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 whether and 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 habitat 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. A full listing of mitigation measures can be found in Chapter Nine.

This final 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 for the specific activities proposed at specific locations in the lease sale area.

It is important to note that all post-leasing activities are also subject to local, state, and federal statutes, regulations, and ordinances, many 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 will be required by permitting agencies if exploration and development proposals are submitted.

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, freshwater, and marine habitats and fish and wildlife of the lease sale area and uses of these resources. These activities could include seismic surveys related to exploration, development, and production; environmental and other studies; excavation of material sites; construction and use of support facilities such 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 would also have effects.

A. Effects on Air Quality

1. Potential Cumulative Effects

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). 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 is in compliance with both NAAQS and Alaska Ambient Air Quality Standards (AAAQS) for all pollutants and averaging periods (BLM 2008b). In order to ensure maintenance of air quality standards, emissions of nitrogen dioxide, sulfur dioxide, carbon monoxide, ozone, and particulate matter are closely monitored under the provisions of the Prevention of Significant Deterioration Program, which is administered by ADEC (ADEC 2007a).

Oil and gas exploration, development, and production activities may produce emissions that potentially affect air quality. Equipment that could produce pollutants includes boilers, diesel engines, drilling equipment, flares, glycol dehydrators, natural gas engines and turbines, and fugitive emissions (leaks from sealed surfaces associated with process equipment) (MMS 2004a, b).

Greenhouse gas emissions (CO2 and CH4) 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 CH4 emissions from oil and gas operations. Beaufort Sea sources of anthropogenic greenhouse gas emissions represent a negligible contribution ($\leq .02$ percent) to U.S. greenhouse gas emissions (MMS 2008).The Alaskan oil and natural gas industry emitted an estimated 3.0 million metric tons of greenhouse gases statewide in 2005, contributing about 6 percent of the state's total greenhouse gas emissions (Roe et al. 2007). This is a 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).

Air emissions from seismic operations arise primarily from the main engines and generators of the seismic and support vessels. Marine seismic operations would cause only a short-term, local increase in the concentration of criteria pollutants. In addition, because emissions would be from mobile sources, they would be spread over a substantially larger area and are expected to be rapidly dispersed by prevailing offshore winds. The potential impacts to air quality from marine seismic work are considered negligible (MMS 2007c).

On-road and off-road vehicles, heavy construction equipment, and earth-moving equipment would 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 would 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 would 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, would produce emissions (MMS 2008).

Other sources of air pollution include evaporative losses of volatile organic compounds (VOC) from oil/water separators, tanks, pump, compressor seals, and valves. Venting and flaring could be an intermittent source of VOC 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 US 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.

The probability of a gas blowout is considered low. If a gas blowout did occur, it is estimated that it would not persist more than 1 day and that it would release less than 2 tons of volatile organic compounds (MMS 2003b).

Other effects on air quality include possible damage to vegetation, acidification of nearby areas, and atmospheric visibility impacts. Effects could be short term (hours, days, or weeks) or long term (seasons or years), local (near the activity only) or regional (North Slope) (BLM 2005).

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 §§7401-7661), 18 AAC 50, and AS 46.14, are expected to avoid, minimize, and mitigate those potential effects. Therefore, additional mitigation measures are not included.

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 2007). Although the EPA is the primary federal agency responsible for controlling air pollution, monitoring air quality, and inspecting facilities (EPA 2007), many of these authorities in Alaska have been delegated to ADEC under a federally-approved State Implementation Plan (ADEC 2008). 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. 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 (EPA 2008a).

ADEC also operates ambient air quality monitoring networks to assess compliance with the National Ambient Air Quality Standards (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 2008).

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.

B. Effects on Water

1. Potential Cumulative Effects

Potential cumulative effects on marine water quality would probably be due primarily to three factors: discharges of drilling muds, cuttings, and produced waters; increased turbidity from construction of gravel islands and subsea pipeline trenches; and oil spills. Turbidity, which is related to suspended particles in the water column, could increase if pipeline repairs or gravel island or pipeline 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. MMS (2007a) has stated that effects of discharges and offshore construction activities are expected to be short term, lasting as long as the individual activity, and would have the greatest impact in the immediate vicinity of the activity.

Monitoring studies of marine waters near oil and gas facilities in the Beaufort Sea showed that concentrations of Ba, Cu, Cr, Ni, and Pb in Beaufort Sea sediments were not significantly influenced by anthropogenic inputs or diagenetic processes (Trefry et al. 2009). Concentrations of dissolved trace metals such as Fe and Cu in rivers during peak flows were occurring naturally. Concentrations of dissolved As, Cr, and Pb were well below EPA water quality criteria, and no significant differences were found between concentrations of dissolved trace metals near Northstar Island and the overall study area. Differences in concentrations of particulate metals were not found, with the possible exception of Pb in one year of the study (Trefry et al. 2009).

Onshore 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. Operations are restricted to winter.

Seismic equipment, other than vessels, must not enter open-water areas of a watercourse during winter, and any roads, bridges, or approach ramps constructed near river, slough, or stream crossings must be free of extraneous material before breakup. Alterations of the banks of a watercourse are prohibited. Adherence to these conditions avoids or minimizes post-seismic increases in erosion, turbidity, and suspended solids in a drainage area.

Marine water quality could be affected by accidentally spilled lubricating oil or diesel fuel from vessels and equipment associated with seismic survey operations. MMS concluded the effect of spilling a few barrels or gallons probably would be un-measurable. MMS assessed the effects of a 1,000-bbl spill, concluding that the effects would be low regionally, but moderate locally (MMS 2007b).

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 2007b). Under standard ADNR permit conditions for off-road activity, fuel and hazardous substances must have secondary containment apparatuses. A 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 (ADGC 1995). 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 (ADGC 1995).

The federal Clean Water Act established National Pollutant Discharge Elimination System (NPDES) permits to regulate discharges of pollutants into U.S. waters by "point sources," such as industrial and municipal facilities. Administration of NPDES permits is being transferred from EPA to ADEC over a three-year time period. Permits are designed to maximize treatment and minimize harmful effects of discharges as water quality and technology improvements are made. ADEC certifies that these discharge permits will not violate the state's water quality standards.

ADEC also certifies U.S. Army Corps of Engineers permits to dredge and fill wetlands and navigable waters, to ensure compliance with state water quality standards.

ADEC issues industrial and municipal wastewater permits and monitors wastewater discharges and the water quality of water bodies receiving the discharges. ADEC certifies federal wastewater permits with mixing zones that allow industrial and municipal facilities to meet state water quality standards. Industrial and municipal wastewater facilities are inspected annually. ADEC provides technical assistance for design, installation, and operation of industrial and municipal wastewater systems.

Drilling Muds and Produced Water: Improperly disposed 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 aquatic life, including fish and benthic organisms (Olsgard and Gray 1995). Effects could be lethal, or sub-lethal effects could subtly reduce or impair physiological and reproductive fitness (Davis et al. 1984). Sedentary animals, such as oysters, clams, and mussels, are more susceptible to releases of petroleum products than fish and shellfish such as crabs and shrimps, which are capable of active avoidance (Davis et al. 1984). MMS monitoring in the Beaufort Sea has determined that drilling sites have not accumulated hydrocarbons or heavy metals; amphipods and clams analyzed at Northstar and other coastal Beaufort Sea sites showed no differences (MMS 2003b). Oil spills or impairments to water quality could have detrimental effects on mariculture industries (ADF&G 2007). Type and extent of effects depend 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 the chemical, and use of counteracting or dispersing agents (Davis et al. 1984). Cumulative impacts from exploration and development activities could adversely affect water quality; however, the impacts are expected to be local and temporary because of dilution, settling, and other natural altering and regenerative processes (MMS 2008).

Byproducts of drilling and production activities include muds and cuttings, produced water, and associated wastes. During drilling and after a well is in production, water comes to the surface mixed with oil and gas and must be separated before further refining. Drilling employs the use of carefully mixed fluids, called muds. Cuttings are small fragments of rock up to an inch across that are dislodged and carried to the surface by drill muds. Drilling muds are mostly water-based mixtures of clay and other earthen materials, such as almond husks, which are used to cool and lubricate the drilling bit, facilitate the drilling action, flush out cuttings within the well bore, seal off cracks in down-hole formations to prevent the flow of drilling fluids into these formations, and maintain reservoir pressure. Chemicals may be added to maximize the effectiveness of drilling and casing. 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). According to a 1993 EPA report, the use of water-based muds generates 7,000 to 13,000 barrels of waste per well. Depending on the depth and diameter of the well, 1,400 to 2,800 of these barrels are cuttings. Oil-based mud volumes are generally used less than water-based muds, because they are more efficient, may be reconditioned, reused, and re-sold. Technological advances in drilling mud systems have developed mud systems less toxic to the environment (NRC 2003). Newer synthetic-based muds produce even less waste, improve drilling efficiency, are reusable, and have advantages in environmental protection over oil or water-based muds (Wojtanowicz 2008). Synthetic muds are more expensive and are typically reconditioned instead of discharged (BLM 2008b). Discharge of untreated oil-based muds into any water column violates federal and state pollution laws.

Produced water contains naturally occurring substances such as clay, sand, oil, water, and gas. These substances are found in the subterranean strata. Produced waters are usually saline with some level of hydrocarbons. 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. Like drilling muds, chemicals may be added to produced water to remove harmful bacteria, halt corrosion, break up solids, prevent buildup of scale, and break oil/water emulsions (EPA 1995).

Most drilling wastes from onshore and nearshore operations are disposed of under ADEC's solid waste disposal program. Re-injection is the preferred method for disposal of drilling fluid. 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.

The AOGCC ensures proper and safe handling and disposal of drilling wastes. The AOGCC functions as the regulatory agency overseeing the underground operation of the Alaska oil industry on private and public lands and waters. The commission administers the Underground Injection Control (UIC) Program for oil and gas wells, acts to prevent waste of oil and gas resources and ensure maximum recovery, and protects subsurface property rights. All disposal wells inject fluids deep beneath any drinking water aquifers.

2. Mitigation Measures and Other Regulatory Protections

Although oil and gas activities subsequent to leasing could potentially have cumulative effects on marine habitats, fish, and wildlife, measures in this final 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.

For example, because of the potential effects discussed above, effluents discharged by the oil and gas industry into marine waters of the Beaufort Sea are regulated through EPA's NPDES program (see Chapter Seven). This program, which covers a broad range of pollutants, ensures that state and federal clean water quality standards are maintained by requiring a permit to discharge wastes into U.S. waters (EPA 2008b). 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 2008a). Therefore, marine fish, mammals, 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.

Mitigation measures included in this best interest finding which address water quality include: protection of wetland, riparian, and aquatic habitats, prohibitions of discharges into marine waters, turbidity reduction, water quality monitoring, stream buffers, and water conservation. A complete listing of mitigation measures is found in Chapter Nine.

C. Effects on Lower Trophic-Level Organisms

1. Potential Cumulative Effects

Organisms near the bottom of the food chain include marine plankton, shellfish, marine invertebrates, and terrestrial vegetation. Some oil and gas activities may affect the viability, distribution, reproduction, and abundance of these creatures, which may in turn affect species that feed on them. Habitat protection measures are designed to avoid, minimize, or mitigate adverse effects from potentially harmful oil and gas activities.

Seismic Surveys: Seismic surveys are expected to have little or no effect on plankton, because the energy sources (airguns) do not appear to have any adverse effect on this group of organisms. In general, even high explosives have had relatively little effect on marine invertebrates. Airguns also were shown to have no lethal effect on caged oysters placed close to the airguns. The use of ocean-bottom cable seismic arrays has the potential to cause harm, although the effect, if any, would probably not be measurable. Seismic activities are, therefore, expected to have little or no effect on lower trophic level organisms (MMS 2008).

Drilling and Production Discharges: The types of materials discharged while drilling include drilling muds and cuttings. During production, the main discharge is produced waters. These discharges may contain small amounts of hydrocarbons and create plumes of material that disperse rapidly in the water column. In most continental shelf areas, most drilling muds and cuttings land on the sea bottom within 1,000 m of the discharge point. The effect of drilling discharges on lower trophic-level organisms appears to be restricted to benthic organisms living nearest to the discharge source. There is no evidence of effects on plankton from drilling muds (MMS 1998). Other than those caused by permitted discharges and physical alterations or addition of structures, there have been few measurable effects on marine invertebrate communities from oil exploration and production operations in the region (NRC 2003).

Discharge of produced waters into open or ice covered waters less than 33 ft is prohibited; nearly all of the lease sale area lies in waters shallower than 33 ft. In areas deeper than 33 ft, the commissioner of ADEC may approve discharges on a case-by case basis. MMS estimates that drilling discharges would affect less than 1 percent of benthic organisms and none of the plankton. Effects would mostly be sublethal, but some benthic organisms would be killed (MMS 2003b). Muds and cuttings from exploratory wells are typically discharged onto sea ice. This silty material, similar to riverine overflow sediments, may block sunlight and reduce photosynthesis of plankton in the water column. The area of impact would be limited to the immediate vicinity of the drill site, or where the ice melted when cuttings are carried out to sea with drifting ice after spring break-up.

Permitted drilling discharges are estimated to adversely affect less than 1 percent of the benthic organisms in the lease sale area. These organisms likely would recover within a year. In the unlikely event that a large oil spill occurs, it is expected to be lethal for less than 1 percent of the planktonic organisms and, assuming a winter spill, less than 5 percent of the epontic organisms in the vicinity. Recovery of plankton would likely occur within 2 weeks (MMS 2003b).

Disturbance: Offshore construction typically involves the placement of bottom-founded production platforms and laying pipe. These activities normally would affect only benthic invertebrates and marine plants in the immediate vicinity. Construction is expected to have little or no effect on phytoplankton or zooplankton communities. However, dredging can affect benthic invertebrates and marine plants by physically altering the benthic environment, increasing sediments suspended in the water column, and killing organisms directly through mechanical actions.

Recovery time assumes that populations are stable or increasing at the time of impact. For those populations that may be declining, recovery to pre-development conditions may take longer. Population level (Beaufort wide) effects from construction of gravel islands and pipelines and from caisson use on lower trophic-level communities are very unlikely because of the relatively small area directly affected. Construction of gravel islands has had a short-term (1 to 2 years) affect on some benthic organisms near islands or dredging sites (MMS 1996). Platform and pipeline construction is estimated to adversely affect less than 1 percent of the immobile benthic organisms in the lease sale area (MMS 2003b). Recovery likely would occur within a decade (MMS 2008). Kelp communities likely would colonize and slowly benefit from newly constructed gravel islands (MMS 2003b).

Gravel islands may be constructed in the nearshore zone off river deltas, in areas of high deposition. During high flow periods, the Colville and Sagavanirktok River delta systems transport and deposit large volumes of sediment in the nearshore environment. The sedimentation and turbidity caused by gravel island construction would be nearly undetectable against the naturally high sediment load in the Colville River delta system (BLM 2004). The greatest effects on water turbidity that construction may have would be during clear water phases, which occur during frozen conditions.

Increased turbidity can affect biological productivity by preventing sun light from penetrating the water column. During the winter, ice, temperature, and lack of sunlight are more influential in affecting biological productivity than water turbidity. During construction of gravel islands, benthic creatures may be buried and affected by the down current sediment plume. Factors affecting sedimentation are current speed, construction materials, and depth of water. It was concluded that, at distances beyond 100 m from an island, it would be difficult to detect differences in sedimentation volume between gravel island construction and natural sedimentation in the area. The increased turbidity from permitted construction activities would be local and short term (MMS 2003b).

Ice roads and pads cause depressions in microtopography due to compaction. The thaw depth in summer increases, as does wetness due to compression. Ice roads compress and shear tussocks, which may take up to 4 years or more to recover. Ice road and pads also affect tundra regeneration, with certain species recovering faster after summer melt than others. Vegetation should recover within three seasons following melt. Ice road thaw depths return to pre-impact levels after several years (Yokel et al. 2007).

Natural Gas Development: If a natural gas blowout occurred, some marine invertebrates in the immediate vicinity might be killed. Natural gas and condensates that did not burn in the blowout would be hazardous to any organisms exposed to high concentrations. A plume of natural gas vapors and condensates would be dispersed very rapidly from the blowout site, but is not expected to be hazardous for greater than 1 kilometer downwind or for greater than one day. Activities associated with laying a gas pipeline would have localized effects on marine organisms. Mobile organisms such as adult crabs are expected to have virtually no adverse effects; however, longer-term but extremely localized effects over a small area are possible for immobile benthic organisms, such as clams. In some instances, the alteration of the benthos by laying pipe could enhance habitat for some lower trophic level organisms. Natural gas exploration and/or development in the Beaufort Sea are expected to have little to no effect on lower trophic-level organisms (MMS 1998).

Oil Spills: The effects of spilled oil on phytoplankton, zooplankton, and benthic communities range from lethal to sublethal. Adverse effects are expected to be greater in areas where water circulation is reduced, such as bays and estuaries. Phytoplankton would regenerate rapidly (9 to 12 hours) limiting any effect on phytoplankton communities and animals at higher trophic levels. Zooplankton communities experience short-lived effects from oil and appear to recover rapidly due to their wide distribution, large numbers, and rapid rate of regeneration (MMS 1996). If oil entered the substrate, some specie communities may require years to recover, and may be completely replaced by more hydrocarbon-tolerant specie communities.

In cases where studies have been conducted following an oil spill, a lack of substantial adverse effects on phytoplankton populations from spilled oil is common. Even if it is assumed that large numbers of phytoplankton are contacted by an oil spill in an open-ocean area, regeneration time (9-12 hours) and rapid replacement are expected to prevent any major effect on phytoplankton communities. Further, vertical distribution of most phytoplankton in the water column typically is below the area were they would be adversely affected by spilled oil. For these reasons, a large oil spill is not expected to have significant effects on phytoplankton. Recovery likely would occur within a month (within a year where water circulation is significantly reduced) (MMS 2003b).

There is no traditional intertidal zone in the Beaufort Sea. This is due to the annual pre-dominance of shorefast ice, which restricts marine plant life and most fauna along the shoreline. Nonetheless, marine plants do exist subtidally at a few locations in the Beaufort Sea, most notably at the Boulder Patch. The estimated effect of a large oil spill on subtidal marine plants in the Beaufort Sea area depends on the type and amount of oil reaching them. However, the only type of oil that can reach marine plants in the subtidal zone (most are 5 to 10 m deep) would be highly dispersed oil having no measurable toxicity due to heavy wave action and vertical mixing. The amount and toxicity of oil reaching subtidal marine plants is expected to be so low as to have no measurable effect on them (MMS 1998).

2. Mitigation Measures and Other Regulatory Protections

Although oil and gas activities subsequent to leasing could potentially have cumulative effects on lower trophic organisms, 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, because of the potential effects discussed above, effluents discharged by the oil and gas industry into marine waters of the Beaufort Sea are regulated through EPA’s NPDES program (see Chapter Seven). This program, which covers a broad range of pollutants, ensures that state and federal clean water quality standards are maintained by requiring a permit to discharge wastes into the nation’s waters (EPA 2008b). 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 2008a). Discharge of produced waters in marine waters less than ten meters deep is prohibited; most waters in the lease sale are shallower. The commissioner of ADEC may approve discharges into waters greater than ten meters in depth after a case-by-case review of environmental factors and consistency with the conditions of a state-certified development and production phase NPDES permit. Furthermore, lessees must have an approved oil discharge prevention and contingency plan (C-Plan) before commencing operations. A complete listing of mitigation measures and other regulatory protections is found in Chapter Nine.

D. Effects on Land Habitat

1. Potential Cumulative Effects

Although this is primarily an offshore sale, a very small amount of sale lands lie onshore between the Colville and Canning rivers. During oil and gas development and production, various activities could impact vegetation in the lease sale area. These activities include construction and use of gravel pads, staging areas, roads, airstrips, and pipelines, excavation of material sites, and construction of ice roads and ice pads.

Transportation: Winter seismic surveys can affect tundra vegetation, depending on snow depth, vehicle type, traffic pattern, and vegetation type. Camp-move trails disturb vegetation more than seismic trails. Multiple vehicles in a single narrow trail cause more disturbance than dispersed tracks. Trails in shrub-dominated tundra recover slower than other vegetation types (Jorgenson and Martin 1997).

Seismic Surveys: Seismic surveys can compress microtopography, resulting in a wetter microenvironment and decreased vegetation cover of upright shrubs (willows), lichens, and mosses. Winter seismic trails have little adverse effect on, and may possibly enhance growth of, *C. aquatalis* and *E. angustifolium* due to the resulting wetter microenvironment (Noel and Pollard 1996, citing to Felix and Raynolds, 1989). Effects could be substantial if operations are conducted improperly. Vehicles can leave visible tracks in the tundra that should disappear with the recovery of the vegetation within a few years. Vehicles using tight turning radii have sheared off upper layers of vegetation, but left rhizomes intact, so those plants should recover. Dry, snowless ridges and vegetated sand dunes are at higher risk of damage. Damage to vegetation can be avoided by limiting travel to areas with at least 6 inches of snow cover, and avoiding minimum radius turns. In areas where damage is extensive and natural recovery not expected, restoration may be required of operators (DO&G 1996).

Overland moves and seismic surveys could alter the thermal balance, and increase the risk of thermokarsting, which is an irregular land formation due to the uneven melting of permafrost. The increase of thermokarsting, gullying, and sedimentation could impact other resources and land uses; for instance, surface travel could become more difficult. Soil erosion would increase and, in turn, disturb vegetation; therefore, the most effective mitigation would be to keep areas of disturbance as small as possible (BLM 2005).

Observations by the BLM and others (NRC 2003) indicate that short-term, transitory impacts to the tundra by seismic surveys can be estimated at about 1 percent of the seismic line mileage conducted during a winter season. Long-term impacts due to thermokarst are estimated at about 1 percent of the short-term impacts. Thus, modern-day seismic equipment has minimal impact to the tundra and a limited role in causing thermokarst. Limiting land seismic surveys to areas with adequate snow cover would greatly reduce the potential for thermokarst and long-term impacts to the tundra (BLM 2005). Based on earlier studies there should be no long-term impacts to vegetation from seismic lines (BLM 2005).

Drilling and Production Discharges: 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 reinjected into the subsurface at an approved injection well. All production muds and cuttings on the North Slope are reinjected into a Class II injection well. All produced waters are reinjected either into the producing formation to enhance recovery or into an injection well. The Underground Injection Control program is administered by AOGCC. Drilling and production discharges are expected to have no impact on tundra habitat.

Construction and Gravel Infilling: Effects of constructing pads, roads, and pipelines include direct loss of acreage due to gravel infilling, and loss of dry tundra habitat due to entrainment and diversion of water. A secondary effect of construction activities includes dust deposition, which may reduce photosynthesis and plant growth.

While rehabilitation methods for gravel pad and roads vary depending on site-specific conditions, the overall goal of rehabilitation in the existing oil fields is to create a mosaic of moist meadows, sedge meadows, and grass marshes.

Development in the Prudhoe Bay and Kuparuk areas has directly affected about 9,500 acres because of gravel excavation and filling and indirectly affects many adjacent acres. The total affected acreage is a small part of the Arctic Coastal Plain, and cumulative effects probably are not significant to the overall productivity of tundra plants in this area (MMS 2008).

Gas Blowouts: If a natural gas blowout occurred, plants in the immediate vicinity could be destroyed. Natural gas and condensates that did not burn in the blowout would be hazardous to any organisms exposed to high concentrations. Insects such as mosquitoes would also be affected or killed by a gas blowout. A plume of natural gas vapors and condensates would be dispersed very rapidly from the blowout site, but is not expected to be hazardous for more than 1 kilometer downwind or for more than one day. Impacts to vegetation from pollutants would likely not substantially alter the plant communities in the lease sale area (BLM 2005).

Oil Spills: Spills can have toxic effects on soil productivity, depending on the season. Soils can also be impacted by compaction and thermokarst during cleanup activities. Oil spills of any size would affect soils by altering vegetation. The oil alone would decrease plant growth, but would leave the surface organic mat intact. Spill cleanup would be more likely to damage soils (BLM 2007).

In the March 2006, severe corrosion in a BP transit pipeline caused more than 6,357 bbl of oil to leak onto almost 2 acres of tundra. The spill resulted in a $6 million cleanup (see Chapter Six). ADEC officials believe the environmental damage to the tundra was minimal (ADN 2006a).

Fungi are important decomposers of organic material in tundra soil. Large numbers of fungi have been found in association with a natural oil seep at Cape Simpson. Under the right conditions involving oxygen, temperature, moisture in the soil, and the composition of the crude being spilled, bacteria assist in the breakdown of hydrocarbons in soils. Petroleum-contaminated soils are commonly treated with fertilization, raking, and tilling (bioremediation).

2. Mitigation Measures and Other Regulatory Protections

Oil and gas activities subsequent to leasing could potentially have cumulative effects on land habitat. 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, impacts to important wetlands must be minimized, exploration facilities, including exploration roads and pads, must be temporary and must be constructed of ice, the preferred method for disposal of muds and cuttings from oil and gas activities is by underground injection. Impermeable lining and diking, or equivalent measures, will be required for reserve pits. New solid waste disposal sites will not be approved or located on state property during the exploration phase. A complete listing of mitigation measures is found in Chapter Nine.

E. Effects on Fish

1. Potential Cumulative Effects

Major anadromous streams within the lease sale area, or that drain into the Beaufort Sea, include the Colville, Sagavanirktok, Shaviovik, Kavik, Canning, and Kadleroshilik Rivers. Numerous other rivers and streams that flow through the sale area also support anadromous fish populations. Several species of anadromous fish spawn and overwinter in these rivers and during summer migrate to nearshore coastal waters of the sale area 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, facility siting, and water removal; impediments to migration; and fish kills due to oil spills.

Habitat Loss: 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. Streambeds could be affected if stream banks are altered, such as in cases of damage from equipment crossings. Overwintering habitat may be limited; the Colville River provides the most consistently available overwintering habitat for anadromous fish in the lease sale area.

Withdrawal of water from lakes and ponds could affect fish overwintering habitat by entraining juvenile fish, lowering water levels, and increasing disturbance. The construction of roads across rivers and streams may also affect the ability of fish to reach overwintering areas by blocking movement and causing direct loss of overwintering habitat. Blockage of movement could also occur from the improper installation of culverts in streams for permanent roads.

If it was unregulated, gravel removal from fishbearing 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. Alternatively, gravel mine sites can be restored as overwintering habitat and thus add to total available fish habitat.

Removal of water from lakes 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.

Seismic Activities: The principle impact attributed to seismic surveys involves the acoustic-energy pulses emitted by airguns. These energy sources may damage or kill eggs, larvae, and fry of some fishes occurring in close proximity to an airgun, but the harm generally is limited to within 5 m (15 ft) of the airgun and is greatest within 1 m (3 ft). Airguns are unlikely to cause immediate deaths of adult and juvenile marine fishes. Overall, the available scientific and management literature suggests that mortality of juvenile and adult fish, the age-classes most relevant to future reproductive fitness and growth, likely would not result from seismic-survey activity. MMS anticipates any injury to adult and juvenile fish to be limited to a small number of animals (MMS 2007b). Fish distribution and feeding behavior can be affected by the sound emitted from airguns and airgun arrays. Normal fish behavior likely returns when the airguns are turned off. Effects from seismic activity on marine and freshwater fish, in both the exploration and development stages, would be low (MMS 2003b).

Shockwaves from explosions can also shock and jar fish eggs at sensitive stages of development. These types of impacts are mitigated by restricting the use of explosives in close proximity to fishbearing lakes and streams. Mitigation measures are considered by DO&G on a case-by-case basis as a condition for obtaining a geophysical exploration permit. Mitigation measures to protect fish eggs may include limiting the timing of seismic work. Other restrictions may include requiring that seismic activities be set back from freshwater fish spawning areas so that shockwaves are reduced to safe levels before reaching incubating eggs during sensitive stages of development. Seismic surveys are not expected to have any measurable effect on Arctic fish populations (BLM 2005).

Vessel traffic may disturb some fish resources and their habitat during operations. However, vessel noise is expected to be chiefly transient; fishes in the immediate vicinity of such vessels are believed likely to avoid such noise perhaps by as much as several hundred meters. Vessel noise is likely to have negligible impact to fish resources (MMS 2007a).

Additional disturbance agents involve the introduction of hydrophone arrays towed or suspended in the ocean or placed on the seafloor. Seismic surveys typically cover a relatively small area and only stay in a particular area for hours, thereby posing transient disturbances. Adverse effects to the migration, spawning, and hatchling survival of fish most likely would be temporary and localized, and only a moderate level of disturbance or displacement would occur (MMS 2007a).

Causeways: Continuous-fill causeways are prohibited. Though remote, the possibility of needing a causeway into the nearshore Beaufort Sea to support development in portions of the lease sale area does exist. Placement of causeways, particularly continuous-fill causeways into the nearshore Beaufort Sea or in river deltas, can alter patterns of nearshore sediment transport, alter patterns of water discharge to the nearshore environment, and alter temperature and salinity regimes in areas near the causeway. The extent of alterations depends on the size or length of the causeway, its location relative to nearby islands and river mouths or deltas, and pre-causeway oceanographic characteristics. Minimizing alterations is accomplished by proper siting, minimal size, and by ensuring that breaches are sized and located to maximize goals. Changes to the physical environment may alter patterns of use of the deltaic area by anadromous and marine fishes. Changing marine current flow and circulation patterns result in physical changes to delta channeling and shorelines which could affect use by animals which feed on fish, such as shorebirds and waterfowl (ADF&G 1996).

Any gravel structure that obstructs the natural migratory corridor near river mouths has the potential to adversely affect anadromous fish. Altering temperature and salinity in nearshore waters may affect the distribution and abundance of organisms upon which fish feed. For these reasons, continuous-fill causeways are prohibited. Many designs, although ideal for field development, are unsuitable for the nearshore environment. Additionally, significant alterations of the shoreline or changes to natural temperature and salinity patterns are prohibited. Overall, the construction of non-continuous-fill causeways is not expected to have a measurable effect on fish populations in and adjacent to the lease sale area(BLM 2005).

Gas Blowouts: If a natural-gas blowout occurred, some fish in the immediate vicinity might be killed. Natural gas condensates that did not burn in the blowout would be hazardous to any organisms exposed to high concentrations. A plume of natural gas vapors and condensates would be dispersed very rapidly from the blowout site but is not expected to be hazardous (MMS 1998).

Discharges and Oil Spills: 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). Sedentary animals, such as oysters, clams, and mussels, are more susceptible to releases of petroleum products than fish and shellfish such as crabs and shrimp, which are capable of active avoidance (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).

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 would depend on many factors, including the time of year, size of the spill, and water body affected. Potential adverse effects include direct mortality from oiling of the gills, mortality of prey species, mortality from consumption of contaminated prey, and blockage of movement or displacement from important habitats. Mortality of egg and larvae could occur in spawning or nursery areas. Sublethal effects may also reduce fitness and impair an individual's ability to endure environmental stress. Effects of oil spills during the winter would be expected to be negligible, but could be more significant during the open-water season, depending on the site-specific conditions. Mitigation measures to protect fish and eggs from an oil spill include: siting facilities away from fishbearing streams and lakes, development of oil spill contingency plans, and providing adequate spill response training. Oil spills are not expected to have a measurable effect on freshwater or anadromous fish populations within and adjacent to the lease sale area (BLM 2005). The effects of an oil spill would be moderate because, in most cases, salmon likely would recover within one generation. One year of salmon smolt would be affected, and salmon populations would expect to recover (MMS 2003b).

2. Mitigation Measures and Other Regulatory Protections

Oil and gas activities subsequent to leasing could potentially have cumulative effects on uses of fish populations. 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. AS 16.05 requires protection of documented anadromous streams from disturbances associated with development. Use of continuous-fill causeways is prohibited. Disposal of wastewater into freshwater bodies is prohibited unless authorized by an NPDES permit. A complete listing of mitigation measures is found in Chapter Nine.

F. Effects on Birds

1. Potential Cumulative Effects

The principal sources of potential adverse effects to birds in the Beaufort Sea and onshore areas of the lease sale include habitat loss; seismic surveys; disturbance from vessel presence and noise; aircraft presence and noise; and oil spills.

Habitat Loss: Habitat loss occurs as facilities are developed, covering tundra habitats used by birds for nesting, foraging, broodrearing, and molting. Hundreds of acres of North Slope bird habitats have been filled by oil and gas infrastructure (fill pads, pipelines, roads, gravel pits, etc.), as well as community development (residences, schools, airports, roads, landfills, etc.). While some species may have or will benefit from wetter or drier habitats near these facilities, evidence suggests that many birds avoid using habitats near these developments and the human activities they support. For example, regular vehicle traffic on roads could permanently displace nesting birds near the development (MMS 2008). Secondary effects, including changes in drainage patterns, thermokarst, deposition of dust, and disturbance associated with activity on roads, can displace additional individuals. Shorebird densities are lower near roads and, but higher on the leeward sides of roads suggesting that dust shadows could create conditions attractive to shorebirds (MMS 2008). Collision of birds with manmade objects may occur (Day et al. 2003).

Shorebird populations have probably been affected by the loss in food supply caused by contamination of wetlands by reserve pits. However, because reserve pits are no longer used for disposal of drilling waste and because existing reserve pits are being emptied, the outlook is improved (NRC 2003).

Seismic Activities: Most seismic surveys to collect geological data and exploratory drilling would occur during the winter months when birds are mostly absent from the lease sale area. Birds displaced by seismic activities would likely return to preferred habitats after the airgun arrays passed through the area. Disturbance to birds near the shoreline could result from support activities such as use of helicopters to transport personnel and supplies. Disturbance related to support activities could result in permanent or temporary displacement from nesting, feeding, or brood-rearing habitats.

Conducting support activities after the completion of the nesting and broodrearing periods would eliminate nest abandonment and loss of productivity (BLM 2005).

Seismic surveys by vessel and air traffic have a potential to affect marine and coastal birds, however the increased potential for impacts is not expected to be significant. There may be localized, temporary displacement and disruption of feeding for some offshore species, but any cumulative adverse impacts to marine birds would be negligible. Aircraft needed to support seismic-survey vessels and possibly to conduct aerial monitoring for marine mammals would be a relatively small addition to existing commercial air traffic servicing local communities. No adverse cumulative impacts to marine birds are anticipated from air traffic required to support seismic-survey activities or related aerial monitoring. (MMS 2007b).

Disturbance: How waterfowl and marine birds respond to vessel presence and noise disturbances can vary widely depending on the species, time of year, disturbance source, habituation, and other factors. Vessels might disturb waterfowl and marine birds that are foraging or resting at sea or, in the case of a few species, molting at sea. It appears that in some species of waterfowl, the distance at which disturbances will be tolerated varies depending on flock size, because larger flocks react at greater distances than smaller flocks. There is an energetic cost to moving away from a disturbance as well as a cost in terms of lost foraging opportunities or displacement to an area of lower feeding availability (MMS 2008).

Disturbance is most likely to have an impact during those periods of the annual cycle 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. Frequent disturbance could result in energy expenditures that prolong the molt beyond the ice-free period or decrease the amount of stored energy reserves available for winter survival (MMS 2008).

Low-level helicopter or other aircraft traffic could adversely affect birds on the North Slope and coastal areas by displacing adults and/or broods from preferred habitats during prenesting, nesting, and broodrearing and migration; displacing females from nests, exposing eggs or small young to inclement weather or predators; and reducing foraging efficiency and feeding time. Aircraft flights could force large numbers of birds to interrupt feeding. (MMS 2008).

Some birds may be able to tolerate aircraft noise. The behavioral response of eiders to low-level aircraft flights is variable; some spectacled eiders nest and rear broods near the Deadhorse airport. Individual tolerances are expected to vary, however, and the intensity of disturbance, in most cases, would be less than that experienced by birds at the Deadhorse airport. Some birds may be displaced, with unknown physiological and reproductive consequences (MMS 2008).

Helicopter and fixed-wing aircraft operating at low altitudes have the potential to flush birds into the path of the aircraft, where a collision could occur. While such strikes are relatively rare, aircraft/bird collisions threaten the safety of aircraft/passengers. Migrating birds colliding with vessels have been well documented. These are usually caused by weather conditions such as storms associated with rain, snow, icing, and fog or low clouds (MMS 2008).

The level of impacts depends on the location and extent of facilities. However, once exploration and development or production ceases in an area, bird populations could recover from the effects of disturbance, reducing overall effects (BLM 2005).

Gas Blowouts: In the event of a natural gas explosion and fire, birds in the immediate vicinity could be killed. Blowouts of natural gas condensates that did not burn would be dispersed very rapidly at the blowout site. Thus, it is not likely that toxic fumes would affect birds or their food sources except those very near to the source of the blowout (MMS 1996). Any accidental release of oil or gas could be intentionally ignited during cleanup. Burning could affect air quality in two ways. For a gas blowout, burning would reduce emissions of gaseous hydrocarbons by 99.98 percent and slightly increase emissions of other pollutants (MMS 2008).

Oil Spills: Bird deaths due to oil spills arise from exposure from wetting and loss of thermoregulatory ability, loss of buoyancy, or from matted plumage and inability to fly or forage. Alcids and sea ducks are highly vulnerable to oil spills, because they spend most of their time on the sea surface and aggregate in dense flocks. Fouled plumage is the primary cause of mortality and stress in oiled birds. Oil causes marked loss of insulation, waterproofing, and buoyancy in the plumage. Oiled feathers lose their ability to keep body heat in and cold water out, and resultant hypothermia can kill birds. Waterlogging and loss of buoyancy can rapidly lead to drowning (MMS 2008).

Inhalation of highly concentrated petroleum vapors can lead to inflammation and damage of the mucous membranes of the airways, lung congestion, emphysema, pneumonia, hemorrhage, and death. If a bird were unable to leave the immediate area of the source of the spill or were confined to a contaminated lead or bay, it could inhale enough vapors to cause some damage. Birds away from the immediate spill area or exposed to weathered or residual oils would not be expected to suffer any adverse effects from vapor inhalation (MMS 2008).

Oil contains many toxic compounds that can have fatal or debilitating effects on birds when ingested. The major route by which birds would be expected to ingest oils is by preening it off their feathers after exposure. These same toxic compounds could be absorbed through the skin. Additionally, food may be contaminated either directly or by hydrocarbons within the food chain. Food resources used by birds could be displaced from important habitats or be reduced following a petroleum spill. Benthic habitats that support marine invertebrates, however, would not be expected to experience substantial adverse effects following a spill (MMS 2008).

2. Mitigation Measures and Other Regulatory Protections

Oil and gas activities subsequent to leasing could potentially have cumulative effects on birds. Most of these potential effects would likely occur as secondary effects from effects on habitat. 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. If oil development occurs, some alteration of bird habitat can be expected. However, with state and federal government oversight, any activities within the lease sale area should not prevent overall bird population levels from remaining at or near current levels. Specific mitigation measures require permanent, staffed facilities to 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. 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.” A complete listing of mitigation measures is found in Chapter Nine.

G. Effects on Caribou

1. Potential Cumulative Effects

Although this is primarily an offshore sale, a very small amount of sale lands lie onshore between the Colville and Canning Rivers. In addition, according to ADF&G, caribou will occasionally stand in water when insects are particularly bad and sometimes have been reported on the barrier islands. Most caribou studies and analysis consider impacts to caribou onshore, especially to the Central Arctic Caribou Herd, which uses the North Slope area most affected by oil industry exploration and development. These studies have been included in this finding to cover the small amount of acreage on which caribou could be found. Post-sale activities have the potential to affect caribou of the Western Arctic, Teshekpuk, Central Arctic, and the Porcupine herds. Caribou from each herd may pass through the small amount of uplands in the lease sale area, especially when they seek relief from insect harassment each summer.

The principal herd using onshore lands in the lease sale area is the Central Arctic herd, although other caribou may use the area as well. The caribou herds that use the North Slope have grown over the last 30 to 40 years, although there have been cyclical declines. In 1970, the Western Arctic herd numbered about 242,000 caribou, declined to about 75,000 animals in 1976 (MMS 2008). Since then the herd has grown to about 401,000 caribou (MMS 2008). The Teshekpuk Lake herd's population has ranged from 11,822 in 1984 to 45,166 in 2002 (BLM 2008b). The Central Arctic herd has also grown, from 5,000 in 1975 to about 31,857 in 2002 (MMS 2008). The Porcupine herd, in ANWR and away from the oil industry complex in the central North Slope, may be declining; it numbered 100,000 in 1972, increased to 178,000 in 1989 and has declined since then (MMS 2008).

Research regarding the effects of North Slope industrial development on caribou herds has been contentious. Although much research has been conducted on caribou in the region, researchers have disagreed over the interpretation and relative importance of some data and how serious data gaps are (NRC 2003; Cameron et al. 2005; Haskell et al. 2006; Joly et al. 2006). Since 1975, government and industry have conducted research on caribou biology and on various aspects of their interaction with North Slope oil and gas developments. Population characteristics (calf production and survival, and adult mortality), habitat use, movement and distribution, and behavioral responses of caribou to oil and gas developments have been widely studied. Some researchers think caribou have become habituated to the presence of development (Haskell et al. 2006). Some researchers think populations (reproduction and viability) are subject to natural cycles in the ability of the land to support large numbers of caribou (carrying capacity), while others think caribou numbers are influenced by many factors, such as disease, nutrition, predator abundance (including insects), and weather. "Demonstrating cause-and-effect relationships between resource extraction and wildlife populations is complicated by natural variation in caribou behavior, population trends, habitat selection, and climate. Detection of potential industrial impacts to the CAH [Central Arctic herd] has been further hampered by insufficient long-term distributional data collected prior to surface development." (Person et al. 2007:239) Nonetheless, some studies show that local distribution and behavior of caribou are influenced by infrastructure and human activities within producing oil fields.

Potential impacts can occur at all phases, but most are likely to occur during development and production. Adverse effects are discussed below. Potential effects to caribou populations from the sale include habitat loss and displacement from insect relief and calving areas due to construction, operations, and from oil spills.

<u>Habitat Loss and Displacement</u>: Direct habitat loss could result from construction of well pads, pipelines, roads, airfields, processing facilities, housing, and other infrastructure. Indirect habitat loss is possible if caribou avoid areas because of the presence of humans and traffic.

Shifting calving away from higher value forage habitat with higher value nutrition could affect maternal success and calf health (Cameron et al. 2005). Independent of oil activity, forage quality and quantity vary seasonally and annually and also affect herd success (Murphy and Lawhead 2000). Forage quality and quantity are superior in drier habitat south of the lease sale area (Murphy and Lawhead 2000).

Caribou are subject to mosquito harassment from mid-to-late June through July, and to oestrid fly harassment from mid-July to late-August. To escape mosquitoes, caribou move from inland feeding areas to windswept, vegetation-free coastal areas, where they rely on various coastal habitats such as sandbars, spits, river deltas, and some barrier islands for relief from insect pests (MMS 1987). Caribou also seek relief from insects farther inland, in the foothills of the Arctic coastal plain. Flies are less tolerant of shade, so when oestrid flies dominate, caribou favor shade created by industrial buildings and pipes (Murphy and Lawhead 2000). Gravel pads are also favored habitat for relief from both mosquitoes and flies (Ballard et al. 2000).

Above-ground pipelines can restrict caribou movement and deter them from seeking preferred habitat unless provisions are made to allow for their free passage. Biologists representing both industry and ADF&G have agreed that facilities built earlier in the development of the Prudhoe Bay oil field created impediments to caribou movements. Flow and gathering pipelines were elevated only 1 to 4 feet 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, elevating pipelines and separating pipelines from roads with traffic have allowed caribou to move with ease through the oil field.

In the Kuparuk field, where all pipelines are elevated a minimum of 5 feet above ground, insect-harassed caribou were able to pass through the field on their way to and from insect-relief habitat, although they typically detoured around drill pads and were often delayed up to several hours at road crossings (BLM 2005). Current mitigation measures require that pipe be elevated 7 feet, higher than the previously required 5 feet.

If displacement from coastal insect-relief areas did occur during the construction of oil and gas facilities, it would be temporary and disturbance reaction would diminish after construction is complete, provided that road systems are not spaced too closely.

Documenting positive effects of oil field development is as challenging as documenting adverse effects. Dust settling alongside roads in the spring leads to earlier snowmelt and green-up of vegetation, facilitating travel and feeding. Caribou use roads and gravel pads and the shade of pipelines and buildings for relief from oestrid flies (Murphy and Lawhead 2000; BLM 2008a).

The Central Arctic and other herds have grown considerably during the period of oil field development, but researchers hotly disagree about the impact of industry activity on caribou populations. Still, research indicates that caribou can accommodate most oil field activities, although questions remain regarding the impact of high intensity or frequent disturbances (Murphy and Lawhead 2000). 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).

Seismic Surveys: Onshore seismic surveys would occur during winter, when most caribou overwinter in areas farther inland. Air or boat traffic associated with offshore surveys could disturb caribou using shorelands or islands. This would most likely be limited to periods of insect harassment.

Caribou cows and calves crossing road, North Slope.

Disturbance: Cow and calf groups are most sensitive to human disturbance just before calving and post-calving, but Haskell (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 DelVecchio 2007). On the other hand, high populations would force the caribou into lower nutrition areas anyway.

Few caribou now calve in the Prudhoe Bay industrial complex; however, there is no evidence that calving levels were historically higher (Murphy and Lawhead 2000). Calving caribou prefer rugged, dry terrain and the Prudhoe Bay terrain is flat and wet, which may indicate caribou were unlikely to historically use this habitat (Ballard et al. 2000). Some displacement of the Central Arctic herd caribou from a portion of the calving range near Prudhoe Bay and Milne Point facilities has been reported (Cameron et al. 2005), but caribou continue to calve at Kuparuk and Milne Point, although in smaller numbers and densities (Murphy and Lawhead 2000). Variations could be attributed to annual snow melt patterns (Ballard et al. 2000). Other researchers posit that calving levels at Kuparuk and Milne Point cannot be definitively linked to disturbance-caused displacement because of a lack of historical data (Murphy and Lawhead 2000).

While aerial surveys of radio-collared females conducted between 1978 and 1987 indicate that parturient females 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 and that pipelines do not delay travel to the coast (Noel et al. 2004). In the 1992 study, after construction of the Milne Point road, caribou were significantly less numerous within 1 kilometer of roads and significantly more numerous 5 to 6 kilometers from roads. Noel's 2004 study of recent post-road calf densities reported that densities within 1 kilometer 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 (Noel et al. 2004). Joly (Joly et al. 2006), however, contests the findings. Pipelines elevated at least 5 feet allow for effective crossing, except when they were in proximity to roads with moderate to heavy traffic (15 or more vehicles per hour). Noel et al studied pipe elevated 5 feet; mitigation measures now require that pipelines shall be elevated 7 feet. The Alaska Caribou Steering Committee concluded the most effective mitigation is achieved when pipelines and roads are separated by at least 500 feet (Cronin et al. 1994). 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.

During construction, small groups of caribou may be temporarily displaced; however, the reaction would diminish after construction is complete. Construction will not take place over the entire sale area at the same time and construction related to exploration will occur during winter, when caribou are absent from the lease sale area. Furthermore, it is likely that industry will rely, to the extent feasible, on the existing oil infrastructure, thus minimizing new construction.

Motor vehicle and aircraft traffic can also disturb caribou. Caribou can be briefly disturbed by low-flying aircraft, with highly variable 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. Exploration-related disturbance of caribou, particularly by helicopter traffic, is expected to have minor impacts on caribou, particularly large groups, with animals being briefly displaced from feeding and resting areas when aircraft pass nearby. Vehicle traffic associated with transportation corridors has the potential to affect habitat use in intensely developed areas. Acute disturbance effects may in combination result in a cumulative effect on habitat availability for those individuals with fidelity to a calving area, but may have little or no effect on the Central Arctic herd population. It is expected these disturbances would be short term (BLM 2005). Despite the fact that cumulative effects at the population level are difficult to quantify, measures should be incorporated into operations planning and facility design to avoid both direct and indirect impacts to caribou.

<u>Gas Blowouts</u>: Impacts of a gas blowout on caribou would be similar to that of other terrestrial mammals. If a natural gas explosion and fire occurred on land or very near the coast, caribou in the immediate vicinity could be killed or displaced. Blowouts of natural gas condensates that did not burn would disperse very rapidly. Therefore, toxic fumes would not affect animals, except those very near the source of the blowout.

<u>Oil Spills</u>: Caribou may also be impacted by oil spills. Caribou that become oiled could die from toxic-hydrocarbon inhalation and absorption through the skin. If caribou were to ingest oil-contaminated vegetation, the result would be significant weight loss and aspiration pneumonia, leading to death. In the event of an oil spill that contaminated tundra or coastal habitats, however, caribou probably would not ingest the oiled vegetation. Caribou are selective grazers and are particular about the plants they consume (MMS 1996).The majority of impacts would result from disturbance associated with spill cleanup activities, such as the presence of cleanup workers and

machinery or the use of hazing to divert caribou from oiled areas; these disturbances would, in turn, help minimize direct contact with oil.

2. Mitigation Measures and Other Regulatory Protections

Oil and gas activities subsequent to leasing could potentially have cumulative effects on caribou. Most of these potential effects would likely occur as secondary effects from effects on habitat. 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 mitigation measures addressing fish, wildlife, and habitat, other mitigation measures specifically address caribou. Specifically, pipelines shall be designed and constructed to avoid significant alteration of caribou movement and migration patterns. Lessees are encouraged to maintain aircraft at an altitude greater than 1,500 feet or a lateral distance of 1 mile, excluding takeoffs and landings, from caribou concentrations. Seasonal restrictions may be imposed on activities located in, or requiring travel through or overflight of, important caribou calving areas. Lessees are encouraged in planning and design activities to consider the recommendations for oil field design and operations contained in the final report to the Alaska Caribou Steering Committee (Cronin et al. 1994). A complete list of mitigation measures is found in Chapter Nine.

H. Effects on Muskoxen

1. Potential Cumulative Effects

Although this is primarily an offshore sale, a very small amount of sale lands lie onshore between the Colville and Canning Rivers. In addition, muskoxen have been sighted offshore on the sea ice.

Muskoxen were reintroduced in Kaktovik in 1969 and are spreading across the North Slope; they are found from the Kogru River in NPR-A east to Canada (MMS 2008, Vol. I, Chapter Three). Muskoxen have been sighted on sea ice 25 miles offshore (BLM 2008b). Little is known regarding the influence of roads, traffic, and pipelines on muskox movements.

<u>Habitat Loss and Displacement</u>: Direct habitat loss will result from construction of well pads, pipelines, roads, airfields, processing facilities, and other infrastructure; however, industry will likely rely on existing infrastructure to the extent practical.

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. Displacement from preferred habitat could have a negative effect on muskoxen populations. The magnitude of the effect is difficult to predict, but would likely be related to the magnitude and duration of the displacement (USFWS 1987). Muskoxen populations on the North Slope have been declining in recent years (ADN 2006), while herds elsewhere in the state are healthy. Most of the losses have been in ANWR. Biologists are not certain why, but starvation, drowning in floods, and predation by grizzly bears may play a role. Hunting has not played a big role, but state and federal managers closed hunting because herd numbers are so low (ADN 2006).

<u>Seismic Surveys</u>: As year-round residents of the coastal plain, muskoxen could be impacted by winter seismic studies. Response varies from herd to herd (NRC 2003), Muskoxen activity drops each winter as the animals slow to conserve energy. Wintertime seismic surveys could disturb them at a time when they can least afford the energy expenditure.

<u>Disturbance</u>: Muskoxen may be subject to disturbance from oil and gas activities. Primary sources of disturbance include seismic activity, vehicle traffic, and aircraft. Muskoxen remain relatively sedentary in the winter, to conserve energy to compensate for reduced forage (Reynolds et al. 2002). The energetic costs associated with forced movements during winter may be as significant an impact as disturbance during calving. 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).

Gas Blowouts: Impacts on muskoxen from a gas blowout would be similar to those to other terrestrial mammals. If a natural gas explosion and fire occurred on land or very near the coast, muskoxen or moose in the immediate vicinity could be killed or displaced. Blowouts of natural gas condensates that did not burn would disperse very rapidly. Thus, it is not likely that toxic fumes would affect animals except those very near to the source of the blowout.

Oil Spills: In general, the effects of an oil spill on muskoxen would be similar to that of other terrestrial mammals. Muskoxen, because they have been spotted on the sea ice, could be adversely affected by a wintertime offshore spill, if one were to occur and if any animals were in the vicinity. An oil spill may contaminate individual animals in the immediate vicinity, contaminate habitat, and contaminate some local food sources. However, muskoxen are unlikely to eat contaminated vegetation and, while absorption or inhalation of oil is toxic, oiled animals would shed oiled fur before growing winter fur (BLM 2004). If a large oil spill oiled habitats used by muskoxen, cleanup workers and traffic from vehicles and aircraft would be expected to disturb and displace these species during cleanup operations, thus minimizing the animals' exposure to spilled oil. In addition, oil spill responders would employ hazing to divert animals from the cleanup area.

2. Mitigation Measures and Other Regulatory Protections

Oil and gas activities subsequent to leasing could potentially have cumulative effects on muskoxen. Most of these potential effects would likely occur as secondary effects from effects on habitat, 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 mitigation measures addressing fish, wildlife, and habitat, other mitigation measures specifically address muskoxen. Lessees are encouraged to maintain aircraft at an altitude greater than 1,500 feet or a lateral distance of 1 mile, excluding takeoffs and landings, from muskoxen concentrations. Seasonal restrictions may be imposed on activities located in, or requiring travel through or overflight of, important muskoxen calving or wintering areas. Pipelines shall be designed and constructed to avoid significant alteration of large ungulate movement and migration patterns. A complete list of mitigation measures is found in Chapter Nine.

I. Effects on Brown Bear

1. Potential Cumulative Effects

Although this is primarily an offshore sale, a very small amount of sale lands lie onshore between the Colville and Canning Rivers. Brown (grizzly) bears on the coastal plain are at the northern limit of their range. Densities are low, with the highest levels near the Prudhoe and Kuparuk complexes. The availability of food is limited and their reproductive potential is low; the region is considered marginal bear habitat (Shideler and Hechtel 2000).

Habitat Loss and Displacement: Direct habitat loss could result from construction of well pads, pipelines, roads, airfields, processing facilities, housing, and other infrastructure. Quantifying the number of animals involved is difficult. Brown bears travel along the major river corridors and feed in riparian areas in and near the lease sale area. Siting facilities outside these areas will reduce potential impacts on brown bears (USFWS 1987).

Seismic Surveys: Seismic activity that occurs in winter may disturb denning bears. Studies have found that radio-collared bears in their dens were disturbed by seismic activities within 1.2 miles 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 (BLM 2008a).

Disturbance: Brown bears may be subject to disturbance from oil and gas activity. Primary sources of disturbance include seismic activity, vehicle traffic, and aircraft. While human activity may initially cause bears to avoid an area, if food is present, human activity also 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 shoot "problem" animals. In 2001, five grizzlies were shot in the Prudhoe Bay fields (NRC 2003). Another food source thriving in the oil fields is the Arctic squirrel (see Section J), a staple for bears located there (Shideler and Hechtel 2000). While cub survival is higher at Prudhoe/Kuparuk, these bears have a lower than normal survival rate as they become sub-adults (Ibid). Bears can also be displaced by human land use activities.

Gas Blowouts: Impacts on brown bear from a gas blowout would be similar to those to other terrestrial mammals. If a natural gas explosion and fire occurred on land or very near the coast, brown bear in the immediate vicinity could be killed or displaced. Blowouts of natural gas condensates that did not burn would disperse very rapidly. Thus, it is not likely that toxic fumes would affect bears except those very near to the source of the blowout.

Oil Spills: The potential effects of oil spills on brown bears include contaminating of individual animals, coastal habitats, and some local food sources. Bears feed on fish concentrations at overwintering and spawning areas and on carrion along the coast. If an oil spill contaminates beaches, bears are likely to ingest contaminated food sources. If a large oil spill oiled habitats used by bears, cleanup workers and traffic from vehicles and aircraft are expected to disturb and displace these species during cleanup operations, thus minimizing the animals' exposure to spilled oil. In addition, oil spill responders would employ hazing to divert animals from the cleanup area.

2. Mitigation Measures and Other Regulatory Protections

Oil and gas activities subsequent to leasing could potentially have cumulative effects on brown bears. Most of these potential effects would likely occur as secondary effects from effects on habitat. 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 mitigation measures addressing fish, wildlife, and habitat, other mitigation measures specifically address bears. For projects near areas frequented by bears, lessees are required to prepare and implement a human-bear interaction plan designed to minimize conflicts between humans and bears. The plan must include measures to minimize a facility's attraction to bears, including garbage and food waste. Before commencement of any activities, lessees must consult with ADF&G to identify the locations of known brown bear den sites. Exploration and production activities started between September 20 and May 15 may not be conducted within one-half mile of known occupied brown bear dens. A complete list of mitigation measures is found in Chapter Nine.

J. Effects on Furbearers

1. Potential Cumulative Effects

Gray wolves, wolverines, and arctic foxes are the furbearer species that may use the lease sale area's limited upland and, during winter, offshore areas. Gray wolves have travelled across at least 70 km of sea ice (MMS 2008, Vol. I, Chapter Three). Wolverines are more common the Brooks Range than in the coastal plain (BLM 2008b).

Habitat Loss and Displacement: Winter arctic fox habitat is primarily along the coast and sea ice. Denning occurs up to 15 miles inland. Habitat destruction would primarily affect foxes through destruction of den sites. Placement of oil and gas infrastructure at or near den sites may either destroy den sites or cause foxes to den elsewhere (USFWS 1986). However, foxes have been known to use culverts and other construction materials for denning.

The effects of direct habitat loss on wolves would likely be negligible. The abundance of wolves is ultimately determined by the availability of prey. The ability of adults to provide food is the key determinant in wolf pup survival. Reduction in prey species, such as caribou, could reduce wolf populations (USFWS 1987).

Seismic Activities: Wolves, foxes, and wolverine may be disturbed by wintertime onshore seismic activity. These species are highly mobile and foxes and wolves readily adapt to human presence. Impacts are expected to be transitory.

Disturbance: These furbearers may be disturbed by oil and gas activity, particularly vehicle and aircraft traffic. Wolves and foxes readily habituate to human activity, leading to human-animal encounters. Primary sources of disturbance are aircraft traffic. Helicopters generally invoke a stronger response from wolves and foxes than fixed-wing aircraft. Ice roads connecting well sites and supply areas would provide a source of disturbance from vehicles. During construction of the Dalton Highway and TAPS, wolves readily accepted handouts from construction workers (USFWS 1987). When wolves approach humans, they are sometimes shot (McNay 2002)

Foxes are especially attracted to human activity because of potential scavenging sources. Arctic fox density is greater in the Prudhoe Bay complex than in undeveloped areas nearby (MMS 2008, Vol. I, Chapter Three). Fox populations vary in response to fluctuations in their natural prey sources, but a constant food supply could maintain the fox population at artificially high levels. This could cause near total nest failure of all waterfowl and shorebirds in the development area because foxes prey on eggs and young birds. Foxes and wolves are also noted for rabies outbreaks, which increase when population densities are high and which risk human health. Oil and gas activity may attract foraging foxes and wolves, especially to refuse disposal areas. Wolverines apparently are not attracted to garbage (USFWS 1986).

Gas Blowouts: Impacts on wolves, wolverines, and foxes from a gas blowout would be similar to those of other terrestrial mammals. If a natural gas explosion and fire occurred on land or very near the coast, animals in the immediate vicinity could be killed or displaced. Blowouts of natural gas condensates that did not burn would disperse very rapidly; thus, it is not likely that toxic fumes would affect animals except those very near to the source of the blowout.

Oil Spills: The general effects of an oil spill on wolves, wolverines, and foxes include contamination of individual animals, habitats, and some local food sources. Furbearers, particularly foxes, may be attracted to oiled carrion. Foxes may be attracted to cleanup related activity in hopes of scavenging food or garbage. If a large oil spill oiled habitats used by bears, cleanup workers and traffic from vehicles and aircraft are expected to disturb and displace these species during cleanup operations, thus minimizing the animals’ exposure to spilled oil, with the possible exception of foxes. In addition, oil spill responders would employ hazing to divert animals from the cleanup area.

2. Mitigation Measures and Other Regulatory Protections

Oil and gas activities subsequent to leasing could potentially have cumulative effects on furbearers, particularly foxes. Most of these potential effects would likely occur as secondary effects from effects on habitat. 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. 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. Proper disposal of garbage and putrescible waste is essential to minimize attracting wildlife. The lessee must use the most appropriate and efficient method to achieve this goal. A complete list of mitigation measures is found in Chapter Nine.

K. Effects on Polar Bear

1. Potential Cumulative Effects

In 2008, the USFWS listed the polar bear as a threatened species under the Endangered Species Act (ESA) (USFWS 2008). (See Chapter Four.)

Polar bears may be present in the upland and offshore areas year round. Potential impacts to polar bears include disruption of denning, attraction to areas of activity, and adverse interaction with humans. If an oil spill occurred, potential effects could include ingestion of oil and oil contamination.

Habitat Loss and Displacement: The primary impacts to polar bears from production-related activities include habitat losses due to construction of production facilities and human-bear encounters. Just over half of Alaska's dens are found in offshore pack ice, well north of the lease sale area, and just under half occur on land (Durner et al. 2006). Potential habitat losses on barrier islands and along the coast could displace polar bears from denning areas that appear to be increasing in importance. Denning is an integral part of the reproductive process and critical to reproductive success. Maternal denning is widely scattered, which may facilitate human avoidance of denning sites (Amstrup 2000). If disturbances lead bears to prematurely abandon dens before cubs are sufficiently mature, cub survival could be reduced. Bears denning near the Prudhoe Bay oil field did not show evidence of being disturbed by humans (Durner et al. 2006). In fact, bears near roads showed fewer episodes of vigilant behavior than bears at undisturbed den sites. The researchers concluded that the near-road bears were habituated to traffic. Noise generated by exploration and development, particularly seismic activities, could lead pregnant bears to leave denning habitat or pre-maturely abandon dens. Again, the Prudhoe Bay study showed bears became habituated and did not abandon dens (Durner et al. 2006). Research testing noise levels within artificially constructed dens revealed that most vehicle noise was undetectable when the source was 500 meters away. The temporary displacement of some polar bears from preferred habitats is anticipated as a result of routine exploration activities. Chronic disturbance or displacement can have moderate effects over time (MMS 2008, Vol. I, Chapter Two).

Alaskan polar bears spend most of their life on the sea ice; however, bears may be increasing their use of land during the fall open water season. Increased time onshore may be more related to access to seals than human-related food sources (Schliebe et al. 2008), but one consequence of more time onshore is increased human-bear interactions. Miller et al. (2006) raise concerns about bears scavenging the remains of bowhead whales harvested by Inupiat whalers. The findings express concern over the large number of bears drawn by whale remains and other food to areas near humans and the potential for conflicts (Miller et al. 2006); some of these sites are in or near the lease sale area. Polar bears can be attracted to artificial structures; buildings offer places for bears to forage for human discards. This increases the chances that bears will need to be driven away or killed to protect human safety (NRC 2003). Preparation of human-bear interaction plans and proper disposal of garbage will minimize conflicts with bears and humans.

Seismic Surveys: Polar bears are less sensitive to disturbance from seismic activities than many marine mammal species. However, seismic noise may disturb females in dens, both on sea ice and onshore. (See Habitat Loss and Displacement.)

Disturbance: The primary sources of noise disturbance would come from air and marine traffic. Seismic activities and low-frequency noise from drilling operations would also be sources of noise. (See Habitat Loss and Displacement.) Females in dens, both on sea ice and onshore are at risk to disturbance from any vehicular traffic or noise. Exploration and development is likely to increase temporary displacement and disturbance. More vessel traffic could result in minor impacts to polar bears. Other sources of disturbance include building ice roads, temporary ice islands as drilling platforms, helicopter flights to move crews and lightweight equipment, rollogons, snow machines, vibroseis equipment, and other motorized vehicles. The level of impact related to these activities will depend upon the timing and extent of activities occurring simultaneously. If displacement is temporary and localized, disturbance impacts to polar bears are expected to be minor (MMS 2008, Vol. I, Chapter Three).

Oil Spills: Large-scale reduction or contamination of food sources (ringed and bearded seals) could reduce survival and reproductive success of polar bears. Small-scale reductions in seal populations are less likely to impact polar bears, because they tend to disperse over large areas in search of prey. However, polar bears are not likely to avoid oiled carcasses, and ingestion of oiled prey is likely to have lethal effects. The ingestion of petroleum hydrocarbons leads to anorexia and damage to kidneys, liver, and other tissues. The effects of the damage were not apparent for several weeks after ingestion (MMS 2008). Oiled fur loses it insulating qualities (USFWS 2008).

Amstrup et al. (Amstrup et al. 2006) conducted a modeling study to predict the probability that polar bears on the North Slope would be exposed to hypothetical oil spills from two locations in the Beaufort Sea, one that is currently operating offshore (Northstar) and one that was proposed for offshore (Liberty). The model incorporated actual weather data such as wind, ice, and currents, and used NOAA methods for modeling oil spills. Data from studies of radio-collared polar bears from 1985-2003 were also used. The model examined the worst case scenario: the largest anticipated catastrophic spill; the largest anticipated chronic spill; the worst possible times, the maximum open water period (September), and the period of maximum polar bear density (October); no attempt at cleanup or other human intervention; and maximum effect (all bears touched by oil killed). The model did not take into account uncertainty in polar bear population estimates or oil weathering. Median numbers of polar bears oiled by a worst-case scenario spill at Liberty were 1 bear in September and 3 bears in October; median numbers oiled at Northstar were 3 bears in September and 11 bears in October. Based on this model, there is a very low probability that a large number of polar bears would be affected by an oil spill; and, if an oil spill were to happen, there is a large probability that a low number of bears would be affected (Amstrup et al. 2006).

The Amstrup et al. (Amstrup et al. 2006) model did not take into account the risk of an oil spill. There have been no marine oil spills in the Beaufort Sea in more than 25 years of exploration and development and there has never been an oil spill from a platform blowout in Alaska. The Northstar pipeline is designed to operate without leaking even if all the potential sources of failure (ice gouging, strudel scour, settlement) occur at the same time and same location. This is an extraordinarily conservative design basis. MMS evaluated the design of the Northstar project and concluded the risk of an oil spill of 1,000 bbl or greater was on the order of 1 to 2 percent. From all approaches reviewed, zero was the most likely number of spills (MMS 2003a).

Finally, if a spill were to occur and to occur during broken ice, challenges with cleanup could increase the spill's effects on polar bears. Still, the risk of a major spill in the lease sale area is small.

The Marine Mammal Protection Act prohibits the taking of marine mammals, including polar bears and ringed seals, except in specifically permitted circumstances. The MMPA allows the secretary of commerce to permit industrial operations to take small numbers of marine mammals provided that doing so has a negligible effect on the species and will not reduce the availability of the species for subsistence use by Alaska Natives (NRC 2003). At the leasing phase, it is not possible to predict if, when, where, how or what kind of exploration, development or production might occur, but any activities that could occur subsequent to the lease sale will be subject to the mitigation measures in Chapter Seven. In addition, a host of other rigorous state, federal, and NSB permitting restrictions and regulatory mechanisms addressing polar bears, or applicable to them, are in place. Additional state regulatory mechanisms include large project planning (OPMP), ACMP, DMLW permits and approvals, ADF&G habitat and permitting, and SPCO mitigation measures and stipulations.

2. Mitigation Measures and Other Regulatory Protections

Oil and gas activities subsequent to leasing could potentially have cumulative effects on polar bears. Most of these potential effects would likely occur as secondary effects from effects on habitat. 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 complying with the Endangered Species Act and the Marine Mammal Protection Act, lessees shall consult with the USFWS to identify the location of known polar bear den sites. Operations must avoid known polar bear dens by 1 mile. A lessee who encounters an occupied polar bear den not previously identified by USFWS must report it to the USFWS within 24 hours and subsequently avoid the new den by 1 mile. If a polar bear should den within an existing development, off-site activities shall be restricted to minimize disturbance. Lessees are required to prepare human-bear interaction plans. Proper disposal of garbage and putrescible waste is essential to minimize attraction of wildlife. Lessees are required to have an approved oil discharge prevention and contingency plan. A complete list of mitigation measures is found in Chapter Nine.

L. Effects on Bowhead Whales

1. Potential Cumulative Effects

Bowhead whales are listed as threatened on the Endangered Species list. Bowhead whales migrate across the Beaufort Sea each spring and fall. The spring migration east typically rounds Point Barrow then shifts north of sale waters, into the central Beaufort; the fall migration west is closer to shore in the lease sale area. Whales are more likely to use federal OCS waters than shallower nearshore state waters. Inupiat whalers estimate that bowheads take about two days to travel west from Kaktovik to Cross Island, reaching the Prudhoe Bay area by late September, and five days to travel from Cross Island to Point Barrow (MMS 2003b).

NMFS, in 2002, issued a determination within the Federal Register deciding against designating critical habitat for bowheads. NMFS determined (1) the population decline was due to overexploitation by commercial whaling, and habitat issues were not a factor in the decline; (2) the population is abundant and increasing; (3) there is no indication that habitat degradation is having any negative impact on the increasing population; and (4) existing laws and practices adequately protect the species and its habitat (67 FR 55767, August 30, 2002).

NMFS has concluded that leasing and exploration are not likely to jeopardize the continued existence of the bowhead whale (NOAA 2006). The agency remains concerned about the potential additive effects of oil and gas exploration and development on bowhead whales. Sale-related activities likely to cause disturbance to bowhead whales may include seismic surveys, vessel and aircraft traffic, drilling noise, construction, discharge of drilling muds and cuttings, and an oil spill, should one occur.

Data gaps challenge studies of longer-term and cumulative effects of oil and gas activities on whales. Whales have long life spans, long-term experiments are logistically difficult, data on whales before human activities began are scarce, data accumulate slowly, and it is difficult to distinguish human from natural effects (Richardson et al. 1995). Results of some studies may be inconclusive or open to multiple interpretations.

The discussion below generally focuses on bowhead whales. However, much of the discussion is also generally applicable to other whale species that may occur in the Beaufort Sea, such as beluga whale.

<u>Drilling and Production Discharges</u>: Discharges from well drilling and production may be intentional, such as permitted discharges regulated by the NPDES, or unintentional, such as gas

blowouts, leakages, and spills. However, in the circumpolar Arctic, 80-90 percent of petroleum hydrocarbons entering the environment originate from natural seeps (Huntington 2007). Excluding oil spills, activities related to oil and gas exploration, development, and production are minor contributors of petroleum hydrocarbons to the environment (Huntington 2007).

The preferred method for disposal of muds and cuttings from oil and gas activities is by underground injection. Discharge of produced waters into open or ice-covered marine waters of less than 33 feet in depth is prohibited. All discharges must be permitted under the NPDES program administered by ADEC and must meet state and federal water quality standards (see Chapter Seven, SectionB4). Discharged drilling muds and cuttings during drilling operations are not expected to cause significant effects on bowhead whales either directly through contact or indirectly by affecting prey species (MMS 2008).

Disturbance: Activities that may cause disturbance to bowhead whales are seismic surveys, vessel and aircraft activities, drilling noise, and construction. Noise is the common factor; whales have sensitive hearing and may use hearing to navigate under pack ice and locate polynyas (open water) to surface. High noise levels may cause temporary or permanent effects to bowhead whale hearing, or impact their use of sound to communicate or navigate (NOAA 2008). Exposure to noise could have temporary non-lethal effects (NOAA 2008).

Available information indicates that bowhead whales are responsive, in some cases highly responsive, to anthropogenic noise in their environment. Response to noise could include behavioral changes, including local avoidance to noise from aircraft and vessel traffic; seismic surveys; exploratory drilling; construction activities, including dredging; and development drilling and production operation that occur within several miles of the whales. Noise could divert whales from their migratory path and feeding habitat. If two or more types of disturbance occur at the same time, the effects could be greater than those observed from a single source.

The primary documented response to noise is avoidance, sometimes at considerable distance. Collective observations of whaling captains indicate that pods of migrating bowhead whales can be displaced (diverted away from shore) as much as 30 miles from their normal migratory path, and that the whales begin their diversion at distances of up to 35 miles from an active seismic operation (NOAA 2008). This behavior helps the whales avoid the potential for any harm to their hearing from the noise. However, data indicate that fall migrating bowheads can show greater avoidance of active seismic vessels than do feeding bowheads. Response is variable, even to a particular noise source, and the reasons for this variability are not fully understood. In other species of mammals, including cetaceans, females with young are more responsive to noise and human disturbance than other segments of the population (NOAA 2008).

Whales demonstrate stronger responses to consistent noise than to pulsed noise, like that generated by seismic exploration, even if the pulsed noise is louder (Schick and Urban 2000). Whales also demonstrated greater response to sources with increasing sound levels, such as that of an approaching ship.

Whales may be disturbed by sound from drill rigs. When a drill rig is present, whales were distributed farther from the rig than they would be under a random scenario, indicating a significant temporary loss of habitat. The researchers suggest that bowheads vary their response to drill rigs during fall and summer feeding. However, the researchers had no data on noise levels and the study year was a year experiencing heavy ice, when whales would migrate farther offshore. They concluded that linkage between a drilling rig and whale avoidance patterns is incomplete, especially without data regarding long-term effects of short-term exposure to industrial noise (Schick and Urban 2000). Studies conducted as part of a monitoring program for Northstar indicate that, in one of the three years of monitoring efforts, the southern edge of the bowhead whale fall migration path may have been slightly (2-3 miles) farther offshore during periods when higher sound levels were recorded and detected no significant effect of sound during the other two years monitored (Angliss and Outlaw 2008). High noise levels that year were attributed to vessel traffic, not the rig itself. Noise on artificial gravel islands, like Northstar, must pass through gravel to reach water. The gravel lessens noise levels, substantially lowering noise levels within 4 km and often making them undetectable at 9.3 km (MMS 2006). Research conducted in the Canadian Beaufort Sea in the mid 1980s indicated that bowheads reduced their use of the main industrial area. However, surveys were only funded during oil activity, with no data no compare levels before and after the oil exploration (Richardson et al. 1995).

Studies in the Alaskan Beaufort Sea by BBN Laboratories and LGL Limited (Miles et al. 1987) indicate that bowhead whales may respond to industrial noise at greater distances than previously thought, with drillships and related support vessels creating the largest potential zone of disturbance. However, another study shows that the whales did not deter from their migratory pattern even when only a long, narrow lead of 656 feet was available and they had to pass a projector emitting drillship noises. They only altered their pattern by passing the projector on the other side of the lead (Richardson et al. 1991). Several reports from drillships show that temporary displacement may occur at the direct approach of a boat or aircraft, but the bowheads continue their patterns of feeding and migratory behavior soon after the disturbance has passed, and even in the presence of drillship activity.

Seismic exploration presents the highest probability for avoidance of any of the activities associated with oil exploration. Seismic exploration generates strong underwater sound pulses from arrays of airguns, and sound may be detected 50 to 100 km away. Strong pulses elicit short term responses–longer dives, lower percent to time at the surface and less frequent raised flukes–which tend to make whales less conspicuous when at the surface. Richardson et al (Richardson et al. 1995) suggest being “less conspicuous” might be a long term effect of intermittent exposure to humans and might protect whales from some human activities, like hunting. During the fall migration bowhead whales may avoid an area around a seismic vessel operating in nearshore waters by a radius of about 20 km (NOAA 2008). Avoidance did not persist beyond 12 hours after the end of seismic operations. Bowhead whales may begin to deflect around a seismic source at distances up to 35 km.

NMFS and MMS believe that seismic surveys during the open-water period, with airgun noise and increased vessel activity and aircraft traffic, have the potential to disturb bowhead whales. Available information does not indicate any long-term population-level adverse effects on bowhead whales. Therefore, NMFS and MMS conclude that seismic surveys are not expected to add significantly to the cumulative impacts on bowhead whales from past, present, and future activities (MMS 2008, Vol. I, Chapter Two; NOAA 2008). Whales may exhibit temporary avoidance behavior to seismic surveys, vessel and aircraft activities, drilling, and construction, but overall effects to bowheads from disturbance and noise likely would be temporary and nonlethal. (MMS 2003b; NOAA 2008, Vol. I, Chapter 2).

Marine-vessel traffic, especially between mid-August and mid-to-late September, may disturb bowhead whales. Fleeing behavior from vessel traffic generally stops within minutes after a vessel has passed, but whales may remain scattered for a longer period (NOAA 2008). Smaller whales seem less wary of an approaching boat and may approach the boat (Carroll and Smithhisler 1980). Whaling captains from Alaskan North Slope communities have observed that as nearshore vessel traffic has increased in the Beaufort Sea during fall whaling, whales have been displaced farther offshore, thus making them less accessible to the whaling crews, and negatively impacting fall whaling (MMS 2003b).

A springtime study of whales migrating along leads and through pack ice found that a minority of bowhead whales (14 percent) dove or otherwise exhibited short term behavioral changes due to the approach of a Bell 212 helicopter (Patenaude et al. 2002). A Twin Otter airplane used in the study generated a less pronounced response, possibly because of its weaker and less complex sound. Bowheads showed no conspicuous startle reactions even when aircraft began circling at 460 m altitude and a radius of 1 km. There was no indication that bowheads reacted more frequently during lower altitude flights.

Bowhead movement patterns seem to have an effect on avoidance behavior. Fall-migrating bowheads in the U.S. Beaufort Sea display a tendency to avoid seismic sounds at a distance of 20-30 km (Richardson and Miller 1999). In the summer, "stationary" whales in the Canadian Beaufort Sea have a much smaller reaction zone of approximately 2 km (Miller and Davis 2002). The difference may be attributed to whale activity; whales in Canada more tolerant of noise were feeding, while the whales which avoided seismic noise were migrating. In 2007, whales were observed within 2 km of an active array on three occasions; these whales may have been feeding (NOAA 2008).

Behavioral studies have suggested that bowhead whales habituate to noise. For example, when hunting bowheads, the whale is struck with a harpoon with a line and float attached. The device normally includes an explosive device charged with black powder. The sound of one or more bomb detonations during a strike is audible for some distance. Whaling crews have observed that whales may act skittish and wary after a bomb detonates, or may be displaced farther offshore. However, disturbances to migration as a result of a strike are temporary. A biological opinion prepared by NOAA, found that overall, bowhead whales exposed to noise producing activities such as vessel and aircraft traffic, drilling operations, and seismic surveys most likely would experience temporary, nonlethal effects (NOAA 2008).

Evidence to support that permanent changes to feeding or migratory patterns have occurred is not conclusive (Fraker et al. 1982). These biologists believe that little information is available showing that bowheads abandon an area, travel far, or remain disturbed for extended periods after a ship passes. In terms of displacement from areas with heavy traffic, past observations and studies demonstrate that various cetacean species react differently to long-term disturbances, and consequently, bowhead whale responses to repeated disturbances cannot be predicted accurately. The most intense, and potentially most disturbing, human activities are subsistence whaling, commercial vessel traffic, and marine seismic activities (Miller et al. 1991).

Calculating the effect of noise on migration is hampered by natural factors affecting migration route selection; noise may not be only factor affecting migration routes. Ice cover may influence the timing or duration of the fall migration. Researchers attribute migration proximity to shore to the severity of ice; whales migrate closer to shore in light or moderate ice years and farther offshore in heavy ice years (MMS 2008, Vol. I, Chapter Three). Treacy (2002) detected no localized deflections caused by seismic exploration.

Hofman (2003) reviewed available studies of the effects of industrial noise on whales, finding that some effects on activity patterns of some whales were documented, but that research was insufficient for understanding which species are affected, how many animals are affected, distances at which various species are affected, and the biological significance of the effects. Although some studies found distribution and behavior changes for some whales, the changes were negligible and no harmful effects were documented (Hofman 2003). Research is also lacking on whether or not some species may become habituated to, and stop being affected by, certain kinds of sounds, or whether certain species may become more sensitive to sounds with increased exposure (Hofman 2003). Researching these effects on marine mammals and other marine animals is a difficult undertaking. Hofman (2003) explained the many variables that influence the effects of noise on animals in the marine environment: The nature and significance of acoustic effects are dependent on a number of variables. They include

- the intensity, frequency, and duration of the sound;

- the location of the sound source relative to the potentially affected animals;
- water depth, bottom reflectivity and other features of the environment;
- the distance between the animal and the sound source;
- whether the sound source is stationary or moving;
- the species, age, sex, reproductive status, activity, and hearing ability of the animals exposed to the sound;
- whether the animals use similar sounds for communicating, locating, and capturing prey; and,
- whether and how frequently the animals in question are exposed to the sound.

There are a few published, peer-reviewed studies of the effects of noise from oil and gas activities on marine animals. Several additional studies measured sound levels from drilling and operations in the Beaufort Sea, but these studies did not measure the effects of the sounds on marine life (Blackwell and Greene 2004, 2006). In one of the few controlled experiments on the response of whales to noise, a four-year study examined responses of whales to airguns used in seismic surveys in the Gulf of Mexico. This study found no horizontal avoidance to seismic airgun sounds by sperm whales (Jochens et al. 2008).

Behavioral disturbance to marine mammals is considered to be “take by harassment” under the MMPA. Based upon the predicted acoustics of the Northstar project, NMFS estimated up to 1,533 whales per year could be “taken” as they detect and react to the noise during the annual fall migrations. Recognizing there is considerable variability with such an estimate, NMFS would not expect this number of whales to be harassed year after year (NOAA 2008). Two existing offshore production facilities, at Ooogurük and Nikaitchuq, were constructed in nearshore state waters; neither is expected to result in takes of bowhead whales. All open-water seismic and other operations, like drilling programs, that have the potential to “incidentally take” marine mammals, including the bowhead whale, have monitoring programs. All seismic and other offshore energy projects undergo multi-agency review that includes NMFS. NMFS is notified of and receives copies of all geophysical exploration permit applications received by the division. The Alaska Region office routinely participates in seismic monitoring and mitigation plan reviews. During these reviews, specific recommendations for monitoring programs are made. Under the MMPA, Incidental Harassment Authorizations (IHAs) can be issued by NMFS that authorize unintentional disturbance but not serious injury or mortality. Disturbing or taking bowhead whales without an IHA would violate the MMPA and lessees must comply with the provisions of the Marine Mammal Protection Act of 1972 as amended. NMFS requires that seismic programs conducted under IHAs include provisions to monitor for marine mammals and to shut down airguns when mammals are detected within designated safety radii.

In addition, any tract or portion thereof in the lease sale area may be subject to seasonal drilling restrictions. The measure provides specific seasonal drilling restrictions for exploratory drilling operations from bottom-founded and floating drilling structures and natural and man-made gravel islands. The effect of this mitigation measure is to prevent whales from being disrupted during their migration and when they are most likely to be hunted by Inupiat whalers.

Offshore exploratory drilling operations in U.S. waters of the Beaufort Sea have been limited by a seasonal drilling restriction since the first Beaufort Sea OCS sale in 1979. The Joint Federal and State Beaufort Sea Lease Sale imposed a seven- month drilling seasonal drilling restriction on most leases to protect endangered bowhead whales. (Grogan 1990). The 1979 seasonal drilling restriction was modified in 1982 to generally restrict exploratory drilling during the fall bowhead migration. In 1985, two oil companies submitted requests for departures from the fall bowhead migration. These companies used drillships, which had not previously been used in the Alaskan Beaufort Sea. In response to this request the state, in consultation with the oil industry, federal government, and NSB, undertook a review of all information relevant to exploratory drilling activities and their effects on the bowhead whale. As a result of this review, the state established a seasonal drilling restriction policy in May 1986 which would apply to exploration activities on federal leases subject to the state's coastal consistency review, as well as offshore state oil and gas leases (Grogan 1990).

Geophysical exploration activities are governed by 11 AAC 96 and are not affected by leasing. Lessees or non-lessee companies may propose various operations, which include seismic surveys, in the lease sale area. Restrictions on geophysical exploration permits, whether lease-related or not, will depend on the size, scope, duration, and intensity of the proposed project and on the reasonably foreseeable effects on important species, specifically marine mammals.

In 1986 industry and the Alaska Eskimo Whaling Commission formed an Oil/Whalers Agreement (now called a Conflict Avoidance Agreement, or CAA) to coordinate actions that may potentially affect whaling activities (EDAW/AECOM 2007). Through this agreement, industry provides logistical support to whaling crews, particularly from Nuiqsut. It provides facilities at Cross Island to use as a hunting camp during the fall hunt, as well as some transportation for the harvested meat. The CAA also provides a communications office in Deadhorse to coordinate industry exploration activities to minimize interference with whale migration and whaling expeditions.

Causeways: Although the post-construction environmental effects of continuous solid fill causeways are the subject of differing opinions, it is generally accepted that nearshore causeways have little or no effect on marine mammals. Bowhead whales have been sighted in nearshore areas of the Arctic coast, but they normally inhabit deeper water farther from shore and as experience with the Endicott and West Dock causeways near Prudhoe Bay has shown, the deeper water food sources eaten by whales, as well as ringed seals, are not affected by the construction and maintenance of a causeway (USACOE 1984). Furthermore, because noise propagates poorly in shallow waters where causeways are generally utilized, noise disturbance is not expected to affect the migration patterns or food sources of marine mammals in the lease sale area. Use of continuous-fill causeways is prohibited and significant alterations to nearshore oceanographic circulation patterns are prohibited. The mitigation measure imposes design parameters that ensure natural salinity and temperature regimes that may affect fish distribution are not altered. Environmentally preferred alternatives for field development include use of buried pipelines, onshore directional drilling, or elevated structures. Non-continuous-fill causeways, if permitted, are not expected to affect whale migration or feeding because they are in-shore structures in shallow water.

Natural Gas Development: The most likely effect of natural gas development and production on whales would come from air traffic to and from production platforms and support facilities (probably at Deadhorse) and from platform and offshore-pipeline installation, with potential disturbances similar to those discussed above.

The effect of installing gas-production platforms and laying gas pipeline would be similar to the effect of installing oil production platforms and laying oil pipelines. Effects would be minimal or avoided because all construction occurs in winter when whales are not present. Construction is temporary lasting one to three seasons, thus any impacts during summer months would be near the gas production platforms along the pipeline routes. Although this effect could increase the habitat alterations, and possibly alter the availability of some food supplies, changes are expected to be short-term (less than one year) and local (within about 1.6 km of the activity) (MMS 1998:IV-HL-11).

If a natural gas blowout occurred with a possible explosion and fire, whales in the immediate vicinity of the blowout could be killed, particularly if the explosion occurred below the water surface. Natural gas and condensates would disperse rapidly. Animals that are away from the immediate area or that are exposed to weathered oils would not be expected to suffer serious consequences from inhalation (MMS 2008). A blowout that results in an oil spill is extremely rare and has never occurred in Alaska. However, natural gas blowouts have occurred. Blowout preventers, 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.

Available data do not indicate that noise and disturbance from oil and gas exploration and development activities since the mid-1970s has had lasting population level adverse effects on bowhead whales. Bowhead populations are robust, increasing in abundance, and have been approaching the lower limit of their historic population size at the same time that oil and gas exploration activities have been occurring in the Beaufort Sea (NOAA 2006).

Overall Effects of Development: Although whales may change their behavior in response to anthropogenic sounds, the most common effects are expected to be temporary and unlikely to prevent whales' survival and recovery (NOAA 2008). The majority of bowhead whales that may encounter seismic and other noise related to oil exploration and development are migrating to summering or wintering habitats. While feeding does occur in the U.S. Beaufort Sea, it seems to occur primarily during fall migrations and does not appear to be critical to survival.

Because offshore oil and gas activities in State waters are generally well shoreward of the bowheads' main migration route, and some of the activities occur inside the barrier islands, the overall effects on bowheads from activities on State leases is likely to be minimal (NOAA 2008). These impacts could be magnified, however, if construction activity associated with additional development projects were to occur simultaneously, rather than consecutively.

The Bering-Chukchi-Beaufort Seas stock of bowhead whales has approximately doubled in size since 1978, and the population may be approaching carrying capacity (Brandon and Wade 2004). Because the population is approaching its pre-exploitation population size and has been documented to be increasing at a roughly constant rate for over 20 years, the impacts of oil and gas industry on individual survival and reproduction in the past have likely been minor (Angliss and Outlaw 2008).

Oil spills: There is little data about the effects of oil on bowheads and other cetaceans (NOAA 2008). Primary concerns about the potential effects of oil spills on bowheads in the Beaufort Sea include: 1) accumulation of oil in eroded areas of the bowhead's skin and around the eye, leading to noxious effects from surface contact with hydrocarbons; 2) accidental ingestion or inhalation of oil while feeding, possibly resulting in lethal or sublethal effects, including gastrointestinal tract obstructions; 3) fouled baleen, resulting in reduced filtering efficiencies; and 4) destruction or contamination of critical food sources from acute or chronic oil pollution. Bowheads could also be affected by passing through residual oil, even if they were not present during the spill (NOAA 2008). A spill in broken ice, if one occurred, would be more difficult to clean up than one on land or on solid ice. If spilled oil migrated into leads or ice-free areas used by migrating whales, a significant proportion of the population could be affected (NOAA 2008).

Bowhead whales have not been observed in the presence of an oil spill, so it is uncertain if they can detect oil or would avoid surface oil. Bowhead skin, like most cetaceans, is mostly soft and smooth. However, it also contains up to several hundred roughened lesions on the surface of the skin. If a bowhead came in contact with spilled oil it is unlikely that the oil would stick to the smooth areas of its skin, but might adhere to rough areas on the skin surface. If bowheads left the oiled area it is likely that most of the oil would wash off within a short time. Bratton et al. (1993) concluded that bowhead encounters with fresh or weathered oil present little topological hazard to the skin of a bowhead. However, oil adherence to the roughened parts of the skin has the potential to introduce tissue-destructive pathogens (NRC 2003).

Bowheads would most likely contact oil as they surfaced to breathe. Although unlikely, inhalation of oil vapor might cause intoxication, irritation of the mucus membrane and respiratory tract, and the absorption of volatile aromatic hydrocarbons into the bloodstream. These would likely be rapidly excreted. Vapor concentrations that could be harmful to whales would likely dissipate within a few hours. However, whales exposed to toxic vapors within a few hours of the oil spill could suffer pulmonary distress and possible death. Generally, only a few whales would likely be affected at any given time. Newborn calves would be the most likely to be affected (MMS 2008). Oil may also enter and irritate the eye tissues through the bowhead's large conjunctival sac (NRC 2003).

If feeding bowheads contacted spilled oil, the baleen hairs might be fouled. Repeated baleen fouling over an extended period of time might result in reduced food intake which might affect the health and survival of bowheads. There is a potential pathway for the accumulation of petroleum hydrocarbons in animals that feed on contaminated zooplankton, including a primary food species of the bowhead, *Calanus hyperboreus* (Bratton et al. 1993). Bowheads might ingest some tar balls or large blobs of oil along with oil-contaminated prey while feeding. While the fate of an ingested tar ball is difficult to ascertain, toxic chemicals in tar could obstruct digestive passages resulting in acute illness or death (Bratton et al. 1993:724, citing to Tarpley, 1985). Production of zooplankton, the major food source of bowheads, would not be permanently affected by an oil spill. The amount lost even in a large spill would be negligible in comparison with the plankton resources available in the bowhead's summer feeding grounds in the Canadian Beaufort (NOAA 2008). While feeding does occur in the central Beaufort, its importance as an energy source diminishes compared to feeding in the Canadian Beaufort (Richardson and Thomson 2002). Pipelines must be designed to prevent accidental rupture or discharge. Drilling is prohibited during periods of broken ice in summer when cleanup would be most difficult.

Cleanup activities, with associated presence of boats, aircraft, and workers, as well as strategies such as in-situ burning, may also impact bowhead whales (NOAA 2008).

Past studies found that effects from oil would be of local and limited distribution (Geraci and Aubin 1982, Richardson and Bradstreet 1987). More specifically, they found that: (1) the effects of oil on important feeding grounds would be local and of limited duration; (2) there is growing evidence that bowheads feed over a large area in the Beaufort Sea; (3) the fouling of baleen by oil would have a limited, short-term influence on the filter/feeding process; (4) lethal effects from ingestion of oil are unlikely unless aspiration of vomitus occurs, which could also cause sublethal lung damage; and (5) evidence to date shows that while oil may cause some short-term effects on cetacean skin, such effects are not lethal.

It is unlikely that an oil spill entering the substrate would have any population-level effect on either the bowhead whale food source or the whale itself. First, primary bowhead whale feeding areas are outside of the lease sale area (see Chapter Four). Second, if oil entered the substrate, some specie communities would require years to recover. These species include epibenthic organisms and the number of organisms affected would be limited to the area oiled. However, copepods and euphausiids are the principal foods of bowhead whales, not epibenthic species. Copepods are nearly microscopic free-living zooplankton and their entire life cycle can be completed within 2 weeks. Euphausiids are a small group of pelagic (in water column) crustaceans, commonly called krill. Epibenthic invertebrates such as mysids and gammarid amphipods occasionally are dominant foods, but are usually consumed incidentally while whales are feeding on copepods and euphausiids. Third, the Western Arctic bowhead whale stock is healthy and growing approximately 3.2 percent/year and is therefore less vulnerable to mortality associated with an oil spill. In conclusion, an oil spill could not create a significant impact on the Beaufort Sea bowhead population.

2. Mitigation Measures and Other Regulatory Protections

Oil and gas activities subsequent to leasing could potentially have cumulative effects on bowhead whales. 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 to bowhead whales as well as any other whales that may be found in the lease sale area. In addition to complying with the Marine Mammal Protection Act, lessees must comply with seasonal drilling restrictions in identified subsistence whaling zones and coordinate with local whaling groups, communities, and other interested parties. Exploration, development, and production activities located on tracts 1 through 26 shall be conducted in a manner that prevents unreasonable conflicts between oil and gas activities and subsistence whale hunting. Lessees are required to have an approved oil discharge prevention and contingency plan. Pipelines must be designed to prevent accidental rupture or discharge from geophysical hazards, like ice scouring. Permanent facility siting on Cross Island, within 3 miles of Cross Island, and in state waters between the west end of Arey Island and the east end of Barter Island is prohibited unless development will not preclude reasonable access to whales. A complete listing of mitigation measures is found in Chapter Nine.

M. Effects on Other Marine Mammals

1. Potential Cumulative Effects

Oil and gas activities subsequent to leasing could potentially have cumulative effects on other marine mammals, such as the region’s most common pinnipeds, ringed, spotted, and bearded seals, and walrus. Ringed seals are the seal species most commonly seen in the sale area. Spotted seals are common in coastal waters during ice-free seasons. Bearded seals are found in the Beaufort Sea from July to October at the pack ice edge. Spring and summertime oil and gas exploration and development activities in the sale area and elsewhere in the Beaufort Sea could disturb seals. The majority of the North Pacific walrus population occurs west of Barrow, although a few walrus may move east throughout the Alaskan portion of the Beaufort Sea to Canadian waters during the open water season.

Habitat Loss: Some pinnipeds could be temporarily displaced by construction activities associated with causeway construction or creating a gravel drilling/production pad on land. Onshore development in the limited uplands included in the sale could also disturb a small number of pinnipeds. However, the amount of displacement is likely to be very small in comparison with the natural variability in seasonal habitat use and is not expected to affect seal populations. Effects are likely to be 1 year or 1 season or less, with any disturbance of pinnipeds declining after construction activities are complete (MMS 1996). A study on the abundance and distribution of seals near the Northstar development indicated that seal densities during spring were unaffected (Moulton et al. 2005). Habitat, temporal, and weather factors did affect densities. The researchers concluded that the effect of Northstar on basking ringed seals is slight. In another seal study, Moulton et al. (2002) found that industrial activities on landfast ice (ice road construction, drilling from an artificial island, and on-ice seismic surveys using vibroseis) did not affect seal densities. Williams et al. (2006) found no evidence that ringed seal use of the landfast ice less than 2 km from Northstar or the ice roads was different than their use of ice 2 to 3.5 km distant. Vehicle traffic on the ice road did not influence ringed seals’ use of ice (Williams et al. 2006).

Disturbance, Including Seismic Exploration: The primary sources of noise and disturbance of pinnipeds would come from marine traffic, drill rigs, air traffic, and geophysical surveys. A secondary source would be low frequency noises from drilling operations. Boat traffic could disturb some pinniped concentrations; however, such traffic is not likely to have more than a short-term (a few hours to a few days) effect. Helicopter traffic is assumed to be a source of disturbance to pinnipeds hauled out on beaches or sea ice. Such brief occasional disturbances are not likely to have any serious consequences. Noise and disturbance from pipeline, island, or causeway construction may also adversely affect pinnipeds in the area. Ringed seals near Northstar in 2000 and 2001 established lairs and breathing holes in the landfast ice within a few meters of Northstar, before and during the onset of winter oil activity. These seals' use of the habitat continued undisturbed despite low-frequency noise and vibration, construction, and use of an ice road, indicating their ability to adapt to highly variable habitat availability (Williams et al. 2006).

Noise and disturbance from seismic operations could cause a brief disturbance response from seals. Numbers, sighting distances, and behavior of seals were studied during a nearshore seismic program off northern Alaska in 1996 (Harris et al. 2001). During daylight, seals were seen at nearly identical rates during periods with no airguns firing, 1 airgun, and a "full-array" of 8-11 120-in^3 airguns. Seals tended to be farther away during full-array seismic testing. Seals did avoid a 150 meter zone away from the boat during full-array seismic, but seals apparently did not move much beyond 250 m. "Swimming away" was more common during full-array than no-airgun periods. Affected animals are likely to return to normal behavior patterns within a short period of time (MMS 1996).

MMS has determined that oil and gas activities should result in a negligible level of direct, indirect, or cumulative impacts to seals(MMS 2008, Vol. I, Chapter Two). Seismic exploration and the presence of drill rigs could displace seals (MMS 2008, Vol. I, Chapter Two).

<u>Oil Spills</u>: Direct contact with spilled oil by pinnipeds may result in mortalities. Newborn seal pups that come in contact with oil may lose their thermo-insulation capabilities and die from hypothermia. Adults may only suffer from temporary eye and skin irritations. The specific effects would depend on many factors, including the seal's age and health. Seals are known to be capable of metabolizing as well as excreting and absorbing oil. In general, deaths from contact with oil among adult seals are most likely to occur during periods of high natural stress, such as during the molting season, times of inadequate food supply or if affected by disease (MMS 1987). Seals' eyes may be damaged by exposure to oil; captive ringed sales placed in crude and seals in the Antarctic after a spill developed corneal ulcers and abrasions, conjunctivitis, and swollen nictitating membranes (NOAA 2006). In the event of a large oil spill contacting and extensively oiling coastal habitats with concentrations of pinnipeds, boat, vehicle, and aircraft traffic operating in the area is expected to cause disturbance and displacement of pinnipeds during cleanup operations. If operations occurred in the spring they would contribute to increased stress and reduced pup survival of seals (MMS 1996).

2. Mitigation Measures and Other Regulatory Protections

Oil and gas activities subsequent to leasing could potentially have cumulative effects on seals. 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. Lessees must comply with the Marine Mammal Protection Act. Lessees are required to have an approved oil discharge prevention and contingency plan. Continuous-fill causeways are discouraged. If causeways are approved, they must be designed, sited, and constructed to prevent significant changes to nearshore oceanographic circulations patterns and water quality characteristics. A complete listing of mitigation measures is found in Chapter Nine.

These measures will also protect other marine mammals, including other seals and walrus, from the effects of oil and gas exploration and development.

N. Effects on Subsistence Uses

1. Potential Cumulative Effects

For centuries, survival in the Arctic has centered on 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 on handing down traditional knowledge and beliefs about subsistence resources. This knowledge included observations of game behavior, how to use those observations to successfully locate and harvest game, and how hunters and their families should behave to ensure successful harvests in the future. For the Inupiat, subsistence and culture continue to be inextricably intertwined. The process of obtaining, refining, and passing on subsistence skill is inextricably linked to the Inupiat culture, which is based on interdependent family groups, and a tradition of sharing harvested resources (MMS 2007b).

Traditional subsistence uses include: bowhead and beluga whaling; walrus, polar bear, and seal hunting; brown bear, caribou, muskox, and moose harvesting; hunting and trapping of furbearers, such as wolf, fox, weasel, wolverine, and squirrel; hunting migratory waterfowl and collecting their eggs; fishing for whitefish, char, salmon, smelt, grayling, trout, and burbot; collecting berries, edible plants, and wood; and producing crafts, clothing, and tools made from these wild resources. Equally important, subsistence also includes social activities of consuming, sharing, trading and giving, cooperating, teaching, and celebration among members of the community.

Potential post-lease activities that could have cumulative effects on subsistence uses of the Beaufort Sea lease sale area include seismic surveys, discharges from well drilling and production, construction of support facilities, and ongoing disturbances from production activities such as vehicle, boat, and aircraft traffic. In addition, gas blowouts and oil spills could potentially occur during development and production. Subsistence uses of the Beaufort Sea area depend on the area’s fish, wildlife, and habitats. Therefore, potential cumulative effects from oil and gas exploration, development and production on the area’s fish, wildlife, and habitats could also affect subsistence uses. Potential cumulative effects to fish, wildlife, and habitats are discussed in the preceding sections. Other potential effects on subsistence uses are discussed below. However, quantitative studies are generally unavailable. For example, controlled studies are lacking to determine whether spatial redistribution of species such as caribou and bowhead whale affect harvest and the time required to for a successful hunt (NRC 2003).

Potential effects on subsistence uses could include: increased or decreased access to hunting and fishing areas; concerns about safety of subsistence foods; and increased competition for nearby subsistence resources. The inability to harvest seals or other marine mammals could affect subsistence uses other than for food consumption, such as use of seal skins for covering umiaks, or skins and furs for clothing and handicrafts. Reducing impacts to subsistence resources from oil and gas development is a primary goal for mitigation measures in this finding.

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, pg. 4-24, citing to Kruse 1986, 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, pg. 4-24, 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, effects which could linger for many years. For example, 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 70 percent after the 1989 Exxon Valdez oil spill (Fall 1999).

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, ocean warming, increased competition for fish and wildlife resources by other user groups, predators, and increased awareness about paralytic shellfish poisoning and other contaminants (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).

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 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. A loss of subsistence resources would probably be a loss of income for the entire community (MMS 1996).

Although noise, traffic disturbance, and oil spills might produce short-term impacts on subsistence species, these impacts would probably not lead to the elimination of any subsistence resource (MMS 2007a). Most potential impacts to subsistence species associated with oil and gas exploration, development, and production would be localized and would probably not substantially affect subsistence species numbers, as long as the activities occurred outside of key habitat areas or migratory zones when animals are present (BLM 2005).

If new discoveries are made, the number of development-related facilities might increase. If subsistence hunters were displaced from traditional hunting areas, they might have to travel greater distances and spend more time harvesting resources. However, 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. If competition were to increase, game managers might restrict non-subsistence hunting and fishing.

2. 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, fish, or wildlife, 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 mitigation measures addressing fish, wildlife, and habitat, other mitigation measures specifically address harvest interference avoidance, public access, road construction, and oil spill prevention. A plan of operations must include a training program to inform each person working on the project of environmental, social, cultural, health, and safety concerns. Local communities have a unique understanding of their environment. Involving residents in the planning process for oil and gas activities can be beneficial to the industry and to the community. A complete listing of mitigation measures is found in Chapter Nine.

O. Effects on Historic and Cultural Resources

1. Potential Cumulative Effects

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 accidents such as an oil spill.

Potential impacts could occur in the exploration, development, or production phases, but are more likely to occur if development occurs. Impacts 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. Impacts could include disturbance of historic and archeological sites. Damage to archaeological sites may include direct breakage of cultural objects; damage to vegetation and 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 crews collecting artifacts (USFWS 1986).

Cumulative effects on archaeological sites from oil and gas exploration, development, and production are expected to be low. In the event that an increased amount of ground-disturbing activity takes place, state and federal laws and regulations should mitigate effects to archaeological resources. The expected effects on archaeological resources from an oil spill are uncertain.

<u>Well Blowout or Explosion</u>: 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.

<u>Oil Spills</u>: Oil spills can have an indirect effect on archaeological sites by contaminating organic material, which would eliminate the possibility of using carbon-dating methods (MMS 1998; USFWS 1986). Subsequent to the *Exxon Valdez* 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 1993). 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.

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 accidents such as an oil spill.

Although oil and gas activities subsequent to leasing could potentially have cumulative effects on historic and cultural resources, 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. In addition, all field-based response workers are required to adhere to historic properties protection policies that reinforce that it is unlawful to collect or disturb, remove, or destroy any historic property or suspected historic property and to immediately report any historic property that they see or encounter (AHRS 2008).

Under North Slope Borough municipal code, proposed development shall not impact any historic, prehistoric, or archaeological resource before the assessment of that resource by a professional archaeologist (NSBMC 19.50.030(F)). Borough municipal code 19.70.050(F) says, “Development shall not significantly interfere with traditional activities at cultural or historic sites identified in the Coastal Management Program” (NSB 2008b). These provisions give the NSB authority to protect cultural and historic resources and current subsistence uses of these sites.

Mitigation measures address education and protection of historic and archeological sites. A complete listing of mitigation measures is found in Chapter Nine.

P. Fiscal Effects

1. Statewide

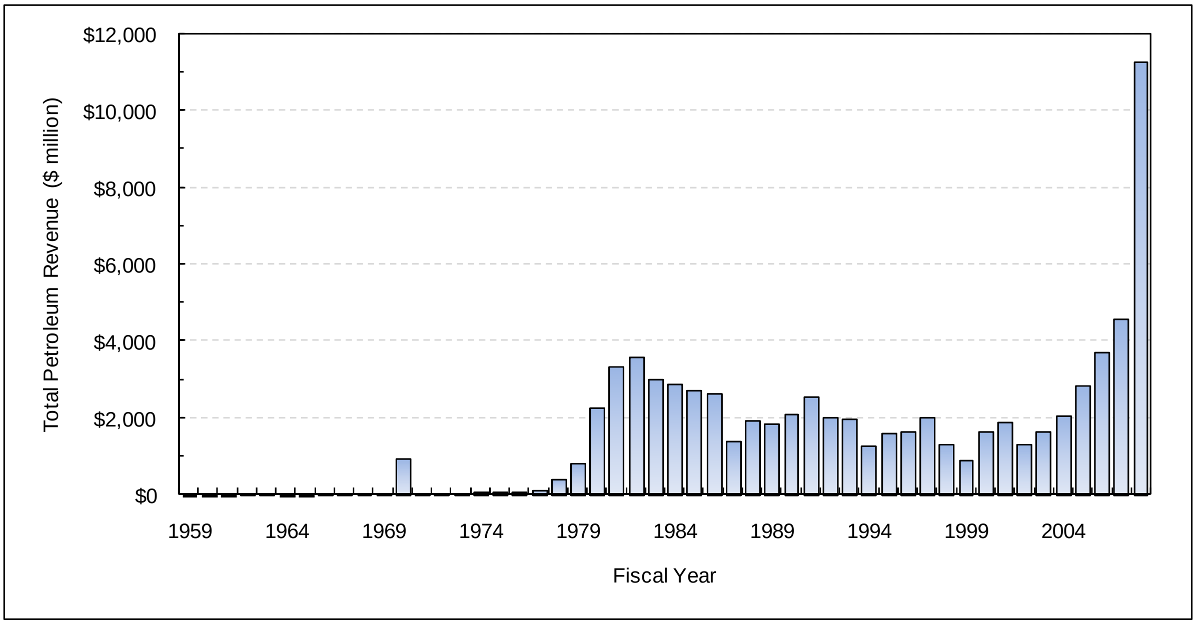
Alaska’s economy depends heavily on revenues related to oil and gas production and government spending resulting from those revenues. Oil and gas lease sales generate income to state government through royalties (including bonuses, rents, and interest), production taxes, petroleum corporate income taxes, and petroleum property taxes. Total oil revenue totaled $11.2 billion in fiscal year (FY) 2008 (Figure 8.1; ADOR 2009a). Revenue in FY 2009 is expected to drop to $5.8 billion due to declining oil prices and production (ADOR 2008c).

Bonus payments are the amounts paid by winning bidders for the individual tracts leased. Since 1959, 6,832 tracts have been leased, generating more than $2 billion in bonus income and interest to the state (ADNR 2008a).

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 the royalty due under the lease for that year equal to the rental amount. Rental income from state leases for FY 2007 (July 2006 through June 2007) was approximately $7.4 million. Rentals from federal leases were approximately $2 million (ADNR 2008b).

Royalties represent the state’s share of the production as the mineral interest owner. Royalties, including bonuses, rents, and interest provided more than $2.4 billion in revenue to the state in FY 2008 (ADOR 2008c). Royalty rates can vary depending on tracts. For the most recent Beaufort Sea Areawide Oil and Gas Lease Sale held October 22, 2008, the royalty rate was either 12.5 percent or 16.666 percent.

Production taxes are the biggest source of state revenue. In 2007, the state replaced the Petroleum Profits Tax (PPT) with the Alaska’s Clear and Equitable Share (ACES). The revision increased overall rates and narrowed allowances for cost deductions and investment credits. With the new law, oil revenue estimates are significantly higher than would have been expected under the prior law. For FY 2008 production taxes were $6.879 billion; for FY 2009 they are forecast to be $3.579 billion (ADOR 2008c).



Source: ADOR 2007b.

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, 1959-2007.

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 2008, oil and gas corporation taxes were $605.8 million and are forecast to be $635 million for FY 2009 (ADOR 2007b, 2008c).

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 taxes amounted to $81.5 million in FY 2008 and are anticipated to be $72.5 million for FY 2009(ADOR 2008c).

In addition, tax settlements to the Constitutional Budget Reserve Fund amounted to approximately $438.3 million and National Petroleum Reserve-Alaska (NPR-A) royalties, rents, and bonuses amounted to $5.2 million. Alaska's oil revenue in 2008 totaled $11.2 billion (ADOR 2008c).

Unrestricted oil revenue comprised approximately 93 percent of the state's general fund unrestricted revenue in FY 2009 (ADOR 2008a). Such revenues finance the state's education funding, operating budget, and capital budget. State spending supports nearly one out of every three jobs, and $3 of every $10 of personal income result from state spending. Nearly one of every two local government jobs (including school district jobs) in Alaska relies on state funding (Goldsmith 1991). Table 8.1 shows state funding and enrollment figures for the NSB School District.

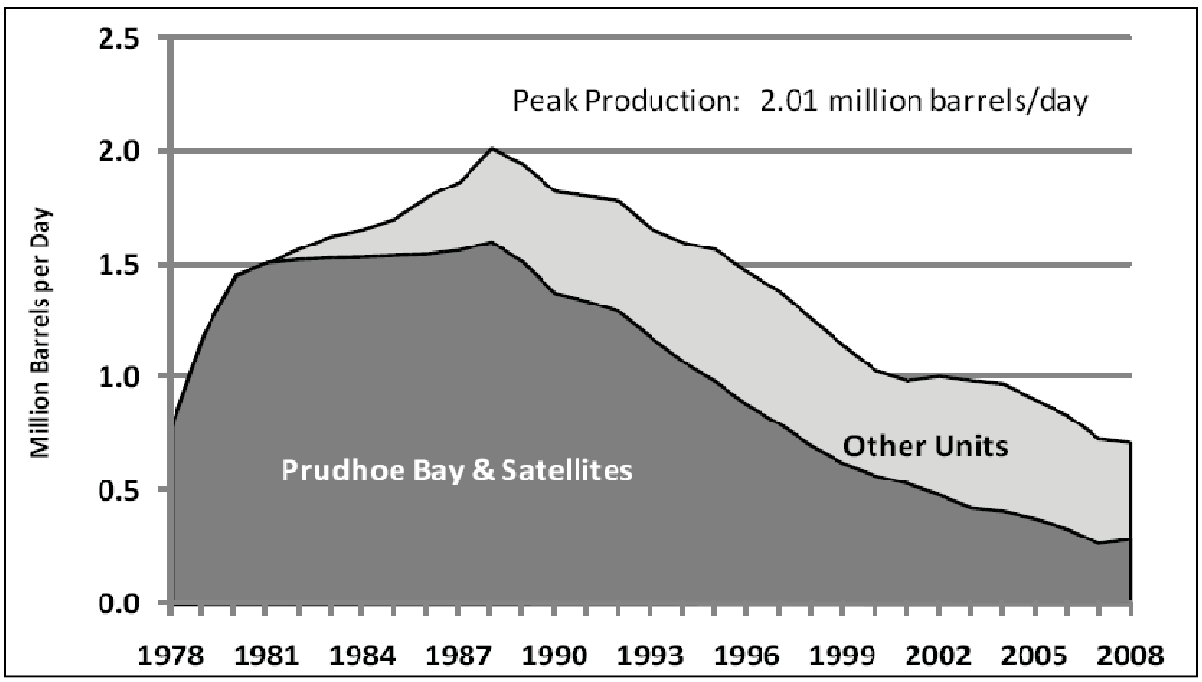
Table 8.1. State aid and enrollment for the North Slope Borough School District, fiscal year 2000-2008.

Fiscal Year	2000	2001	2002	2003	2004	2005	2006	2007	2008
Aid in millions	$8.96	$9.75	$8.94	$8.47	$8.70	$9.28	$11.60	$12.24	$10.20
Enrollment	1,936	2,187	2,165	2,115	2,065	1,938	1,941	1,859	1,864

Source: ADEED 2009a, b.

Alaska North Slope production peaked at 2.006 million bbl per day in FY 1988 and has declined steadily since then (Figure 8.2). The Alaska Department of Revenue (ADOR) anticipates production will decline by 3.8 percent in FY 2009 to about 0.689 million bbl per day. For FY 2010, ADOR projects a 3.5 percent decrease in North Slope production to 0.665 million bbl per day (ADOR 2008c). ADOR expects oil prices to average $57.78 per bbl in FY 2010, down from $90.46 in FY 2008 (ADOR 2009b).

The energy industry is Alaska's largest industry, spending $2.1 billion annually in the state. The industry directly spends $422 million on payroll in Alaska and $1.7 billion on goods and services in-state. Overall, this spending generates 33,600 jobs, $1.4 billion in payroll, and adds $1.8 billion in value to the Alaska economy, for total output of $3.1 billion. Oil and gas account for 12 percent of private sector jobs and 20 percent of private sector payroll. The oil and gas industry has the highest average wage in Alaska. The average producer company pays a monthly wage of $7,754, which is 2.8 times higher than the statewide average of $2,798 (Information Insights and McDowell Group 2001).



Source: ADOR 2008c.

Figure 8.2. Alaska North Slope oil production, 1978-2008.

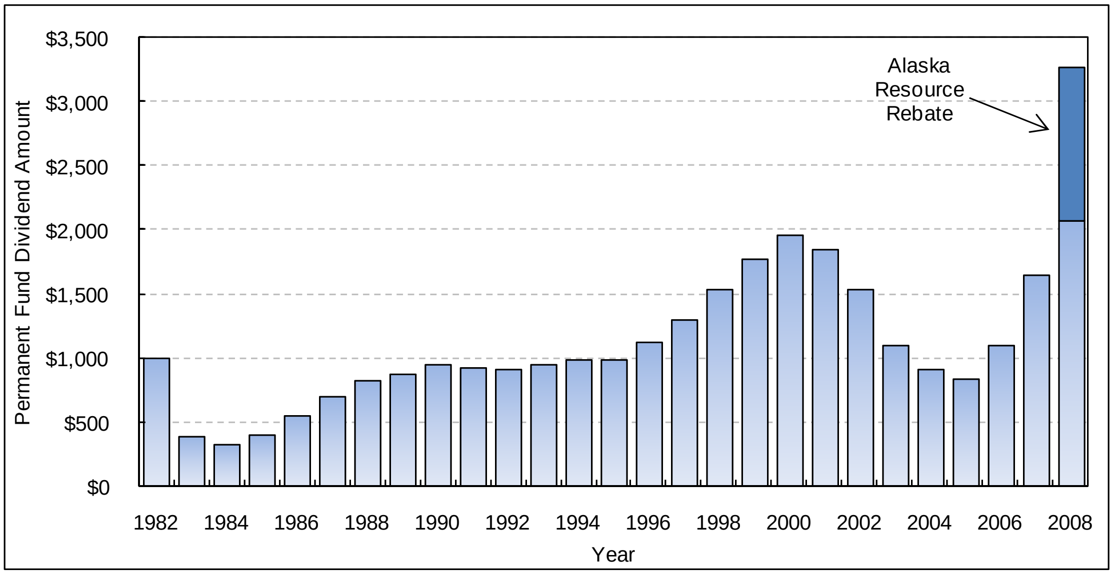
When state and local governments spend oil and gas revenues, Alaska's petroleum industry exercises significant indirect impacts on local communities. Money is spent throughout the state on capital projects, to support basic government operations (including payroll for state government employees), for revenue sharing and municipal assistance, to fund education, and to pay the annual Permanent Fund dividend (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).

In 2006, nonresidents accounted for 30.8 percent of the statewide oil industry's workforce (major oil companies and oilfield services), an increase of 1.2 percentage points over 2005 (ADOL 2008). Earnings paid to nonresidents working in the oil industry increased from $242.9 million in 2005 to $327.6 million in 2006. The nonresident share of earnings in the oil industry was 28.7 percent, a figure much higher than the statewide private sector average of 12.9 percent. By comparison, Alaska's seafood processing industry employed the highest percentage of nonresident workers of any industry sector in 2006; 76.4 percent of workers were nonresidents (ADOL 2008).

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 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.

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 is forecast to exceed $40 billion in FY 2008 (APFC 2008). All eligible Alaskans who apply receive an annual Permanent Fund Dividend (PFD) from the earnings of the fund. In 2008, the PFD was $2,069 per person; 610,768 dividends were paid, totaling $1.2 billion (ADOR 2008b; Figure 8.3). In addition, in 2008 every Alaska resident also received an additional $1,200 resource rebate. 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: ADOR 2007a; ADOR 2008b.

Figure 8.3. Amount of the Alaska Permanent Fund Dividend, 1982-2008; includes Alaska Resource Rebate in 2008.

2. Municipalities and Communities

The North Slope Borough (NSB) is host to the production center for the state's oil industry and no other borough is more influenced by the oil and gas industry. Although the borough relies on oil revenues, most local residents pursue a traditional and community-based economic life. The finances of the NSB government depend predominately on tax revenues from oil properties. Approximately 98 percent of all local property tax collections come from oil producers. For fiscal year 2008/2009, property tax receipts are anticipated to be $248 million (NSB 2008a).

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 2005 property tax rate for the NSB was 19.03 mills. Since the 1980s, the NSB property tax base has consisted mainly of high-value property owned or leased by the oil industry in the Prudhoe Bay area (BLM 2007)

A critical issue facing the NSB is a growing shortfall in revenues consequent to reductions in the assessed value of oil facilities as they depreciate. The real property assessed valuation for the NSB has declined from $11.5 billion in 1992 to $194 million in 2005. The full value determination of real property was $10.36 billion in 2005. Future assessed values could be higher than current projections if industrial infrastructure is built in the NSB. In the near term, a decline in tax revenues and bonding capacity is anticipated (BLM 2007).

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. (MMS 2008).

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).

While the NSB ranks highly on income statistics (Table 8.2), it also has one of the highest costs of living in the state. The Cooperative Extension Service of the University of Alaska Fairbanks surveys food prices in 24 locations in the state. In June 2004, it listed Nuiqsut and Barrow as the second and fourth most expensive places for weekly food costs for a family with 2 school-age children. Food items were more than 2.3 times higher in Nuiqsut and 2.1 times higher in Barrow than in Anchorage (ADOL 2005).

Table 8.2. Comparison of NSB per capita personal income to other locations.

Location	Income ($)
United States	34,685
Alaska	36,636
Anchorage Municipality	40,670
Fairbanks North Star Borough	33,568
North Slope Borough	42,209
Northwest Arctic Borough	26,339

According to a spring 2004 construction cost survey conducted for the Alaska Housing Finance Corporation, Barrow bears the highest material costs among 11 Alaska locations surveyed. A basic construction market basket that does not include doors or windows was quoted to cost $37,873, exceeding the Anchorage price by 114 percent. Most of the additional price is attributed to transportation costs. Airfares are also among the highest in the state because of the distance and the costs involved with service to remote locations (ADOL 2005).

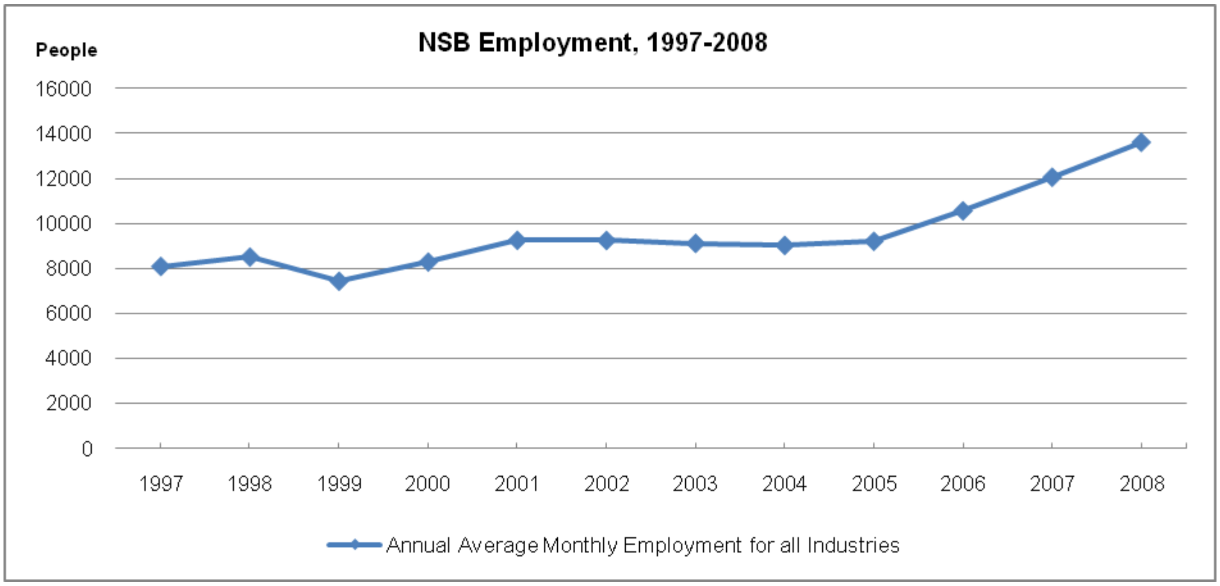
The NSB established its own permanent fund that contains assets that are to be held in perpetuity. As of June 30, 2008, the value of the fund was approximately $462 million. Income from the fund is to be added to the corpus of the fund, except that an annual transfer is made to the general fund in an amount up to 8 percent of the average total fair value of the fund at the end of the 3 preceding fiscal years (NSB 2009).

The accumulated beneficial effects of oil and gas development 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 corporate 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, and combined 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 (individuals, corporations, and other taxable sources) per capita taxable net asset values average about $74,000; this compares to $1.53 million per capita for the NSB (NRC 2003).

Q. Effects of Oil and Gas on Municipalities and Communities

1. Employment North Slope Borough 2009

Local government is the largest employer of borough residents and the median household income is $63,173 (MMS 2007c). Barrow is a hub and economic center of the North Slope Borough. Borough, state, and Federal agencies provide 57 percent of total employment. The Arctic Slope Regional Corporation and subsidiaries employ 5.2 percent. Seven residents hold commercial fishing permits. Fourteen oil and gas industry jobs on the North Slope are held by Barrow residents. Census 2000 reports Barrow's per capita income at $22,902 and household income at $67,097 (BLM 2008a citing to Shepro and Maas 2003). Employment in all industries increased from 1997-2008 (Figure 8.4). Residents within the financial industry earned the highest monthly income (Table 8.3). Number of people employed in Barrow increased from 2,194 in 1998 to 2,377 in 2003 (Table 8.4).



Source: ADOLWD 2009.

Figure 8.4. Employment in the NSB, all industries, 1965-2005.

Table 8.3. NSB employment profile: average monthly employment and earnings, first quarter, 2007

Industry	Workers	Average Monthly Earnings
Construction	163	$7,628
Transportation/Trade/Utilities	444	$6,075
Retail Trade	204	$2,842
Federal Government	18	$4,953
State Government	62	$5,006
Local Government	1,713	$3,413
Financial Activities	208	$9,141

Source: ADOL 2007.

Table 8.4. Barrow employment in 1998 and 2003.

	1998		2003	
Employment Status	Number	Percent	Number	Percent
Permanent Full-time	1,565	71.4	1,461	61.5
Temporary/Seasonal	287	13.1	301	12.7
Part-time	91	4.2	155	6.6
Unemployed	251	11.5	460	19.4
Totals/Percentages	2,194	100.0	2,377	100[a]

Source: URS Corp. 2005a citing to Shepro, Maas et al. 2003.

[a] Total percentage rounded off.

In Nuiqsut, education and other government services provide the majority of full-time employment (Table 8.5). The Kuukpik Native Corporation and the North Slope Borough including its school district are the largest employers. Government employment, including part-time or temporary, totaled 44 of 98 workers in the village in 2003. Arctic Slope Regional Corporation and subsidiaries employed 3 persons providing services to oil field operations. Three oil and gas industry jobs on North Slope were held by local residents. In 2003, per capita income was $13,633 and household income was $59,907 (BLM 2008a, citing to Shepro and Maas 2003).

Table 8.5. Nuiqsut employers in 2003.

Employer	Total
State Government	1
City Government	5
NSB Government	29
NSB School District	27
NSB CIP	2
Oil Industry	3
Private Construction	3
ASRC or Subsidiary	3
Village Corp./Subsidiary	37
Other	11
Total	121

Source: URS Corp. 2005c citing to Shepro, Maas et al. 2003.

The primary employers in Kaktovik are the North Slope Borough, NSB, North Slope Borough School District, and the Kaktovik Inupiat Corporation (Table 8.6). Craft sales are also part of Kaktovik's economy. Approximately 19 percent of households participated in craft sales in 2003, but the majority of artisans made less than $500 per year. Table 8.7 shows the labor status of village residents.

Table 8.6. Household member employer by ethnicity and gender, Kaktovik.

Employer	Inupiat		Non-Inupiat	
	Male	Female	Male	Female
Federal Government	0	0	1	0
State Government	0	0	0	0
City Government	1	1	1	0
NSB Government	16	10	1	0
NSB School District	3	5	6	7
NSB CIP	0	0	0	0
Oil Industry	1	0	0	0
Private Construction firm	5	0	0	0
ASRC or Subsidiary	3	2	0	0
Village Corp./Subsidiary	10	7	0	1
Finance/Insurance	0	0	0	0
Transportation	0	0	0	0
Communications	0	0	0	0
Trade	0	0	0	0
Service	0	0	0	0
Ilisagvik	0	0	0	0
Other	0	1	1	1
Total	39	26	10	9

Source: URS Corp. 2005b, citing to Shepro and Maas 2003.

Table 8.7. All individuals reporting labor status, 2003.

Employment Status	Number	Percent
Permanent full-time	63	36.8
Temporary/Seasonal	10	5.8
Part-Time	9	5.3
Unemployed	16	9.4
Retired	12	7.0
Still in school	61	35.7

Source: URS Corp. 2005b citing to Shepro and Maas 2003.

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 (Table 8.8). A study contracted by MMS showed that 34 North Slope Natives interviewed comprised half of all North Slope Natives who worked at Prudhoe Bay in 1992, and that the North Slope Natives employed at Prudhoe Bay comprised less than 1 percent of the 6,000 North Slope oil-industry workers (BLM 2008c).

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 2008c).

ConocoPhillips has 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 2008c).

Table 8.8. Estimated number of resident jobs by sector, NSB communities, 2003.

Sector	Anaktuvuk Pass	Atqasuk	Barrow	Kaktovik	Nuiqsut	Point Hope	Point Lay	Wainwright
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 2008c.

Nanook Incorporated, a subsidiary of Kuukpik Corporation, based in Nuiqsut, has a training program that could be used to train Natives for position in the oil industry, such as technicians and other long-term jobs (MMS 2008)

As exploration takes place, and if development occurs in the lease sale area, it would add jobs to the local economy. These jobs would not be limited to the petroleum industry, but would be spread throughout the 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 sale area would 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. This way of life will be impossible to maintain unless significant revenues continue to come into those communities from outside; the prospects of other sources of revenue appear to be modest. Painful adjustments can and probably will be postponed for as long as oil and gas are being extracted, but eventual adjustment is 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).

2. Public Health

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 limited to effects of exploration, development, production, and transportation involving oil and gas or gas only [(AS 38.05.035(g)(B)(x)]. 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 borough's HIA contractor, Northern Health Impact Group (NHIRG), has been conducting 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).

Each year, under AS 38.05.035(e)(6)(F), ADNR issues a call for comments requesting substantial new information that has become available since the most recent finding for that sale area was written. Based on information received, ADNR will determine whether it is necessary to supplement the finding. By this mechanism, ADNR will have the opportunity to consider health impacts once the Alaska Inter-Tribal Council and NSB complete their HIAs and the state finalizes its HIA policy.

HIA's have not been routinely performed in the United States. However, BLM in its 2007 NPR-A Draft Supplemental and MMS in their 2008 Beaufort Sea and Chukchi Sea Draft Environmental Impact Statement considered health effects of North Slope oil and gas development. Their analysis is summarized below.

The overall health of Alaska Natives, including the North Slope Inupiat, has improved significantly since 1950 due to the combination of improved socio-economic status, housing, sanitation, and health care and infection control efforts. Health status on the North Slope has continued to improve as measured by overall mortality and life expectancy. Since 1979, overall mortality has declined roughly 20 percent (BLM 2007, citing to Goldsmith 2004; Bjerregaard, Young et al 2004; Day et al 2006). Despite these improvements, significant disparities remain between Alaska Natives and the general U. S. population as cancer, social pathology, and chronic diseases are rapidly increasing (MMS 2008).

The incidence and the mortality rates for cancer have increased roughly 50 percent since 1969. Cancer is now the leading cause of death on the North Slope. Three cancers, breast, colon, and lung, account for much of the overall increase. By a small margin, North Slope Alaska Natives have the highest incidence of cancer in Alaska, at 579/100,000. The increase in lung cancer and possibly breast and colon cancer may be due to smoking, although there are no definitive studies to prove this (BLM 2007). However, smoking rates on the North Slope are extremely high (BLM 2007, citing to Wells, 2004). Radon gas exposure also is a risk factor in some areas of Alaska and, nationwide, it is thought to be the second leading cause of lung cancer behind smoking tobacco (MMS 2008, citing to EPA, 1993).

Colorectal cancer has known genetic risk factors, in addition to family history. Cigarette smoking is a known risk factor, and recent studies have suggested that increased insulin levels associated with sedentary lifestyle and consumption of high sugar diets also are risk factors. Breast cancer has several known risk factors, including genetics, use of estrogen-progesterone hormone replacement therapy, obesity, and consumption of 4 or more alcoholic drinks daily. Prostate cancer risk factors include age and possibly a diet high in animal fat. Stomach cancer is far more frequent in Alaskan Natives. The major known risk factor for this cancer is infection with the bacteria Helicobacter pylori, which causes a chronic infection in the lining of the stomach (MMS 2008).

Psychological and social problems including alcohol and drug abuse, depression, assault, sexual abuse, and suicide are highly prevalent on the North Slope, as they are in many rural Alaska Native villages and Inuit villages in Canada and Greenland. The prevalence of suicide on the North Slope in recent years has been estimated at roughly 45/100,000, more than 4 times the rate in the general U.S. population. In one recent survey, 3 percent of NSB Alaskan Native residents reported having seriously considered suicide within the last year, compared with 7 percent in the Northwest Arctic Borough (NWAB). The same survey found that 6 percent of NSB Alaskan Native residents were likely to be depressed based on responses to a series of mental health screening questions, compared with 14 percent of NWAB residents (MMS 2008 citing to Poppel et al., 2007).

Unintentional injury rates are high in the North Slope because of factors such as high rates of alcohol and substance abuse and risk-taking behavior in youth. Research suggests that social pathology problems are related to the rapid cultural changes that have occurred. Alcohol prohibition has been demonstrated to reduce rates of suicide, homicide, and other social pathology (BLM 2007).

Diabetes, obesity, and related metabolic disorders were previously rare or non-existent in the Inupiat but are now increasing. The prevalence of diabetes in the North Slope is estimated at only 2.4 percent compared with the U.S. rate of roughly 7 percent. However, between 1990 and 2001, the rate of diabetes climbed roughly 110 percent, nearly 3 times the rate of increase in the general U.S. population (Alaska Native Medical Center Diabetes Program). Available data suggest that younger Inupiat people are consuming relatively higher proportions of market foods (MMS 2008 citing to Nobmann et al., 2005). This raises a number of concerns, because foods available and affordable in village stores are costly and often of poor nutritional value (MMS 2008 citing to Bersamin et al., 2006). Subsistence diets and the associated active lifestyle are known to be the main protective factors against diabetes. The increase in diabetes may reflect the increased use of store-bought food, a more sedentary lifestyle, and, potentially, genetic susceptibility (BLM 2007, citing to Murphy, Schraer et al., 1995; Naylor, Schraer et al., 2003; Ebbesson, Kennish et al., 1999).

Cardiovascular disease rates are significantly lower in Alaska Natives than in non-Natives in the U.S. On the North Slope, recent mortality figures show death rates roughly 10 percent less than the U.S. population (BLM 2007, citing to Day, et al., 2006). However, many of the risk factors are increasing, and smoking rates are already extremely high (BLM 2007 citing to Wells, 2004).

North Slope residents have the highest mortality rate in the state from chronic lung diseases, at nearly three times the mortality rate for the U.S. (130/100,000 compared with 45/100,000) (Day et al 2006). The disparate rates of increase and mortality from pulmonary disease are accompanied by high smoking rates, which many public health experts believe to be the primary explanation. Smoking rates in the NSB are high. According to a regional analysis of federal Behavioral Risk Factor Surveillance System (BRFSS) data from 2005-2007, 44 percent of North Slope residents reported being smokers, compared to a statewide rate of 23 percent (ADHHS, unpublished data). In one North Slope survey, 61 percent of those sampled reported smoking daily (MMS 2008 citing to Poppel et al., 2007).

Indoor air quality also has been suspected as a cause of increasing rates of chronic lung disease in the Arctic. Modern, highly insulated housing in remote Inupiat villages has caused a decrease in ventilation. One recent study in Canadian Inuit villages noted that ventilation in these houses was poor, and CO2 levels were higher than recommended. It is not known whether these study results can be generalized to NSB housing (MMS 2008).

It is impossible to estimate the contribution of environmental factors because there are no available data on local fine particulate concentrations, hazardous air pollutants, and indoor air quality. Data generally does not exist to allow the direct attribution of a particular illness to a specific development project. However, an ambient Air Quality Monitoring Station has operated at Nuiqsut since 1999, as permit condition for the Alpine field. Data collected indicate that air quality is in compliance with National Ambient Air Quality Standards (NAAQS) and Alaska Ambient Air Quality Standards (BLM 2007). However, adverse health effects may occur at levels below NAAQS thresholds and particularly to vulnerable groups: the elderly and very young, people with chronic illnesses, and the socioeconomically disadvantaged (MMS 2008).

While reductions in infectious disease has significantly improved the health status of the North Slope Inupiat people since the 1950s, BLM concludes that the rates of cancer, chronic diseases such as diabetes, hypertension, and asthma, and social pathology have increased. At present, no evidence exists to conclusively link rates of any of these problems to oil and gas development (BLM 2007).

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