public input. Chapter Seven describes many of the other permits and approvals required by local, state, and federal agencies for oil and gas exploration, development, and production.

**Use of the Gulf of Mexico Deepwater Horizon Incident Current Information Comment Summary:** NSB requested that ADNR consider the report from the national Oil Spill Commission about the BP Deepwater Horizon oil spill and offshore drilling, released January 11, 2011.

**ADNR Response:** Information about the BP Deepwater Horizon oil spill in the Gulf of Mexico has been added to the Final Finding in Chapter Six, Section F.

**Use of Current ADEC Information Comment Summary:** The NSB requested that ADNR consider the Alaska Department of Environmental Conservation's (ADEC) recent study, the Alaska North Slope Spills Analysis, Final Report on North Slope Spills Analysis and Expert Panel Recommendations on Mitigation Measures.

**ADNR Response:** Information about the ADEC spills analysis and reports have been added to the Final Finding in Chapter Six, Section F.

To reflect the new, current information, a Lessee Advisory B(5) has been added to Chapter Nine in the Final Finding.

**Recent Oil Releases Comment Summary:** The NSB requested that ADNR consider the May 2010 pipeline valve failure and the January 2011 leak at a North Slope pipeline pumping station, both of which forced shut down of the Trans-Alaska pipeline due to these failures.

**ADNR Response:** Information about the ADEC spills specified in the comments has been added to the Final Finding in Chapter Six, Section F.

**Climate Comment Summary:** The NSB stated that there are no mitigation measures that address climate change and geological hazards, and that information from the Governor's Climate Change Sub-Cabinet and the Alaska Climate Impact Assessment Commission (ACIAC) should be considered. The NSB stated that the overly narrow scope of review avoids consideration of potential future effects from climate, and they requested consideration of mitigation measures to address these effects.

**ADNR Response:** Climate of the lease sale area, the Sub-Cabinet, and Commission were discussed in Chapter Three, Section F. The NSB provided additional references to additional information, which are discussed below.

In 2009 the ACIAC released a report that addressed mitigation, presented a range of potential mitigation measures, and stated that more analysis is needed for effective mitigation. The report's Chapter Six specifically discusses the impacts of the oil and gas sector. Some potential issues discussed were carbon dioxide emissions, the estimated proportion attributed to oil and gas activities, and the percentage that is generated in Alaska (0.7%) (ACIAC 2009). The Commission's Mitigation Advisory Group clarified that the recommendations in the report require further study before implementation as mitigation measures. As information becomes available, it will be considered to

be incorporated into the state's management strategy (ACIAC 2011). In the Final Report to the Legislature, the Commission wrote that no near term changes to statutes or regulations are needed, but that efforts to identify the needs for adaptive actions and new mitigation measures should continue (ACIAC 2008).

Information about the 2009 ACIAC report has been added to the Final Finding in Chapter Three, Section F.

**Geologic Hazards Comment Summary:** The NSB also referred to information available about geological hazards in the lease sale area, and requested that mitigation measures address these hazards.

**ADNR Response:** The geological hazards of the area are discussed in Chapter Three. In this discussion, ADNR refers to potential natural hazards such as faults, earthquakes, permafrost, frozen-ground phenomena, mass movements, river erosion, flooding and slope movements. A reference to geological hazard projects information was added to Chapter Three, Section G in the Final Finding.

**Health Comment Summary:** The NSB stated that the Final Finding should clarify the state's Health Impact Assessment (HIA) policy, that HIA(s) should be conducted prior to any lease sales, that potential health impacts of the proposed oil and gas leasing and operations should be identified, and that mitigation measures should be provided.

**ADNR Response:** HIA(s) were discussed in Chapter Eight, Section I(3) of the Preliminary Finding, where it was explained that a HIA is a tool that seeks to identify potential lasting or significant changes, both positive and negative, of different actions on the health and social well-being of a defined population as a result of a program, project, or policy.

As discussed in the Preliminary Finding, the Alaska Inter-Tribal Council received a grant from the Robert Wood Johnson Foundation to integrate an HIA into the federal environmental impact study process. In 2007, the NSB was awarded a \$1.67 million NPR-A impact grant to perform a HIA. The goal is to aid the NSB in analyzing and understanding potential impacts of proposed development on the health of communities and to design appropriate mitigation measures. The State is evaluating appropriate policies and procedures for conducting HIAs. The Final Finding may be supplemented as necessary as information becomes available about HIAs.

**Mitigation Measures Comment Summary:** The NSB stated that the value of many mitigation measures is significantly diminished by the qualification that compliance is required only when "practicable." The NSB suggested that ADNR adopt a policy that no exception to the requirement of implementing a mitigation measure should be granted unless the applicant demonstrates that the objective of the measure can be met through a means other than implementation of the specified mitigation measure. The NSB stated that is particularly important regarding subsistence activities.

**ADNR Response:** The request to evaluate and change the use of the term practicable resulted in changes to mitigation measures, where the mitigation measures now state that the Director must approve any proposed alternative. The changes made in the Final Finding are in mitigation measures, Chapter Nine, Sections A(1)(c), A(1)(e), A(1)(f), A(1)(h), A(1)(i), A(2)(f), and A(4)(h).

**Local Permits Comment Summary:** The NSB stated that lessees should be informed that there are requirements to obtain a NSB permit in connection with these activities: construction of facilities, placement of gravel pads, use of explosive devices, and tundra travel.

**ADNR Response:** Lessee advisories are discussed to alert lessees to additional statutory and regulatory requirements imposed under other administrative jurisdictions in the lease sale area. ADNR included lessee advisories to address the concerns that NSB stated relating to requirements to obtain permits from NSB prior to implementation for construction of facilities, placement of gravel pad, use of explosive devices, and tundra travel into Chapter Nine B(10)(g) in the Final Finding.

**NSB TLUI Certificate Comment Summary:** The NSB stated that applicants must obtain a Certificate of Inupiat History, Language and Culture/Traditional Land Use Inventory (IHLC/TLUI) Clearance from the NSB Planning Department for an earth-moving activity, ice road, or seismic survey. The NSB also requested that this be connected to the mitigation measures in Chapter Nine.

**ADNR Response:** Lessee advisories are provided to alert lessees to additional statutory and regulatory requirements imposed under other administrative jurisdictions in the lease sale area. ADNR included a lessee advisory for the concerns that NSB stated relating to requirements to obtain a certificate from NSB prior to earth-moving activity, ice road, or seismic surveys. These may require obtaining a Certificate of Inupiat History, Language and Culture/Traditional Land Use Inventory (IHLC/TLUI) Clearance from the NSB Planning Department prior to the activity.

Information about the TLUI was included in Chapter Three, Section D of the Final Finding. In addition, a lessee advisory was included into Chapter Nine, Section B(10)(h) of the Final Finding.

**Pipeline Height Comment Summary:** The NSB recommended that the mitigation measures provide for the pipeline height to be measured from the top of the average snow depth to the bottom of cables and vibration dampeners or bottom of the vertical support member (VSM).

**ADNR Response:** Mitigation measure A(1)(g), specifying the requirement for pipeline height, is representative and more protective than the recommendation of the Final Report of the Alaska Caribou Steering Committee, which suggested a pipeline elevation height of 5 feet above ground level (Cronin et al. 1994). The higher, more conservative height of 7 feet above ground level is more protective than the Steering Committee's recommendation. ADNR will retain the mitigation measure as stated in the Preliminary Finding.

**Caribou Migration Comment Summary:** The NSB suggested that exploratory drilling operations should be restricted to the same dates as restrictions for exploration activities, from August 1 through October 31 each year.

**ADNR Response:** The mitigation measure addressing exploration drilling activities found in mitigation measure A(3)(c), was changed to align the dates with the related mitigation measure A(3)(d) for exploration activities in the Chandler, Nanushuk, Itkillik, Kuparuk, and Anaktuvuk River valleys to allow for subsistence hunting. In the Final Finding these two mitigation measures have the same date restrictions for activities, August 1 through October 31 of each year.

**Oil Spill Comment Summary:** The NSB stated that spill response equipment sufficient to respond to a spill up to 5,000 gal should be updated and should replace the stated volume of 5 gal, as found in mitigation measure A(4)(d).

**ADNR Response:** Spill prevention of oil is under the jurisdiction of the ADEC. One of the goals of the Division of Spill Prevention and Response (SPAR) is oil spill prevention for exploration and production facilities. SPAR ensures that operators use proper spill prevention as approved in each operator's oil discharge and prevention contingency plan (C-plan) (ADEC 2011). Spill prevention is regulated under the statutes and regulations of ADEC. Therefore, no changes were made to the mitigation measures in the Final Finding.

**Access Comment Summary:** The NSB stated that access to ice roads and the lease areas should be prohibited for motorized vehicles originating from the James Dalton Highway.

**ADNR Response:** The State has established generally allowable uses on state owned land (DMLW 2009). These include using a highway vehicle with a curb weight of up to 10,000 pounds, including a four-wheel drive vehicle and a pick-up truck, or using a recreational-type vehicle off-road or all-terrain vehicle with a curb weight of up to 1,500 pounds, including a snowmobile and four-wheeler, on or off an established road easement, if use off the road easement does not cause or contribute to water quality degradation, alteration of drainage systems, significant rutting, ground disturbance, or thermal erosion. An authorization is required from the ADF&G Division of Habitat for any motorized travel in fish bearing streams.

The limitation imposed by mitigation measure A(5)(b) addresses prevention of problems associated with potential hazards within the immediate vicinity of drill sites, buildings, and other related facilities. It also prevents blockage of access to or along navigable or public waters. State statute and regulations are not structured to restrict generally allowed uses on state owned land. Access restrictions as requested by NSB would only be applicable on lands not owned by the State of Alaska, and would be conditioned by the statutes, regulations or policies of the land owner. Therefore, no changes were made to the mitigation measures in the Final Finding.

**Comment Summary regarding the Alaska Coastal Management Program (ACMP):** The NSB commented about the Alaska Coastal Management Program (ACMP) evaluation.

**ADNR Response:** These comments are addressed in the ACMP proposed consistency determination, a companion document to the Final Finding for the North Slope Foothills.

**References:**

- ACIAC (Alaska Climate Impact Assessment Commission). 2008. Final report to the legislature. Representative Ralph Samuels, Chairman, and Representative Reggie Joule, Vice-Chairman. March 17, 2008. [http://www.housemajority.org/coms/cli/cli\\_finalreport\\_20080301.pdf](http://www.housemajority.org/coms/cli/cli_finalreport_20080301.pdf)
- ACIAC (Alaska Climate Impact Assessment Commission). 2009. Mitigation Advisory Group Final Report. Alaska State Legislature's Joint Alaska Climate Impact Assessment Commission. <http://www.climatechange.alaska.gov/advgrp.htm>
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- DMLW (Division of Mining , Land and Water). 2009. Generally allowed uses on state land fact sheet. [http://dnr.alaska.gov/mlw/factsht/gen\\_allow\\_use.pdf](http://dnr.alaska.gov/mlw/factsht/gen_allow_use.pdf)



# Appendix B: Laws and Regulations Pertaining to Oil and Gas Exploration, Development, Production, and Transportation

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# Appendix B: Laws and Regulations Pertaining to Oil and Gas Exploration, Development, Production, and Transportation

## A. Alaska Statutes (AS) and Administrative Code (AAC) Sections

### 1. Alaska Department of Natural Resources (ADNR)

- |                              |  |
|------------------------------|--|
| AS 38.05.027                 | Management of legislatively designated state game refuges and critical habitat areas is joint responsibility of ADF&G (AS 16.20.050-060) and ADNR. Lessees are required to obtain permits from both ADNR and ADF&G.  |
| AS 38.05.127                 | Provides for reservation of easements to ensure free access to navigable or public water.  |
| AS 38.35.010 to AS 38.35.260 | Right-of-way leasing for pipeline transportation of crude oil and natural gas is under control of commissioner of ADNR. Commissioner shall not delegate authority to execute leases.                                 |
| 11 AAC 51.045                | Easements to and along navigable or public water.  |
| 11 AAC 83.158(a)             | Plan of operations for all or part of leased area or area subject to oil and gas exploration license must be approved by ADNR commissioner before any operations may be undertaken on or in leased or licensed area. |
| 11 AAC 96.010                | Operations requiring permits, including use of explosives and explosive devices, except firearms.  |
| 11 AAC 96.025                | Generally allowed land use activities are subject to general stipulations that will minimize surface damage or disturbance of drainage systems, vegetation, or fish and wildlife resources.                          |

### 2. ADNR, Division of Oil and Gas (DO&G)

- |                       |  |
|-----------------------|--|
| AS 38.05.035(a)(8)(C) | Requires geological and geophysical data to be kept confidential upon request of supplier.   |
| AS 38.05.130          | Allows DO&G director to approve oil and gas exploration and development activities in cases where surface estate is not held by state or is otherwise subject to third-party interests, provided director determines that adequate compensation has been made to surface estate holder for any damages that may be caused by lease activities. |
| 11 AAC 83.155         |  |
| AS 38.05.132          | Establishes exploration licensing program.   |
| 11 AAC 82             |  |

AS 38.05.180	Establishes oil and gas leasing and gas only leasing programs to provide for orderly exploration for and development of petroleum resources belonging to the State of Alaska.
11 AAC 96.010 to 11 AAC 96.110	Provides controls over activities on state lands in order to minimize adverse activities; applies to geophysical exploration permit.
11 AAC 83.158	Requires a plan of operations.

### **3. ADNR, Division of Forestry**

AS 41.17.082	Alaska Forest Resources Practices Act. Requires that all forest clearing operations and silvicultural systems be designed to reduce likelihood of increased insect infestation and disease infections that threaten forest resources.
11 AAC 95.195	Describes approved methods of disposal or treatment of downed spruce trees to minimize spread of bark beetles and reduce risk of wildfire.
11 AAC 95.220	Requires lessee to file detailed plan of operations with state forester.

### **4. ADNR, Division of Mining, Land and Water (DMLW)**

AS 38.05.075	Governs public auctions for leasing lands (including tidelands and submerged lands) — procedures, bidding qualifications, and competitive or noncompetitive bidding methods.
AS 38.05.850	Authorizes the director to issue permits, rights-of-way, or easements on state land for recovery of minerals from adjacent land under valid lease.
11 AAC 80.005 to 11 AAC 80.085	Establishes pipeline right-of-way leasing regulations.
11 AAC 93.040 to 11 AAC 93.130	Requires a water rights permit for appropriation of state waters.
11 AAC 93.210 to 11 AAC 93.220	Provides for temporary water use permits and application procedures.
11 AAC 96.010 to 11 AAC 96.110	Land use permit activities not permitted by multiple land use permit or lease operations approval.

### **5. ADNR, Division of Coastal and Ocean Management (DCOM)**

6 AAC 80.070(b)(3)	Requires that energy facilities in coastal areas be consolidated to extent feasible and prudent.
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- 6 AAC 80.070(b)(10) Requires that energy facilities in coastal areas be sited to extent feasible and prudent where development will necessitate minimal site clearing, dredging, and construction in productive habitats; to minimize risk of oil spills in, or other contamination of, productive or vulnerable habitats; and to allow for free passage and movement of fish and wildlife.
- 6 AAC 80.070(b)(12)
- 6 AAC 80.130(c)(3) Requires that wetlands and tide flats be managed to assure adequate water flow and to avoid adverse effects on natural drainage patterns, destruction of important habitat, and discharge of toxic substances.
- 11 AAC 110 Alaska Coastal Management Program implementation.

## **6. Office of History and Archaeology (ADNR)**

- AS 41.35.200 to AS 41.35.230 Governs the preservation and protection of the historic, prehistoric, and archaeological resources from loss, desecration and destruction, for the continued use by the people and future generations of the State of Alaska.
- 11 AAC 16.010 to 11 AAC 16.900 Defines the processes and procedures for reporting, obtaining permits, surveying, investigation, and collection of historic, prehistoric or archaeological resources of the state.

## **7. Alaska Department of Fish and Game (ADF&G)**

- AS 16.05.841 Requires that an obstruction across a fishbearing stream provide for fish passage.
- AS 16.05.871 Provides for protection of anadromous fish and game in connection with construction or work in beds of specified water bodies and calls for approval of plans by ADF&G for construction of hydraulic project or any use, diversion, obstruction, change, or pollution of these water bodies.
- AS 16.20 Manages legislatively designated game refuges, sanctuaries, and critical habitat areas.
- AS 16.20.060 and AS 16.20.530 Commissioner, ADF&G, may require submission and written approval of plans and specifications for anticipated use and construction work and plans for proper protection of fish and game (including birds) within legislatively designated game refuges, critical habitat areas, and sanctuaries.
- AS 16.20.180 to AS 16.20.210 Requires measures for continued conservation, protection, restoration, and propagation of endangered fish and wildlife.
- 5 AAC 95.010 Atlas and catalog of waters important for spawning, rearing, or migration of anadromous fish. Permit application procedures.

## **8. Alaska Oil and Gas Conservation Commission (AOGCC)**

- AS 31.05.005 Establishes and empowers AOGCC.
- AS 31.05.030(d)(9) Requires oil and gas operator to file and obtain approval of plan of development and operation.
- AS 46.03.100 Standards and limitations for accumulation, storage, transportation, and disposal of solid or liquid waste or heated process or cooling water.
- AS 46.03.900(35) Defines waste.
- 20 AAC 25 Requires permit to drill, to help maintain regulatory control over drilling and completion activities in state. Regulates well spacing and underground injection.
- 20 AAC 25.140 Requires authorization to allow an abandoned oil and gas well to be converted to a freshwater well.

## **9. Alaska Department of Environmental Conservation (ADEC)**

- AS 26.23.900(1) Defines Alaska State Emergency Response Commission.
- AS 46.03 Sets state policy; to conserve, improve, and protect the state's natural resources and environment, and control water, land, and air pollution.
- AS 46.03.100 Requires solid waste disposal permits.
- AS 46.03.759 Establishes maximum liability for discharge of crude oil at \$500 million.
- AS 46.03.900(35) Defines waste.
- AS 46.04 Oil and Hazardous Substance Pollution Control Act. Prohibits discharge of oil or any other hazardous substances unless specifically authorized by permit; requires those responsible for spills to undertake cleanup operations; and holds violators liable for unlimited cleanup costs and damages as well as civil and criminal penalties.
- AS 46.04.030 Requires lessees to provide oil discharge prevention and contingency plans (C-plans). Also provides regulation of aboveground storage facilities that have capacities of greater than 5,000 bbl of crude oil or greater than 10,000 bbl of noncrude oil.
- AS 46.04.050 Exemptions for oil terminal facilities that have capacities of less than 5,000 bbl of crude oil or less than 10,000 bbl of noncrude oil.
- 18 AAC 50 Provides for air quality control, including permit requirements, permit review criteria, and regulation compliance criteria.

- 18 AAC 50.316 Preconstruction review for construction or reconstruction of major source of hazardous air pollutants.
- 18 AAC 60.265 Requires proof of financial responsibility before a permit for operation of hazardous waste disposal facility may be issued.
- 18 AAC 60.200 Requires a solid waste disposal permit.
- 18 AAC 60.430(a)(2) General requirement for containment structures used for disposal of drilling wastes.
- 18 AAC 70 Sets water quality standards.
- 18 AAC 72 Protects public health, public and private water systems, and the environment from diseases transmitted by domestic wastewater by establishing minimum treatment, construction, operation, and maintenance standards for domestic wastewater treatment works and disposal systems.
- 18 AAC 75.005 to Requirements for oil storage facilities for oil pollution prevention.
- 18 AAC 75.025
- 18 AAC 75.065 to Requirements for oil storage tanks.
- 18 AAC 75.075
- 18 AAC 75.080 Facility piping requirements for oil terminal, crude oil transmission pipeline, and exploration and production facilities. Requires a corrosion control program.
- 18 AAC 75.235 Sets financial responsibility levels for oil discharges
- 18 AAC 75.300 Requires ADEC be notified of spill of oil and other hazardous substances.
- 18 AAC 75.400 to Requires oil discharge contingency plans and specifies their contents.
- 18 AAC 75.496

## **B. Federal Laws and Regulations**

Notes: CFR is the Code of Federal Regulations; USC is the United States Code.

### **1. Clean Water Act and Amendments**

- 33 USC §§ 1251 to 1387 Establishes water pollution controls to restore and maintain the integrity of U.S. waters
- 33 USC § 1344 Requires a COE Section 404 permit to excavate, fill, alter, or otherwise modify course or condition of navigable or U.S. coastal waters and to discharge dredge-and-fill material
- 40 CFR 435.30-32 Regulations to prohibit the discharge of water pollutants from any source associated with oil and gas production, field exploration, drilling, well completion, or well treatment.

### **2. Oil Pollution Act of 1990**

- 33 U.S.C. §2701 et seq. (1990) This statute focuses on prevention and response to oil spills. It sets forth requirements for planning, reporting and implementing spill prevention and response actions at specific facilities, and on a regional scale.

### **3. Environmental Protection Agency (EPA)**

Oil and other hazardous substance regulations.

- 40 CFR § 109 Establishes criteria for oil removal (spill) contingency plans
- 40 CFR § 110 Requires reporting of spills
- 40 CFR § 112 Oil pollution prevention, designed to form a comprehensive federal/state spill prevention program that minimizes the potential for discharges
- 40 CFR § 112.7 General requirements for spill prevention, control, and countermeasures plan
- 40 CFR § 113 Sets liability limits for small onshore storage facilities (oil)
- 40 CFR § 116 Designates hazardous substances
- 40 CFR § 117 Determination of reportable quantities for hazardous substances

Water quality regulations.

- 40 CFR § 121 State certification of activities requiring federal license or permit which may result in any discharge into navigable waters

- 40 CFR § 122            NPDES permit regulations
- 40 CFR § 125            Sets criteria and standards for NPDES permits
- 40 CFR § 129            Sets toxic pollutant effluent standards and lists toxic pollutants
- 40 CFR § 136            Establishes test procedures for the analysis of pollutants
- 40 CFR § 401            Prescribes effluent limitations guidelines and standards
- 40 CFR § 435            Sets discharge criteria for onshore and offshore facilities

Underground injection regulations.

- 40 CFR § 144            Requirements for underground injection control program
- 40 CFR § 146            Sets technical criteria and standards for the underground injection control program
- 40 CFR § 147            Sets forth state-administered underground injection control program

Ocean dumping regulations.

- 40 CFR §§ 220 to 228    Regulations, permits, and criteria related to dumping of material in the ocean

Materials discharge and disposal regulations.

- 40 CFR § 230            Regulates the discharge of dredged or fill material into navigable waters
- 40 CFR § 231            Sets the procedures for approving or prohibiting disposal of dredged or fill material at a site

Oil and other hazardous substance pollution regulations.

- 40 CFR § 300            National Oil and Hazardous Substances Pollution Contingency Plan, to provide for efficient, coordinated, and effective response to discharges of oil and hazardous substances

## **4. U.S. Coast Guard, Department of Homeland Security**

Regulations relevant to a determination of a hazard to navigation and oil spills in navigable waters.

- 33 CFR § 64.31      Determination of hazard to navigation
- 33 CFR §§ 153 to 158      Prescribes regulations concerning notification to the Coast Guard of the discharge of oil or hazardous; the procedures for the removal of a discharge of oil; the costs that may be imposed or reimbursed for the removal of a discharge; and for the transfer of oil to, from, or within vessels

## **5. U.S. Army Corps of Engineers**

Navigable waters regulations.

- 33 CFR § 209.200      Regulations governing navigable waters
- 33 CFR §§ 320 to 327      Prescribes policies and procedures applicable to review of applications for and 330 certain activities in U.S. waters, including discharge of dredged or fill material, including nationwide permits
- 33 CFR §§ 328 and 329      Defines waters and navigable waters of the U.S.

## **6. Fish and Wildlife Coordination Act**

- 16 USC § 662(a)      Requires consultation between agencies on activities conducted in waters.

## **7. Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)**

- 42 USC §§ 9601 to 9675      Defines and designates hazardous substances, sets quantities for reportable releases, and sets cleanup standards

## **8. Safe Drinking Water Act**

- 42 USC § 300 (f) to (h)      Regulates public water systems to ensure their safety

- 40 CFR Parts 144 & 145      These are the requirements for the federal Underground Injection Control Program (UIC), which is responsible for regulating the construction, operation, permitting, and closure of injection wells that place fluids underground for storage or disposal. It includes fluids and waste management for oil and gas activities.

## **9. Solid Waste Disposal Act, as amended by Resource Conservation and Recovery Act**

42 USC §§ 6901 to Regulates solid waste disposal planning and management and sets reduction  
6991 or elimination of hazardous waste as national policy

## **10. Clean Air Act**

42 USC §§ 7401 to Encourages and promotes reasonable governmental actions for air pollution  
7671 prevention; sets standards, and permit requirements

## **11. Toxic Substances Control Act**

15 USC §§ 2601 to Controls toxic substances, including asbestos  
2655

## **12. National Environmental Policy Act (NEPA)**

42 USC §§ 4321 to Sets environmental policy; requires a detailed statement of environmental  
4347 impacts in reports on proposed federal actions significantly affecting the  
quality of the environment.

Council on Environmental Quality-administers NEPA-related regulations

40 CFR §§ 1500 to Provides regulations applicable to and binding on federal agencies for  
1508 implementing NEPA, including when and whether to prepare and  
environmental impact statement

## **13. Endangered Species Act**

16 USC §§ 1531 to Interagency cooperation, prohibited acts, penalties, and enforcement  
1543

## **14. U.S. Fish and Wildlife Service (USFWS)**

Threatened and endangered species regulations

50 CFR § 17 Threatened and endangered wildlife and plant species

50 CFR § 402 Directs federal agencies to further the purposes of the Endangered Species  
Act

## **15. Pipeline Inspection, Protection, Enforcement, and Safety Act (PIPES Act) of 2006**

- 49 CFR § 192 Prescribes minimum safety requirements for pipeline facilities and the transportation of gas
- 49 CFR § 195 Prescribes safety standards and reporting requirements for pipeline facilities used in the transportation of hazardous liquids or carbon dioxide

## **16. Migratory Bird Treaty Act**

16 USC §§ 703 to 712 Protects migratory birds, per the act and international treaties and 715

## **17. Archaeological and Historic Preservation Act**

- 16 USC § 469 Preserves historical and archaeological data that might be lost or destroyed due to a federally licensed activity

## **18. National Historic Preservation Act**

- 16 USC § 470 Protects prehistoric and historic resources

## **19. Occupational Safety & Health Administration**

PL 91-596, 84 STAT. 1590 This law establishes the requirements to assure safe and healthful working conditions, enforcement of federal safety standards, and promotes education and training for occupational safety and health.

## **20. Leases and Permits on Restricted Properties**

- 25 CFR § 162 Leasing and permitting on Native and restricted lands

## **C. Local Laws and Regulations**

### **1. North Slope Borough (NSB)**

- Title 19 North Slope Borough land management regulations, planning, and permitting powers.

# Appendix C: Sample Competitive Oil and Gas Lease

Competitive Oil and Gas Lease

Form #DOG 200604 (rev. 3/2009)

## STATE OF ALASKA DEPARTMENT OF NATURAL RESOURCES

### Competitive Oil and Gas Lease

**ADL No.**

THIS LEASE is entered into , between the State of Alaska, "the state," and

"the lessee," whether one or more, whose sole address for purposes of notification is under Paragraph 25.

In consideration of the cash payment made by the lessee to the state, which payment includes the first year's rental and any required cash bonus, and subject to the provisions of this lease, including applicable stipulation(s) and mitigating measures attached to this lease and by this reference incorporated in this lease, the state and the lessee agree as follows:

1. GRANT. (a) Subject to the provisions in this lease, the state grants and leases to the lessee, without warranty, the exclusive right to drill for, extract, remove, clean, process, and dispose of oil, gas, and associated substances in or under the following described tract of land:

containing approximately                          acres, more or less (referred to in this lease as the "leased area"); the nonexclusive right to conduct within the leased area geological and geophysical exploration for oil, gas, and associated substances; and the nonexclusive right to install pipelines and build structures on the leased area to find, produce, save, store, treat, process, transport, take care of, and market all oil, gas, and associated substances and to house and board employees in its operations on the leased area. The rights granted by this lease are to be exercised in a manner which will not unreasonably interfere with the rights of any permittee, lessee or grantee of the state consistent with the principle of reasonable concurrent uses as set out in Article VIII, Section 8 of the Alaska Constitution.

(b) For the purposes of this lease, the leased area contains the legal subdivisions as shown on the attached plat marked Exhibit A.

(c) If the leased area is described by protracted legal subdivisions and, after the effective date of this lease, the leased area is surveyed under the public land rectangular system, the boundaries of the leased area are those established by that survey, when approved, subject, however, to the provisions of applicable regulations relating to those surveys. If for any reason the leased area includes more acreage than the maximum permitted under applicable law (including the "rule of approximation" authorized in AS 38.05.145 and defined in AS 38.05.965 (18)), this lease is not void and the acreage included in the leased area must be reduced to the permitted maximum. If the state determines that the leased area exceeds the permitted acreage

and notifies the lessee in writing of the amount of acreage that must be eliminated, the lessee has 60 days after that notice to surrender one or more legal subdivisions included in the leased area comprising at least the amount of acreage that must be eliminated. Any subdivision surrendered must be located on the perimeter of the leased area as originally described. If a surrender is not filed within 60 days, the state may terminate this lease as to the acreage that must be eliminated by mailing notice of the termination to the lessee describing the subdivision eliminated.

(d) If the State of Alaska's ownership interest in the oil, gas, and associated substances in the leased area is less than an entire and undivided interest, the grant under this lease is effective only as to the state's interest in that oil, gas, and associated substances, and the royalties and rentals provided in this lease must be paid to the state in the proportion that the state's interest bears to the entire undivided fee.

(e) The state makes no representations or warranties, express or implied, as to title, or access to, or quiet enjoyment of, the leased area. The state is not liable to the lessee for any deficiency in title to the leased area, nor is the lessee or any successor in interest to the lessee entitled to any refund due to deficiency in title for any rentals, bonuses, or royalties paid under this lease.

**2. RESERVED RIGHTS.** (a) The state, for itself and others, reserves all rights not expressly granted to the lessee by this lease. These reserved rights include, but are not limited to:

(1) the right to explore for oil, gas, and associated substances by geological and geophysical means;

(2) the right to explore for, develop, and remove natural resources other than oil, gas, and associated substances on or from the leased area;

(3) the right to establish or grant easements and rights-of-way for any lawful purpose, including without limitation for shafts and tunnels necessary or appropriate for the working of the leased area or other lands for natural resources other than oil, gas, and associated substances;

(4) the right to dispose of land within the leased area for well sites and well bores of wells drilled from or through the leased area to explore for or produce oil, gas, and associated substances in and from lands not within the leased area; and

(5) the right otherwise to manage and dispose of the surface of the leased area or interests in that land by grant, lease, permit, or otherwise to third parties.

(b) The rights reserved may be exercised by the state, or by any other person or entity acting under authority of the state, in any manner that does not unreasonably interfere with or endanger the lessee's operations under this lease.

**3. TERM.** This lease is issued for an initial primary term of 7 years from the effective date of this lease. The term may be extended as provided in Paragraph 4 below.

**4. EXTENSION.** (a) This lease will be extended automatically if and for so long as oil or gas is produced in paying quantities from the leased area.

(b) This lease will be extended automatically if it is committed to a unit agreement approved or prescribed by the state, and will remain in effect for so long as it remains committed to that unit agreement.

(c) (1) If the drilling of a well whose bottom hole location is in the leased area has commenced as of the date on which the lease otherwise would expire and is continued with reasonable diligence, this lease will continue in effect until 90 days after cessation of that drilling and for so long as oil or gas is produced in paying quantities from the leased area.

(2) If oil or gas in paying quantities is produced from the leased area, and if that production ceases at any time, this lease will not terminate if drilling or reworking operations are commenced on the leased area within six months after cessation of production and are prosecuted with reasonable diligence; if those drilling or reworking operations result in the production of oil or gas, this lease will remain in effect for so long as oil or gas is produced in paying quantities from the leased area.

(d) If there is a well capable of producing oil or gas in paying quantities on the leased area, this lease will not expire because the lessee fails to produce that oil or gas unless the state gives notice to the

lessee, allowing a reasonable time, which will not be less than six months after notice, to place the well into production, and the lessee fails to do so. If production is established within the time allowed, this lease is extended only for so long as oil or gas is produced in paying quantities from the leased area.

(e) If the state directs or approves in writing a suspension of all operations on or production from the leased area (except for a suspension necessitated by the lessee's negligence), or if a suspension of all operations on or production from the leased area has been ordered under federal, state, or local law, the lessee's obligation to comply with any express or implied provision of this lease requiring operations or production will be suspended, but not voided, and the lessee shall not be liable for damages for failure to comply with that provision. If the suspension occurs before the expiration of the primary term, the primary term will be extended at the end of the period of the suspension by adding the period of time lost under the primary term because of the suspension. If the suspension occurs during an extension of the primary term under this paragraph, upon removal of that suspension, the lessee will have a reasonable time, which will not be less than six months after notice that the suspension has been removed, to resume operations or production. For the purposes of this subparagraph, any suspension of operations or production specifically required or imposed as a term of sale or by any stipulation made a part of this lease will not be considered a suspension ordered by law.

(f) If the state determines that the lessee has been prevented by force majeure, after efforts made in good faith, from performing any act that would extend the lease beyond the primary term, this lease will not expire during the period of force majeure. If the force majeure occurs before the expiration of the primary term, the primary term will be extended at the end of the period of force majeure by adding the period of time lost under the primary term because of the force majeure. If the force majeure occurs during an extension of the primary term under this paragraph, this lease will not expire during the period of force majeure plus a reasonable time after that period, which will not be less than 60 days, for the lessee to resume operations or production.

(g) Nothing in subparagraphs (e) or (f) suspends the obligation to pay royalties or other production or profit-based payments to the state from operations on the leased area that are not affected by any suspension or force majeure, or suspends the obligation to pay rentals.

5. RENTALS. (a) The lessee shall pay annual rental to the state in accordance with the following rental schedule:

- (1) For the first year, \$1.00 per acre or fraction of an acre;
- (2) For the second year, \$1.50 per acre or fraction of an acre;
- (3) For the third year, \$2.00 per acre or fraction of an acre;
- (4) For the fourth year, \$2.50 per acre or fraction of an acre;

(5) For the fifth year and following years, \$3.00 per acre or fraction of an acre; provided that the state may increase the annual rental rate as provided by law upon extension of this lease beyond the primary term.

(b) Annual rental paid in advance is a credit on the royalty or net profit share due under this lease for that year.

(c) The lessee shall pay the annual rental to the State of Alaska (or any depository designated by the state with at least 60 days notice to the lessee) in advance, on or before the annual anniversary date of this lease. The state is not required to give notice that rentals are due by billing the lessee. If the state's (or depository's) office is not open for business on the annual anniversary date of this lease, the time for payment is extended to include the next day on which that office is open for business. If the annual rental is not paid timely, this lease automatically terminates as to both parties at 11:59 p.m., Alaska Standard Time, on the date by which the rental payment was to have been made.

6. RECORDS. The lessee shall keep and have in its possession books and records showing the development and production (including records of development and production expenses) and disposition (including records of sale prices, volumes, and purchasers) of all oil, gas, and associated substances produced

from the leased area. The lessee shall permit the State of Alaska or its agents to examine these books and records at all reasonable times. Upon request by the state, the lessee's books and records shall be made available to the state at the state office designated by the state. These books and records of development, production, and disposition must employ methods and techniques that will ensure the most accurate figures reasonably available without requiring the lessee to provide separate tankage or meters for each well. The lessee shall use generally accepted accounting procedures consistently applied.

**7. APPORTIONMENT OF ROYALTY FROM APPROVED UNIT.** The landowners' royalty share of the unit production allocated to each separately owned tract shall be regarded as royalty to be distributed to and among, or the proceeds of it paid to, the landowners, free and clear of all unit expense and free of any lien for it. Under this provision, the state's royalty share of any unit production allocated to the leased area will be regarded as royalty to be distributed to, or the proceeds of it paid to, the state, free and clear of all unit expenses (and any portion of those expenses incurred away from the unit area), including, but not limited to, expenses for separating, cleaning, dehydration, gathering, saltwater disposal, and preparing oil, gas, or associated substances for transportation off the unit area, and free of any lien for them.

**8. PAYMENTS.** All payments to the State of Alaska under this lease must be made payable to the state in the manner directed by the state, and unless otherwise specified, must be tendered to the state at:

DEPARTMENT OF NATURAL RESOURCES

550 WEST 7<sup>TH</sup> AVENUE, SUITE 1410

ANCHORAGE, ALASKA 99501-3561

ATTENTION: FINANCIAL SERVICES SECTION

or in person at either of the Department's Public Information Centers located at

550 W. 7<sup>th</sup> Ave., Suite 1260  
Anchorage, Alaska

3700 Airport Way  
Fairbanks, Alaska

or to any depository designated by the state with at least 60 days notice to the lessee.

**9. PLAN OF OPERATIONS.** (a) Except as provided in (b) of this section, a plan of operations for all or part of the leased area must be approved by the commissioner before any operations may be undertaken on or in the leased area.

- (b) A plan of operations is not required for:  
(1) activities that would not require a land use permit; or  
(2) operations undertaken under an approved unit plan of operations.

(c) Before undertaking operations on or in the leased area, the lessee shall provide for full payment of all damages sustained by the owner of the surface estate as well as by the surface owner's lessees and permittees, by reason of entering the land.

(d) An application for approval of a plan of operations must contain sufficient information, based on data reasonably available at the time the plan is submitted for approval, for the commissioner to determine the surface use requirements and impacts directly associated with the proposed operations. An application must include statements and maps or drawings setting out the following:

- (1) the sequence and schedule of the operations to be conducted on or in the leased area, including the date operations are proposed to begin and their proposed duration;

(2) projected use requirements directly associated with the proposed operations, including the location and design of well sites, material sites, water supplies, solid waste sites, buildings, roads, utilities, airstrips, and all other facilities and equipment necessary to conduct the proposed operations;

(3) plans for rehabilitation of the affected leased area after completion of operations or phases of those operations; and

(4) a description of operating procedures designed to prevent or minimize adverse effects on other natural resources and other uses of the leased area and adjacent areas, including fish and wildlife habitats, historic and archeological sites, and public use areas.

(e) In approving a lease plan of operations or an amendment of a plan, the commissioner will require amendments that the commissioner determines necessary to protect the state's interest. The commissioner will not require an amendment that would be inconsistent with the terms of sale under which the lease was obtained, or with the terms of the lease itself, or which would deprive the lessee of reasonable use of the leasehold interest.

(f) The lessee may, with the approval of the commissioner, amend an approved plan of operations.

(g) Upon completion of operations, the lessee shall inspect the area of operations and submit a report indicating the completion date of operations and stating any noncompliance of which the lessee knows, or should reasonably know, with requirements imposed as a condition of approval of the plan.

(h) In submitting a proposed plan of operations for approval, the lessee shall provide ten copies of the plan if activities proposed are within the coastal zone, and five copies if activities proposed are not within the coastal zone.

**10. PLAN OF DEVELOPMENT.** (a) Except as provided in subparagraph (d) below, within 12 months after completion of a well capable of producing oil, gas, or associated substances in paying quantities, the lessee shall file two copies of an application for approval by the state of an initial plan of development that must describe the lessee's plans for developing the leased area. No development of the leased area may occur until a plan of development has been approved by the state.

(b) The plan of development must be revised, updated, and submitted to the state for approval annually before or on the anniversary date of the previously approved plan. If no changes from an approved plan are contemplated for the following year, a statement to that effect must be filed for approval in lieu of the required revision and update.

(c) The lessee may, with the approval of the state, subsequently modify an approved plan of development.

(d) If the leased area is included in an approved unit, the lessee will not be required to submit a separate lease plan of development for unit activities.

**11. INFORMATION ACQUIRED FROM OPERATIONS.** (a) The lessee shall submit to the state all geological, geophysical and engineering data and analyses obtained from the lease within 30 days following the completion of a well. The lessee shall submit to the state data and analyses acquired subsequent to well completion within 30 days following acquisition of that data. The state may waive receipt of operational data from some development, service or injection wells. The state will inform the operator of the waiver prior to well completion. The lessee shall submit the data and analyses to the Division of Oil and Gas, Department of Natural Resources, at the location specified in paragraph 25 of this lease. The data and analyses shall include the following:

(1) a copy of the completion report (AOGCC form 10-407) with an attached well summary, including daily drilling reports, formation tops encountered, a full synopsis of drillstem and formation testing data, an identification of zones of abnormal pressure, oil and gas shows and cored intervals;

(2) latitudinal and longitudinal coordinates for the completed surface and bottom hole locations;

(3) a copy of the permit to drill (AOGCC form 10-401 only, additional documentation not required) and the survey plat of the well location;

(4) a paper copy (no sepia copies) of all final 2-inch open hole and cased hole logs, including measured depth and true-vertical depth versions, specialty logs (such as Schlumberger's cyberlook, formation microscanners and dipmeter logs), composite mud or lithology log and report, measured-while-drilling (MWD) and logged-while-drilling (LWD) logs, velocity and directional surveys;

(5) a digital version of well logs in LAS, LIS or ASCII format on IBM format floppy disks, a digital version of velocity surveys in SEG Y format, a digital version of directional surveys in ASCII format (other formats may be acceptable upon agreement with the Division of Oil and Gas); and

(6) a paper copy of all available well analyses, including geochemical analyses, core analyses (porosity, permeability, capillary pressure, photos, and descriptions), paleontologic and palynologic analyses, thermal maturation analyses, pressure build up analyses, and fluid PVT analyses (an ASCII format digital version of the above information shall also be submitted, if available). The state may require the lessee to submit additional information in accordance with the applicable statutes and regulations in effect at the time of the completion date of the well.

(b) Any information submitted to the state by the lessee in connection with this lease will be available at all times for use by the state and its agents. The state will keep information confidential as provided in AS 38.05.035(a)(9) and its applicable regulations. In accordance with AS 38.05.035(a)(9)(C), in order for geological, geophysical and engineering information submitted under paragraph 11(a) of this lease to be held confidential, the lessee must request confidentiality at the time the information is submitted. The information must be marked **CONFIDENTIAL**.

12. DIRECTIONAL DRILLING. This lease may be maintained in effect by directional wells whose bottom hole location is on the leased area but that are drilled from locations on other lands not covered by this lease. In those circumstances, drilling will be considered to have commenced on the leased area when actual drilling is commenced on those other lands for the purpose of directionally drilling into the leased area. Production of oil or gas from the leased area through any directional well surfaced on those other lands, or drilling or reworking of that directional well, will be considered production or drilling or reworking operations on the leased area for all purposes of this lease. Nothing contained in this paragraph is intended or will be construed as granting to the lessee any interest, license, easement, or other right in or with respect to those lands in addition to any interest, license, easement, or other right that the lessee may have lawfully acquired from the state or from others.

13. DILIGENCE AND PREVENTION OF WASTE. (a) The lessee shall exercise reasonable diligence in drilling, producing, and operating wells on the leased area unless consent to suspend operations temporarily is granted by the state.

(b) Upon discovery of oil or gas on the leased area in quantities that would appear to a reasonable and prudent operator to be sufficient to recover ordinary costs of drilling, completing, and producing an additional well in the same geologic structure at another location with a reasonable profit to the operator, the lessee must drill those wells as a reasonable and prudent operator would drill, having due regard for the interest of the state as well as the interest of the lessee.

(c) The lessee shall perform all operations under this lease in a good and workmanlike manner in accordance with the methods and practices set out in the approved plan of operations and plan of development, with due regard for the prevention of waste of oil, gas, and associated substances and the entrance of water to the oil and gas-bearing sands or strata to the destruction or injury of those sands or strata, and to the preservation and conservation of the property for future productive operations. The lessee shall carry out at the lessee's expense all orders and requirements of the State of Alaska relative to the prevention of waste and to the preservation of the leased area. If the lessee fails to carry out these orders, the state will have the right, together with any other available legal recourse, to enter the leased area to repair damage or prevent waste at the lessee's expense.

(d) The lessee shall securely plug in an approved manner any well before abandoning it.

14. OFFSET WELLS. The lessee shall drill such wells as a reasonable and prudent operator would drill to protect the state from loss by reason of drainage resulting from production on other land. Without limiting the generality of the foregoing sentence, if oil or gas is produced in a well on other land not owned by the State

of Alaska or on which the State of Alaska receives a lower rate of royalty than under this lease, and that well is within 500 feet in the case of an oil well or 1,500 feet in the case of a gas well of lands then subject to this lease, and that well produces oil or gas for a period of 30 consecutive days in quantities that would appear to a reasonable and prudent operator to be sufficient to recover ordinary costs of drilling, completing, and producing an additional well in the same geological structure at an offset location with a reasonable profit to the operator, and if, after notice to the lessee and an opportunity to be heard, the state finds that production from that well is draining lands then subject to this lease, the lessee shall within 30 days after written demand by the state begin in good faith and diligently prosecute drilling operations for an offset well on the leased area. In lieu of drilling any well required by this paragraph, the lessee may, with the state's consent, compensate the state in full each month for the estimated loss of royalty through drainage in the amount determined by the state.

**15. UNITIZATION.** (a) The lessee may unite with others, jointly or separately, in collectively adopting and operating under a cooperative or unit agreement for the exploration, development, or operation of the pool, field, or like area or part of the pool, field, or like area that includes or underlies the leased area or any part of the leased area whenever the state determines and certifies that the cooperative or unit agreement is in the public interest.

(b) The lessee agrees, within six months after demand by the state, to subscribe to a reasonable cooperative or unit agreement that will adequately protect all parties in interest, including the state. The state reserves the right to prescribe such an agreement.

(c) With the consent of the lessee, and if the leased area is committed to a unit agreement approved by the state, the state may establish, alter, change, or revoke drilling, producing, and royalty requirements of this lease as the state determines necessary or proper to secure the proper protection of the public interest.

(d) Except as otherwise provided in this subparagraph, where only a portion of the leased area is committed to a unit agreement approved or prescribed by the state, that commitment constitutes a severance of this lease as to the unitized and nonunitized portions of the leased area. The portion of the leased area not committed to the unit will be treated as a separate and distinct lease having the same effective date and term as this lease and may be maintained only in accordance with the terms and conditions of this lease, statutes, and regulations. Any portion of the leased area not committed to the unit agreement will not be affected by the unitization or pooling of any other portion of the leased area, by operations in the unit, or by suspension approved or ordered for the unit. If the leased area has a well certified, under 11 AAC 83.361, as capable of production in paying quantities as defined in 11 AAC 83.395(4) on it before commitment to a unit agreement, this lease will not be severed. If any portion of this lease is included in a participating area formed under a unit agreement, the entire leased area will remain committed to the unit and this lease will not be severed.

**16. INSPECTION.** The lessee shall keep open at all reasonable times, for inspection by any duly authorized representative of the State of Alaska, the leased area, all wells, improvements, machinery, and fixtures on the leased area, and all reports and records relative to operations and surveys or investigations on or with regard to the leased area or under this lease. Upon request, the lessee shall furnish the State of Alaska with copies of and extracts from any such reports and records.

**17. SUSPENSION.** The state may from time to time direct or approve in writing suspension of production or other operations under this lease.

**18. ASSIGNMENT, PARTITION, AND CONVERSION.** This lease, or an interest in this lease, may, with the approval of the state, be assigned, subleased, or otherwise transferred to any person or persons qualified to hold a lease. No assignment, sublease, or other transfer of an interest in this lease, including assignments of working or royalty interests and operating agreements and subleases, will be binding upon the state unless approved by the state. The lessee shall remain liable for all obligations under this lease accruing prior to the approval by the state of any assignment, sublease, or other transfer of an interest in this lease. All provisions of this lease will extend to and be binding upon the heirs, administrators, successors, and assigns of the state and the lessee. Applications for approval of an assignment, sublease, or other transfer must comply with all applicable regulations and must be filed within 90 days after the date of final execution of the instrument

of transfer. The state will approve a transfer of an undivided interest in this lease unless the transfer would adversely affect the interests of Alaska or the application does not comply with applicable regulations. The state will disapprove a transfer of a divided interest in this lease if the transfer covers only a portion of the lease or a separate and distinct zone or geological horizon unless the lessee demonstrates that the proposed transfer of a divided interest is reasonably necessary to accomplish exploration or development of the lease, the lease is committed to an approved unit agreement, the lease is allocated production within an approved participating area, or the lease has a well capable of production in paying quantities. The state will make a written finding stating the reasons for disapproval of a transfer of a divided interest. Where an assignment, sublease, or other transfer is made of all or a part of the lessee's interest in a portion of the leased area, this lease may, at the option of the state or upon request of the transferee and with the approval of the state, be severed, and a separate and distinct lease will be issued to the transferee having the same effective date and terms as this lease.

**19. SURRENDER.** The lessee at any time may file with the state a written surrender of all rights under this lease or any portion of the leased area comprising one or more legal subdivisions or, with the consent of the state, any separate and distinct zone or geological horizon underlying the leased area or one or more legal subdivisions of the leased area. That surrender will be effective as of the date of filing, subject to the continued obligations of the lessee and its surety to make payment of all accrued royalties and to place all wells and surface facilities on the surrendered land or in the surrendered zones or horizons in condition satisfactory to the state for suspension or abandonment. After that, the lessee will be released from all obligations under this lease with respect to the surrendered lands, zones, or horizons.

**20. DEFAULT AND TERMINATION; CANCELLATION.** (a) The failure of the lessee to perform timely its obligations under this lease, or the failure of the lessee otherwise to abide by all express and implied provisions of this lease, is a default of the lessee's obligations under this lease. Whenever the lessee fails to comply with any of the provisions of this lease (other than a provision which, by its terms, provides for automatic termination), and fails within 60 days after written notice of that default to begin and diligently prosecute operations to remedy that default, the state may terminate this lease if at the time of termination there is no well on the leased area capable of producing oil or gas in paying quantities. If there is a well on the leased area capable of producing oil or gas in paying quantities, this lease may be terminated by an appropriate judicial proceeding. In the event of any termination under this subparagraph, the lessee shall have the right to retain under this lease any and all drilling or producing wells for which no default exists, together with a parcel of land surrounding each well or wells and rights-of-way through the leased area that are reasonably necessary to enable the lessee to drill, operate, and transport oil or gas from the retained well or wells.

(b) The state may cancel this lease at any time if the state determines, after the lessee has been given notice and a reasonable opportunity to be heard, that:

(1) continued operations pursuant to this lease probably will cause serious harm or damage to biological resources, to property, to mineral resources, or to the environment (including the human environment);

(2) the threat of harm or damage will not disappear or decrease to an acceptable extent within a reasonable period of time; and

(3) the advantages of cancellation outweigh the advantages of continuing this lease in effect. Any cancellation under this subparagraph will not occur unless and until operations under this lease have been under suspension or temporary prohibition by the state, with due extension of the term of this lease, continuously for a period of five years or for a lesser period upon request of the lessee.

(c) Any cancellation under subparagraph (b) will entitle the lessee to receive compensation as the lessee demonstrates to the state is equal to the lesser of:

(1) the value of the cancelled rights as of the date of cancellation, with due consideration being given to both anticipated revenues from this lease and anticipated costs, including costs of compliance with all applicable regulations and stipulations, liability for clean-up costs or damages, or both, in the case of an oil spill, and all other costs reasonably anticipated under this lease; or

(2) the excess, if any, over the lessee's revenues from this lease (plus interest on the excess from the date of receipt to date of reimbursement) of all consideration paid for this lease and all direct expenditures made by the lessee after the effective date of this lease and in connection with exploration or development, or both, under this lease, plus interest on that consideration and those expenditures from the date of payment to the date of reimbursement.

**21. RIGHTS UPON TERMINATION.** Upon the expiration or earlier termination of this lease as to all or any portion of the leased area, the lessee will be directed in writing by the state and will have the right at any time within a period of one year after the termination, or any extension of that period as may be granted by the state, to remove from the leased area or portion of the leased area all machinery, equipment, tools, and materials. Upon the expiration of that period or extension of that period and at the option of the state, any machinery, equipment, tools, and materials that the lessee has not removed from the leased area or portion of the leased area become the property of the state or may be removed by the state at the lessee's expense. At the option of the state, all improvements such as roads, pads, and wells must either be abandoned and the sites rehabilitated by the lessee to the satisfaction of the state, or be left intact and the lessee absolved of all further responsibility as to their maintenance, repair, and eventual abandonment and rehabilitation. Subject to the above conditions, the lessee shall deliver up the leased area or those portions of the leased area in good condition.

**22. DAMAGES AND INDEMNIFICATION.** (a) No rights under the AS 38.05.125 reservation may be exercised by the lessee until the lessee has provided to pay the owner of the land, his lessees and permittees, upon which the AS 38.05.125 reserved rights are sought to be exercised, full payment for all damage sustained by the owner by reason of entering the land. If the owner for any reason does not settle the damages, the lessee may enter the land after posting a surety bond determined by the state, after notice and an opportunity to be heard, to be sufficient as to form, amount, and security to secure to the owner, his lessees and permittees, payment for damages, and may institute legal proceedings in a court of competent jurisdiction where the land is located to determine the damages which the owner of the land may suffer. The lessee agrees to pay for any damages that may become payable under AS 38.05.130 and to indemnify the state and hold it harmless from and against any claims, demands, liabilities, and expenses arising from or in connection with such damages. The furnishing of a bond in compliance with this paragraph will be regarded by the state as sufficient provision for the payment of all damages that may become payable under AS 38.05.130 by virtue of this lease.

(b) The lessee shall indemnify the state for, and hold it harmless from, any claim, including claims for loss or damage to property or injury to any person caused by or resulting from any act or omission committed under this lease by or on behalf of the lessee. The lessee is not responsible to the state under this subparagraph for any loss, damage, or injury caused by or resulting from the sole negligence of the state.

(c) The lessee expressly waives any defense to an action for breach of a provision of this lease or for damages resulting from an oil spill or other harm to the environment that is based on an act or omission committed by an independent contractor in the lessee's employ. The lessee expressly agrees to assume responsibility for all actions of its independent contractors.

**23. BONDS.** (a) If required by the state, the lessee shall furnish a bond prior to the issuance of this lease in an amount equal to at least \$5 per acre or fraction of an acre contained in the leased area, but no less than \$10,000, and must maintain that bond as long as required by the state.

(b) The lessee may, in lieu of the bond required under (a) above, furnish and maintain a statewide bond in accordance with applicable regulations.

(c) The state may, after notice to the lessee and a reasonable opportunity to be heard, require a bond in a reasonable amount greater than the amount specified in (a) above where a greater amount is justified by the nature of the surface and its uses and the degree of risk involved in the types of operations being or to be carried out under this lease. A statewide bond will not satisfy any requirement of a bond imposed under this subparagraph, but will be considered by the state in determining the need for and the amount of any additional bond under this subparagraph.

(d) If the leased area is committed in whole or in part to a cooperative or unit agreement approved or prescribed by the state, and the unit operator furnishes a statewide bond, the lessee need not maintain any bond with respect to the portion of the leased area committed to the cooperative or unit agreement.

**24. AUTHORIZED REPRESENTATIVES.** The Director of the Division of Oil and Gas, Department of Natural Resources, State of Alaska, and the person executing this lease on behalf of the lessee shall be authorized representatives for their respective principals for the purposes of administering this lease. The state or the lessee may change the designation of its authorized representative or the address to which notices to that representative are to be sent by a notice given in accordance with Paragraph 25 below. Where activities pursuant to a plan of operations are underway, the lessee shall also designate, pursuant to a notice under Paragraph 25 below, by name, job title, and address, an agent who will be present in the state during all lease activities.

**25. NOTICES; PROTEST.** (a) Any notices required or permitted under this lease must be by electronic media producing a permanent record or in writing and must be given personally or by registered or certified mail, return receipt requested, addressed as follows:

TO THE STATE:

DIRECTOR, DIVISION OF OIL AND GAS  
DEPARTMENT OF NATURAL RESOURCES  
550 WEST 7TH AVENUE, SUITE 800  
ANCHORAGE, ALASKA 99501-3560

TO THE LESSEE:

(b) Any notice given under this paragraph will be effective when delivered to the above authorized representative.

(c) A lessee who wishes to protest the amount of money due the state under the lease or any action of the state regarding a provision of this lease must file a written protest with the Division of Oil and Gas within 30 days after the mailing date of the state's notice or bill. A lessee who fails to file a protest within the required time waives any further right to protest. The state will establish the administrative appeal procedure to be followed and will inform the lessee of the procedure no later than 30 days after the filing of the written protest.

**26. STATUTES AND REGULATIONS.** This lease is subject to all applicable state and federal statutes and regulations in effect on the effective date of this lease, and insofar as is constitutionally permissible, to all statutes and regulations placed in effect after the effective date of this lease. A reference to a statute or regulation in this lease includes any change in that statute or regulation whether by amendment, repeal and replacement, or other means. This lease does not limit the power of the State of Alaska or the United States of America to enact and enforce legislation or to promulgate and enforce regulations affecting, directly or indirectly,

the activities of the lessee or its agents in connection with this lease or the value of the interest held under this lease. In case of conflicting provisions, statutes and regulations take precedence over this lease.

**27. INTERPRETATION.** This lease is to be interpreted in accordance with the rules applicable to the interpretation of contracts made in the State of Alaska. The paragraph headings are not part of this lease and are inserted only for convenience. The state and the lessee expressly agree that the law of the State of Alaska will apply in any judicial proceeding affecting this lease.

**28. INTEREST IN REAL PROPERTY.** It is the intention of the parties that the rights granted to the lessee by this lease constitute an interest in real property in the leased area.

**29. WAIVER OF CONDITIONS.** The state reserves the right to waive any breach of a provision of this lease, but any such waiver extends only to the particular breach so waived and does not limit the rights of the state with respect to any future breach; nor will the waiver of a particular breach prevent cancellation of this lease for any other cause or for the same cause occurring at another time. Notwithstanding the foregoing, the state will not be deemed to have waived a provision of this lease unless it does so in writing.

**30. SEVERABILITY.** If it is finally determined in any judicial proceeding that any provision of this lease is invalid, the state and the lessee may jointly agree by a written amendment to this lease that, in consideration of the provisions in that written amendment, the invalid portion will be treated as severed from this lease and that the remainder of this lease, as amended, will remain in effect.

**31. LOCAL HIRE.** The lessee is encouraged to hire and employ local and Alaska residents and companies, to the extent they are available and qualified, for work performed on the leased area. Lessees shall submit, with the plans of operations, a proposal detailing the means by which the lessee will comply with this measure. The lessee is encouraged, in formulating this proposal, to coordinate with employment services offered by the State of Alaska and local communities and to recruit employees from local communities.

**32. CONDITIONAL LEASE.** If all or a part of the leased area is land that has been selected by the state under laws of the United States granting lands to the state, but the land has not been patented to the state by the United States, then this lease is a conditional lease as provided by law until the patent becomes effective. If for any reason the selection is not finally approved, or the patent does not become effective, any rental, royalty, or other production or profit-based payments made to the state under this lease will not be refunded.

**33. NONDISCRIMINATION.** The lessee and the lessee's contractors and subcontractors may not discriminate against any employee or applicant because of race, religion, marital status, change in marital status, pregnancy, parenthood, physical handicap, color, sex, age, or national origin as set out in AS 18.80.220. The lessee and its contractors and subcontractors must, on beginning any operations under this lease, post in a conspicuous place notices setting out this nondiscrimination provision.

**34. DEFINITIONS.** All words and phrases used in this lease are to be interpreted where possible in the manner required in respect to the interpretation of statutes by AS 01.10.040. However, the following words have the following meanings unless the context unavoidably requires otherwise:

(1) "oil" means crude petroleum oil and other hydrocarbons, regardless of gravity, that are produced in liquid form by ordinary production methods, including liquid hydrocarbons known as distillate or condensate recovered by separation from gas other than at a gas processing plant;

(2) "gas" means all natural gas (except helium gas) and all other hydrocarbons produced that are not defined in this lease as oil;

(3) "associated substances" means all substances except helium produced as an incident of production of oil or gas by ordinary production methods and not defined in this lease as oil or gas;

(4) "drilling" means the act of boring a hole to reach a proposed bottom hole location through which oil or gas may be produced if encountered in paying quantities, and includes redrilling, sidetracking, deepening, or other means necessary to reach the proposed bottom hole location, testing, logging, plugging, and other operations necessary and incidental to the actual boring of the hole;

(5) "reworking operations" means all operations designed to secure, restore, or improve production through some use of a hole previously drilled, including, but not limited to, mechanical or chemical treatment of any horizon, plugging back to test higher strata, etc.;

(6) "paying quantities" means production in quantities sufficient to yield a return in excess of operating costs, even though drilling and equipment costs may never be repaid and the undertaking considered as a whole may ultimately result in a loss; and

(7) "force majeure" means war, riots, acts of God, unusually severe weather, or any other cause beyond the lessee's reasonable ability to foresee or control and includes operational failure of existing transportation facilities and delays caused by judicial decisions or lack of them.

35. ROYALTY ON PRODUCTION. Except for oil, gas, and associated substances used on the leased area for development and production or unavoidably lost, the lessee shall pay to the state as a royalty 12.50 percent in amount or value of the oil, gas, and associated substances saved, removed, or sold from the leased area and of the gas from the leased area used on the leased area for extraction of natural gasoline or other products.

36. VALUE. (a) For the purposes of computing royalties due under this lease, the value of royalty oil, gas, or associated substances shall not be less than the highest of:

(1) the field price received by the lessee for the oil, gas, or associated substances;

(2) the volume-weighted average of the three highest field prices received by other producers in the same field or area for oil of like grade and gravity, gas of like kind and quality, or associated substances of like kind and quality at the time the oil, gas, or associated substances are sold or removed from the leased or unit area or the gas is delivered to an extraction plant if that plant is located on the leased or unit area; if there are less than three prices reported by other producers, the volume-weighted average will be calculated using the lesser number of prices received by other producers in the field or area;

(3) the lessee's posted price in the field or area for the oil, gas, or associated substances; or

(4) the volume-weighted average of the three highest posted prices in the same field or area of the other producers in the same field or area for oil of like grade and gravity, gas of like kind and quality, or associated substances of like kind and quality at the time the oil, gas, or associated substances are sold or removed from the leased or unit area or the gas is delivered to an extraction plant if that plant is located on the leased or unit area; if there are less than three prices posted by other producers, the volume-weighted average will be calculated using the lesser number of prices posted by other producers in the field or area.

(b) If oil, gas, or associated substances are sold away from the leased or unit area, the term "field price" in subparagraph (a) above will be the cash value of all consideration received by the lessee or other producer from the purchaser of the oil, gas, or associated substances, less the lessee's actual and reasonable costs of transportation away from the leased or unit area to the point of sale. The "actual and reasonable costs of transportation" for marine transportation are as defined in 11 AAC 83.229(a), (b)(2), and (c) – (l).

(c) In the event the lessee does not sell in an arm's-length transaction the oil, gas, or associated substances, the term "field price" in subparagraphs (a) and (b) above will mean the price the lessee would expect to receive for the oil, gas, or associated substances if the lessee did sell the oil, gas, or associated substances in an arm's-length transaction, minus reasonable costs of transportation away from the leased or unit area to the point of sale or other disposition. The lessee must determine this price in a consistent and logical manner using information available to the lessee and report that price to the state.

(d) The state may establish minimum values for the purposes of computing royalties on oil, gas, or associated substances obtained from this lease, with consideration being given to the price actually received by the lessee, to the price or prices paid in the same field or area for production of like quality, to posted prices, to prices received by the lessee and/or other producers from sales occurring away from the leased area, and/or to other relevant matters. In establishing minimum values, the state may use, but is not limited to, the methodology for determining "prevailing value" as defined in 11 AAC 83.227. Each minimum value determination will be made only after the lessee has been given notice and a reasonable opportunity to be heard. Under this provision, it is expressly agreed that the minimum value of royalty oil, gas, or associated substances under this lease may not necessarily equal, and may exceed, the price of the oil, gas, or associated substances.

37. ROYALTY IN VALUE. Except to the extent that the state elects to receive all or a portion of its royalty in kind as provided in Paragraph 38 below, the lessee shall pay to the state that value of all royalty oil, gas, and associated substances as determined under Paragraph 36 above. Royalty paid in value will be free and clear of all lease expenses (and any portion of those expenses that is incurred away from the leased area), including, but not limited to, expenses for separating, cleaning, dehydration, gathering, saltwater disposal, and preparing the oil, gas, or associated substances for transportation off the leased area. All royalty that may become payable in money to the State of Alaska must be paid on or before the last federal banking day of the calendar month following the month in which the oil, gas, or associated substances are produced. The amount of all royalty in value payments which are not paid when due under this lease or the amount which is subsequently determined to be due to the state or the lessee as the result of a redetermination will bear interest from the last federal banking day of the calendar month following the month in which the oil, gas, or associated substances were produced, until the obligation is paid in full. Interest shall accrue at the rate provided in AS 38.05.135(d) or as may later be amended. Royalty payments must be accompanied by such information relating to valuation of royalty as the state may require which may include, but is not limited to, run tickets, evidence of sales, shipments, and amounts of gross oil, gas, and associated substances produced.

38. ROYALTY IN KIND. (a) At the state's option, which may be exercised from time to time upon not less than 50 days' notice to the lessee, the lessee shall deliver all or a portion of the state's royalty oil, gas, or associated substances produced from the leased area in kind. Delivery will be on the leased area, unit area, or at a place mutually agreed to by the state and the lessee, and must be delivered to the State of Alaska or to any individual, firm, or corporation designated by the state.

(b) Royalty oil, gas, or associated substances delivered in kind must be delivered in good and merchantable condition, of pipeline quality, and free and clear of all lease expenses (and any portion of those expenses incurred away from the leased area), including, but not limited to, expenses for separating, cleaning, dehydration, gathering, saltwater disposal, and preparing the oil, gas, or associated substances for transportation off the leased area.

(c) After having given notice of its intention to take, or after having taken its royalty oil, gas, or associated substances in kind, the state, at its option, may elect to receive a different portion or none of its royalty in kind. If, under federal regulations, the taking of royalty oil, gas, or associated substances in value by the state creates a supplier-purchaser relationship, the lessee hereby waives its right to continue to receive royalty oil, gas, or associated substances under that relationship, and further agrees that it will require any purchasers of the royalty oil, gas, or associated substances likewise to waive any supplier-purchaser rights.

(d) The lessee shall furnish storage for royalty oil, gas, and associated substances produced from the leased or unit area to the same extent that the lessee provides storage for the lessee's share of oil, gas, and associated substances. The lessee shall not be liable for the loss or destruction of stored royalty oil, gas and associated substances from causes beyond the lessee's ability to control.

(e) If a state royalty purchaser refuses or for any reason fails to take delivery of oil, gas, or associated substances, or in an emergency, and with as much notice to the lessee as is practical or reasonable under the circumstances, the state may elect without penalty to underlift for up to six months all or a portion of the state's royalty on oil, gas, or associated substances produced from the leased or unit area and taken in kind. The state's right to underlift is limited to the portion of royalty oil, gas, or associated substances that the royalty purchaser refused or failed to take delivery of, or the portion necessary to meet the emergency condition.

**Appendix C: Sample Competitive Oil and Gas Lease**

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Underlifted oil, gas, or associated substances may be recovered by the state at a daily rate not to exceed 100 percent of its royalty interest share of daily production at the time of the underlift recovery.

39. REDUCTION OF ROYALTY. Lessee may request a reduction of royalty in accordance with the applicable statutes and regulations in effect on the date of application for the reduction.

40. EFFECTIVE DATE. This lease takes effect on \_\_\_\_\_.

BY SIGNING THIS LEASE, the state as lessor and the lessee agree to be bound by its provisions.

STATE OF ALASKA

By: \_\_\_\_\_

Director, Division of Oil and Gas

STATE OF ALASKA                )  
                                    )  
                                    ) ss.  
Third Judicial District        )

On \_\_\_\_\_, before me appeared \_\_\_\_\_ of the  
Division of Oil and Gas of the State of Alaska, Department of Natural Resources, and who executed this lease and  
acknowledged voluntarily signing it on behalf of the State of Alaska as lessor.

\_\_\_\_\_  
Notary public in and for the State of Alaska

My commission expires \_\_\_\_\_

LESSEE: \_\_\_\_\_

Signature: \_\_\_\_\_

Printed Name/Title: \_\_\_\_\_

INSERT NOTARY ACKNOWLEDGMENT OF LESSEE'S SIGNATURE HERE.

LESSEE: \_\_\_\_\_

Signature: \_\_\_\_\_

Printed Name/Title: \_\_\_\_\_

INSERT NOTARY ACKNOWLEDGMENT OF LESSEE'S SIGNATURE HERE.

LESSEE: \_\_\_\_\_

Signature: \_\_\_\_\_

Printed Name/Title: \_\_\_\_\_

INSERT NOTARY ACKNOWLEDGMENT OF LESSEE'S SIGNATURE HERE.

