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SECTION 4G
EFFECTS OF THE CUMULATIVE CASE

4G.1 INTRODUCTION

NEPA and its implementing guidelines require an assessment of the proposed project and other projects that have, or are likely to occur, and which together may have cumulative impacts that go beyond the impacts of the proposed project itself. The lead agency is to be made aware of, and consider such cumulative impacts when making decisions. NEPA defines cumulative impacts as follows:

> "Cumulative Impact" is the impact on the environment, which results from the incremental impact of the action when added to the other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. (40 CFR 1508.7 and 1508.25[a][2])

Further,

> To determine the scope of environmental impact statements, agencies shall consider...Cumulative actions, which when viewed with other proposed actions have cumulatively significant impacts and should therefore be discussed in the same impact statement.

The key to the assessment of cumulative impacts is the identification of other past, present, and reasonably foreseeable projects or actions that will impact the environment of the region in the same time span as the proposed action. This section also considers cumulative impacts to resources that migrate into or through the region (such as birds and whales) and whether those impacts may occur in the region or are encountered in other parts of their range.

4G.2 STRUCTURE OF THE CUMULATIVE IMPACTS ASSESSMENT

4G.2.1 Components of the Cumulative Assessment

The cumulative impacts assessment has four components:

- Assessment of the Impacts of the Proposed Project to the Environment – Project-specific impacts (CPAI Development Plan) are first assessed. These have been reported in Section 4A through Section 4D and Section 4F by specific resource.

- Identification of Cumulative Impact Issues – Issues related to cumulative impacts have been identified from the scoping analysis. Issues associated with past and present actions have also been identified. The cumulative impact assessment addresses these issues.

- Identification of Past, Present and Reasonably Foreseeable Future Actions – Other activities that could contribute to cumulative impacts in the geographic area and timeframe are identified. The projects and actions considered are listed and described in Section 4G.2.2.

- Assessment of Cumulative Impact – Cumulative impact is evaluated by adding the impacts of the proposed project to the impacts of past, present, and reasonably foreseeable future projects, including FFD. The sum of all impacts is the "cumulative impact." Impacts are evaluated in the context of the cumulative issues that have been identified.

Protective standards and guiding principles from existing regulatory programs and policies that control management of natural resources are used as guidelines in the cumulative analysis. Where existing standards, criteria, and policies are not available, resource experts use their best judgment on where and how to focus the analysis.

4G.2.2 Cumulative Impact Issues

Cumulative impact issues were identified by obtaining input from members of communities who live in the project area and region, governmental and non-governmental agencies with jurisdiction or interest, previous environmental reviews and through the EIS scoping process. During the EIS scoping process, interested parties voiced a number of concerns. Many concerns were interrelated or were sub-issues of a larger issue. Following completion of the scoping process, the BLM reviewed, sorted, and categorized publicly expressed concerns and formulated a set of integrated issues, which may be addressed at both the project-specific impact assessment and cumulative impact assessment levels. Six general issue areas related to cumulative impacts were identified in the scoping process:

- Adherence to stipulations identified in the Northeast National Petroleum Reserve-Alaska IAP/EIS
- Expanded North Slope oil and gas development to include the National Petroleum Reserve-Alaska
- Impacts to local residents and traditional subsistence-use areas
- Potential impacts to Colville River Delta resources
- Longer-term development to include FFD with the Plan Area
- Potential Impacts to environmental quality

Within each of the general issues listed above are a number of sub-issues. For example, the issue that addresses traditional subsistence includes the evaluation of cumulative impacts to species that is relied upon for subsistence and access to subsistence hunting and fishing areas. The last issue, impacts to environmental quality, encompasses a large array of concerns with impacts to resources and the residents of the North Slope that use the land and resources**.** The general issue areas identified were expanded by resource specialists as the basis for each resource area evaluation.

Coincident with the BLM's scoping process for the ASDP, NRC of the National Academies issued its report on Cumulative Environmental Effects of Oil and Gas Activities on Alaska's North Slope (NRC 2003). This report also included a series of cumulative impact issues, which formed the basis for its evaluation methodology. Table 4G.2.2-1 presents these issues and a cross-reference to the sections in this cumulative impact assessment where the same or similar issues were evaluated. A summary of NRC findings for these issues follows.

Growth of Industrial Activities – The network of roads, pads, pipelines, and power lines, stretching from Alpine to Badami, has grown incrementally as new fields have been brought into production. Nearly all infrastructure remains in place and is likely to remain so for some time. Effects on hydrologic processes, vegetation, animal populations, wildland values, marine mammals, and visual resources extend past the footprint of the structures themselves. These effects will accumulate with expanded activity.

Interaction of Climate Change and Oil Development – If recent warming trends continue, their effects will accumulate over the next century to alter the extent and timing of sea ice, affect the distribution and abundance of marine and terrestrial plants and animals, and affect permafrost. Climate changes would affect the usefulness of many oilfield technologies and how oil and gas activities affect the environment and Native Alaskan cultures.

Damage to Tundra from Off-Road Travel – Extensive areas of North Slope tundra have been altered by off-road travel for seismic exploration. Effects to vegetation, stream bank erosion, and degraded aerial visual experience have accumulated because areas have been resurveyed before the tundra recovered from pervious surveys. Exploration technology improvements have reduced, but not totally eliminated damage to tundra.

Roads – Roads built for North Slope Oilfield operation have directly affected tundra and indirectly caused impacts from dust, roadside flooding, thermokarst, roadside snow accumulation, and alteration of animal habitat and behavior. Roads have increased access to the region for hunters and tourists and have also enhanced communication among communities.

Effects on Animal Populations – Offshore seismic exploration has resulted in displacement of bowhead whales during fall migration and disturbance of some denning polar bears. North Slope industrial activities have provided food sources, causing increased predator densities. Increased bear, arctic fox, raven, and glaucous gull populations and associated predation have led to reduced reproductive success of some bird species. Accumulated effects of industrial development to caribou productivity have not resulted in declines to the overall size of the CAH; however, the spread of oil and gas development into calving and summer use areas may disturb caribou, resulting in reduced reproductive success.

Oil Spills – Three major spills associated with operation of TAPS have occurred on the North Slope. Small spills have occurred in the oilfields, but they have not been frequent or large enough for their effects to have accumulated. If a large spill were to occur at sea, substantial effects would be likely because no current cleanup methods exist for broken ice conditions.

Expansion into New Areas – Damage to tundra from seismic exploration in National Petroleum Reserve-Alaska and into the Brooks Range foothills has been reduced but not eliminated by current technology and permitting regulations. Potential effects in the foothills include damaged vegetation on knolls and riverbanks, increased erosion, and creation of thermokarst.

Legacy of Abandoned Infrastructure and Unrestored Landscapes – Only about 1 percent of habitat affected by gravel fill has been restored to date. The obligation to restore abandoned sites is unclear in state and federal performance criteria and standards. The expense of restoration and possibility of site reuse make it unlikely that most habitat will be restored unless current constraints change dramatically. Because recovery in the Arctic is slow, effects caused by unrestored structures may persist for centuries. Effects will accumulate further as new structures are added in the region.

Socioeconomic Changes in North Slope Communities – Modern western culture, including oil development and the revenue stream it creates, has resulted in major changes to the way of life in North Slope communities. Improvements to schools, health care, housing, and community services have occurred along with changes in culture, diet, and the economic system, as well as increased rates of alcoholism, diabetes, and circulatory disease. Effects to social and individual pathology have accumulated because of the complex interaction and multiple causes.

Interference with Subsistence Activities – Impacts to Inupiat culture result from deflection of bowhead whales during fall migration and fears about a major offshore oil spill. Threats to cultural continuity based on subsistence hunting of bowhead whales accumulate because they are repeated with each new offshore lease sale. Similar widespread, intense fears of Gwich-in Indians about risks to the PCH from repeated proposals to develop in ANWR have led to accumulating effects.

Aesthetic, Cultural, and Spiritual Consequences – Oil development has changed the North Slope landscape, resulting in accumulating aesthetic, cultural, and spiritual consequences. Reduced opportunities for solitude and degraded wildland and scenic values have occurred over large areas. Effects will accumulate further as the area affected by development increases.

Response of North Slope Communities to Declining Revenues – Future adjustments by North Slope Communities to reduced financial resources as a result of declining oil production will be postponed as long as oil and gas are being extracted; however, eventual adjustment is unavoidable. The nature and extent of adjustment will depend on the adaptations communities have made to the cash economy made possible by oil and gas and other activities.

TABLE 4G.2.2-1 ISSUES FROM NRC–CUMULATIVE EFFECTS OF OIL AND GAS ACTIVITIES ON ALASKA'S NORTH SLOPE

No.	NRC Report Issue	Reference to ASDP DEIS
1	Growth of Industrial Activities	4G.4
2	Interactions of Climate Change and Oil Development	4A – D, F.2.3.1, 4G.5.8
3	Damage to Tundra from Off-Road Travel	4A – D, F.3.1, 4G.6.1
4	Roads	Impacts discussed under nearly all parts of Section 4
5	Effects on Animal Populations	4A – D, F.3.2, F3.3, F3.4, F3.5, 4G.6
6	Oil Spills	4.3, 4G.2.4.2
7	Expansion into New Areas	Impacts discussed under nearly all parts of Section 4
8	Legacy of Abandoned Infrastructure and Unrestored Landscapes	2.3.2, 2.3.3, 2.3.4
9	Socioeconomic Changes in North Slope Communities	4A – D, F.4, 4G.7
10	Interference with Subsistence Activities	4A – D, F.4.3, 4G.7.3
11	Aesthetic, Cultural, and Spiritual Consequences	4A – D, F.4.5, 4.8, 4G.7
12	Response of North Slope Communities to Declining Revenues	4A – D, F.4.2, 4G.7.2

4G.2.3 Region and Timeframe of Consideration

4G.2.3.1 Region of Consideration

The geographic boundaries set for the analysis of project-specific impacts are generally the immediate vicinity of specific project actions (the Alpine satellites and its local environs), with some exceptions, such as air quality. Since the cumulative analysis evaluates a broader set of projects and actions, the geographic boundary of the cumulative analysis is necessarily larger. The general geographic region of consideration for the cumulative analysis was the North Slope region of Alaska as defined by the drainage basin north of the Brooks Range (Figure 4G.2.3-1). For the marine environment, the coastal and near coastal portions of the adjacent Chukchi Sea and Beaufort Sea are included. For migrating terrestrial, avian and aquatic species an extended geographic region was considered appropriate to the resources.

4G.2.3.2 Timeframe of Consideration

CEQ guidelines for cumulative analysis under NEPA indicate that the timeframe for cumulative impacts should be the same as the period over which the primary impacts of the proposed project occur. Table 4G.2.3-1 shows estimated timeframes for the various phases of a typical oilfield's life cycle. These phases are expected to be similar for the ASDP. Exploration and discovery have already occurred. Development, production, and abandonment and rehabilitation are the remaining phases for the proposed project. Phased development and initial production may take up to 6 years and production would extend to the extent that economically recoverable reserves are available, possibly as long as 30 years. Abandonment and rehabilitation of facilities may take on the order of 10 years. Thus impacts from development of the ASDP may occur over a time period of up to 50 years.

Given that the project could have some continuing impacts over a period of as long as 50 years, the cumulative impact analysis must consider "reasonably foreseeable future actions" over the same time period.

TABLE 4G.2.3-1 DEVELOPMENT TIMEFRAME FOR A TYPICAL OILFIELD

Phase	Period (years)	Activities
Exploration	1 to 10	Conduct seismic surveys to define prospects Conduct well-site surveys and permitting Drill exploration wells
Discovery	Can occur anytime during or after exploration	Determine producible well Drill delineation well(s) Conduct additional seismic survey (3-D) Appraise and engineer reservoirs Complete project design and environmental studies/factors Apply for permits
Development	Normally takes 3 to 6 years past the initial discovery	Establish construction base camp Set up environmental monitoring programs Install gravel pads for facilities Design and build production modules Begin drilling development wells Install pipelines and pump stations Install production facilities and hookup
Production	30 to 40 years post-development	Continue development-well drilling Ramp-up production (2 to 5 years) Reach peak production plateau (3 to 8 years) Expect production declines Well workovers (every 3 to 5 years) Conduct in-fill drilling (well-spacing reduced) Employ tertiary recovery methods Progressively shut-in wells Reach an economic limit
Abandonment and Rehabilitation	Individual wells can take 2 to 5 years, re-vegetation 5 years or more	Plug and abandon wells Remove production equipment Dismantle facilities Decommission pipeline Restore and re-vegetate sites Phase out environmental monitoring

Source: Adapted from Northeast National Petroleum Reserve-Alaska Amended IAP/EIS.

4G.2.4 Elements Included by Reference in the Cumulative Analysis

4G.2.4.1 Projections of North Slope Oil Production

Projections of North Slope production were included in the recent Northwest National Petroleum Reserve-Alaska Final EIS (BLM and MMS 2003b) for three different crude oil price futures. These projections included low [5 billion barrel (Bbbl)], mid (11 Bbbl) and high (15 Bbbl) estimate ranges (BLM and MMS 2003b, Table iv-15). These forecasts are incorporated by reference in this ASDP EIS.

The purpose of these estimates is to provide a bounding estimate on total oil production for impacts related to operations including oil spills, traffic, and other production activities.

4G.2.4.2 Transportation of Crude Oil

Production of any North Slope reserves would not occur without a means of exporting the production to market by a transportation system. The transportation infrastructure system includes four components: (1) pipelines from the production pads to a processing facility, (2) pipeline from the processing facility to TAPS, (3) TAPS from Prudhoe Bay to Valdez, and (4) seagoing tankers that travel from Valdez to ports on the west coast of the United States and Asia.

Since production in existing Prudhoe Bay Fields has declined, the existing oil transportation system (including TAPS) is expected to be able to transport oil produced by development of new reserves in the areas surrounding the Prudhoe Bay Fields (core fields), as well as additional enhanced recovery from the Prudhoe Bay Fields during the cumulative analysis period. New fields would use existing infrastructure (except pipelines from production pads to processing facilities) to transport processed crude oil to the TAPS pipeline. This existing infrastructure includes the western sector, (the existing Alpine and Kuparuk field units), which would accommodate the National Petroleum Reserve-Alaska; the central sector (Northstar); and the eastern sector (Badami).

Currently, the TAPS terminal at Valdez handles about 990,000 bbls of crude daily. At peak production, the ASDP would contribute up to 145,000 bbls per day of crude oil to the total amount transported by TAPS. Assuming future production on the North Slope (including offshore) grows to the high end of projections, oil tankers still could be transporting on the order of 1.0 MMbbl daily from Valdez in 2009.

TAPS is currently in place, operational, and has sufficient capacity to support the ASDP and the associated FFD. Transport of product to TAPS would be through a connector pipeline from the Plan Area to the existing APF-1, and from there the oil would be transported in existing pipelines from the Alpine Field to the Kuparuk Field and on to TAPS. The cumulative impacts of operating the TAPS transportation system were evaluated in the recent TAPS Renewal FEIS. These impacts included consideration of continuing use of the crude oil transportation system to transport current and future production. It also considered the probability and consequence of spills from various elements of the system. Because none of the ASDP alternatives would add to or change operations of this transportation system downstream of APF-1, the conclusions about the cumulative impacts associated with transportation of crude oil from the North Slope presented in the TAPS Renewal FEIS are equally applicable to the ASDP and are incorporated into this cumulative analysis. A copy of the TAPS Renewal EIS can be reviewed on-line at http://tapseis.anl.gov/.

The conclusions of the TAPS Renewal FEIS on impacts from continued operation of the pipeline and tanker transportation system were the following:

- **Paleontology, Air Quality, Transportation, Waste Management, Terrestrial Vegetation and Wetlands, and Cultural Resources** – TAPS would have very minor or no impact.

- **Soils and Permafrost** – Increased throughput could expand thaw bulbs and ground settlement near TAPS. Reduction in throughput could cause frost heaves. TAPS would be a minor contributor to cumulative effects related to soils and permafrost.

- **Sand, Gravel, and Quarry Resources** – TAPS would be a minor contributor to requirements for these resources.

- **Surface Water Resources** – Impacts to surface waters would be localized unless an oil spill occurs, in which case impacts could be substantial. TAPS operation would have a very small effect on surface water quality.

- **Groundwater** – An oil spill from TAPS or oil development activities could impact groundwater quality to a small or large extent, depending on the spill's size, location, and the effectiveness of response activities.

- **Physical Marine Environment** – The marine environment could be affected by spills from tankers in Prince William Sound or along Pacific transportation routes. Reasonably foreseeable spills would be small, rapidly cleaned up, and of local consequence. Larger, less probable spills might take longer to clean up and may result in widespread contamination of the marine environment.

- **Noise** – Operation of facilities would have the potential to produce local impacts on noise.

- **Human Health and Safety** – No adverse health impacts would be expected from the inhalation of industrial air emissions in the Valdez area. Valdez Marine Terminal operations contribute to, but are not the sole source of, organic air pollution emissions in the Valdez area. The general public would be exposed to more vehicle emissions over the next 30 years unless additional controls are placed on such emissions. Accidental releases of hazardous materials and spills into the marine environmental could have small impacts on public health.

- **Fish** – Risks of large spills with large consequences would be low; however, a major spill into a waterway could cause severe and possibly long-term adverse effects.

- **Birds and Terrestrial Mammals** – Impacts from many activities could be large in local areas but would be minor on the population level.

- **Threatened, Endangered, and Protected Species** – Impacts are anticipated to be negligible to minor and are not anticipated to threaten population viability, unless a low-probability, high-volume spill from oil transportation occurred in Prince William Sound or along Pacific transportation routes. Such a spill might cause high impacts in localized areas.

- **Economics** – Continued production of North Slope petroleum reserves, including transportation, would make a substantial, though declining contribution to domestic oil production and would continue to reduce the need for foreign oil imports, thus improving national energy security and the overall balance of trade. Significant federal tax revenue would be generated with continued TAPS operation, together with marine and shipbuilding employment, and employment in the economy as a whole.

- **Subsistence** – There would be low impacts on subsistence, except on the North Slope where impacts would be moderate. Contributions from TAPS to these [subsistence] cumulative impacts are expected to be relatively small.

- **Socio-Cultural Systems** – In socio-cultural systems founded on cooperation and subsistence, cumulative impacts might accompany their continued interaction with modern American society and the continued growth in the importance of a cash economy. However, these changes occurring throughout Alaska are not attributable solely to cumulative actions considered in [the Renewal EIS]. The contribution of TAPS to these cumulative impacts would be relatively small.

- **Land Use and Coastal Management** – The contribution of the TAPS operation to these cumulative impacts is expected to be relatively small. However, an oil spill to marine waters from marine transportation or from oil production could impact implementation of CMPs.

- **Recreation, Wilderness, and Aesthetics** – Oil spills associated with TAPS operations could impact recreation, aesthetic, and wilderness values. Because spills could result in long-term impacts, aesthetic impacts along the TAPS may be major.

4G.2.4.3 Size and Frequency of Oil Spills

The potential to spill oil, other hazardous materials, and seawater is present during exploration, development, and production. No large spills (greater than 1,000,000 bbl) have been recorded on the North Slope. However, small localized spills in a range of sizes regularly occur. A discussion of spill frequency, type, and analysis of spills has

also been incorporated into the Northeast National Petroleum Reserve-Alaska IAP/EIS (a portion of the ASDP Plan Area is in the Northeast National Petroleum Reserve-Alaska), Northwest National Petroleum Reserve-Alaska IAP/EIS, and the TAPS Right-of-way Renewal EIS. The Northwest National Petroleum Reserve-Alaska IAP/EIS, represents a refinement of previous spill analyses. Since no materially new information is available on the size or frequency of oil spills, the spill analysis included in the Northwest National Petroleum Reserve-Alaska IAP/EIS is incorporated by reference. Further discussion of the conclusions of that analysis, as they pertain to the CPAI Development Plan and FFD, may be found in Section 4.3 of this EIS.

The spill analysis from the Northwest National Petroleum Reserve-Alaska IAP/EIS is relevant to the ASDP cumulative analysis. Appendix 9 of the Northwest National Petroleum Reserve-Alaska IAP/EIS provides the information, models, and assumptions used to analyze the effects of oil spills. Analysis of oil spills in the cumulative case centered on the fact that most oil originating from either onshore or offshore fields on the North Slope of Alaska flows through TAPS pipelines and into TAPS tankers. Oil spill size categories used to estimate large crude oil spills for the cumulative analysis were ≥ 500 bbl for the Alaska North Slope and TAPS pipeline and ≥1,000 bbl for Beaufort OCS and TAPS tanker. Historic spill rates/ used to estimate potential large spills were: 0.23 Bbbl for Beaufort OCS, 0.64 Bbbl for the Alaska North Slope, 0.21 Bbbl for TAPS pipeline, and 0.88 Bbbl for TAPS tanker.

Past, present, and reasonably foreseeable reserve/production estimates for the cumulative analysis in the Northwest National Petroleum Reserve-Alaska IAP/EIS totaled 10.68 Bbbl for both onshore and offshore fields. Based on these reserve and resource volumes, the analysis found an estimated mean number of large spills, as defined above, to be: 0.65 Bbbl for offshore, 5.28 Bbbl for onshore, 2.24 Bbbl for TAPS pipeline, and 9.72 Bbbl for TAPS tankers.

4G.3 GUIDING PRINCIPLES FOR CUMULATIVE IMPACT ASSESSMENT

4G.3.1 Reliance on Federal and State Programs for Resource Protection

A number of federal and state programs have been established to protect environmental resources and, in cases where there is existing environmental impairment, to effect restoration. The assessment of cumulative impacts must recognize the existence of these programs and assume that the mandate under which each program was established will continue. The practical effect of these programs is that they are assumed to require the avoidance or mitigation of the environmental impacts that they are designed to address. The programs assumed to continue for the cumulative impact assessment are described by the resource that they manage or protect as follows:

- **Threatened, Endangered, and Protected Species** – The ESA of 1973 is intended to protect listed species from harassment and harm that could be detrimental to the continued existence of the species. This protection considers direct project effects, and cumulative effects of multiple actions. Consultation on listed species identified in the Plan Area by NOAA Fisheries and the USFWS under Section 7.0 of the ESA are incorporated by reference in this cumulative analysis. The potential effects on each of the other species identified through scoping were also reviewed and included, as appropriate in this EIS. Cumulative effects were also analyzed for those species listed as "endangered," "threatened," "proposed," or "candidate" on the North Slope, in the Beaufort Sea, and in the Chukchi Sea and which NOAA Fisheries and the USFWS indicated that this EIS should assess.

- **Marine Mammals** – The management of seals by NOAA Fisheries and polar bears by the USFWS under the MMPA of 1972 provides for monitoring these species' populations and managing or mitigating potential effects of development on these species. For example, the USFWS implements measures to protect polar bear den sites through a Letter of Authorization under the MMPA.

- **Essential Fish Habitat (EFH)—** The amended Magnuson-Stevens Act requires federal agencies that authorize, fund, or conduct activities that "may adversely affect" EFH to work with NOAA Fisheries to develop measures that minimize damage to EFH. By providing EFH Conservation Recommendations

before an activity begins, NOAA Fisheries may help to prevent habitat damage before it occurs, rather than restoring it after the fact, which is less efficient, unpredictable, and often more costly.

- **Caribou** – The ADF&G monitors caribou by a census of caribou calving and caribou distribution. These monitoring efforts provide a means of determining whether significant cumulative effects on caribou have occurred or are occurring on the North Slope and help in developing measures to minimize effects.

- **Water Quality** – Water quality on the North Slope is regulated and/or monitored through various permitting and regulatory programs administered by the USEPA, ADNR, ADEC, ADF&G, and the NSB. These programs have been established to protect against the degradation of water quality associated with specific human and development activities. In evaluating the cumulative effects to water quality, collective impacts associated with both permitted/regulated activities and non-regulated activities and/or naturally occurring events are considered.

- **Air Quality** – The CAA and its PSD regulations establish controls on major point sources of air emissions to maintain specific ambient air quality standards. This regulatory program addresses individual project emissions in a cumulative regional context. For sources located in the OCS, the PSD program is administered by the USEPA. For sources in state waters and onshore, the PSD program is administered by the ADEC. The analysis of cumulative effects to air quality considers the contribution of both major and minor sources of air pollution on the North Slope.

- **Wetlands and Floodplains** –Impacts to wetlands and floodplains are mitigated through the stipulations in the 1998 Northeast National Petroleum Reserve-Alaska IAP/EIS ROD and the terms and conditions of permits and approvals issued by the BLM at the exploration and development stage on BLM managed lands in the National Petroleum Reserve-Alaska. These require protection and mitigation of impacts to wetlands. In addition, CWA – Section 404CWA, administered by the USACE, regulates the discharge of any dredged or fill material into waters of the United States including wetlands.

- **Environmental Justice (EJ) –** Executive Order 12898 Federal Actions to Address EJ in Minority Populations and Low-Income Populations and an accompanying presidential memorandum require each federal agency to make the consideration of environmental justice part of its mission. The existing demographics (race and income) and subsistence consumption of ADF&G are discussed, disproportionate environmental and health effects on Alaska Natives are evaluated, and mitigating measures and their effects are presented.

- **Native Consultation** – Executive Order 13084 Consultation and Coordination with Indian Tribal Governments requires consultation with Native tribal governments on "Federal matters that significantly or uniquely affect their communities," so that an effective process is established that "permits elected officials and other representatives of Indian tribal governments to provide meaningful and timely input." Representatives of the BLM and the cooperating agencies have met with local tribal governments to discuss subsistence issues relating to the ASDP EIS and have established a dialogue on environmental justice with these communities. Mitigation measures included in this EIS include measures advocated by tribal groups. Inupiat traditional knowledge had a part in developing mitigation.

4G.3.2 Types of Cumulative Impacts Considered

The purpose of the cumulative impact analysis is to identify impacts of a proposed action or its alternatives that may not be of consequence when considered alone, but when combined with the impacts of other actions may become consequential. Three types of cumulative effects are considered (Council on Environmental Quality, *Considering Cumulative Effects Under the National Environmental Policy Act, January 1997*):

- **Additive** – Accumulated effects to a resource from more than one action such that the operation of independent nearby projects all impact the same resource.

- **Countervailing** – Adverse effects that are offset by beneficial effects to the same resource.

- **Synergistic** – Accumulated effects to a resource that are more than additive. Synergistic impacts occur when additive effects escalate beyond the normal incremental increase in impacts expected to occur from individual projects or actions.

Cumulative impacts to each resource were evaluated for each of the three types of impacts listed. It should be noted that if one of the types of impacts did not occur in connection with a particular resource, it is not listed.

4G.4 METHODOLOGY/SCOPE OF CUMULATIVE IMPACT ANALYSIS

4G.4.1 Background

Alaska's North Slope is a sparsely populated region of extreme climate, which has abundant energy and other natural resources. This region is treeless tundra where low temperatures and ice conditions dominate all natural processes. Native cultures are known to have subsisted on the North Slope for many thousands of years. Exploration and industrial development for extraction of the mineral resources of the region (principally oil and gas) has been active over the past 80 years and this development is the most significant man-induced change to the North Slope. Early exploration in northern Canada resulted in the first oil discovery in the region in 1920 at Norman Wells, a site that has been intermittently productive. The USGS explored for oil in the early 1920s in lands set aside by the federal government as a naval petroleum reserve. The Umiat Oilfield, in the southeastern National Petroleum Reserve-Alaska, was discovered during exploration by the U.S. Navy in 1946 but remains undeveloped. The South Barrow gas field began production in 1950. More extensive exploration in the 1960s resulted in numerous oil and gas discoveries in northern Alaska and the adjacent Mackenzie Delta in Canada. The largest of these, Prudhoe Bay, was discovered in 1968 to have nearly 13 Bbbl of recoverable oil. An extensive exploration program in the National Petroleum Reserve-Alaska was conducted first by the U.S. Navy and later by the USGS during the 1970s and early 1980s when test wells were drilled and seismic data were collected. After completion in 1977 of TAPS, which provided a means of transportation for produced crude oil out of the region, a number of North Slope oil discoveries were brought into production. The most recent of those discoveries was the Alpine Field in the Colville River Delta. The first oil production from the Alpine Field occurred in November 2001.

During the 80-year oil and gas industrialization period, the most intense development activity occurred during the 1970s and early 1980s. It was then that the Prudhoe Bay Fields were developed, gravel sources were mined, TAPS and the Dalton Highway (haul road) were constructed, and a large portion of the roads, drilling pads, collector pipelines, and production facilities were built. Since then, additional development has occurred but incremental physical disturbance to the environment has been reduced. More recent fields were generally developed in areas adjacent to existing producing areas, reducing the amount of additional support infrastructure (roads, pipelines, and processing facilities) needed to support additional production. At the same time, changes and improvements in technology have generally lessened the physical disturbance caused by more recent exploration, development, and production activities.

Until development of the Alpine Field in the eastern part of the National Petroleum Reserve-Alaska Plan Area and Badami to the east of Prudhoe Bay, most development was in and adjacent to Prudhoe Bay. This encompasses an area approximately 120 to 130 miles east-to-west and ranging from 10 to 20 miles inland from the Beaufort Sea Coast. Development of the Alpine Field, would extend the primary area of oil production to the west approximately 40 miles and in from the coastline up to 40 miles. To form a context for the proportional size of the development area, the North Slope (including the general area north of the Brooks Range) is a regional area of approximately 55,000 mi^2 (including ANWR), with 650 miles of coastline. The oil development area (not including the TAPS corridor) is an area of approximately 3,000 mi^2, with a coastline of approximately 230 miles. Thus, oil development (including the ASDP) affects approximately 5.5 percent of the land area and 35 percent of the coastline of the North Slope. It should be noted that a description of the proportional area of development does not impute a specific level of cumulative impact to resources.

The Native population of the North Slope has established settlements from Kaktovik in the east to Point Hope in the west. From these settlements, hunting and fishing areas (traditional subsistence use areas) extend across the

landscape and coastal waters of the Chukchi and Beaufort seas. Of the four communities in proximity to the ASDP, only Nuiqsut is close to the primary oil development area. Barrow, the next closest, is approximately 130 miles from Prudhoe Bay. The area of current and proposed oil development is within the subsistence use areas of Barrow and Nuiqsut (BLM and MMS 1998a) and Anaktuvuk Pass. Until leasing in the National Petroleum Reserve-Alaska and development of the Alpine Field, the development area was to the west of Nuiqsut, although the development area occurred within Nuiqsut's subsistence use area. With development of the Alpine Field, including the proposed project, Nuiqsut will have oilfield development extending to the north and west of the village site and further extending into its subsistence use area. As overall oilfield development is pursued in the National Petroleum Reserve-Alaska, the other North Slope communities will have oilfield development closer to their village sites and increased overlap between the development and their subsistence use areas.

To assess cumulative impacts, an evaluation was made of the historical development, the proposed development (Alternative A), and other projects and activities that may occur including FFD. Differences in the cumulative impacts from other ASDP alternatives are also examined. The purpose of the cumulative impact analysis is to identify any project impacts that when combined with other impacts to resources or the region may cumulatively become significant. It should be noted that the analysis of project-specific impacts (see Sections 4A through 4D, and 4F) presents project impacts within the context of existing environmental conditions, which includes the operation and related impacts of current oil development, subsistence use by local residents, and other existing activities.

4G.4.2 Alternatives Evaluated in Cumulative Analysis

The ASDP has been evaluated in six alternative configurations and the No-Action Alternative. Alternative A is the applicant's proposal; Alternatives B, C-1, C-2, D-1, and D-2 represent different means of achieving the same or similar objectives. Alternative E is the No-Action Alternative and Alternative F represents the Preferred Alternative. FFD has been included as part of the reasonably foreseeable future actions in the analysis of cumulative impacts. The following analysis describes cumulative impacts based on Alternative A. The cumulative impacts of the other alternatives are then assessed (including the Preferred Alternative) and described following the analysis of Alternative A**.**

4G.4.3 Defining Reasonably Foreseeable Future Actions for Cumulative Analysis

The cumulative analysis evaluates the proposed project together with past, present and other reasonably foreseeable future actions. These actions include projects or activities that may occur in a broader geographic area than the impact area considered in Sections 4A through 4F and projects that may be in any one of a number of stages of development. To identify projects or actions for inclusion in the cumulative impact analysis, the BLM considered the following criteria:

- **Past Development/Past and Current Production**: Activities that were associated with past actions and may involve present operations. This involves infrastructure development, non-oil related actions, and oil industry facilities and present production from those facilities.

- **Present Development/Production**: This includes exploration, development, or production operations and related activities that may just have come on-line, are currently under way, or planned for the near future. This may also include other non-oil-related development that is presently under development or is planned for the near future.

- **Reasonably Foreseeable Future Development**: Oil and gas discoveries or other projects that are clearly identified and are expected to initiate development-related activities (site surveys, permitting, appraisal drilling, or construction) within the next 20 years. In addition to oil and gas development, other reasonably foreseeable future actions were identified. They include the Colville River Road project and continued human activities such as sport and subsistence hunting and fishing, commercial fishing, sport harvest, tourism, and recreational activities**.**

FFD scenarios for each alternative represent a more detailed evaluation of the cumulative impacts of future development in the Plan Area.

- **Speculative Development**: Additional new discoveries could be made and developed beyond 20 years. For example, more distant future state and federal lease sales may lead to new future discoveries.While the chance for development is too uncertain for detailed analysis at this time, additional exploration activities (wells and seismic surveys) are likely to occur and have been factored into the analysis.

4G.4.4 Oil and Gas Development

Recent EISs prepared by the BLM (Northeast National Petroleum Reserve-Alaska, Northwest National Petroleum Reserve-Alaska, TAPS) and the NRC report have projected oil and gas development on the North Slope and described the types of impacting activities that would occur. These forecasts and descriptions have been reviewed by the BLM and updated as necessary to identify past, present, and reasonably foreseeable future oil and gas development.

4G.4.4.1 Past, Present and Future Oil Development and Production

PAST DEVELOPMENT/PAST AND CURRENT PRODUCTION

Past development/past and current production includes producing fields on the North Slope and nearshore areas of the Beaufort Sea and is listed on Table 4G.4.4-1. Infrastructure, cumulative production, and remaining reserves are well defined. Individual oil pools have been developed together as fields that share common wells, production pads, and pipelines. Fields have been grouped into production units with common infrastructure, such as processing facilities. Impacts associated with development have occurred over the past three decades, and there are data from monitoring that accurately reflect some of the long-term effects. Future activity may include installation of additional wells at existing locations and rework of existing wells. Addition to existing infrastructure would be minor.

TABLE 4G.4.4-1 PAST OIL AND GAS DEVELOPMENT AND PRESENT PRODUCTION

PAST DEVELOPMENT AND PRODUCTION			
FIELD/UNIT	**FIELD/SATELLITE**	**BEGAN/2001 PRODUCTION**	**RESERVES**
Onshore			
Duck Island	Sag Delta	89/included in Duck Island below	-
	Ivishak	-/0.14	-
Prudhoe Bay (PB)	Prudhoe Bay	1977/194.24	2,454
	P.B. Satellites	-/0	144
	Lisburne	1981/3.68	33
	West Beach	1994/0.02	5
	North P.B.	1993/18.69	1
	Midnight Sun	1999/1.35	11
	Aurora	2001/0.42	38
	Borealis	2001/1.31	63
	Polaris	2001/0.07	49
Kuparuk River	Kuparuk River	1981/68.27	814
	Tabasco	1998/1.32	24
	Tarn	1998/8.05	46
	West Sak	1998/2.0	100
	Meltwater	2001/0.15	52
	Palm	2002/-	35

TABLE 4G.4.4-1 PAST OIL AND GAS DEVELOPMENT AND PRESENT PRODUCTION (CONT'D)

PAST DEVELOPMENT AND PRODUCTION			
FIELD/UNIT	**FIELD/SATELLITE**	**BEGAN/2001 PRODUCTION**	**RESERVES**
Milne Point	Milne Point	1985/15.27	260
	Cascade	1996/-	Included in Milne Pt.
	Schrader Bluff	1991/3.82	99
	Sag River	1994/0.25	7
Colville River	Alpine	2000/28.69	398
	Nanuq	2001/.02	40
National Petroleum Reserve-Alaska	East Barrow	1981/- (gas only)	-
	South Barrow	1950/-(gas only)	-
	Walakpa	1993/-(gas only)	-
Offshore			
Duck Island	Endicott	1987/10.96	177
	Sag Delta North	89/included above	-
	Eider	98/0.66	4
Prudhoe Bay	Niakuk	94/3.68	49
	Pt. McIntyre	93/1.74	208
Badami	Badami	98/0.67	8
Northstar	Northstar	01/1.27	175

Source: Northwest National Petroleum Reserve-Alaska 2002, State of Alaska AOGCC 2002, MMS OCS Alaska

This category contains 33 discoveries that are currently producing oil. Table 4G.4.4-1 lists the discoveries, year of initial production, 2001 production, and reserves. Their location and the general infrastructure interconnecting them is shown in Figure 4G.4.4-1. All of these fields, with the exception of Northstar, Endicott, Sag Delta North, and Eider, are onshore on state leases**.** The Niakuk, Point McIntyre, Lisburne and Badami oilfields are mainly offshore but are produced from onshore sites.

The most recent additions to this category are in the Alpine Field. During 1996, ARCO announced that the Alpine Prospect in the Colville River Delta was producible and contained an estimated 365 MMbbl of oil. More recent estimates of Alpine are over 475 MMbbl (ADR 2003c). The first production from the Alpine Field came on line in November 2000 and is currently producing approximately 80,000 bbls of oil per day. Alpine resources are extracted from two production pads known as CD-1 and CD-2 and are connected by a 3-mile-long road. An oil processing facility has also been constructed at CD-1. Oil is transported through a 34-mile pipeline to the Kuparuk processing facility, where Alpine production is mixed with Kuparuk output and exported via TAPS. The Alpine pipeline to Kuparuk crosses under the Colville River channel. Ice roads and bridges provide access during the winter. There are no gravel roads connecting the Kuparuk infrastructure to Alpine. Alpine's 40,000-acre field was developed on approximately 100 surface acres of wetlands.

The disturbed land area resulting from past development/past and current production is shown on Table 4G.4.4-2. This includes gravel roads, gravel pads, gravel mines, pipelines and tundra-impacted areas.

TABLE 4G.4.4-2 NORTH SLOPE OIL INFRASTRUCTURE, 1968-2001

	1968	1973	1977	1983	1988	1994	2001
Gravel roads							
oilfield (mi.)	0	100	139	294	358	370	400
oilfield (ac.)	0	677	1,002	2,029	2,448	2,536	2745
Dalton Highway (mi.) [a]	0	170	170	170	170	170	170
Dalton Highway (ac.) [a]	0	332	332	332	332	332	332
Gravel pads							
Production, Processing, Support, Exploration (no.)	4	100	158	277	325	341	353
Production, Processing, Support, Exploration (ac.)	14	901	1,981	4,570	5,552	5,692	5817
Airstrips (no.)	1	15	19	20	20	20	20
Airstrips (ac.)	6	136	252	287	313	313	287
Offshore islands (no.)	0	0	2	12	15	16	17
Offshore islands (ac.)	0	0	5	54	133	149	155
Gravel Mines							
In rivers (ac.)	25	4,732	4,996	5,011	5,063	5,061	5,082
In tundra (ac.)	0	34	151	745	1,179	1,186	1,283
Pipeline corridors							
Oilfield (mi.) [b]							450
Trans-Alaska Pipeline [c]	0	166	166	166	166	166	166
Tundra impacted areas (ac.)							
Gravel footprint areas [d]	352	2,045	3,620	7,354	9,013	9,252	9,557
Other impacted areas [e]	308	1,388	1,552	1,694	1,698	1,753	1,765
Gravel mines	25	4,766	5,146	5,756	6,241	6,246	6,364
Total Disturbed area (ac.)	685	8,200	10,319	14,804	16,952	17,251	17,686

Source: Cumulative Environmental Effects of Oil and Gas Activities on Alaska's North Slope, 3-03; *Environmental Atlas of the Trans Alaska Pipeline System*.

Notes:

[a] Does not include portions of the highway south of the North Slope.

[b] Multiple pipelines are included in some corridors, e.g., 366 miles have 1-5 pipelines and 73 miles have 6-11 pipelines.

[c] A buried gas pipeline roughly parallels the oil pipeline for 144 miles south to pump station 4; mileage only includes those on the North Slope.

[d] Includes gravel roads, gravel or paved airstrips, offshore and onshore gravel pads/islands.

[e] Includes exploration site-disturbed area around gravel pad, exploration airstrip, peat roads, tractor trail, exploration roads, and gravel pad removed.

PRESENT DEVELOPMENT/PRODUCTION (Within the Next Few Years)

Present Development/Production includes fields that are in planning stages for development or in development but have not yet begun production. Infrastructure components, scheduling, and reserve estimates are fairly well defined, although reserve volumes could be revised. Because new developments are commonly tied into existing infrastructure, continued development depends on the continued operation of this infrastructure.

Two fields are at this stage of development, the ASDP and Orion. ADR estimates that CPAI's current proposal to develop CD-3 through CD-7 could produce a total of 332 MMbbls of oil in the next two decades (ADR, Tax Division. Unpublished files from Spring 2003 Revenue Sources Book). Orion, within the Prudhoe Bay unit, is also at this stage and is estimated to have reserves of approximately 50 MMbbls.

REASONABLY FORESEEABLE FUTURE DEVELOPMENT/PRODUCTION (Beginning within Approximately the Next 20 Years)

Reasonably foreseeable future development includes projects that are reasonably foreseeable to begin development in the period of up to 20 years. Known discoveries outside of the ASDP are listed in Table 4G.4.4-3, which shows the date of discovery and location of each. Accurate oil volumes for individual fields are generally unavailable, though for cumulative impacts analysis purposes, it is assumed that the pools listed in the table contain approximately 1,500 MMbbls, two-thirds of which are off-shore. Figure 4G.4.4-1 shows the locations of these areas.

Development in addition to that which CPAI is currently proposing may also occur in areas only recently made available for oil and gas leasing in National Petroleum Reserve-Alaska (Figure 4G.4.-2). This development, which would include as yet undiscovered reserves (including on lands expected to be leased in the next several years) could occur both within the ASDP Plan Area and west of the Plan Area, including lands made available for leasing as a result of the Northwest National Petroleum Reserve-Alaska IAP/EIS (BLM 2003b) and that may be made available by the propsed amendment to the Northeast National Petroleum Reserve-Alaska IAP/EIS. However, the amount, nature, and location of such development is unknown. For purposes of analysis, this ASDP EIS assumes that the FFD scenario represents the reasonably foreseeable future development within the ASDP.

Many of the discoveries shown in Table 4G.4.4-3 were made decades ago and remain non-commercial at this time. Development in these cases will depend largely on technology advancements and higher petroleum prices. These developments would most likely occur near existing (past and present) fields to share infrastructure systems.

TABLE 4G.4.4-3 REASONABLY FORESEEABLE FUTURE OIL AND GAS DEVELOPMENT OF PREVIOUSLY DISCOVERED FIELDS

REASONABLE FORESEEABLE FUTURE OIL ANDS GAS DEVELOPMENT		
	POOL	DISCOVERY/LOCATION
Western Group		
	Kalubik	1992/Offshore
	Thetis Island	1993/Offshore
Central Group (Northstar)		
	Gwydyr Bay	1969/Offshore
	Pete's Wicked	1997/Onshore
	Sandpiper	1986/Offshore
Eastern Group		
	Mikkelson	1978/Onshore
	Sourdough	1994/Onshore
	Liberty	1983/Offshore
	Yukon Gold	1994/Onshore
	Point Thomson	1977/Onshore
	Flaxman Island	1975/Offshore
	Stinson	1990/Offshore
	Hammerhead	1985/Offshore
	Kuvlum	1987/Offshore

Source: National Petroleum Reserve-Alaska Northwest, 2002, Vol. 2; State of Alaska, AOGCC (2002); MMS,OCS Alaska

Additional amounts of oil could be produced by enhanced recovery technology[1] from existing fields and from undeveloped (or undiscovered) satellite pools adjacent to existing production areas and from future federal and state leases. Some of this production would replace declining production at existing fields. Although the extent of both of these new resources (reserve growth and satellites) is as yet undetermined, it is reasonable to assume that a portion would be brought into production in the next 20 years. For the analysis, it was assumed that half of (2 Bbbl of the 4 Bbbl) the estimated total for enhanced recovery and satellite fields would be brought into production in the foreseeable future. Because enhanced recovery and satellite fields would be developed largely from existing infrastructure, the incremental addition of new infrastructure and related land disturbance is expected to be minimal. The assumptions for oil infrastructure development for the reasonably foreseeable development scenario include the following**:**

FUTURE ASDP AREA DEVELOPMENT

FFD assumptions for each alternative were reviewed and the upper value for each measure was used as follows (note range among alternatives shown in parenthesis);

- Acres of land disturbed (includes production pads, airstrips, helipads, and 147 miles of roads) – 1,283 acres (545 – 1,283)
- Pipeline – 150 miles (136 – 150)

OTHER REASONABLY FORESEEABLE OIL DEVELOPMENT: (BLM Northwest National Petroleum Reserve-Alaska Final IAP-EIS adjusted to subtract ASDP)

- Land disturbed – 450 acres
- Pipeline – 180 miles

SPECULATIVE DEVELOPMENT (BEYOND 20 YEARS)

Speculative resources include both discovered (though uneconomic) and undiscovered (purely speculative) resources that may be developed more than 20 years from now. Speculative development includes those small discoveries and undiscovered resources that are very unlikely to be developed in the next 20 years. Among the speculative developments are fields discovered 50 years ago and remain noncommercial today because of their very remote locations, low production rates, and the lack of a gas-transportation system. Because they are currently noncommercial and are not planned for development, they are speculative and were not included in the cumulative impacts analysis.

4G.4.4.2 Future Gas Development

Development of gas resources on the North Slope is also considered speculative because no means of transporting this gas to North American or Asian markets is available. Plans to construct a gas export transportation system have been conceptualized but have not been able to overcome high project development costs or marketing hurdles even though gas reserves have already been identified which are adequate to supply such a project. Three gas transportation projects are in various stages of development, although none is currently active. A fourth project to use the existing TAPS is in the feasibility evaluation phase. These projects are listed on the following page.

[1] Enhanced recovery adds production from known reservoirs, effectively creating "reserve growth." For example, the Prudhoe Bay Field was originally estimated to hold 9.6 Bbbl of reserves, and today it has reserves approaching 13 Bbbl. More than 3 Bbbl were added by factoring in enhanced recovery technologies.

- **Trans Alaska Gas System (TAGS)** – A natural gas pipeline constructed parallel to the TAPS crude oil pipeline from Prudhoe Bay and terminating at a LNG at Valdez. The project has been designed and permitted since 1988. At this time it is not actively under development.

- **Alaska National Gas Transportation System (ANGTS)** – A natural gas pipeline that parallels the TAPS pipeline to Delta Junction then is routed across the Yukon Territory to connect with gas pipeline systems in Canada. This project has been permitted since 1980. It is not actively under development.

- **Arctic Resources, Northern Gas Pipeline Project** – A pipeline constructed offshore from Prudhoe Bay to the Mackenzie River Delta then south to connect with the gas pipeline system in Canada. This project has not received regulatory approvals and has no commitments from shippers.

- **Natural Gas to Liquids Conversion** – This project would convert natural gas to liquid that could be shipped through the TAPS and exported from Valdez. An experimental conversion facility to determine the feasibility of this approach is currently under development.

Because the export of known gas resources is currently uneconomic, it is speculative to predict the viability, timing, or scale of future gas production projects. If a gas transportation system were constructed in the future, current gas reserves (46 Tcf) associated with existing oil production would be used before the industry is likely to invest in new gas exploration. The development of remote, undiscovered, and more expensive gas resources is considered to be unlikely while there are adequate supplies of known, readily available reserves.

4G.4.4.3 Typical Oil and Gas Activities

To assess cumulative impacts, the activities of present and future oil development and production that cause impacts must be described. Section 2 includes a description of the proposed activities to be undertaken, including the construction sequence for construction and operation of CPAI's proposed development project. These same types of activities would be undertaken for expansions of existing fields and development of new fields on the North Slope.

- **Surveys** – Seismic and other surveys, typically conducted in the winter, to estimate potential for presence of reserves. Onshore surveys include, overland transportation of survey crews using low-pressure tire type vehicles, initiation of micro-scale seismic inputs, and temporary installation of recording equipment to collect data. Seismic input and data collection are generally one-time temporary activities causing small, localized disturbance. Seismic input generates temporary noise events.

- **Leasing Activity** – Auctions of lease rights to explore and develop mineral resources, conducted by Native corporations, and state and federal government agencies. Most leases are preceded by an environmental review that may include field collection of data to verify the presence and extent of natural resources. Such surveys may include the use of Rolligons, helicopters, and other wheeled vehicles for access. Survey activity is minimally to non-impacting.

- **Exploration Drilling** – Typically conducted in the winter. Exploration drilling requires construction of a temporary ice access road and ice drilling pad. Drilling muds and cuttings are typically injected in the annular space of the well or transported to a disposal site approved by the USEPA. Exploration drilling includes installation of some temporary structures for workspace and personnel. There is a potential for inadvertent spill of petrochemicals (diesel fuel), drilling muds, and other material, although any spills would be of limited quantity and localized to the exploration site.

- **Production Drilling** – Typically requires construction of a permanent access road or local airstrip and may include expansion of an existing production pad. Production drilling requires transportation of equipment and materials to the site, operation of fossil-fuel-fired equipment, a water supply, and disposal of drilling muds and cuttings. Production drilling includes installation of buildings and materials handling and storage facilities, including containment for storage of liquids required for operation. Similar to exploration,

drilling has the potential for inadvertent spill of petrochemicals (diesel fuel), drilling muds, and other material, although a spill would most likely be of limited quantity and localized to the site. Drilling multiple wells extends the period of intense site activity to 12 to 24 months, during which traffic (road or air) to the site would be frequent. Offshore production drilling is similar to onshore except that a gravel island is constructed that would have a larger footprint than the onshore production pad.

- **Infrastructure Installation** – Each production site is interconnected by pipeline to a centralized processing facility that, in turn, interconnects directly or indirectly to the TAPS pipeline for exporting of crude oil. Pipeline installation requires construction of a temporary ice road to provide access and construction laydown area during pipeline construction. Pipelines are installed above ground on pilings or VSMs placed into the permafrost. Permanent ground disturbance is limited to the piling location. The installed aboveground pipeline becomes a linear landscape feature. In some circumstances, the pipeline may be installed adjacent to the production site access road to facilitate routine pipeline inspection and maintenance. Pipeline construction includes the use of fossil-fuel-fired equipment, noise from construction activities, and a need for a water supply. After completion, the pipeline is cleaned and hydrostatically tested. Cleaning wastes and hydrostatic test water requires disposal. During construction, small spills of diesel fuel and lubricants may occur during equipment fueling and maintenance operations. The assumption that oil spills of any magnitude are unlikely during operation is based on past operating experiences.

- **Production** – Operation of the wells during production requires the use of diesel-fired equipment and the transportation of recovered oil, diesel, and injection water through the pipeline system. Limited onsite personnel are required during operations, minimizing the number of trips by vehicle or aircraft to the site. During operations of the collector pipeline system, inadvertent spills of seawater, diesel fuel, or recovered oil may occur. If spills were to occur, they may not be confined, except to the extent that existing topography limits the extent of a spreading. Spills may occur at locations, which may lead to the introduction of spill fluids directly, or indirectly into watercourses, surface water bodies, or wetlands. Aircraft operations serving production sites served by an airstrip (a roadless development) will intermittently produce local noise.

- **Processing** – Production also includes processing of the recovered product at a centralized processing facility to separate the crude oil from other constituents including natural gas, water, and solids. The recovered natural gas and water is transported back to the production site and re-injected into the producing structure to maintain reservoir pressure. Since a single processing facility serves multiple production sites, few new processing facilities will be constructed.

- **Transportation** – Crude oil exported from the processing facility is transported via TAPS to the marine terminal at Valdez, where it is loaded aboard seagoing tankers and transshipped to markets on the west coast of the United States and Asia. Because no other export means are available, all North Slope production is expected to be transported by this system.

  The Northeast National Petroleum Reserve-Alaska IAP/EIS prohibits permanent roads connecting Northeast National Petroleum Reserve-Alaska facilities to outside infrastructure. Stipulation 48 for the Northeast National Petroleum Reserve-Alaska IAP/EIS ROD states, "Permanent roads (that is gravel, sand) connecting to a road system or docks outside the planning area are prohibited, and no exceptions may be granted" (BLM and MMS 1998b). Similarly, ongoing and planned oil-development projects such as Badami, Alpine, Northstar, and the other satellite production pads currently proposed by CPAI in the Plan Area (except under Sub-Alternative C-2) are not expected to have permanent gravel roads connecting to Prudhoe Bay. Transportation to these fields is assumed to be by aircraft and/or marine vessels; in winter, temporary ice roads also will be used. However, permanent roads may be constructed within the planning area which would interconnect production facilities. The Northeast National Petroleum Reserve-Alaska Amended IAP/EIS is recommending removal of the prohibition on roads to a road system or dock outside the Plan Area. The State's proposed road to Nuiqsut could be part of a road to new oil fields in the National Petroleum Reserve-Alaska.

- **Gravel Resources** – Road, production pad, and gravel island construction requires the extraction and transportation of gravel resources. While gravel is reasonably abundant on the North Slope, gravel extraction has historically occurred at two types of locations: in river or stream channels or in upland areas. In upland areas, gravel extraction requires removal and stockpiling of overburden. Construction activities requiring gravel mining and transportation typically occur in the winter. Blasting to excavate gravel material would likely be required and would produce noise effects. Because gravel resources must be transported by truck, the location of gravel mine sites is optimized to reduce transportation distance.

- **Water Resources** – Water resources are required for construction of ice roads and bridges and other needs during construction. Construction water needs are typically high-volume but short-term. A minimum but continuous quantity of water is required during operation.

- **Waste Management** – Current and expected future development and production methods allow for zero-discharge waste operations. All waste material is recycled, reused, or disposed of onsite.

All of the activities considered under present and future oil development would include the above activities.

4G.4.5 Proposed Colville River Road

The ASDP DEIS described the ADOT&PF proposed 102-mile road from Pump Station 2 to Nuiqsut, across the Brooks Range foothills. Since the ASDP DEIS was issued, ADOT&PF has selected a different route for this project and is moving forward with its development.

The revised proposal is known as the Colville River Road Project and is proposed to be located in an 18-mile corridor mostly on state land, linking Nuiqsut and National Petroleum Reserve-Alaska to Tarn Road and farther to the Dalton Highway via the existing Spine Road through the Kuparuk and Prudhoe Bay oilfields. The project includes a 3,300-ft road bridge, crossing the Colville River approximately three miles south of Nuiqsut. A reconnaissance-level-planning effort for the project was completed in November, 2003 (ADOT&PF 2003b). Final design is expected to be complete by late 2005, and construction would be completed by late 2009. The route currently proposed for the Colville River Road is shown in Figure 4G.4.5-1

The Colville River Road has its own utility and is neither part of the ASDP or necessary for its execution. The ADOT&PF submitted a permit application for the project to the USACE in December 2003 (ADOTPF, 2003b). The proposed project includes fill placement on approximately 265 acres of wetlands. An additional 325 acres of wetlands would be excavated at two gravel mine sites. The USACE has indicated an EIS must be prepared for the project in accordance with NEPA. Accordingly, the potential environmental consequences of the project will be fully addressed in a future, separate EIS. However, to assess cumulative impacts, activities associated with the proposed Colville River Road project have been identified from the planning report (ADOT&PF 2003b), and are included in the scope of this analysis.

- **Gravel Mining** – Mining activities, required to generate gravel materials for road construction, may cause changes in water quality, drainage patterns, vegetation, and habitats. Removal of material may result in disturbance or displacement of vegetation and habitat for birds, small mammals and their prey. Hydraulic changes resulting from gravel mining could delay or obstruct vegetative recovery and create permanently ponded habitats, or extensive gravel and mudflat habitats used by water birds. Alteration of substrate materials and interruption of ice flows and stream flows could cause changes to water quality, substrate, and drainage channels. Alterations of habitats could affect terrestrial and aquatic biodiversity, and Nuiqsut subsistence resources. Excavated gravel pits could flood and create additional fish habitat.

- **Road Construction** – Construction of roads could alter drainage patterns, interrupt ice flows, and result in thawing of permafrost and subsidence causing further hydrologic changes. Thermokarst and snowmelt near roads could open road areas to wildlife prior to natural snowmelt areas. Thermokarst and subsequent flooding causing hydraulic changes could result in the submergence of nesting areas. Gravel placement could result in loss of underlying and directly adjacent vegetation. Construction-related noise and visual

disturbances could result in temporary or permanent displacement of habitat use and habitat fragmentation for birds and mammals. Erosion and other disturbances to the roadbed during construction could result in water quality degradation and siltation of fish habitats at and downstream of road and bridge sites.

- **River and Stream Crossings** – Although the Colville River Bridge is the major crossing, multiple river and stream crossings would be required. Bridges would be constructed at all fish bearing stream crossings to minimize impacts to fish. Cross culverts, bridges and erosion protection would also maintain the existing hydrological regime and minimize impacts to stream channels, water quality, and aquatic species. Construction of river and stream crossings could result in water quality degradation, erosion and other disturbances to streambeds. Consolidated flow though culverts could result in changes in hydrology, water quality, streambed substrate, erosion and sedimentation.

- **Road Operation and Maintenance** – The presence of roads could alter existing drainage patterns, interrupt ice flows, and result in thawing of permafrost and subsidence causing further hydrologic changes. Interruption of ice flows and stream flows could cause changes in water/habitat quality and interrupt fish movement. Consolidated flow through culverts could block fish from migrating upstream during high flow periods and downstream during low flow periods. Pools created by scour could be used as winter habitat for freshwater species; if saltwater intrudes into these pools, habitat values would change from good to poor.

  Dust from roads could cause changes in air quality. Reduced soil moisture from altered hydrology or decreased vegetative cover from road dust may result in melting permafrost and subsidence. Dust could darken accumulated snows along roadways, allowing early thaws, or cause loss or decline in vegetation surface available for photosynthesis. Loss of vegetative cover could reduce suitable nesting habitat for birds. The project's potential effects on vegetation, fish, and wildlife may affect Nuiqsut subsistence resources.

- **Road Usage and Area Access** – Construction of the Colville River Road would allow motor vehicle traffic into and out of Nuiqsut. Travel to and from the village would be easier and may change use levels of the Nuiqsut airstrip and other village infrastructure. Public use of roads could result in non-native plant invasion and increased mortality to wildlife. Improved road access could bring outsiders who could damage cultural sites and areas. The project could also result in an increase in transportation and job opportunities for Nuiqsut, including opportunities to work outside the village. Access to outside purchase of materials could increase. Nuiqsut could have greater potential for selling and trading fish and other resources. Potential effects on vegetation, fish and wildlife from the road construction/operation may affect Nuiqsut and Anaktuvuk Pass subsistence, such as increased Nuiqsut subsistence and outside recreational hunting brought by increased access for hunters.

4G.4.6 Amendment to the Northeast National Petroleum Reserve-Alaska IAP/EIS

On June 23, 2003, BLM announced that it would undertake an amendment to the Northeast National Petroleum Reserve-Alaska IAP/EIS. The BLM is conducting an EIS to amend the plan, which it anticipates completing in late 2004. Following this NEPA review, the BLM may approve changes to the stipulations and other requirements of the original Northeast National Petroleum Reserve-Alaska IAP/EIS. Stipulations developed through the amendment will apply to future BLM leases on lands it manages in the Northeast National Petroleum Reserve-Alaska IAP/EIS plan area, including some lands within the ASDP Plan Area. The stipulations developed in the original Northeast National Petroleum Reserve-Alaska IAP/EIS ROD are attached to all current federal leases within the ASDP Plan Area, including those that CPAI seeks to develop for CD-6 and CD-7.

Any proposed changes to the Northeast National Petroleum Reserve-Alaska IAP/EIS will undergo NEPA review, including analysis of any cumulative impacts of the proposed action. Furthermore, no changes to the stipulations attached to the existing leases will occur until after consideration in the full NEPA review for the Northeast National Petroleum Reserve-Alaska Amended IAP/EIS and renegotiations with the leaseholders. As a result of the NEPA review, some lease stipulations may be revised to include more performance, rather than

prescriptive stipulations. The amendment will also consider making available additional lands for leasing in the Teshekpuk Lake area, and may ultimately lead to greater development. However, no decision has been made to provide more lands for leasing in the Northeast National Petroleum Reserve-Alaska. This cumulative impacts analysis considers the cumulative impacts of possible additional leasing and changes to stipulations in the Northeast National Petroleum Reserve-Alaska IAP/EIS.

4G.4.7 Summary of Past, Present and Reasonably Foreseeable Future Development

Table 4G.4.7-1 shows total area projected to be disturbed for development of past, present and reasonably forseeable facilities on the North Slope. This table shows area disturbed in 2002 (past and present development) then adds Alternative A (CPAI Development Plan and FFD Scenario), the development of other future oil production facilities, and construction of the proposed Colville River Road. As the table shows, total area disturbed will increase by approximately two percent over the current status with completion of CPAI's proposed project, and 21 percent if Alternative A (CPAI Development Plan and FFD Scenario), the Colville River Road and other foreseeable oil facilities are all developed. This cumulative development and related disturbance would take place over an approximate 20-year time span or longer.

TABLE 4G.4.7-1 PAST, PRESENT, AND REASONABLY FORESEEABLE FUTURE DEVELOPMENT INFRASTRUCTURE

	2002	WITH CPAI'S PROPOSED 5 PADS (CPAI-ALT. A)	WITH CPAI (ALT. A) AND REASONABLY FORESEEABLE DEVELOPMENT [a]
Gravel footprint	9,640 acres	9,881 acres	12,147 acres
Gravel mines [b]			
(in tundra)	1,283 acres	1,348 acres	2,233 acres
(in rivers)	5,082 acres	5,082 acres	5,202 acres
Other Disturbed Areas [c]	1,765 acres	1,765 acres	1,817 acres
Total Disturbed area	17,770 acres	18,076 acres	21,402 acres [c]
Percent Increase over 2002	---	2% increase	21% increase

Source: NRC Cumulative Environmental Effects of Oil and Gas Activities on Alaska's North Slope, 3-03 for data to 2001; 2002 data includes addition of Meltwater and Palm gravel footprint to NAS 2001 data.

Notes:

[a] Includes FFD with maximum disturbance, Colville River Road and other reasonably foreseeable oil industry development. No estimate is provided for other reasonably foreseeable, but as yet undiscovered fields.

[b] Assumes increased disturbance for gravel mining is proportional to increases from 1994 - 2001 in the NAS 2001 study.

[c] Other disturbed areas includes areas affected by a variety of activities, including disturbance around exploratory gravel pads, tundra scarring from thin gravel roads and airstrips, and from tractor trails. Estimates are based on 1994 – 2001 proportional increase in this category of disturbance in the NRC 2001 study.

4G.4.8 Global Climate Change

The following discussion is adopted from the Northwest National Petroleum Reserve-Alaska IAP/EIS.

Based on current scientific research, there is growing concern about the potential effects of primary greenhouse gases (GHG) (CO, methane, NO_x, ozone, water vapor, and chlorofluorocarbons) on global climate. Through many complex interactions on a regional and global scale, the lower layers of the atmosphere experience a net warming effect. These trends could be caused by greenhouse warming or natural fluctuations in the climate. There is an ongoing scientific debate about the cause of these trends.

The assessment of the impacts of climate change is in its formative phase, and it is not yet possible to know with confidence the net impact of such change. The potential effects of a global climate change could alter water supply, food security, sea-level fluctuations, and natural variances in the ecosystem. Global climate

change may affect surface resources on the North Slope. Possible impacts of global climate change include negative effects on the ecology of the Arctic tundra and changes in the permafrost depth. Reduction in sea ice as a result of global climate change would affect marine mammals (particularly polar bears), fish, and birds, with related implications for Native subsistence harvest. In addition, potential sea level rise and increases in severe weather could have negative effects on oil and gas-related infrastructure, including those associated with potentially more destructive storm surges.

Because climate change must be viewed from a global perspective, the magnitude of the emissions potentially contributed by oil and gas activities on the North Slope needs to be viewed in that context. Activities associated with exploration, development, and production of oil and gas resources from the Plan Area will produce some of the listed greenhouse gases, primarily as a result of power requirements and fuel consumption, activities that production CO_2. The incremental contribution of greenhouse gases from the proposed alternatives on the North Slope would be negligible when compared to total GHG contributions.

The winter drilling season the North Slope has been shortened by half because warmer temperatures result in later freezing of the tundra and earlier thaws in the spring. Althrough the 2003-2004 winter dirlling season had the earliest opening in several years, no conclusions can be drawn as to whether it is the beginning of a trend. Based on the last 30 years, the overall trend is that the drilling season is getting shorter, in spite of an occasional earlier opening or later spring thaw. If this trend continues, the continued shortening of the drilling season will have serious impacts on the way in which oil and gas activities are conducted, with the greatest impact on exploration activities. It is possible that technological advances in transportation and drilling equipment would mitigate the effects of shorter seasons and result in an entirely new approach to drilling in the Arctic that would have much less impact on the environment. It is not possible at this time to estimate the long-term effects of the shortened seasons on the discovery of hydrocarbon resources, but if trends continue, shorter drilling seasons could have the effect of reducing the recovery of the available resources.

4G.5 ANALYSIS OF CUMULATIVE IMPACTS TO THE PHYSICAL ENVIRONMENT

4G.5.1 Physiography

4G.5.1.1 Evaluation

Cumulative impacts to the physiography of the North Slope would likely result from changes to landforms caused by continued development and construction of roads, pads, airstrips, and gravel mines. Direct impacts would be localized to the immediate footprint of the facilities and the immediate surroundings. Breaking the vegetated surface layer, however, is not an acceptable construction practice; thus, the existing physiographic terrain features on the North Slope generally would not be directly altered to construct the facilities.

The exception would be gravel mine sites. In order to meet the gravel needs for ASDP and accommodate continued development on the North Slope, additional gravel mining sites are necessary for pad, road, and airstrip construction and maintenance. New gravel mine sites would affect the existing tundra surface by complete removal and extraction of the underlying gravels. A large disturbance such as this could cause melting of the permafrost soils around the mine site perimeter, which would create additional landform changes. If ponds are created in the mine area, they would likely be much deeper than the typical North Slope lake and, as typical under a water body that does not freeze completely during winter, thaw bulb formation would likely follow. However, when gravel extraction is completed, the mine site would be re-contoured, approximating natural terrain features thus decreasing the likelihood for long-term adverse cumulative impacts.

To date, North Slope oil development has resulted in approximately 1,283 acres of gravel mines on the tundra and 9,640 acres of gravel footprint in roads, airstrips, and pads (Table 4G.4.7-1). Construction of CPAI's proposed project, reasonably foreseeable future oil development, and the Colville River Road may result in 1,070 acres of additional gravel mines (based on the past ratio of gravel mine to gravel footprint) and 2,536 or more additional acres of gravel footprint. This total impact to the physiography is only a fraction of a percent of

the approximately 56.8 million-acre arctic coastal plain. Of the cumulative impact of past, present, and reasonably foreseeable development to the physiography of the area, CPAI's proposed action would result in direct physiographic effects from gravel mines of 65 acres and from 241 acres of additional roads, airstrips, and pads. This constitutes 5 percent and 2 percent, respectively, of the past, present, and reasonably foreseeable impacts from gravel mines and gravel footprint**.**

4G.5.1.2 Conclusion

Impacts to the physiography are similar to the impacts to soil, permafrost, sand, and gravel and are associated with the development and construction of gravel pads, roads, air strips, pipelines, and pump stations. The largest cumulative impacts on phyisography are anticipated from gravel mining and its associated activities. The duration of the impacts range from short-term to long-term and are dependent upon the success of re-contouring the terrain back to its original features. Of the alternatives considered in this EIS, Sub-Alternative C-1 would contribute the most to cumulative impacts and would consequently have the largest cumulative impact. Alternative D would have the least cumulative impact of the action alternatives, and Alternative B, the second least impact**.** However, the proportion contributed by the ASDP is relatively small compared to the effects of other cumulative actions considered. While physiographic impacts, especially those resulting from gravel mining, are additive, the total incremental amount of disturbed area is small compared to the total resources within the North Slope region and is not considered to be cumulatively significant.

4G.5.2 Geology

4G.5.2.1 Evaluation

The following discussion of cumulative impacts of the proposed action to geologic resources is limited to bedrock (lithified, inorganic materials) and their associated petroleum resources. Cumulative impacts to unconsolidated material are discussed in Sections 4G.5.3, Soils and Permafrost, and 4G.5.4, Sand and Gravel.

The primary impact to North Slope geology of past, present, and reasonably foreseeable development on the North Slope has been the extraction of oil reserves. Through 2001 approximately 13.6 Bbbl of oil has been extracted from Prudhoe Bay and other existing fields, more than 70 percent of the estimated original reserves of the past and present developed fields. In the next twenty years, CPAI's proposal would remove approximately 332 MMbbls, according to ADR projections (BLM and MMS 2003a**).**

4G.5.2.2 Conclusion

Cumulative geological impacts are mainly additive, and**,** given the project objectives**,** cause affects to the geologic environment that are unavoidable. The proposed action would likely remove a significant percent of total economically recoverable petroleum resources available within the area of known reserves**,** just as past, present, and reasonably foreseeable development has, and will continue to, remove oil from other known, and perhaps as yet unknown fields. All the action alternatives will have similar cumulative effects, though Alternative B, by reducing recovery from CD-6, would have marginally smaller cumulative impacts.

4G.5.3 Soils and Permafrost

4G.5.3.1 Evaluation

Cumulative changes to soils on the North Slope would occur from natural processes (weathering and the annual freeze/thaw cycle) and disturbance by humans. Human-induced impacts have primarily occurred as a result of disturbance from industrial activities related to both oil and gas (exploration and transportation). Other disturbance has occurred from human settlements and subsistence living, archaeological excavation, cleanup of contaminated sites, overland moves, and the small amount of tourism and recreation that has occurred on the North Slope. The analysis for cumulative impacts to soils is similar to the analysis for vegetation and is measured by accounting for the acreage of roads, pads for facilities (drilling, production facilities, and airstrips),

and gravel extraction sites. In addition, oil spills can affect soils. The mechanism for impact is the placement of gravel overburden to provide foundations for roads and pads. The overburden covers and eliminates tundra vegetation but insulates and protects permafrost. Impacts to soils and permafrost are additive.

The total impact to soils and permafrost from all past and present oil industry-related activity projects on the North Slope**,** including the Dalton Highway**,** is approximately 17,700 acres. Impacts for foreseeable future projects (not including ASDP) are estimated to occur on approximately 3,326 acres; total impacts including all past, present and reasonably foreseeable future action will affect approximately 21,402 acres (Table 4G.4.7-1 and Figure 4G.5.3-1). Of the cumulative impacts, CPAI's proposal represents less than 3 percent of tundra gravel mines (approximately 1 percent of all gravel mines) and approximately 2 percent of the total gravel footprint**.**

Oil spills may also affect soils, leading to the alteration of vegetation. The oil alone would decrease vegetation growth, but oil spills probably would leave the surface organic mat intact. Spill cleanup, however, is more likely to damage soils. Cleanups are not always well controlled; heavy traffic and digging are common, resulting in damaged soils. Oil-spill cleanup mitigates impacts on soils only if cleanup methods and operations are very carefully controlled to minimize surface disturbance. The area affected is limited to that area immediately adjacent to and covered by the spill.

4G.5.3.2 Conclusion

Impacts to soils are similar to the impacts to vegetation and occur from activities associated with development, which include construction of gravel pads, roads, airstrips, pipelines, and pump stations and the excavation of material sites. The duration of the impacts ranges is short-term (one to several years) if the vegetation is disturbed and up to several decades if the soils are destroyed. Incremental impacts of the proposed project would be small (approximately 2-3 percent when compared to past, present, and future development. With the exception of Alternative C-1 or C-2, the cumulative impacts of the other alternatives would be less than those for Alternative A. While soils and permafrost impacts are additive, the total and incremental amount of disturbed area is small compared to the total resource within the North Slope region and is not considered to be cumulatively significant.

4G.5.4 Sand and Gravel

4G.5.4.1 Evaluation

Sand and gravel resources are a primary building material used for construction of temporary and permanent roads, pads, processing facility foundations, and airstrips throughout the North Slope. Sand and gravel are extracted from quarry areas after removal of overburden and from watercourses and rivers. Sand and gravel resources are common in the river delta areas throughout the coastal plain. These resources are less abundant inland, especially west of the Colville River. The past, present, and foreseeable future use of sand and gravel resources (measured in acres) disturbed are likely to increase by 74 percent in tundra gravel sources and 2.4 percent in river gravel sources, as shown in Table 4G.4.7-1.

4G.5.4.2 Conclusion

Use of sand and gravel resources reduces the availability of the remaining resources for future use. The contribution of Alternative A – CPAI Development Plan to additive cumulative gravel and sand use (as measured by surface area from tundra gravel sources) is approximately 5 percent, much less than the approximately 74 percent increase that would occur for the total of reasonably foreseeable future development. Once used, sand and gravel resources for construction of roads, pads, or airstrips may only be available for reuse upon abandonment.

4G.5.5 Paleontological Resources

4G.5.5.1 Evaluation

Oil and gas exploration, related development activities, and road development on the North Slope have been, and are expected to continue to be the primary source of disturbance and cumulative effects on North Slope paleontological resources in terms of the geographic extent of impact. However, activities such as non-oil-related and gas-related overland moves, scientific data gathering, recreational use by the public, and activities ancillary to the management of the area may have a slight impact at localized areas. Excavation of gravel for the production pads, roads, facility foundations, and airstrips poses the greatest potential for impact to paleontological resources. Most mammalian fossils are found in Quaternary age deposits that are also the primary source of most North Slope sand and gravel resources. Therefore, the more gravel deposits that are excavated for development construction activities, the more chances that significant impacts to paleontological resources would occur.

Most paleontological deposits are revealed as the result of natural erosion, such as the action of flowing water or wind, seasonal freezing and thawing (cryoturbation), thermokarsting, and solifluction. To the extent that erosion is modified or increased by future development, incrementally additive impacts are likely to occur. However, in most cases the exposure of resources as a result of erosion processes is regarded as revealing the resource rather than as negatively impacting the resource.

The effects of a large terrestrial oil spill on a paleontological deposit would be directly related to the time of year (frozen versus unfrozen) and the context of the resource. In an unfrozen context, surface or near-surface paleontological resources could be easily impacted—primarily from contamination that would render radiocarbon and biomolecular assays valueless—leading to more significant impacts to the resource. Impacts could occur as the result of the cleanup rather than the actual spill. During the frozen months, both a spill and the resulting cleanup would cause considerably less impact.

4G.5.5.2 Conclusion

While the nature of paleontological deposits (specifically, their unpredictable location and context on surface, near-surface, or deeply buried) make impacts difficult to assess, the continued use of current procedures for survey and inventory, before exploration and development, are expected to minimize the potential for impacts to occur. Effects across the North Slope of Alaska are expected to be additive and minor. The potential for any cumulative oil spill impacts to paleontological resources is considered to be minimal because the probability that a large oil spill would occur is extremely low (see discussion in Section 4.3)

4G.5.6 Water Resources

Existing and future North Slope development has the potential to cumulatively affect water resources in two ways: by altering the landscape, and by withdrawing water for construction and operations use. Further landscape alteration can occur as a direct result of either development or thermokarst action.

Construction of roads, production pads, pipelines, processing facilities**,** and bridges has the potential to alter surface water hydrology. This alteration occurs when the construction of facilities or removal of gravel from riverine pools, or construction of facilities, disturbs watercourses or lake shorelines by diverting, impeding, or blocking flow in stream channels, lake currents, or shallow-water tracts. Ice conditions and break-up conditions, especially in the Colville River Delta floodplain, can exacerbate flow constrictions at bridge sites and road culverts. Unless properly designed, water flow can be adversely affected by oilfield infrastructure, especially under ice conditions and in floodplains**.** Such alterations may also lead to subsequent melting of permafrost (thermokarst) and additional changes in stream morphology. Development of roads, because they are linear features as differentiated from the compact footprint of production pads and processing facilities, has a greater potential to alter surface water drainage patterns and flows in watercourses. Water resource impacts related to sand and gravel extraction are likely to be additive and concentrated because economically exploitable sand and

gravel resources are only available in limited areas. Subsidence of the ice-rich permafrost along the stream banks and lakeshores may occur from the long-term effects of thermokarst, especially in areas where the wave action of the water will accelerate the removal of the degrading protective cover. Fine-grained sediments melting out of the ice-rich permafrost result in increased sediment erosion and suspended sediment, and changes to the morphology of stream channels and beds.

Both construction and operation of North Slope oil production and transportation facilities require freshwater resources. Ice roads typically require 1 million gallons (approximately 3.1 ac-ft) per square mile to construct. When use of the road is completed, the road is allowed to melt, so water use for road construction is not consumptive in the same way that it would be if the water were used for an industrial process. Recent water use for all North Slope oil- and gas-related activities has ranged from 776 million gallons (approximately 2,400 ac-ft) in 1996 to 1,458 million gallons (approximately 4,500 ac-ft) in 2000. These quantities change from year to year depending on the amount of construction occurring, because construction is a more water-intensive activity than operations. Water requirements for the ASDP range from 26 to 81 million gallons during the years of project development (2005 to 2009), then drop to 10 million gallons per year during operating years. At 81 million gallons, Alternative A – CPAI represents an incremental impact of approximately 5.5 percent over actual 2000 water usage for North Slope construction and operations. Construction plans and the use of ice roads for reasonably foreseeable future actions is not known and can only be estimated.

4G.5.6.1 Conclusion

Development of oilfield facilities and associated transportation systems at settlements have, and will continue to affect water resources. These impacts are most likely to be related to road development. There is currently approximately 570 miles of road development (including the Dalton Highway) on the North Slope outside of villages. However, these potential impacts can be minimized by proper siting of roadways and bridges by using construction methods that minimize streambed alteration and erosion impacts. On a regional basis, these impacts would be considered additive, but local, short-term, and minor in effect. Development of Alternative A would contribute about 26 miles of road to the cumulative number of roads.

No cumulative impact to North Slope water supplies from withdrawal of water for construction and operation of any of the alternatives is expected because the annual yield (runoff and refill of lakes) is many times greater than the amount withdrawn. Further, water use peaks during construction, which is a temporary, not-permanent activity and is generally not consumptive, so a continuous minimal increase in water use is not expected. Localized and temporary impacts may occur at those lakes used for water supply.

4G.5.7 Surface Water Quality

4G.5.7.1 Evaluation

Cumulative impacts to surface water quality could occur in two ways: erosion and sedimentation in streams and lakes that increase turbidity and the introduction of contaminants as a result of oil spills, or the release of hazardous materials from industrial facilities and activities. Other recent discussions of the cumulative effects of North Slope activities on water quality are incorporated here by reference. See Section V.C.1 of the Beaufort Sea Planning Area Sales 186, 195, and 202 EIS (MMS 2002a), which is summarized below.

The mechanisms and potential for increased sedimentation from construction of new facilities, principally roads, is also discussed in Section 4G.5.6. In that discussion, potential impacts to water resources from cumulative development on the North Slope are identified, but the extent of additional additive impacts was found to be small.

The long-term quality of fresh water is not expected to be affected by any of the major projects considered in the cumulative case. The effects of construction activities are expected to be short-term, lasting as long as the individual activity, and have the greatest impact in the immediate vicinity of the activity. The construction activities are not expected to introduce or add any chemical contaminants.

Hydrocarbons could be transported to and contaminate surface water resources if a large oil spill were to result from oil and gas development or production. The potential and extent of such contamination is governed by the time of year it occurs (winter, spring thaw/high runoff, summer/low water flow or fall/high water event), proximity to flowing watercourses, and the magnitude of the spill. The spill history for North Slope operations is summarized in Section 4.3. The risk of a spill is related both to the volume and length of time over which production occurs; in the cumulative case, future projects that extend the life of industrial activities in the region will prolong the risk of exposure (increase spill risk). However, spill size has historically been small (over 99 percent of all spills are less than 100 gallons [see Section 4.4]), generally limiting the effects of spills to localized areas and limiting the potential for extensive impacts to water resources.

In the Prudhoe Bay area, studies have found trace metal contamination (nickel and mercury) from limited sampling in the snowpack near the ARCO gas-handling facility, and elevated levels of several metals (mercury, antimony, cadmium, copper, and lead) near the NSB solid-waste incinerator have been found (Woodward et al. 1988; Snyder-Conn et al. 1997). While sampling has revealed the presence of contaminants, contamination of soils and surface water has not been documented. Further, because future cumulative development does not include the addition of numerous other similar facilities, the increase of such contamination, to the extent it exists, is unlikely.

To date, exploration, development, and production activities in the Beaufort Sea estuarine waters have not generated reportable cumulative impacts. More than 40 exploration drilling units (gravel islands, drill platforms) have been constructed or used in the Beaufort Sea as a result of past federal and state oil and gas lease sales. There are no reports of cumulative effects of discharges on estuarine water quality. Several million cy of gravel and dredge-fill material have affected at least a few square kilometers; these activities may have temporarily and locally affected turbidity, but the effects have not been cumulative. Two long causeways have been built along the Beaufort Seacoast, one of which still creates measurable changes in water quality (that is, water temperature and salinity) in spite of enlarged breaches.

4G.5.7.2 Conclusion

Cumulative impacts from development of any of the alternatives to surface-water quality across the North Slope are similar to those described from impacts to water resources and are additive, but they are expected to be limited. Cumulative impacts to water quality from a historically small release of petroleum hydrocarbons during oil spills and contamination from hazardous materials, while they may occur, are also expected to be localized, limited in extent and persistence, and have minimal impact to the environment. Such impacts are not expected to be cumulative.

A large crude or refined oil spill (greater than or equal to 500 bbls from a pipeline or 900 bbls from a facility) would affect water quality by increasing the concentration of hydrocarbons in the water column of nearby lakes and streams, if such a spill were to occur and enter these environments. However, the chance of a large spill occurring is low. Regional (more than 1,000 km²), long-term (more than one year) degradation of water quality to levels above state and federal criteria because of hydrocarbon contamination is considered to be unlikely.

If a large oil spill were to result from oil and gas development in the Beaufort Sea, the marine environment would be degraded through the release of petroleum hydrocarbons into the water column. The hydrocarbon concentration could exceed the 1.5 ppm acute-toxic criteria for a day in an area of approximately 2 km². The 0.015-ppm chronic criterion also could be exceeded for 10 or more days in an area of approximately 12 to 45 km². Small spills could exceed the acute-toxic level (1.5 ppm) for less than a day and chronic criteria (0.015 ppm) could be exceeded for less than a month in an area of less than 100 km².

Tankering of Beaufort Sea and North Slope oil resources from the southern end of the TAPS could result in an unlikely, very large tanker spill, and the oil could contact nearshore areas in Prince William Sound or the Gulf of Alaska in a relatively non-weathered state. Such a spill is estimated to affect water quality within the affected area for a period of between one day and one to two weeks in high energy areas, and for a few days to several months in low energy embayments and lagoons (TAPS Owners 2001a). The magnitude of impact will decrease

rapidly as the oil disperses and weathers, and the spatial extent of the impacts will depend upon wind, water currents, air and water temperature, volume of oil spilled and effectiveness of response and cleaning operations.

Alternative A – CPAI Development Plan is not expected to contribute to cumulative impacts to marine and estuarine water quality. Spills from other oil and gas developments on marine or estuarine waters or along streams draining into such water bodies could impact those waters. The extent of such contamination would be related to the size of the oil spill. Because spill frequency and volume are expected to be low, the cumulative impact from oil spills is not considered to be an additive cumulative impact. If a 500- to 900-bbl spill were to occur during the ice-covered season, the effects would be minor. If it were to happen during the open-water or broken-ice seasons, hydrocarbons dispersed in the shallow estuarine water column could exceed acute-toxic criteria during the initial spill period. However, it is expected that the effect would be short-term and localized.

4G.5.8 Climate and Air Quality

4G.5.8.1 Evaluation

Cumulative impacts to air quality are evaluated in terms of regional ambient air quality, aggregated contributions to localized impacts near emissions sources or groups of clustered emission sources, and potential effects on climate change.

REGIONAL AIR QUALITY

Cumulative air quality impacts from North Slope oil and gas exploration and production activities primarily result from the collective emissions from fuel burning equipment and fugitive emission from mobile and process sources. These impacts are regionally additive (increased concentrations of specific pollutants) and, likely synergistic (chemically reactive). However, as described in Section 3.2.3, ambient air quality on the North Slope of Alaska is relatively pristine even though oil and gas exploration, development, and production have been under way for more than 30 years. Air monitoring at sites in the existing Kuparuk and Prudhoe Bay Fields and Nuiqsut finds that concentrations of NO_2, SO_2, O_3, PM_{10} are well within the NAAQS. Air quality modeling for the Liberty project conducted by BPX A found that emissions from the Prudhoe Bay and Kuparuk fields have very little effect on ambient concentrations elsewhere.

Another potential regional air quality issue on the North Slope is associated with Arctic haze. Arctic haze is a phenomenon resulting from elevated concentrations of fine particulate matter found over the Arctic, primarily in winter and spring. Based on sources apportionment and long-range transport research, scientists believe that most of these pollutants are from combustion sources in Europe and Asia. The arctic haze phenomenon was first observed in the 1950s, long before oil development started on the North Slope. The expected decrease in existing production facility emissions associated with the downward trend in oil production) means that potential project contribution to arctic haze formation by local sources would be reduced. Emissions from development resulting from the proposed Alternative A would be small compared to the emissions from Prudhoe Bay and Kuparuk oilfield production. For example, actual emissions reported for the Prudhoe Bay oilfields for the year 1994 to 1995 listed 56,000 tons of NO_X, 1,471 tons of SO_2, and 6,200 tons of PM_{10} (USACE 1999b). Projected emissions from the CPAI's proposed plan would be only a small percentage of current and projected emissions (see Section 4A.2.3).

GLOBAL CLIMATE CHANGE

The global climate change analysis performed for the OCS Oil and Gas Leasing Program: 2002-2007 (MMS 2002d, OCS EIS/EA MMS 2002-006: Section 4.1.2 and Tables 4-7a and 4-7b) estimated that the emission rate of GHG [(CO_2, methane, and nitrious oxide (N_2O)] from the OCS cumulative program activities for Alaska would be from 381 to 723 thousand metric tons of carbon equivalent per year for CO_2 and from 1.1 to 2.1 thousand metric tons of carbon equivalent per year for methane. Emissions of N_2O were not calculated because of lack of information about emission factors. However, N_2O emissions are expected to be much smaller than for the other GHG. The total estimated GHG emissions from the three Beaufort Sea Lease Sales (186, 195, and

202), including emissions from tanker transport to United States west coast ports, were from 177 to 311 million metric tons of carbon equivalent. This is approximately 0.01 to 0.02 percent of current nationwide GHG emissions. The Northstar EIS estimated that the GHG emissions from current North Slope oil production (including shipping, refining, product transportation, and consumption) is approximately 1 percent of the global fossil fuel GHG emissions (USACE 1999b). However, these emissions are dominated by consumption of refined petroleum products, not from the production of oil.

The cumulative analysis for the current Northwest National Petroleum Reserve-Alaska first sale proposal considers three ranges of onshore and offshore future production activity:

- The low range includes reserves in currently producing fields and resources and discoveries in the planning or development stage.

- The mid-range consists of the low-range figure plus any reasonably foreseeable future production.

- The high range is created by adding in potential speculative future production.

Using the mid-range production estimate (11 Bbbl of oil), and assuming that this entire amount would be produced over a 20-year period, an average production rate is established at approximately 1.4 MMbbl of oil per day. This is very close to the 1996 North Slope oil production rate. While it is difficult to precisely estimate GHG emissions from future oil and gas production activities in northern Alaska, GHG emissions would conservatively continue to be proportional to the oil production rate at approximately the same ratio as presently exists. Based on that assumption, not taking into account combustion and emission control technology improvements, the regional GHG emissions associated with future cumulative production would be approximately the same as the 1996 North Slope emission levels. This is approximately 27 percent higher than current levels (since the 1999 North Slope production rate was approximately 1.1 MMbbl of oil per day).

AIR QUALITY IMPACTS

The air quality impact analysis for the Liberty Development and Production Plan FEIS (MMS 2002b) found that maximum concentrations from emissions would occur within 100 to 200 meters of the facility boundary and would be considerably lower at 1 kilometer from the facility. These results are representative of results from previous North Slope modeling and monitoring. They confirm that there would be very little cumulative interaction between developments under this proposal and other oil-producing facilities.

A more comprehensive discussion of potential cumulative impacts from oil and gas development can be found in the "Impacts on Air Quality" sections of MMS OCS EIS/EA (MMS 2002a). That discussion is incorporated here by reference. Section 4.3.3.2 of the same document (specific to Alaska) discusses the most commonly emitted air pollutants associated with Alaska OCS oil and gas activities, including operations in areas affected by ice cover, the construction of ice islands and gravel islands, and the concentration of activities into short timeframes. The conclusions drawn there are that the impacts from the 5-year program on the pollutant levels, the ozone levels, and visibility would all be minor or negligible. Section V.C.13 of the Liberty Development and Production Plan FEIS (MMS 2002b) discusses the cumulative effects on air quality of all North Slope of Alaska oil and gas activity since 1969. It concludes that the cumulative effects of all projects affecting the area in the past and occurring now have caused generally little deterioration in air quality, which remains better than required by national standards. The Beaufort Sea Oil and Gas Development Northstar and Liberty Development and Production Plan projects, in addition to all other reasonably foreseeable North Slope projects would not change the air quality status.

Section IV.C.6.b.(2) of the Liberty Development and Production Plan FEIS concludes that small oil spills could produce small, very localized increases in concentration of hydrocarbons may occur. However, concentrations of all criteria pollutants would remain well within federal air-quality standards and the overall effects on air quality would be very low.

Potential impacts from future lease sales on the OCS and on land are difficult to evaluate. However, one can expect that any development would be scattered over a large area. Modeling performed for the Lease Sale 144 Final EIS (MMS 1996a) showed that impacts from widely scattered emissions sources on the OCS are small and well within regulatory standards. The Final 5-Year Program EIS for 2002-2007 (MMS 2002a) discusses the cumulative effects of the program in all areas. The relevant major finding was that no major degradation of onshore air quality is predicted. Emissions associated with routine program activities could cause small increases in onshore concentrations of some air pollutants, although are not expected to exceed national or state air quality standards.

Very little cumulative interaction is expected to take place between emissions from sources included in the ASDP and any other existing, planned, or potential oil or gas development projects. For the North Slope as a whole, air is expected to improve in those areas where oil production currently is the greatest, and to decline in areas where future development is expected to take place. It is likely that new development would be relatively scattered, thereby limiting regional impacts and keeping elevated concentrations of pollutants localized in the immediate vicinity of production facilities.

4G.5.8.2 Conclusion

The cumulative effects of all projects affecting the Alaska's North Slope in the past and occurring now have caused generally little deterioration in air quality, which achieves national standards. Production levels for the foreseeable future are not anticipated to be higher than the 1996 level. Thus, while reasonably foreseeable North Slope projects are additive, they are not expected to have synergistic cumulative impacts on air quality.

4G.5.9 Noise

The operation of equipment during exploration, drilling, facility construction (including mining activities) and production and use of aircraft for transportation of personnel and materials contribute noise to the environment. The Plan Area is remote and sparsely populated with few existing sources of man-made noise.

Existing sources of noise include: vehicle operations; aircraft operations, boat operations (outboard motors), and oil and oil field equipment operations. During peak periods of construction and drilling, noise levels would be considerably higher than during operations, but would be short-term and would not occur for all facilities at the same time. The village of Nuiqsut is several miles from the nearest ASDP proposed development, so noise impacts would be minor unless future development occurred much closer to the village of Nuiqsut or any other village.

The ASDP would result in negligible incremental increases in localized ambient noise from construction and operations equipment and aircraft. From the cumulative perspective, noise effects from infrastructure and activities related to past, present and reasonably foreseeable are localized and short-term, and the sources of noise are not geographically concentrated.

4G.5.10 Physical Environmental Cumulative Effects for Alternatives B, C-1, C-2, D-1, D-2, and F – CPAI Development Plan

Those cumulative effects to the physical environment under Alternatives B, C-1, C-2, D-1, D-2 and F for development of 5 pads proposed by CPAI are expected to be similar to those described above for Alternative A. However, under Alternatives B, D-1, and D-2 where less overall acreage will be disturbed by construction of new facilities than under Alternative A, cumulative impacts that are additive will be marginally reduced and synergistic impacts would experience greater reduction. For example, Sub-Alternatives D-1 and D-2 propose limited gravel roads with aircraft accessibility. This is a decrease from Alternatives A and F in total disturbed acreage which will result in less overall cumulative impacts to soil, gravel, water, and air resources from Alternative D-1 and D-2 than from Alternatives A and F. Similarly, cumulative impacts on the physical environment are anticipated to be greatest under Sub-Alternatives C-1 and C-2 because of an increase in the disturbed acreage. While these impacts could be additive to other future development, even after the reasonably

foreseeable future development occurs, overall effects on the physical environmental resources would be negligible. The one exception to the above characterization among physical resources is geology. The cumulative effects on geology are the same for all the action alternatives, except for Alternative B in which there would be a small reduction in oil extracted because of the relocation of CD-6**.**

4G.5.11 Cumulative Physical Environmental Impacts of Alternative E – No-Action

Under Alternative E, no action is proposed. To the extent that cumulative impacts are currently occurring, these impacts would continue. Impacts related to oil production would be expected to continue but then decline in the future if reasonably foreseeable future production projects do occur in Alaska's North Slope. Impacts related to disturbance or displacement would only decline in the future if facilities are removed and the sites reclaimed. No overall cumulative effects to the physical environment result from Alternative E.

4G.6 ANALYSIS OF CUMULATIVE IMPACTS TO BIOLOGICAL RESOURCES

This section describes the cumulative effects to biological resources of Alaska's North Slope that would occur from disturbance by humans and natural processes. Human-induced impacts have primarily occurred as a result of disturbance from oil and gas related industrial activities (exploration and transportation). Other disturbance has occurred from human settlements and subsistence living, archaeological excavations, cleanup of hazardous waste sites, overland moves, and the small amount of tourism and recreation that has occurred on the North Slope.

4G.6.1 Vegetation and Wetlands

4G.6.1.1 Evaluation

Cumulative effects of past actions have resulted in the existing conditions described in Section 4A.3.1. In general, the greatest overall effects to the North Slope have been caused by oil and gas development production and transportation.

Oil and gas exploration, development, and production; oil refining; oil and gas transport; oil storage; human habitation and development; transportation; land management activities and plans; natural resource use; and petroleum spills may affect vegetation through oil spills and through the construction of infrastructure (direct effects of vegetation burial and indirect effects of vegetation change caused by snow drifting, dust, etc.). In terms of acres affected by direct impacts, construction causes more than 99 percent of the impacts, with spills having a very minor role.

Construction activities would disturb soil and would physically injure vegetation or remove vegetation within the disturbed area. In areas with a high proportion of wetlands, such as the Arctic Coastal Plain, or during construction of large projects, such as new production and pipeline facilities, wetlands could be filled. The placement of gravel to construct production pads or service roads would eliminate local vegetation and alter local hydrologic regimes, which could adversely affect terrestrial and wetland communities. These activities would also produce fugitive dust, which could injure or kill vegetation and alter vegetative communities by reducing vegetative cover, altering local soil and permafrost conditions, and changing species composition. Erosion from construction sites could result in the sedimentation of vegetative communities, particularly wetland communities. Sediments could injure or kill vegetation and alter vegetative communities.

Disturbances to vegetative communities would generally require restoration of the affected site and revegetation efforts. Some non-native species could potentially be introduced in seed mixtures during rehabilitation; however, these species would not likely persist or spread beyond the sites where they are introduced (NRC 2003). Activities that disturb the soil or remove vegetation could result in changes to the underlying permafrost, causing thermokarst. Which in turn may eliminate some terrestrial vegetative and wetland communities.

Spills of crude oil, diesel oil, or other fluids could injure or kill vegetation, potentially leaving affected areas unvegetated or sparsely vegetated. Impacted soils might require extended periods of time to revegetate. Small spills, which would be considered likely, or anticipated events would be cleaned up and would generally have negligible to minor cumulative effects on the terrestrial vegetation and wetland communities. Large spills, which would be considered very unlikely events, could have the greater effects but because of their low probability of occurrence would not be considered an ongoing cumulative impact.

Construction and use of the Colville River Road could result in impacts to terrestrial vegetation and wetlands from the generation of fugitive dust, and the discharge of gravel particularly along unpaved highways. Future oil and gas transportation might also involve the construction of additional pipelines. Destruction of terrestrial and wetland communities might occur if any underground pipelines are constructed. Large-scale restoration and revegetation activities might be required. Past construction projects, such as TAPS and the construction of drilling pads on the North Slope, have involved extensive vegetation restoration. Pipeline construction and operation might also result in permafrost changes and accidental petroleum spills. The loading and transport of oil tankers south from Valdez might also result in accidental spills of crude oil that could impact shoreline vegetation.

Mining operations for sand and gravel might remove large quantities of streambed deposits and also riparian vegetative communities. The alteration of hydrologic regimes or surface water drainage patterns could adversely affect vegetation by increasing or decreasing soil moisture or inundation. Mining activities also might result in soil disturbance, dust, erosion, and sedimentation. Mining operations would likely result in a direct loss of habitat while the sites are active and an alteration of habitat types after the mine sites are rehabilitated. Four North Slope plant species listed as sensitive by the BLM (*Poa hartzii Alaskana*, *Potentilla stipularis, Mertensia drummondii,* and *Eurybia pygmaea)* occur in dry habitats such as sand dunes and bars, gravel deposits, and dry sands and gravel of active floodplains, which are the primary sources of ballast and fill used for construction. These sensitive species would be the most susceptible to impacts from gravel mining.

Certain large-scale or global phenomena can also affect terrestrial and wetland vegetation. For example, global warming might result in long-term effects to vegetative communities and wetlands. Increasing temperature would result in an increased presence of deciduous shrubs with a decrease in sedges and grasses. Continued temperature increase could eventually result in the invasion of arctic tundra by taiga forests (Anderson and Weller 1996). Changes in vegetation could in turn, affect other biological resources that utilize the vegetation. While the combined effect of these large-scale impacts with local project-specific impacts may be synergistic, data do not exist to support such a conclusion.

Specifically on the North Slope, impacts to vegetation would result from the construction and use of production pads, modifications of stream banks and channels, new access roads, pipelines, use of sand and gravel mining sites, and ice roads and pads. Although oil and gas exploration, development, and production are expected to continue on the North Slope, the area of impact from individual drilling or production sites has become considerably smaller over the past 30 years by advances in technology which have reduced the area required for well pads and by substituting ice for gravel in some roads and pads (NRC 2003). Losses of vegetative communities might result from direct removal, sedimentation, or spills. These communities might include lowland and upland tundra. However, less than 1 percent of the vegetation of the 56.8 -million-acre Arctic Coastal Plain would likely be impacted by oil development (BLM and MMS 1998a). The cumulative effects of these activities, including construction of the ASDP, on North Slope terrestrial vegetation and wetlands is expected to be minor. The contribution to cumulative impacts from CPAI's proposal would be minor, unless there were a large oil spill (see Section 4.3). Impacts to the North Slope vegetation communities from ASDP termination activities would result in a small temporary contribution to cumulative impacts and a recovery of localized North Slope communities over the long term, although the benefit would be very small relative to the total area of upland and lowland tundra vegetation zones.

Additional discussions of wetland habitat values are located in other sections, including Section 4G.6.3.1, Habitat Loss, Alteration or Enhancement.

4G.6.1.2 Conclusion

Cumulative effects of past actions on vegetation have generally been minor. Impacts to the vegetation of Alaska's North Slope from Alternative A – CPAI Development Plan and past, present and future oil and gas exploration and development in the Plan Area are expected to be additive with respect to the impacts (present and future) from other oil and gas activities outside the Plan Area. The affected area continues to be a very small fraction of the total North Slope acreage. It is also not expected that synergistic impacts (whether beneficial or adverse) to vegetation would occur as a result of developing additional acres. In addition to oil and gas development projects that would directly affect North Slope vegetation, global climate change could alter the species composition**.**

4G.6.2 Fish

4G.6.2.1 Evaluation

This section evaluates the cumulative impacts on fish of the ASDP in combination with other past, present, and foreseeable future activities. The following can affect fish on the North Slope: oil and gas exploration, development, and production; oil and gas transportation; human habitation and development; land management activities; natural resource use; and spills. Additional information on the scopes of these activities is presented in Sections 4A through 4D, and 4F. Like the proposed action, other past, present and reasonably foreseeable future actions can affect fish in a variety of ways that can be broadly categorized into impacts that result from the following:

- Use, alternation or enhancement of fish habitat
- Obstructions to fish passage
- Effects on fish population from increased human access
- Effects of oil, fuel, and chemical spills on fish

LOSS, ALTERATION, OR ENHANCEMENT OF HABITAT

Past, present and reasonably foreseeable future actions on the North Slope might cumulatively contribute to the alteration and loss of fish habitat. Since most North Slope construction occurs in the winter when there is prolonged darkness and thick ice cover, phytoplankton photosynthesis would not likely be substantially affected. Heavy downstream sedimentation from construction or oil production activities could smother the benthos in localized areas, but effects would probably not be widespread. In general, species occupying these areas have adapted to dynamic conditions, and react to short-term fluctuations in water quality and habitat by either enduring and functioning under those conditions, or moving out of the impact zone. Recolonization of affected areas by benthic organisms from surrounding areas would probably occur rapidly in most cases.

Oil and gas exploration and development can affect fish if ground- or vegetation-disturbing activities occur in or near waterways or if chemicals or wastes are discharged into waterways. Loss of habitat in freshwater systems can result from bank hardening, draining of water bodies, changes or temporary diversions in river or stream channels, excavations of streambed materials, removal of riparian vegetation, and changes in water quality parameters. Permits are required under Alaska Title 16 for activities in or near streams that could affect anadromous fish and their freshwater habitat or the free and efficient migrations of resident fish. Discharges of wastes and treated water from oil facilities must also comply with the CWA and NPDES permits. Compliance minimizes the cumulative effects from the described actions on aquatic habitats.

Removal of fresh water from lakes for construction of ice roads and pads and for other operations could also affect fish in these water bodies. Withdrawal of water can reduce water depth in overwintering areas, thereby

reducing their ability to support fish, although some research suggests that such effects may be minimal. Fish may also be entrained through pumps during water withdrawal. Design considerations and mitigation are incorporated into these operations to minimize impacts on fish. Water withdrawals would continue to be necessary for future North Slope oilfield developments, but efficient and appropriate regulation, compliance, and enforcement would reduce the potential impacts. Use of other options for obtaining water for ice roads and pads (for example, use of ice chips, desalination, use of snowmelt water, and water from flooding abandoned mine sites) may also limit potential impacts.

Past, present and reasonably foreseeable future construction and maintenance operations for pipelines on the North Slope would have impacts on freshwater habitats similar to those of the ASDP. Inspection, monitoring, and prompt corrective action would be required to limit impacts.

Alterations to freshwater habitats could reduce fish survival and potentially affect fish populations. These impacts would more likely occur if the alterations were allowed to persist for multiple years and if overwintering habitat were affected. However, such alterations would typically be minor in scope and would not substantially affect fish populations. Many potential impacts would probably be identified and corrected before impacts to populations ever occurred.

Former gravel extraction sites located in river or streambeds or in areas where inundation could occur may provide additional fish spawning habitat. These sites may be available following decommissions or during periods when they are not in active use for gravel extraction.

OBSTRUCTIONS TO FISH PASSAGE

Drainage structures such as culverts and low-water crossings can impede fish migration and obstruct fish passage (Section 4A.3.2). Generally, such impacts may occur intermittently at some, but not all, stream crossings that require drainage structures or that require vehicles to cross streams. Impacts at stream crossings are typically addressed through proper design and maintenance of roads, pipeline river crossings, and culverts, coupled with regulation, monitoring, and corrective actions.

Little or no discernable impact to fish passage in freshwater habitats has occurred in North Slope oilfields as a result of past activities, and it is anticipated that this will also be the case for future North Slope oilfields. Past, present and reasonably foreseeable future construction and operation of pipelines would likely have impacts similar to those from the ASDP. For example, new roads, production pads, and buried pipeline crossings would affect new areas. Construction of additional roads and increased numbers of workers would result in new stream crossings, vehicles crossing streams, and consequently, impacts to fish from obstructed passage at disturbed stream crossing areas. Other development on the North Slope could further increase such impacts, depending on the applicable location, extent of development, level of mitigation, and regulatory control.

Inhibiting fish movement in streams can reduce access to spawning areas and potentially affect fish populations. These results are more likely if the obstructions are allowed to persist for multiple years. For example, fish passage in freshwater habitats has been a continuous maintenance issue along the TAPS ROW (TAPS Owners 2001b), and it is also likely to be an issue in cumulative actions throughout the North Slope. However, obstructions to fish passage would probably be identified and corrected before impacts to populations would occur.

EFFECTS ON FISH POPULATIONS FROM INCREASED HUMAN ACCESS

Increased public access as a result of new pipeline and facilities construction or development would likely have small impacts on fish habitat, primarily resulting from the increased erosion of stream banks by off-road vehicles and the increased amount of dust deposited by vehicles traveling on unpaved roads.

Increased human access along new roads and highways would likely result in additional recreational and subsistence fishing pressure on fish populations, which have low productivity in these northern latitudes.

Currently, recreational fisheries are regulated to maintain adequate stocks and are adjusted to compensate for changes in fishing pressure. However, increased access could result in overharvest if regulations and enforcement were inadequate. The BLM and USACE (1988) reported that individuals of the species preferred for harvest were smaller and less numerous after the construction of the TAPS in areas newly accessible to anglers.

In the North Slope oilfields and Beaufort Sea, increased human access, with its accompanying increased fishing pressure, has not affected fish populations, although some subsistence, sport, and very limited commercial fishing occur. Fishing activities are managed by the ADF&G and the federal land management agencies within federal conservation units. The Federal Subsistence Board manages subsistence fishing by rural Alaska residents. Maintenance of fish at the desired sizes and population levels has been largely accomplished by regulations established by the Alaska Board of Fish and enforced by ADF&G and the Alaska Department of Public Safety.

EFFECTS OF OIL, FUEL, AND CHEMICAL SPILLS ON FISH

Oil, fuel, and chemical spills are a primary concern with regard to oil and gas development, production, and transportation. The potential impacts of freshwater spills are primarily localized and restricted to gravel pads at facilities or roads. Large spills into freshwater have not occurred. However, should one occur in the future, it could have substantial impacts on fish in the affected area.

Future oil and gas operations carry the risk of small-scale spills of oil, fuel, and chemicals from vehicles and machinery. Present and future North Slope oilfield developments might have an impact on fish, particularly in the marine environment. Spills in solid ice or broken ice in this region may be particularly difficult to clean up. Impacts to fish from oil spills would cause differential impacts depending on the location, timing, and volume of the spill, presence of fish in various life stages, and persistence of toxic compounds in the water column following the spill. Impacts could be lethal or sublethal depending on exposure.

4G.6.2.2 Conclusions

The combined impacts to fish from Alternative A – CPAI Development Plan and other past, present, and future projects, while additive, are not expected to affect the viability of species or populations.

Little or no discernable impact to fish passage in freshwater habitats has or would likely occur as a result of North Slope oilfield developments. Overall, cumulative impacts from blocking fish passage in North Slope freshwater habitats are, and would be, low to moderate under the proposed action.

The cumulative impact of increased human access to fish populations (for example, along new roads and highways) is expected to be minor and additive.

Although there is a potential for large impacts to fish from large oil spills, the risk of such spills is relatively small (see Section 4.3). The probability is higher for smaller spills, but the impacts from such spills, if they entered freshwater habitats, would likely be small, temporary, and additive and unlikely to severely affect fish populations, especially in light of control and cleanup activities implemented in response to spill events.

Adverse effects related to material extraction at gravel sites are possible in certain situations. However, past reclamation of deep pits that have been mined has proved beneficial when new habitat for arctic fish species has been established and could be a countervailing impact on fish**.**

In summary, wide-ranging increased impacts to arctic fish populations found on the North Slope are not anticipated. Also, synergistic impacts to fish from disturbance related to oil and gas production in this plan are not anticipated.

4G.6.3 Birds

4G.6.3.1 Evaluation

Oil and gas exploration, development, production, and transport are activities that may affect birds on Alaska's North Slope. Additional activities that could potentially contribute to current and future cumulative effects within the Plan Area include the following: subsistence and sport harvests; natural depredation; human habitation and development; transportation; land management activities and plans; natural resource use, and wildlife research and survey activities. Individually or in combination, these additional activities could potentially affect bird populations as much as, or more than, potential effects from petroleum development and may have contributed importantly to recent declines in some populations. Reported waterfowl subsistence harvests for the Plan Area (Table 3.4.3-2 and 3.4.3-3), assuming the 79 percent harvest of waterfowl within the Plan Area for Nuiqsut (Figure 3.4.3.2-15), was 2,811 birds and eggs in 1993, of which 41 percent were geese and 59 percent were other waterfowl and eggs. Petroleum spills and other hazardous material releases may also affect birds on the North Slope. Activities along migration routes or on winter ranges that could potentially contribute to current and future cumulative effects include: wildlife research and survey activities; subsistence and sport harvests; depredation; commercial fishing; commercial development; environmental contamination; marine shipping; and recreational activities (BLM and MMS 2003b).

Other cumulative impacts that could affect birds include:

- Habitat loss, alteration or enhancement
- Disturbance or displacement
- Mortality
- Obstruction to movement
- Hazardous material spills

The mechanisms for impacts would be similar to those described in detail for Alternative A – CPAI Development Plan in Section 4A.3.3. The effects of development may cause mortality; increased depredation of eggs and young, leading to reduced reproduction; and increased energy expenditures or changes in physiological conditions that may reduce survival or reproduction (NRC 2003, Miller et al. 1994). Possible differences between cumulative impacts and the impacts from the proposed action would depend on the intensity (magnitude), scale (geographic area), duration, timing and frequency, any synergies (impact interactions), and likelihood of the impacts associated with the cumulative actions (USACE 1999a).

HABITAT LOSS, ALTERATION, OR ENHANCEMENT

Within the North Slope, oil and gas exploration, development, and production, along with the construction and operation of ancillary facilities (for example, gravel mines, roads, pipelines, and production pads), would result in a cumulative reduction in avian habitat. Future developments within the North Slope would result in continued habitat loss, alteration or enhancement, although new developments are expected to have smaller footprints and would result in a relatively smaller impact than in the past (BLM and MMS 2003b). Reduction in the quality of available habitat may also occur from fragmentation of large tracts of undisturbed tundra. Evaluation of fragmentation of tundra habitats by facilities in the Prudhoe Bay Oilfield has not produced consistent results, but may negatively affect shorebirds (Troy 2000) as well as other bird groups.

Currently the total habitat loss due to gravel fill and mining from oil and gas related activities on the North Slope is 17,770 acres (see Table 4G.4.7-1) and habitat alteration affects an additional 10,932 acres (Table 4G.4.7-1) (NRC 2003). These cumulative impacts affect an estimated 4 to 5 percent of waterfowl, shorebird and

passerine nests in the unitized area of oil development between the Colville River and the Sagavanirktok River, and less than 1 percent of the Arctic Coastal Plain waterfowl population (Table 3.3.3-3) based on nesting densities of 5.7 nests/km^2 for waterfowl, 43 nests/km^2 for shorebirds, and 17 nests/km^2 for passerines (TERA 1993b). Habitat loss and alteration due to oil and gas development represents a very small portion (approximately 0.02 percent) of the more than 56.8 million acres within the Arctic Coastal Plain (Gilders and Cronin 2000).

Avoidance of key wetland habitats and preferential placement of facilities on moist and dry habitat types results in a disproportionate loss of habitats preferred by dunlins, plovers and buff-breasted sandpipers. Cumulative habitat impacts to shorebirds have resulted in an estimated 5 percent reduction in nesting in the Prudhoe Bay region (Troy 2000). Under Alternative A – CPAI Development Plan, in the Colville River Delta 19 percent of habitat impacts affect moist and dry habitats and in the National Petroleum Reserve-Alaska portion of the Plan Area, 79 percent of habitat impacts affect moist and dry habitats (moist sedge-shrub meadow, moist tussock tundra, upland and riverine dwarf shrub, riverine or upland shrub). Even with this disproportionate impact on moist and dry tundra, Alternative A alters less than 1 percent of available moist tundra and dry dwarf shrub habitats in the Plan Area (Table 3.3.1-1, 4A.3.3-3). In the Northeast National Petroleum Reserve-Alaska moist tundra and dry dwarf shrub habitats cover a total of 56.3 percent of the planning area (BLM and MMS 1998a), however, in the ASDP Plan Area these habitats cover approximately 29 percent of the surface (Table 3.3.1-1). Habitat alterations from use of low-ground-pressure vehicles during summer or winter may also alter tundra vegetation, these changes are most pronounced in moist and dry habitats (Jorgenson et al. 2003a) preferred by some shorebirds and are unlikely to affect wet and aquatic habitats used by waterfowl and loons.

Habitat loss and alteration, as it effects nest numbers, is estimated based on site-specific nesting densities for bird species and species groups in order to compare alternative development scenarios. Additional impacts due to lost productivity are not quantified by this analysis, including impacts due to increased nest depredation caused by attraction of predators to development areas. Productivity is variable by species, area, and weather and rodent abundance. Quantification of reduced productivity due to increased depredation attributable solely to the presence of oilfield infrastructure is not available. In most cases, effects would be localized, and no adverse effects to North Slope bird populations would be expected. Under Alternative A – CPAI Development Plan, approximately 306 acres would be mined or covered by gravel and lost as potential nesting, brood-rearing, and foraging habitat for birds. Habitat losses from gravel fill would be permanent. An estimated 630 bird nests (9 percent waterfowl, 1 percent loons, 55 percent shorebirds, and 33 percent passerines) would be directly and indirectly affected by gravel placement (Table 4A.3.3-5). Reasonably foreseeable oil and gas development would affect a minimum estimated 2,823 bird nests, reducing nesting by 2 to 5 percent for Plan Area waterfowl, loon and seabird populations and 2 percent for Plan Area shorebird and passerine populations and less than 1 percent for North Slope populations. Habitat loss does not involve the direct loss of active nests because winter gravel placement, ice-road construction, snow dumping, and snowdrifting occurs when nests are not active.

Water withdrawn from lakes during winter for construction of ice roads and pads is replaced rapidly by snowmelt runoff in spring. Water withdraw could potentially affect nesting, brood-rearing or foraging habitats for waterfowl, loons, seabirds and shorebirds by altering surface water elevations or water quality, resulting in nest sites left far from the water's edge, reduced invertebrate populations due to changes in bottom saturation, or reduced fish and invertebrate populations due to changes in water quality. However, studies of lakes which have undergone water withdraw have not shown lowered spring surface water elevations or significant changes in water quality parameters (Michael Baker Jr. 2002e).

Oilfield facilities can also enhance habitats on the North Slope for some species. Gravel fill eliminates tundra habitat, but limited traffic and some colonization by vegetation can provides nesting sites for semipalmated plover, ruddy turnstone, and Baird's sandpiper; and feeding habitat for Lapland longspurs (Pollard et al 1989; Truett et al. 1994). Structures may occasionally provide a haven from predators, pests, or weather, or a platform for feeding, hunting, or nesting (Truett et al. 1994). Shorebirds and waterfowl commonly feed and rest on impoundments associated with gravel pads (Pollard et al. 1989). Impoundments created by gravel fill may create new nesting, feeding and brood-rearing habitat that may be used by some waterfowl and loons, although Pacific loon nests established on impoundments that drain before hatch had higher depredation rates than nests

on natural ponds (Kertell 1993, 1994, 1996). Several studies have documented that birds, such as raptors, common ravens and snow buntings perch and nest on oilfield and pipeline structures (for example, several TAPS pump stations). Similarly, Pollard et al. (1989) and Rodrigues (1992) documented extensive use of gravel pads and adjacent disturbed sites in the North Slope oilfields by birds.

DISTURBANCE OR DISPLACEMENT

Potentially disturbing factors associated with oil and gas development and road development include: aircraft, vessel, and vehicle traffic; human presence; construction of facilities, roads, and pads; drilling operations; and spill cleanup (BLM and MMS 2003b). Future oilfield development will contribute to the disturbance and displacement of birds. Protective measures, some of which are currently adopted for existing development**,** such as restricting the timing of activities and locating facilities away from nesting areas, could minimize these impacts. Disturbance of some individual birds as a result of oil and gas operations and road use is expected to be unavoidable (BLM and MMS 2003b).

High levels of air and vehicle traffic are associated with the petroleum industry on the North Slope. Alternative A – CPAI Development Plan is estimated to require up to 6 flights per day during summer and 300 vehicle trips per day during construction and initial drilling during summer 2004-2011. Such activities could cause displacement of nesting, feeding, and/or molting birds (BLM and MMS 1998a). Noise and visual stimuli associated with helicopter and fixed-wing air traffic would disturb waterfowl and loons near the proposed airstrip at the CD-3 site and at the Alpine airstrip. Disturbance due to air traffic would displace an estimated 21 waterfowl, 2 loon and 2 seabird nests at CD-3 during construction (Table 4A.3.3-5). Traffic would be reduced during the operational phase of the project. Additional air traffic at the Alpine Facility in support of construction of CD-3, CD-4, CD-5 and CD-6 would be additive to the current traffic levels at this facility, affecting an estimated 9 waterfowl, 1 loon and 1 seabird nests. Alternative A and reasonably foreseeable development would cause additional disturbance due to air traffic, affecting a minimum estimate of 1 to 2 percent of Plan Area waterfowl, loons and seabirds.

Disturbance impacts resulting from air traffic could be effectively reduced by restricting flight paths to avoid sensitive nesting areas during active breeding and brood-rearing periods, and by establishing minimum flight altitudes to reduce ground-level noise (USACE 1999a). Regardless of attempts to mitigate effects by adjusting routes, continued air traffic in support of roadless developments in the Colville River Delta and Northeast National Petroleum Reserve-Alaska would be likely to result in some low-altitude flights over nesting, brood-rearing, molting and staging birds. Such disturbance could flush females from nests, resulting in lower productivity if eggs are lost to predators or exposure to low temperatures, displace females with broods from preferred foraging areas, and disturb staging flocks during preparation for migration. Long-term displacement (one year or more) from the vicinity of heavily used air traffic corridors and onshore facilities could result in fewer young produced and lower survival of both adults and young if birds are displaced to lower quality habitats.

Aircraft that fly over open water areas in spring could displace loons, king and common eiders, long-tailed ducks, and other species from this essential habitat. Because of the limited quantity of open water in spring, access to such areas is likely to be less available than in the post-breeding period. This could increase competition for food during the energetically stressful period following spring migration and could result in decreased survival or breeding success. Late summer and fall aggregations of birds using offshore areas for staging would also be vulnerable to disturbance. Molting brant react to aircraft by alert posturing, running, or entering water. Interruptions of feeding may have deleterious effects on body reserves (Miller et al. 1994). Disturbance impacts on molting brant might be expected in important molting habitat north and east of Teshekpuk Lake if more of this habitat is made available in the Northeast National Petroleum Reserve-Alaska Amended IAP/EIS (BLM and MMS 2004). A single aircraft could disturb hundreds of waterfowl on dozens of lakes in its flight path (Simpson et al. 1982). Such disturbance would be expected to cause excessive short-term energy use by disturbed individuals and displacement of birds from the vicinity of routinely used air corridors. Primary species included in post-breeding foraging flocks of shorebirds include dunlin, semipalmated sandpipers, red-necked phalaropes, western sandpipers, and pectoral sandpipers (Andres 1994). Displacement

of large flocks of shorebirds from these important and limited habitats could adversely affect the migrant shorebird population passing through the Colville River Delta (Andres 1994).

Some waterfowl and loons would be disturbed during the summer breeding season by vessel and vehicle traffic; noise from equipment on roads or at facilities; and pedestrian traffic. Disturbance by vehicles and equipment activities, such as road grading and compaction or aircraft, during summer would decrease the numbers of waterfowl nesting, brood-rearing or foraging in areas adjacent to roadways and airstrips (Ward and Stehn 1989; Murphy and Anderson 1993; Johnson et al. 2003a). On the North Slope, vehicle traffic, including large trucks hauling cranes and other equipment, and road maintenance equipment had greater effects on geese feeding close to roads than on geese feeding farther away (Burgess and Stickney 1992b; Murphy et al. 1988; Murphy and Anderson 1993). Disturbances to bird activity occur most often during the pre-nesting period, when birds gather to feed in open areas near roads, and during brood-rearing and fall staging. Reactions to vehicular traffic may affect activity and energy budgets of waterfowl and loons resulting in negative impacts on nesting success by increasing the length of time birds are away from the nest during incubation (Johnson et al. 2003a). Disturbance effects during construction of the Alpine Development Project did not cause changes in nest site selection by tundra swans or yellow-billed loons (Johnson et al. 2003a). Analysis of 15 years of tundra swan nest and brood distributions in the Kuparuk Oilfield indicate that there was no significant relationship between the intensity of disturbance and nest or brood densities within 1 km of roads (Anderson and Stickney 2004). However, successful tundra swan nests average further from roads than unsuccessful nests (Ritchie and King 2000). Vessel traffic associated with boom deployment and spill response exercises in the Colville River and the delta area would disturb birds during the open water periods. During pre-nesting, brood-rearing and fall staging these disturbances could affect flocks of hundreds of geese and ducks and thousands of shorebirds. Recent studies of disturbance due to offshore seismic exploration documented no apparent displacement of molting long-tailed ducks (Lacroix et al. 2003).

Glaucous gulls are attracted to gravel structures and associated facilities and human activity because of the potential availability of anthropogenic sources of food. Glaucous gulls that nest in the Plan Area could forage at the landfill in Nuiqsut. Glaucous gulls could key into human-related disturbances to nesting waterfowl that leave nests unattended, allowing gulls to feed on the eggs (Noel et al. 2002b). This attraction can be minimized by implementing and monitoring the proper handling of refuse and by providing workers with training on the problems associated with feeding wildlife.

OBSTRUCTION TO MOVEMENT

Present and future North Slope oilfield developments could further obstruct bird movements. For example, during the brood-rearing period when species such as brant are flightless, roads, causeways, and other structures could present a barrier to movement (ADNR 1999). Movements of flying birds would not be obstructed**,** though fog and low light may reduce visibility and create situations where collisions occur to flying birds**.**

MORTALITY

Increased access to the North Slope resulting from the ASDP and other future energy development associated with road or highway construction would provide improved access to this remote area and could bring increased subsistence hunting pressure on waterfowl and ptarmigan. Birds that nest, forage, or stage for migration in these newly accessible areas will be affected. Subsistence use includes not only weapons-based harvest but also harvest of eggs. Colonial nesting waterfowl, and molting and staging aggregations are especially vulnerable. Alternatively, subsistence harvest may be decreased if hunters avoid development areas. Vehicle collisions would likely also increase as a result of increased road systems. Management actions and mortality related to research are also contributing factors. Disease, depredation, fluctuations in prey, and severe weather are among the natural phenomena that contribute to cumulative impacts on birds (BLM and MMS 1998a).

Birds might also fly into structures, particularly nearshore structures during periods of darkness or fog and poorly visible obstacles such as power lines suspended from poles (proposed for some alternatives). Because structures cumulatively represent relatively small obstructions to the landscape, and when visibility is good,

birds encountering them are expected to see and avoid them, bird mortality from collisions is expected to be low (BLM and MMS 2003). Lighting at facilities may attract birds, especially during periods of poor visibility, incrementally increasing the probability of collisions. However, there is little information on which to base a projected morality estimate (BLM and MMS 2003b).

The NRC's review of the cumulative effects of oilfield development on the North Slope NRC (NRC 2003) concluded ". . . high predation rates have reduced the reproductive success of some bird species in industrial areas to the extent that, at least in some years, reproduction is insufficient to balance mortality." This NRC review focused on the Prudhoe Bay Oilfield with most studies conducted through the mid 1990s when the landfill and dumpsters were accessible by gulls, ravens, bears and foxes. Since the late 1990s the landfill has been fenced to exclude bears, and animal proof dumpsters have been installed throughout North Slope oilfields. The USFWS sponsored a more recent workshop on human influences on predators of ground-nesting birds on the North Slope where participants concluded that common ravens have increased in response to developments, but that increases in arctic fox and glaucous gull populations were uncertain (USFWS 2003). There was further uncertainty in the link between increased predator populations and resulting population level impacts to ground-nesting birds. The numbers of foxes and most avian predators in the Alpine Development Project area did not appear to increase during construction of the project, with the exception of common ravens, which nested on buildings at the Alpine Development site (Johnson et al. 2003a). However, common ravens nesting at Alpine, Nuiqsut and Meltwater reduced nesting success up to 26 miles away at the Anachlik nesting colony by as much as 80 percent (J. Helmericks, pers. comm. 2004). Glaucous gulls also appear to have increased in the Plan Area over the past 40 years (J. Helmericks, pers. comm. 2004). The magnitude and extent of decreased productivity have not been quantified in the ASDP EIS impact analyses, but would be most detrimental to spectacled eiders, which are known to nest in loose aggregations at specific locations year after year, and which have a low total population size.

Many of the birs that occur in the Plan Area are long-distance migrants and/or spend a proportion of their lives off-shore in marine habitats. Additional incremental bird losses include the hundreds of thousands of birds that die annually in drift nets within the North Pacific, Bering Sea, and Gulf of Alaska (BLM and MMS 1998a). Human development impacts may directly and indirectly impact marine systems that provide wintering habitat (e.g. yellow-billed loon wintering in the Yellow Sea), reducing survival and reproductive fitness. Terrestrial habitat alterations, persistent organo-chlorides, and continued legal and illegal use of some toxic pesticides in some Central and South American countries also may result in additional mortality and reduced fitness on return to arctic breeding grounds. These affects are ongoing, wide spread and difficult to quantify but likely exceed the effects of the proposed development.

SPILLS

Approximately 400 spills of diesel, crude, and hydraulic oils and other hazardous substances (such as drilling wastes, methanol, antifreeze and others) occur yearly on the North Slope. Multiple spills could adversely affect birds if additional disturbances occurred while populations were still recovering from the initial disturbance (USACE 1999). Species such as brant, snow geese, long-tailed ducks, common eiders, king eiders, scoters, yellow-billed and red-throated loons and shorebirds could be affected by oil spills into coastal areas such as the Colville River Delta (BLM and MMS 1998a). Over the life of the oilfields, tens of thousands of birds could be killed by oil spilled on the North Slope if quantities of that oil entered the Beaufort Sea (via waterways such as the Colville River). Bird losses would be an incremental addition to the hundreds of thousands of birds that annually die in drift nets within the North Pacific, Bering Sea, and Gulf of Alaska (BLM and MMS 1998a).

Historically, land-based spills of crude oil are uncommon and have only impacted tens of acres. Diesel spills have been more common and have affected hundreds of acres but mostly within gravel pads (Jorgenson 1997), and thus have had a negligible biological impact. Current management and cleanup techniques are effective in reducing the occurrence of spills and in removing spills when they occur (Jorgenson 1997). Present and future North Slope oilfield developments could include more offshore facilities, which would increase the potential for marine oil spills (USACE 1999a). For example, a subsea oil pipeline was installed for the Northstar development in the Alaskan Beaufort Sea, and fuel barges are used for supply. Depending on the time of year and the volume of the oil spill, several thousand birds could be affected by a spill in the Beaufort Sea (USACE

1999a). Significant impacts could affect post-nesting birds that concentrate along the coast for brood rearing, molting, pre-migratory staging, or migration (BLM 1998).

As discussed in Section 4.3, a land-based oil spill can contaminate individual animals, their habitats, and their food resources. Birds are often oiled after being attracted to standing pools of oil or oil floating on water. A very large spill and subsequent cleanup efforts would probably disturb and displace most birds from the area because of extensive activities associated with spill cleanup activities. Leaving some residual oil in place may be less damaging than the potential long-term effects of intensive cleanup activities.

4G.6.3.2 Conclusions

The additive impacts of past, present, and reasonably foreseeable future activities are not expected to cause pervasive cumulative impacts, including impacts from synergistic effects to bird populations on the North Slope. It is expected that the effects of facilities for future projects on bird populations, though additive, would be substantially less than those of past projects because of the smaller areas involved. Oil spills would not significantly add to cumulative impacts, except for an unlikely to very unlikely large spill to aquatic habitats. Increased harvests resulting from increased access to remote areas via new roads, especially from subsistence hunting, could be a serious cumulative factor. Subsistence harvest within the Plan Area would affect approximately 2,800 birds and eggs, compared to an estimated 950 nesting waterbirds and ptarmigan affected by habitat loss, alteration, and disturbance caused by reasonably foreseeable future development within the Plan Area.

The cumulative loss of habitat from all listed projects in the North Slope have reduced available nesting habitat for all species, affecting an estimated 4 to 5 percent within the unitized lease sale areas but affecting less than 1 percent of North Slope bird breeding populations. Cumulative habitat loss may have localized effects on the distribution or density of some bird species over the life of the oilfields (BLM and MMS 1998a).

Overall direct mortality affects due to collisions with vehicles, aircraft, buildings, pipelines, powerlines and communications towers would occur only at very low levels in the North Slope oilfields during present and future developments. The NRC (2003) concluded that reduced productivity was the most substantial cumulative impact to bird populations due to oil and gas development activities. This determination was based on decreased productivity due to increased levels of predators attracted to the development area. The NRC (2003) review focused on the Prudhoe Bay Oilfield, with most studies conducted through the mid 1990s when the landfill and dumpsters were accessible by gulls, ravens, bears and foxes. Since the late 1990s, the landfill has been fenced to exclude bears, and animal proof dumpsters have been installed throughout North Slope oilfields. The numbers of foxes and most avian predators in the Alpine Development Project area did not appear to increase during construction of the project, with the exception of common ravens, which nested on buildings at the Alpine Development Project site (Johnson et al. 2003a). Declines in fitness, survival, or production of young could occur where birds are exposed frequently to various disturbance factors. Human presence that disturbs nesting or brood-rearing birds or attracts predators may result in depredation of unprotected eggs or young. Because the disturbed area will be smaller, the effect of future project infrastructure on bird populations, although additive to prior effects, is expected to be less severe than that of previous arctic developments. However, disturbance in conjunction with predators attracted to development areas, such as common ravens and glaucous gulls, may exacerbate reduced productivity as described by the NRC (2003).

Onshore spills are considered unlikely to occur and would be expected to be contained and cleaned up. However, a spill entering a lake could cause some loss of molting and brood-rearing waterfowl, along with smaller losses of nesting waterfowl, shorebirds, and passerines. In the event a large oil spill were to enter the marine environment during high-use periods, mortality of long-tailed ducks, king eiders, common eiders, yellow-billed loons, red-throated loons and dunlin is possible. Substantial losses of species with low total population sizes or declining populations would represent a significant cumulative effect. Mortality resulting from the cumulative effects of oil and gas projects would be additive to natural mortality and could cause accelerated declines or interfere with the recovery of these species' Arctic Coastal Plain populations.

4G.6.4 Mammals

4G.6.4.1 Terrestrial Mammals

EVALUATION

HABITAT LOSS, ALTERATION, OR ENHANCEMENT

Within the North Slope, oil and gas exploration, development, and production, along with the construction and operation of ancillary facilities (for example, gravel mines, roads, pipelines, and production pads) could result in a cumulative reduction in terrestrial mammal habitat. Future developments within the North Slope could result in continued habitat alteration, although new developments would have smaller footprints and result in a relatively smaller impact than in the past (TAPS Owners 2001a). The cumulative loss from all listed projects in the North Slope may have localized effects on the distribution or density of some wildlife species over the life of the oilfields (BLM and MMS 1998a).

Within the North Slope, more than 17,770 acres have been disturbed and covered by gravel for airstrips, production pads, roads, and other structures. The loss of wildlife habitat from the development projects represents a small decrease in the amount of available tundra habitat in the North Slope (BLM and MMS 1998a). The avoidance by wildlife of areas near industrial developments that might otherwise be usable habitat (functional habitat loss) also contributes to the cumulative loss of habitat associated with facility development (Cameron et al. 1995; Nellemann and Cameron 1998). However, there is disagreement about the cumulative impacts from this development on caribou. If the impact is of consequence, it cannot be quantified.

Gravel fill generally eliminates tundra habitat. However, it can still provide habitat for some species. For example, it provides insect relief areas for caribou and denning habitat for arctic foxes and ground squirrels (Pollard et al. 1989; Truett et al. 1994). The density of arctic fox dens was found to be greater within developed areas than on adjacent undeveloped tundra; foxes were using culverts and road embankments as den sites (Ballard et al. 2000a).

Structures may occasionally provide a haven from predators, pests, or weather, or a platform for feeding, hunting, or nesting (Truett et al. 1994). Mammals rest and, less often, feed on the gravel pads (Pollard et al. 1989). Caribou use gravel pads and roads as insect relief habitat infrequently during the mosquito season (June to mid-July) and more commonly during the oestrid fly season (mid-July to early August), and also use the shade of oilfield structures (pipelines and buildings) and parked vehicles when oestrid flies are abundant (Lawhead and Prichard 2002; Pollard et al. 1996a). The availability of man-made insect-relief habitats may allow caribou to remain near preferred foraging habitats, thereby lessening the energy demands normally imposed upon caribou during the insect season (Pollard et al. 1996a). However, during insect season relatively few caribou occupy the area proposed for development, therefore it is uncertain that this would represent any population level benefit.

Dust shadows might be increased by the addition of roads, facility pads, and greater traffic loads associated with the Colville River Road and North Slope oil and gas development. The dust shadows will continue as long as heavy traffic occurs on gravel roads, though they affect only a limited amount of habitat. Cumulative impacts of dust shadows on wildlife would be similar to those addressed in Section 4A.3.

The cumulative effects of future land-use allocations on terrestrial mammals throughout North Slope would vary depending on which lands are developed. In particular, if much of the TCH caribou calving and insect-relief habitat is either closed to leasing or designated as no-surface occupancy, the potential for cumulative impacts to the TCH caribou from oil and gas development would be reduced. However, if all or most TCH caribou habitat were made available for leasing, including calving habitat under consideration for leasing in the Northeast National Petroleum Reserve-Alaska Amended IAP/EIS, the cumulative impacts would be greater.

The reduction in use of calving habitat near oil development facilities, in theory, could eventually limit the growth of arctic caribou herds within their present ranges and could prevent the herds from reaching the maximum population size that they could achieve without the presence of development. Such an effect may not be apparent, because natural changes in the distribution and productivity of the herds would be likely to influence the abundance and growth of caribou populations over and above the effect of reduced habitat use caused by cumulative oil development. However, recent information on the body weights of CAH cow caribou that calve west of the Sagavanirktok River compared with CAH cow caribou calving east of the Sagavanirktok River suggests that disturbance displacement of cow caribou may be affecting CAH caribou productivity (Cameron 1994; Nellemann and Cameron 1996; Cameron et al. 2002). Alternatively, differences in densities and movements between segments of the CAH on the oilfields and east of the fields may have contributed to the decline (Cronin et al. 1997).

Current oil development in the Prudhoe Bay-Kuparuk area encompasses more than 500 square miles, and hundreds of miles of gravel roads cross a large portion of the calving range of the CAH. At present, approximately 17,770 acres of tundra habitat have been altered where roads, gravel pads, gravel quarries, pipelines, pump stations, and other facilities are situated on the Arctic Slope, and approximately 1,914 additional acres may be developed as part of reasonably foreseeable projects, including Alternative A – CPAI Development Plan (Table 4G.4.7-1). Oil and gas activities on the North Slope would subject TCH and CAH caribou and their summer and calving ranges to effects of oil-development projects. Some TCH insect-relief habitat and WAH summer habitat may be altered or destroyed through construction associated with oil and gas development. The loss of additional TCH and WAH grazing habitat from facility construction in future oil development on the North Slope is expected to represent a smaller proportion of the available grazing habitat than that experienced by the CAH, because of consolidation of facilities and roadless development. This particular loss or alteration of habitat is expected to represent a minor effect on caribou. Displacement of calving caribou caused by disturbance has resulted in a functional loss of habitat for the CAH in areas of existing development. A comparable functional loss of calving habitat might occur in the Teshekpuk Lake area.

The alteration of approximately 17,770 acres of tundra habitat in the Prudhoe Bay area has not had any apparent effect on the distribution and abundance of other terrestrial mammals, with the possible exception of arctic foxes that have increased in numbers near the oilfields. Muskoxen have continued to expand their range westward across the North Slope from an introduced population in ANWR. There does not appear to be any effects of this development on grizzly bears, wolves, and other terrestrial mammal populations.

An increase in abundance of deciduous shrubs, especially birch (less favorable caribou forage), and a decline in the abundance of grasses and sedges such as *Eriophorum vaginatum* (an especially important food of calving caribou) are predicted to occur if there were a significant increase in temperatures in the Arctic, thereby reducing productivity of caribou habitats on the Arctic Slope (Anderson and Weller 1996). Over decades, warming temperatures could result in the invasion of tundra habitat by taiga woody plants (taiga forests), a less favorable habitat for tundra mammals, and some bird species, thereby adversely affecting their populations (Anderson and Weller 1996).

Cumulative oil development on the North Slope is also expected to result in an increase in abundance of arctic foxes near development areas.

DISTURBANCE OR DISPLACEMENT

Future road and oilfield developments may contribute to the disturbance and displacement of wildlife. However, mitigation measures, such as restricting the timing of the activity and locating facilities away from calving areas, could minimize impacts. Operation of a gas pipeline project would have a negligible impact. Localized disturbances to wildlife would occur during its construction. The level of non-oil and gas activities on the North Slope is very low, and impacts consist primarily of short-term disturbance of individual animals. Disturbance of terrestrial mammals by aircraft traffic associated with cumulative resource-inventory survey activities (particularly by helicopter traffic) is expected to have short-term effects on some caribou and muskoxen (particularly cow/calf groups), with animals being briefly displaced within approximately one mile from feeding

and resting areas when aircraft pass nearby. Potential oil spills from both offshore and onshore oil activities associated with federal and State of Alaska leases would likely have a small effect on terrestrial mammals because comparatively low numbers of animals would be expected to be contaminated or to ingest contaminated food sources and die as a result.

Several factors influence caribou populations, including winter weather, oilfield disturbances and developments, hunting, predation, intersegment or interherd movements, and insect harassment (Cronin et al. 1997; Klein 1991). All major caribou herds on the North Slope have increased in size, independent of oilfield development (Klein 1991). These higher population densities may cause dispersal or range changes among caribou herds. Thus, no single cause-and-effect explanation can be made regarding changes over time in caribou herd size and distribution (Cronin et al. 1997). The CAH has increased in size since oilfield development and operation began. Similar increases have occurred to all major caribou herds in northern Alaska and Canada, and are presumed to be independent from the effects of oilfield development (Klein 1991). Populations of a number of species that spend at least part of the year in the vicinity of oilfields (including caribou, muskoxen, brown bear, polar bear, and artic fox) are either stable or larger than when oilfield development began.

Past seismic exploration activities likely have briefly disturbed and displaced caribou near seismic grids, exploration drill sites, and along ice roads and aircraft transportation routes. However, this effect would not have persisted after exploration was complete and probably had no consequential effect on the abundance or productivity of the caribou. Future exploratory work may occur in TCH habitat, and disturbance would be temporary. Disturbance of wintering WAH caribou would be minimal, as the majority of the herd winters south of the Brooks Range. Exploratory work would not result in additional cumulative impacts to the CAH.

Helicopter and fixed-wing aircraft flights associated with North Slope projects could result in combined or repeated disturbances to wildlife. Such impacts could be effectively reduced by establishing minimum flight altitudes to reduce ground-level noise (USACE 1999a). While a few species, such as wolves and foxes, habituate to human presence, they are nevertheless disturbed by aircraft and other vehicles. Repeated exposure of caribou to low-level military jet overflights, especially during sensitive periods, may reduce calf survival and increase daily activities (Calef et al. 1976; Maier et al. 1998; Wolfe et al. 2000). Females of the Delta caribou herd with newborn calves apparently move away from areas where they are disturbed by jet aircraft overflights (Murphy et al. 1993). However, Valkenburg and Davis (1985) believe that the effects of disturbance from hunters on snowmobiles may be more important than aircraft overflights.

Motorized traffic along existing roads and construction of roads associated with future development (as well as traffic on ice roads) would disturb, impede movement of, or displace caribou and other terrestrial mammals. Traffic and human activity associated with oilfields and roads/highways can disturb female caribou with young calves (Whitten and Cameron 1980). Disturbance to caribou would be generally short term (a few hours or less). Less time spent lying down and more time moving about are the two consistent reactions by caribou to disturbance. Disruption of the feeding and resting cycle, accompanied by increased energy expenditures by running may contribute to energetic stress (Murphy and Curatolo 1987). If calving caribou are displaced from a high-quality forage area, there is a potential for lowered calf survival. To date, the cumulative impacts of North Slope oil and gas developments have caused minor displacement of the CAH from a small portion of its calving range without an apparent adverse effect on herd abundance or overall productivity.

In the cumulative case, disturbance of caribou by road traffic associated with pipelines would be expected to cause short-term displacement of caribou within approximately one mile of roads. Road traffic temporarily delays caribou from successfully crossing pipelines and roads and may have significant energetic effects on some animals, but it generally has no measurable effect on herd abundance or overall distribution. The exception would occur when disturbance levels were very high or when development facilities on the calving grounds caused long-term (over the life of the field) displacement or local change in distribution of cows and calves (Dau and Cameron 1986a; Cameron et al. 1992b; Nellemann and Cameron 1996). Potential construction of an east-west road from the Dalton Highway to Nuiqsut would add to the cumulative impacts on the CAH by creating an east-west barrier to movement in addition to the existing north-south barrier created by the Dalton Highway. Grizzly bears, wolves, arctic foxes, and other mammals cross these roads, travel on them, and feed on

animals killed by vehicle traffic. However, increases in traffic eventually would reduce the use of roads and adjacent habitat by these animals.

During the post-calving season, caribou distribution is largely unrelated to distance from infrastructure; they regularly occur within the oilfields, and they often occur close to infrastructure (Cronin et al. 1998a). Although some level of cumulative effect to caribou is likely from petroleum development, clear separation of the cumulative effects from natural variation in caribou habitat use and demography is difficult (Wolfe et al. 2000). No population-level impacts to any wildlife species have been documented (Truett and Johnson 2000).

Cumulative oil and gas development on the North Slope could result in long-term displacement and/or functional loss of habitat of CAH, TCH, and WAH caribou. At present, cumulative oil development in the Prudhoe Bay-Kuparuk area has caused displacement of CAH caribou from a portion of the calving range, with a shift in calving distribution away from the oilfields (Lawhead 1997; Nellemann and Cameron 1996; Cameron et al. 2002). Future state oil-lease sales on the Arctic Slope between the National Petroleum Reserve-Alaska, the ANWR, and the foothills of the Brooks Range would increase the amount of activity associated with oil exploration and development within the CAH range, as would construction of additional pipeline between Alpine and Kuparuk if the existing pipeline proves insufficient for future production. Future state offshore leases in the Beaufort Sea could expose TCH and CAH caribou to additional activities related to oil and gas development (through onshore facilities to support offshore leases). Ongoing and future lease sales in the National Petroleum Reserve-Alaska could expose a large number of the TCH calving caribou to exploration and development activities, particulary if development occurs north and east of Teshekpuk Lake following completion of the Northeast National Petroleum Reserve-Alaska Amended IAP/EIS (BLM and MMS 2004). Offshore oil development could result in a pipeline corridor north of Teshekpuk Lake connecting with existing facilities at Kuparuk. This corridor would transect TCH insect relief and calving habitat. Calving by TCH caribou could be reduced near the pipeline corridors. If displacement of calving activity (reduction in habitat use) were to persist beyond the construction period and endure over the production life of the developed fields, this would represent a long-term (several-generation) effect on the distribution**,** and perhaps population size**,** of the TCH caribou.

Oil development on the North Slope could expose summering WAH caribou to noise and disturbance impacts. This herd is not currently exposed to oil and gas development activities in any other part of their primary range, and cumulative impacts to the WAH would be low. No impacts to the WAH are expected at the population level even if leasing in the Northwest National Petroleum Reserve-Alaska results in development (BLM and MMS 2003b).

OBSTRUCTION TO MOVEMENT

Present and future North Slope oilfield developments could further obstruct wildlife movements. Roby (1978) reported that during summer, caribou with calves were more sensitive to the Dalton Highway than other groups. Caribou cows with calves may be underrepresented along the Dalton Highway during the calving season due to avoidance of the road, habitat selection, or predator avoidance. Roads without adjacent pipelines that have heavy traffic (more than 60 vehicles per hour) appear to impede caribou movement. Pipeline-road combinations tend to have a synergistic effect on impeding caribou movements (Curatolo and Murphy 1986; Cronin et al. 1994). Regardless, the CAH has grown in numbers since the mid-1970s (from approximately 5,000 in 1975 to more than 27,000 in 2000 [Cronin et al. 1998b]), and any redistribution of caribou in the spring has apparently not adversely affected population growth (TAPS Owners 2001a). The ADF&G management objectives for this herd (10,000 individuals) are being met, and herd-level impacts from the oilfield are not apparent (Cronin et al. 1998b).

Development of onshore oil and gas resources in the Northeast National Petroleum Reserve-Alaska could result in construction of an additional pipeline south of Teshekpuk Lake. Additional development near Teshekpuk Lake could occur if more lands are made available for leasing through the Northeast National Petroleum Reserve-Alaska Amended IAP/EIS (BLM and MMS 2004). Development in the Northwest National Petroleum Reserve-Alaska could result in the construction of a pipeline from Northwest National Petroleum Reserve-

Alaska east to Kuparuk and a southern pipeline route connecting to TAPS Pump Station 2. Movement of CAH and TCH caribou between coastal insect-relief habitats and inland foraging areas and calving grounds could be disrupted. Pipelines associated with sales would not have roads and should have minimal effect on caribou movements once construction is completed. Existing State of Alaska oil and gas leases (offshore and adjacent to the CAH and TCH ranges, as well as Federal OCS leases in Harrison Bay, west to Barrow) might include offshore pipelines that would come ashore within either TCH or CAH ranges and connect with the facilities at Kuparuk. Potential offshore oil development adjacent to the TCH and CAH ranges could increase disturbance of caribou by surface-vehicle traffic along transportation corridors that would connect offshore oil discoveries with the existing infrastructure. Offshore oil development in the area probably would result in the expansion of existing coastal facilities at Camp Lonely, west of Cape Halkett. Development also might increase disturbance of caribou by motor vehicle and air-traffic at insect-relief areas along the coast, and perhaps reduce the seasonal use of coastal areas by cows and calves.

It is reasonable to expect that measures designed to provide caribou and other large mammals with unimpeded movement (for example, placing pipelines at least 5 feet above ground and minimizing permanent roads alongside pipelines) would also be used in the future.

MORTALITY

The increase in the number of development facilities on the North Slope would be expected to increase the number of adverse interactions between humans and grizzly bears and to result in the loss of bears because of their attraction to human refuse. These interactions could eventually result in a decline in grizzly bear abundance near development areas.

Vehicle collisions would increase as a result of increased road access. Management and research mortality are also contributing factors. Disease, predation, fluctuations in prey, and severe weather are among the natural phenomena that also contribute to cumulative impacts on wildlife (BLM and MMS 1998a).

Other causes of wildlife mortality include intentional mortality (sport and subsistence harvest, and management and research mortality) and unintentional mortality (road kills, unreported harvests, and defense of life and property mortality) (TAPS Owners 2001a). Vehicle collisions with terrestrial mammals, particularly moose, are an issue of public safety, as well as a source of wildlife mortality (TAPS Owners 2001a).

The Dalton Highway has provided access to previously remote areas north of the Yukon River. Concern exists that this increased access has adversely affected moose, caribou, wolf, and bear populations as a result of increased harvests (BLM 2002a). Similar pressures will likely result from increased human access resulting from the ASDP and future development on the North Slope. The ADF&G has responded to this pressure, where necessary, by restricting seasons and bag limits and by implementing intensive management programs to achieve and maintain population objectives for ungulates available to hunters (TAPS Owners 2001a).

Increased densities of predators and scavengers attracted to areas of human activity may result in increased predation pressure on prey populations (for example, small mammals). This situation has recently become a management issue, mainly for ground-nesting birds on the North Slope (Day 1998), but it is difficult to document. Increases in the abundance of foxes are well documented in the North Slope Oilfields (Burgess 2000).

Similarly, increased densities of predators and scavengers might increase the occurrence and rate of transmission of wildlife diseases, including rabies (Follmann et al. 1988). The primary reservoir of rabies in the North Slope area is the arctic fox, whereas south of the Brooks Range, the red fox and other carnivores are sources of greater concern (Winkler 1975).

Mortality of predators such as bears, occurs primarily from sport and subsistence hunting. Overall, approximately 5 percent of brown bear mortality is related to defense of life and property. Oil and other resource extraction industries have indirectly contributed to brown bear mortality by the construction of roads that have increased access by hunters, poachers, and settlers (BLM 2002a). The oil industry, in cooperation with

the ADF&G, has implemented management activities to reduce impacts to wildlife. These measures have included closing the developed areas to big game hunting, prohibiting firearms within the oilfields proper, educating workers on wildlife safety, and training security personnel on proper techniques for hazing problem animals (Shideler and Hechtel 2000).

Road kills have not been a problem in the North Slope oilfields, although there have been occasional mortalities of caribou and bears. The same would probably remain true following present and reasonably foreseeable future North Slope oilfield development and construction of the proposed Colville River Road. Traffic associated with other industrial activities might result in road kills, depending on the location and extent of developments.

SPILLS

Approximately 400 spills of diesel, crude, and hydraulic oils and other substances (drilling wastes and seawater) occur yearly on the North Slope. Multiple spills could adversely affect wildlife if additional disturbances occurred while populations were still recovering from the initial spill (USACE 1999a). Additional details on spills can be found in Section 4.3.

Caribou could be affected by a large oil spill (for example, from a pipeline) in the North Slope if it occurred during the spring or insect-harassment period, when caribou are found in coastal waters or on beaches. Some individuals or groups of caribou might come in contact with oil and be adversely affected. However, impacts to the herd as a whole would be negligible.

A land-based oil spill can contaminate individual animals, their habitats, and their food resources. Species such as foxes may be attracted by dead oiled wildlife at a spill site or by human activity associated with spill cleanup. A large spill would likely disturb and displace most animals (other than foxes and other scavengers) from the area because of human activity associated with spill cleanup). Leaving some residual oil in place may be less damaging than the potential long-term effects of intensive cleanup activities.

CONCLUSIONS

Past, present, and reasonably foreseeable future activities, including CPAI's proposed development, are not expected to affect the viability of mammal populations. However, some populations may be reduced in number to an extent that would have an adverse impact on subsistence users. Cumulatively, non-oil and gas activities and spills would have little impact on terrestrial mammals.

Cumulative effects on caribou calving distribution are likely to be long-term over the life of the oilfields, but would occur locally within 3 to 4 kilometers (1.8 to 2.5 miles) of roads or other facilities situated within calving areas. Any reduction in the calving and summer habitat used by cows and calves from future onshore leasing represents a functional loss of habitat that may result in long-term effects of the caribou herd's productivity and abundance. However, this potential effect may not be measurable because of the great natural variability in the caribou population productivity. Cumulative impacts that would obstruct wildlife movements would be minor (USACE 1999a), and synergistic effects at the herd level would not be anticipated.

Cumulative oil development on the North Slope would likely result in increased abundance of arctic foxes near development areas, which may present a rabies health hazard to humans in the oilfield areas. The attraction of grizzly bears to human refuse would lead to the loss of bears as the result of interactions with humans and eventual decline in bear abundance near development areas. The cumulative effects on muskoxen, moose, wolves, wolverines, and small mammals from oil and gas development on the North Slope would be local and short term, within one to two miles of exploration or development facilities, with no adverse effects on populations.

4G.6.4.2 Marine Mammals

This section discusses the cumulative effects of the proposed project and ongoing and future development on marine mammals in the Alaskan Arctic. Development could have actual or potential adverse effects on the

distribution or abundance of ice seals (ringed, spotted, and bearded), walruses, beluga whales, gray whales, and polar bears in the Alaskan Arctic (and subarctic Bering Sea). Oil and gas development could affect these species as a result of oil spills, noise and disturbance, and habitat alteration. Other activities with potential effects would be contamination by hazardous materials from past development activities on the North Slope, atmospheric environmental pollutants accumulating in the Arctic, global warming, commercial fishing and hunting/harvesting of marine mammals.

Cumulative effects of offshore activities on marine mammals in the Alaskan Arctic, as well as downstream along marine tanker routes have been addressed adequately in other recent documents (such as the Northwest National Petroleum Reserve-Alaska EIS [BLM and MMS 2003b]) and are herein incorporated by reference and summarized in this section.

EVALUATION

HABITAT LOSS, ALTERATION, OR ENHANCEMENT

Numerous scientific studies have shown that atmospheric contaminants are being deposited in the Arctic (Proshutinsky and Johnson 2001). The contaminants of greatest concern are persistent organic pollutants such as organochlorines and heavy metals such as mercury that are known to biomagnify up the food chain. Organochlorines have been shown to adversely affect marine mammal reproduction and immune systems in temperate regions. While marine mammals possess biochemical methods of deactivating the toxic effects of heavy metals such as mercury (binding it with proteins), the role that organochlorines might play in affecting arctic marine mammal populations is unclear.

Dumping and discarding of solid and liquid hazardous materials has been associated with Department of Defense facilities on the North Slope (including the National Petroleum Reserve-Alaska) and with past oil and gas exploration drilling on the National Petroleum Reserve-Alaska (see Section 3.1.2.3). These wastes included fuel drums and solid wastes stored or buried onshore. Several landfill sites contain low concentrations of petroleum hydrocarbons and the pesticide d-BHC. Several sites have been cleaned up and the debris has been removed or burned. While remaining sites are small local sources of contamination and environmental degradation, they probably do not represent enough habitat degradation to affect marine mammal abundance and distribution.

Recent analysis of seasonal ice cover in the Arctic over the past 20 to 30 years shows a decrease in ice extent and thickness coincidental with temperature warming trends (Maslanik et al. 1996 and Martin et al. 1997 as cited by Tynan and DeMaster 1997). Climate warming has reduced the total arctic sea ice coverage by approximately 15 percent in the past 20 years (Stirling and Lunn 2001). Changes in the extent, concentration, and thickness of the sea ice in the Arctic may alter the distribution, geographic ranges, migration patterns, nutritional status, reproductive success, and ultimately the abundance of ringed and bearded seals and other arctic pinnipeds that rely on the ice platform for pupping, rest, and molting (Tynan and DeMaster 1997). Reductions in sea ice coverage would adversely affect the availability of pinnipeds as prey for polar bears (Stirling and Lunn 2001). If the current warming trend—and associated reduced ice coverage—continues, polar bear and arctic pinniped populations are expected to decline drastically.

DISTURBANCE OR DISPLACEMENT

With respect to onshore development, the proposed facilities along the Colville River would expose some spotted seals and a few polar bears to increased noise and disturbance associated with vessel and air traffic. Future facilities in river deltas and elsewhere along the coast and near rivers would have the potential to affect seals, whales, and/or polar bears.

Ringed and bearded seals, walruses, and beluga and gray whales have already been exposed to oil-exploration activities in the Beaufort Sea, including seismic surveying, drilling, air and vessel traffic, dredging, and gravel dumping. These activities in the Beaufort Sea (especially barge traffic to the North Slope, and some icebreaker

activity to support oil exploration)—if they were to increase in the future—could affect how seals are distributed near the activity for one season (less than one year) during high levels of activity. However, some seals would get used to marine and air traffic, industrial noise, and human presence. Displacement from cumulative industrial activities is not likely to affect the overall abundance, productivity, or distribution of ringed and bearded seals, walruses, gray, and beluga whales in Alaska's Beaufort Sea.

Helicopters flying along the coast to and from Camp Lonely, Prudhoe Bay, and North Slope exploration and production facilities could disturb some polar bears and seals hauled out near the coast. Disturbance of some hauled-out seals during the spring pupping season could cause them to panic and charge into the water, resulting perhaps in the injury, death, or abandonment of small numbers of seal pups. This potential disturbance of seals and polar bears would be expected to cause short-term displacement of individual animals (a few minutes to less than a few days) within approximately one mile of the air-traffic route and to have no significant effects on their populations on the North Slope.

Seals and beluga and gray whales could be affected by noise associated with the construction of gravel islands and drilling activities on gravel islands. However, since the migration corridor for most beluga and gray whales is far offshore, it is likely that few whales would be affected. Much of this noise would occur during the winter and would not affect whales in their wintering areas. Some whales migrating close to gravel islands could be deflected by noise disturbances. Noise associated with vessel traffic could have a greater effect on migrating whales than noise form other industrial sources, and noise associated with seismic exploration could have a greater effect on migrating whales than that of other types of vessel traffic. Construction of subsea pipelines from gravel islands to the mainland would occur during the winter when beluga and gray whales are on wintering grounds.

Individual air- and vessel-traffic disturbances assumed for this analysis likely would disturb a few polar bears for a few minutes to less than an hour. Seismic operations, ice-road traffic, and other activities could disturb some coastal denning sites in Alaska. A few females may have abandoned maternity dens because of nearby noise and humans, and some cubs might have been harmed. However, the number of bears disturbed in any given year is likely to be very low (probably no more than one to three animals). Bears disturbed in one year would not necessarily be expected to be disturbed the next year, because den locations change with snow cover. Current information of the distribution of den locations near oil facilities does not show that bears were permanently displaced from denning habitat. There is no clear indication that disturbance from oil exploration and development has had an additive or synergistic effect on the polar bear population. It has been stated that "Two hunters from Nuiqsut reported that polar bear activity has decreased in recent decades around Prudhoe Bay and west, to the Colville River," while "some hunters stated that the number of polar bears varies from year to year but has remained stable overall" (Kalxdorff 1997).

The MMPA requirements should prevent excessive disturbance to polar bears. A letter of authorization (LOA) requested by industry and issued by the USFWS for incidental take of polar bears recommend a one-mile buffer around occupied polar bear dens. Significant disturbance of polar bears in the Beaufort Sea and along the coast of the North Slope would be avoided by compliance with the LOA.

OBSTRUCTION TO MOVEMENT

Future activities are not expected to obstruct movements of marine mammals.

MORTALITY

A very small number of polar bears have been and could continue to be killed in encounters with humans near industrial sites and settlements associated with cumulative oil development. In the Northwest Territories in Canada, conflicts with humans near industrial sites from 1976 to 1986 accounted for 15 percent (33 out of 265) of the polar bears killed (Stenhouse et al. 1988). Some of these losses were unavoidable, and the polar bear population recovered within one year through recruitment. Four bears were unavoidably killed after being attracted to offshore platforms in the Canadian Beaufort Sea during five years of intensive oil exploration

(Stirling 1988). Fewer losses of polar bears in the Alaskan Arctic are expected because the MMPA requires that the oil industry avoid killing bears. Polar bear loss in Alaska would likely not exceed one animal per year or less. Three lethal takes of polar bears have been related to industrial activities on the North Slope over the past 20 years (Gorbics et al. 1998). These losses have not significantly increased the mortality rate of the polar bear population over that from subsistence harvest and natural causes. The loss rate in Canada over a five-year period was higher than that in Alaska but was not significant to the population, which increased at 2.4 percent per year. The MMPA has kept losses low in Alaska.

International subsistence hunting of seals and polar bears would have no more than a very short-term effect on the abundance of these species (MMS 1998).

SPILLS

Cumulative oil-spill risks to marine mammal habitats along the North Slope could develop from activities associated with federal OCS offshore development (at Endicott, North Star, and Liberty); onshore and possible offshore development in the Dease Inlet in the National Petroleum Reserve-Alaska; and at Sourdough, Alpine, and Badami, as well as possible barging of fuel oil for oil exploration and development.

Offshore spills pose a higher risk to marine mammals than onshore spills, but along the coast of the North Slope, some aggregations of seals and walruses and a small number of polar bears could be contaminated by onshore spills that might reach marine waters from onshore sites (especially via watercourses) and could suffer lethal or sublethal effects. Polar bears would be most vulnerable to spills contacting the flaw zone or the coast.

Spills that occurred during the open-water season (summer)—or that occurred during the winter and persisted in the Beaufort Sea area after meltout—would pose the highest risk to marine mammal habitats. However, spills also could cause effects in winter. A small number of breeding ringed seals and their pups would be likely to be contaminated by spills that might occur during the winter, resulting in the death of a relatively small number of pups because of the sparse distribution of pupping lairs. During the winter season, non-breeding ringed seals, bearded seals, and polar bears could be exposed to cumulative oil spills that might contact the ice-flaw-zone habitat and the Northern Lead System off Point Barrow. During the summer, or open-water season, marine mammals in the western Beaufort Sea could be exposed to spills that might occur to the east during the winter and contact the flaw-zone habitat.

The most noticeable effects of potential oil spills from offshore oil activities would be through contamination of seals, walruses, and polar bears, with lesser effects on beluga whales. Losses of seal pups and adults, walrus calves and adults, and polar bears would be likely to be replaced within one generation or less, with a generation time of approximately five years for ringed seals and at least seven years for polar bears (Kelly 1988; USFWS 1995). Beluga whales would be likely to suffer low mortality (fewer than 10 whales), with population recovery expected within one year.

CONCLUSIONS

The overall cumulative effects of Alternative A – CPAI Development Plan and other past, present, and reasonably foreseeable future activities (mainly from one oil spill, estimated to occur in the marine environment) would be minor. Impacts are expected to be the potential loss of up to 10 polar bears, several hundred seals and walruses, and probably less than 10 beluga and gray whales. In the event of a 1,000-bbl spill, pinniped, polar bear, beluga whale, and gray whale populations would be expected to recover within one year. Cumulative noise and disturbance in the Beaufort Sea and on the North Slope are expected to briefly and locally disturb or displace a few seals, walruses, beluga and gray whales, and polar bears. A few polar bears could be temporarily attracted to oil development facilities, with no significant effects on the population's distribution and abundance.

4G.6.5 Threatened and Endangered Species

The cumulative impacts of Alternative A – CPAI Development Plan and other past, present, and reasonably foreseeable future activities were evaluated for three threatened and endangered species: bowhead whale, spectacled eiders, and Steller's eiders.

4G.6.5.1 Bowhead Whale

Cumulative effects of offshore activities on marine mammals in the Alaskan Arctic, as well as downstream along marine tanker routes, have been addressed in other recent documents (for example, the Northwest National Petroleum Reserve-Alaska DEIS [BLM and MMS 2003b]) and are incorporated by reference and are summarized below. Cumulative effects of onshore activities have also been addressed in the Marine Mammals sections.

A large oil spill that enters marine waters could have effects that are sufficiently far-reaching to affect bowhead whales. If marine traffic is used to supply North Slope activities, there is potential for impacts to bowhead whales from noise, habitat degradation, displacement, and vessel strikes. Other future North Slope activities are not expected to affect bowhead whales. Any impacts would be expected to be similar to those described in Section 4G.6.4.2 and would be expected to be negligible overall.

Cumulative noise effects on bowhead whales from onshore and offshore activities would be similar to those described in Section 4G.6.4.2. Bowhead whales might experience cumulative effects from OCS activities, such as noise from drilling, vessel and aircraft traffic, construction, seismic surveys, oil spills, or oil-spill-cleanup activities. The bowhead whale population has been increasing steadily at the same time that oil and gas activities have been occurring in the Beaufort Sea and throughout the bowhead whale's range.

Bowheads may exhibit temporary avoidance behavior to vessels at a distance of one to four kilometers. Fleeing from a vessel generally stopped within minutes after the vessel passed, but scattering may have persisted for a longer period. Many earlier studies indicate that most bowheads exhibit avoidance behavior when exposed to sounds from seismic activity at a distance of a few kilometers but rarely show avoidance behavior at distances of more than 7.5 kilometers. Bowheads also exhibited tendencies for reduced surfacing and dive duration, fewer blows per surfacing, and longer intervals between successive blows. Bowheads appeared to recover from these behavioral changes within 30 to 60 minutes following the end of seismic activity. However, recent monitoring studies indicate that most bowhead whales during the fall migration avoid an area around a seismic vessel operating in nearshore waters by a radius of approximately 20 kilometers. Avoidance did not persist beyond 12 hours after the end of seismic operations. Bowheads have been sighted within 0.2 to 5 kilometers from drill ships, although some bowheads probably change their migration speed and swimming direction to avoid close approach to noise-producing activities. A few bowheads may avoid drilling noise at 20 kilometers or more. There are no observations of bowhead reactions to icebreakers breaking ice, but it has been predicted that roughly half of the bowheads would respond at a distance of 4.6 to 20 kilometers when the signal-to-noise ratio is 30 dB. Since offshore oil and gas activities in state waters generally are well shoreward of the bowhead's main migration route—some activities occur inside barrier island chains—the effects from activities on state leases is likely to be minimal. Avoidance effects from encounters with aircraft generally are brief, and the whales should resume their normal activities within minutes**.** Overall, bowhead whales exposed to noise-producing activities most likely would experience temporary, nonlethal effects. Some avoidance behavior could persist up to 12 hours.

If an oil spill were to occur as a result of development and production operations associated with any past, present, or reasonably foreseeable future development projects in the arctic region, some bowheads could be affected. However, most exposed whales would be expected to experience temporary, nonlethal effects from skin contact with oil, inhalation of hydrocarbon vapors, ingestion of oil-contaminated prey items, baleen fouling, reduction in food resources, or temporary displacement from some feeding areas. A few individuals could be killed if they were to experience prolonged exposure to freshly spilled oil. Considering the low

probability of spilled oil contacting bowhead habitat, the number of affected individuals would be expected to be very small.

Activities that are not related to oil and gas also could have cumulative effects on bowhead whales. A small number of whales could be injured or killed as a result of entrapment in fishing nets or collisions with ships. Native Alaskan whalers harvest bowheads for subsistence and cultural purposes under a quota authorized by the International Whaling Commission. An average annual take of 51 whales during the subsistence harvest was allowed between 1995 and 1998. Bowheads also may exhibit avoidance behavior in the presence of subsistence-hunting vessels. Native Russian whalers also are authorized to harvest bowhead whales under a quota authorized by the International Whaling Commission. The contribution of OCS activities to cumulative effects on bowhead whales is likely to be of short duration and to result primarily in temporary, nonlethal effects.

Past, present, and reasonably foreseeable future oil and gas activities are not expected to cause cumulative impacts to bowhead whale populations. However, cumulative impacts may occur as a result of non-development activities such as approved hunting or loss/injury from encounters with fishing nets and vessels at sea.

4G.6.5.2 Spectacled and Steller's Eiders

Routine annual management actions, subsistence and sport harvest, oil and gas exploration and development are the principal activities that could contribute to cumulative effects on threatened eiders. Activities associated with other federal and state projects—as well as actions of non-governmental entities—on the Arctic Coastal Plain, along migration routes, or on winter ranges that potentially could contribute to current and future cumulative effects include wildlife research and survey activities, subsistence and sport harvests, natural depredation, commercial fishing, commercial development, environmental contamination, marine shipping, and recreational activities. Most projects and activities not associated with petroleum development, except for subsistence harvest, affect eiders at latitudes south of the Beaufort Sea and outside the summer breeding season. Several of these activities, individually or in combination, probably affect eider populations as much or more than potential effects of petroleum development and may have contributed importantly to recent declines in these populations. Eider harvests within the Plan Area, which may include undistinguished spectacled eider hens, are an unknown proportion of the reported bird and egg subsistence harvest. Oil exploration and development (and other projects and activities) could result in (1) oil or other toxic pollution effects (Section 4.3); (2) additional disturbance during breeding and post-breeding periods; and (3) habitat degradation. Disturbance of some individuals by oil and gas operations would be expected to be unavoidable (BLM and MMS 2003). Offshore cumulative effects on North Slope eiders, as well as downstream along marine tanker routes—such as displacement from the vicinity of vessel transportation corridors and oil spills—have been addressed in other recent documents (BLM and MMS 2003b), which are incorporated and summarized here..

Cumulative actions that could affect spectacled and Steller's eiders include habitat loss, alteration or enhancement; disturbance or displacement; obstruction to movement; mortality; and hazardous material spills. The mechanisms for impacts would be similar to those described in detail for Alternative A – CPAI Development Plan in Section 4A.3.5.2 and 4A.3.5.3. The effects of development may cause mortality; increased depredation leading to reduced reproduction; and increased energy expenditures or changes in physiological conditions that may reduce survival or reproduction (NRC 2003, Miller et al. 1994). The likelihood of impacts to occur or accumulate for Steller's eider is very small, because they occur very rarely in the Plan Area. There would be a loss of potential Steller's eider habitat from the ASDP. Given the current distribution of Steller's eider both on the Arctic Coastal Plain and within the Plan Area, it is unlikely that any of the project alternatives would affect this species.

HABITAT LOSS, ALTERATION, OR ENHANCEMENT

Within the North Slope, oil and gas exploration, development, and production, along with the construction and operation of ancillary facilities (for example gravel mines, roads, pipelines, and production pads), would result in a cumulative reduction in eider habitat. Future oil and gas development are expected to occur within a much smaller disturbed area (footprint) than has occurred in the Prudhoe Bay-Kuparuk area. For example, the total

area covered by roads, pads, and airstrips for the Badami and Alpine development projects are approximately 182 acres plus 89 acres of gravel mines (MMS 2002a). Presumably, the effects on spectacled eider populations of facilities for future projects, though additive, would be substantially less severe because of the smaller areas involved. Effects from dust fallout, thermokarst, and hydrologic change (BLM and MMS 1998a) would be restricted to much smaller areas and result in smaller habitat loss. Comparison of gravel mine areas alone indicates that the Alpine and Badami development projects disturbed 0 and 5.9 percent (respectively) of that altered by Prudhoe Bay region development. Reduction in the quality of available habitat may also occur from fragmentation of large tracts of undisturbed tundra. Evaluation of fragmentation of tundra habitats by facilities in the Prudhoe Bay Oilfield has not produced consistent results.

Total habitat loss due to gravel fill and mining from oil and gas related activity affects 17,770 acres and habitat alteration affects 10,923 acres (Table 4G.4.7-1) (NRC 2003). These cumulative impacts affect an estimated 30 spectacled eiders based on an average nesting density of 0.13 nests/km^2 in the Prudhoe Bay area (TERA 1996), or less than 1 percent of the Arctic Coastal Plain population of 7,149 birds. Avoidance of key wetland habitats and preferential placement of facilities on moist and dry habitat types protects habitats used by spectacled eiders on the North Slope. The number of nests affected by habitat loss and alteration was estimated based on site-specific nesting densities for spectacled eiders to compare alternative development scenarios. Additional impacts due to lost productivity are considered but not quantified by this analysis, including impacts due to increased nest depredation caused by attraction of predators to development areas. In most cases, effects would be localized, and no adverse effects to North Slope spectacled eider populations would be expected. Habitat losses from gravel fill would be long term. An estimated 0.8 spectacled eider nests would be directly and indirectly affected by gravel fill due to Alternative A – CPAI Development Plan, and a minimum estimated 5.2 spectacled eider nests would be affected by reasonably foreseeable development on the North Slope. This represents a minimum of 12 birds or 13 percent of the Plan Area population (92 birds) and less than 1 percent of the Arctic Coastal Plain population (7,149 birds). Spectacled eider nesting densities are highest in the Colville River Delta and most impacts to birds would occur in this area.

Water withdrawn from lakes during winter for construction of ice roads and pads is replaced rapidly by snowmelt runoff in spring. Water withdraw could potentially affect nesting, brood-rearing or foraging habitats for spectacled eiders by altering surface water elevations or water quality, resulting in nest sites left far from the water's edge, reduced invertebrate populations due to changes in bottom saturation, or reduced fish populations due to changes in water quality. Water withdraw has not been shown to result in lowered spring surface water elevations or significant changes in water quality parameters (Michael Baker Jr. 2002e) which could impact invertebrate or fish populations.

DISTURBANCE OR DISPLACEMENT

Potentially disturbing factors associated with oil and gas development include; aircraft, vessel, and vehicle traffic; human presence; construction of facilities, roads and pads; drilling operations; and spill cleanup (BLM and MMS 2003b). The presence of unconcealed humans, whether associated with oil and gas, hunting, or recreational activities, is disturbing to eiders, especially during nesting and brood-rearing periods. Common experience confirms that such presence generally causes birds to move from the immediate area of disturbance. Cumulative effects of such disturbance, with several activities occurring in the same period or one after the other through the summer season, could cause decreased production and survival of young or recruitment into the population. Future oilfield development will contribute to the disturbance and displacement of spectacled eiders. Protective measures, some of which are currently adopted for existing development, such as restricting the timing of activities and locating facilities away from nesting areas, could minimize these impacts. Disturbance of some individual spectacled eiders as a result of oil and gas operations is expected to be unavoidable (BLM and MMS 2003b).

High levels of air and vehicle traffic are associated with the petroleum industry on the North Slope. Alternative A – CPAI Development Plan is estimated to require an average of up to 6 flights per day during summer and 300 vehicle trips per day. Such activities could cause displacement of nesting, feeding, or brood-rearing spectacled eiders (BLM and MMS 1998a). Noise and visual stimuli associated with helicopter and fixed-wing

air traffic would disturb spectacled eiders near proposed ASDP facilities. Alternative A – CPAI Development Plan and reasonably foreseeable development would cause additional disturbance due to air traffic, affecting a minimum of 12 percent of Plan Area spectacled eiders and less than 1 percent of the Arctic Coastal Plain population. Cumulative air traffic activity in the Prudhoe Bay area, Kuparuk River, Point McIntyre, Northstar, and Alpine Fields is likely to represent the greatest source of disturbance to eiders from currently developed areas.

Disturbance by vehicles, equipment activities such as road grading and compaction, or aircraft during summer would decrease the numbers of spectacled eiders nesting, brood-rearing, or foraging adjacent to roadways (Ward and Stehn 1989; Murphy and Anderson 1993; Johnson et al. 2003b). Disturbance and displacement related to vehicular traffic would effect birds along the proposed ASDP road system. This disturbance is in conjunction with habitat alteration that is expected within 50 m of roads and pads, and has been accounted as a habitat impact. Vessel traffic associated with boom deployment and spill response exercises in the Colville River Delta would disturb birds during the open water periods. During pre-nesting, brood-rearing and fall staging these disturbances could affect from a few individuals to small flocks of spectacled eiders.

Regardless of attempts to mitigate effects by adjusting routes, continued activity at this level to support developing fields and future development would likely result in some low-altitude flights over nesting, brood-rearing, staging, or migrating eiders (BLM and MMS 2003b). Such disturbance would be expected to cause excessive short-term energy use by disturbed individuals and displacement of eiders from the vicinity of routinely used air corridors. The latter would be similar to eider responses observed during low-level aerial bird survey overflights where individuals either run or take flight, depending on species and circumstances. Such disturbance could flush females from nests, resulting in lower productivity if eggs are lost to predators or exposure to low temperatures, or could cause displacement of females with broods from preferred foraging areas during brood-rearing, or any individuals during preparation for migration (BLM and MMS 2003b). Long-term displacement (one year or more) from the vicinity of heavily used corridors and onshore facilities could result in fewer young produced and somewhat lower survival of adults and young (BLM and MMS 2003b). Due to the relatively low density of eiders nesting on the North Slope, disturbance resulting from support aircraft noise and visual presence would effects low numbers of individual birds.

Aircraft that fly over open water areas in spring would displace some eiders from this essential habitat. Because there is so little open water available in spring, access to such areas is likely to be more restricted than in the post-breeding period. This could increase competition for the food available during the stressful period following spring migration and could result in decreased survival or breeding success. Beginning in early summer, non-breeding individuals, failed breeders, molting individuals, and males could be feeding in nearshore areas. Helicopters flying 15 or more round trips per day over these areas could cause birds to move away from routinely used flight paths, increasing the stress of preparing for migration in some individuals and decreasing chances for survival (BLM and MMS 2003b).

The presence of onshore facilities could cause eiders to avoid the immediate vicinity for variable periods up to the duration of such presence. Anderson et al. (1992) reported that during the nesting period, spectacled eiders near the GHX-1 facility in the Prudhoe Bay area appeared to adjust their use of the area to locations farther from the facility in response to noise. This potentially could result in lowered productivity if eiders are displaced to poorer quality habitats, or habitats that are more accessible to predators.

OBSTRUCTION TO MOVEMENT

In general, oil and gas infrastructure is not expected to obstruct eider movements. The birds' ability to fly will allow them to move over or around facilities. As described in Section 4G.6.3, facilities may present some temporary obstacles during brood-rearing and molting when the birds are flightless; however, some observations indicate that spectacled eiders do not avoid facilities and are known to cross roads.

MORTALITY

Subsistence harvesting is estimated to remove hundreds of spectacled eiders from the Alaskan population annually (58 FR 27474). Programs currently are under way by the USFWS and the NSB to inform hunters of harvest closures for these two species in an effort to decrease this source of mortality. Increased access to the North Slope resulting from the ASDP and other future energy development associated with road or highway construction would provide improved access to this remote area and could in turn increase subsistence and sport hunting pressures on eiders. Birds that nest, forage, or stage for migration in these newly accessible areas will be affected. Subsistence use includes not only weapons-based harvest but also harvest of eggs. Alternatively, subsistence harvest may be decreased if hunters avoid development areas. Vehicle collisions would also increase as a result of increased road systems. Management actions and mortality related to research are also contributing factors. Disease, depredation, fluctuations in prey, and severe weather are among the natural phenomena that contribute to cumulative impacts on birds (BLM and MMS 1998a). Effects of the other factors (for example, entanglement in fishing nets, and bioaccumulation of toxins in the food chain) on the spectacled eider population currently are undetermined. The effects of these activities on Steller's eiders are also undetermined.

Birds might also fly into structures, particularly nearshore structures during periods of darkness or fog, and poorly visible obstacles such as power lines suspended from poles. Eiders are particularly susceptible to collisions during periods of low visibility during migration, as they often fly at high speeds and low across the water surface. Because structures cumulatively represent relatively small obstructions on the landscape, and birds encountering them are expected to see and avoid them when visibility is good, bird mortality from collisions is expected to be low (BLM and MMS 2003b). Lighting at facilities may attract birds, especially during periods of poor visibility, incrementally increasing the probability of collisions. However, there is little information on which to base a projected morality estimate (BLM and MMS 2003b).

The NRC's review of the cumulative effects of oilfield development on the North Slope (NRC 2003) concluded ". . . high predation rates have reduced the reproductive success of some bird species in industrial areas to the extent that, at least in some years, reproduction is insufficient to balance mortality." The NRC (2003) review focused on the Prudhoe Bay Oilfield with most studies conducted through the mid 1990s, when the landfill and dumpsters were accessible by gulls, ravens, bears and foxes. Since the late 1990s the landfill has been fenced to exclude bears and animal proof dumpsters have been installed throughout North Slope oilfields. The USFWS sponsored a more recent workshop on human influences on predators of ground-nesting birds on the North Slope where participants concluded that common ravens have increased in response to developments, but that increases in arctic fox and glaucous gull populations were uncertain (USFWS 2003). There was further uncertainty in the link between increased predator populations and resulting population level impacts to ground-nesting birds. The numbers of foxes and most avian predators in the Alpine Development Project area did not appear to increase during construction of the project, with the exception of common ravens, which nested on buildings at the Alpine Development Project site (Johnson et al. 2003a). However, common ravens nesting at Alpine, Nuiqsut and Meltwater have shown reduced nesting success up to 26 miles away at the Anachlik nesting colony by as much as 80 percent (J. Helmericks, pers. comm. 2004). Glaucous gulls also appear to have increased in the Plan Area over the past 40 years (J. Helmericks, pers. comm. 2004). The magnitude and extent of decreased productivity has not been quantified in this EIS impact analyses, but would be most detrimental to Spectacled Eiders, which are known to nest in loose aggregations at specific locations year after year, and which have a low total population size.

SPILLS

Approximately 400 spills of diesel, crude, and hydraulic oils and other hazardous substances (such as drilling wastes, methanol, antifreeze and others) occur yearly on the North Slope. Multiple spills could adversely affect spectacled eiders if more disturbances occurred while populations were still recovering from the initial disturbance (USACE 1999a). Spectacled and Steller's eiders could be affected by oil spills into coastal areas such as the Colville River Delta (BLM and MMS 1998a). Over the life of the oilfields, hundreds of spectacled

eiders could be killed by oil spilled on the North Slope if quantities of that oil entered the Beaufort Sea (via waterways such as the Colville River).

Although the magnitude of oil spill effects is uncertain, if a large 500-bbl pipeline spill or 900-bbl spill at a gravel pad were to occur in or enter the marine environment, substantial losses could result—potentially tens to low hundreds of individuals—if released during the open water season when flocks of eiders could be present. Using average estimated density of spectacled eiders in the central Beaufort Sea area calculated from USFWS survey data and average severity of spill-trajectory paths from a rupture of the subsea North Star pipeline (and thus exposure of birds to oil), a USFWS model estimates an average of only two spectacled eiders would be exposed to a large spill (5,912 bbls) within 30 days in July (Stehn and Platte 2000). However, in late July one group of 144 spectacled eiders was observed in Harrison Bay (Fisher et al 2002), suggesting a potential for much higher mortality. It is likely that mortality resulting from oil spills would be additive to naturally occurring mortality. In addition to direct contact losses, any declines of prey populations in foraging areas contacted by oil from a spill at any time of year could result in secondary impacts to eiders, affecting productivity and/or survival. Likewise, negative effects of a spill on shoreline and coastal marsh habitat and water quality could affect eiders adversely when they are moving from onshore brood-rearing areas to the marine environment, or in subsequent years.

A large onshore spill released during the summer season could cause losses of molting and brood-rearing eiders —in addition to smaller numbers of nesting eiders—if the spill were to enter a heavily used lake/river system or coastal habitat. Small spills, whether from field pipelines or spills of refined products, are expected to be contained on gravel pads and/or cleaned up before substantial losses could occur. However, some mortality could result from the cumulative effects of numerous small spills over the 50-year time span considered in this analysis.

Spills from a regional pipeline or the TAPS would not be expected to cause substantial losses of eiders, because there are relatively low densities to the east on the Arctic Coastal Plain, and Steller's eiders would not be expected to be present in this area. Some habitat contacted by oil in the immediate vicinity of the pipeline would become unsuitable for nesting, brood-rearing, or foraging by eiders. Oil entering freshwater aquatic habitats could spread more widely, including into river deltas and nearshore marine habitats, and result in death of individuals contacted and/or rendering a larger area of habitat unsuitable.

In the unlikely event that a large oil spill produced by cumulative arctic oil development were to occur along the tanker route in the Gulf of Alaska, Steller's eiders could be affected. According to spill simulations by LaBelle and Marshall (1995), a large tanker spill assumed to occur 100 to 200 miles offshore would not be expected to contact sensitive coastal bird habitats for more than 30 days. Model spills 80 to 100 miles offshore contacted shore in 30 days. In either case, the probability of spills contacting eiders in winter would be less than 0.5 percent, and the oil would have dispersed as weathered patches. In addition, eider densities are generally quite low in nearshore winter habitats. Although the effect of such a spill on the eider population wintering in the Gulf of Alaska is likely to be substantial, this represents a relatively modest proportion of the world population.

CUMULATIVE IMPACTS

The effects of various cumulative factors on spectacled and Steller's eiders would likely be substantially greater than for any single activity or activities associated with any individual oil and gas lease sale. Disturbance of some individual eiders as a result of both onshore and offshore oil and gas operations would likely be unavoidable over the long term. The effects from typical activities associated with cumulative exploration and development of oil and gas prospects on the North Slope and adjacent marine areas may include small declines in local nesting or loss of small numbers of spectacled eiders (and potentially Steller's eiders) through disturbance effects on survival and productivity, predation pressure enhanced by human activities, and collisions with structures. Increased human access via new roads and highways may result in locally severe increases in subsistence hunting pressures. Alternatively, subsistence hunting may decrease if hunters avoid developed areas.

Declines in fitness, survival, or production of young could occur where eiders are exposed frequently to various disturbance factors, particularly helicopter traffic. Human presence that would disturb nesting or brood-rearing eiders, or attract predators, could result in depredation of unprotected eggs or young. Because of smaller disturbed areas, the effects of future project infrastructure on eider populations—although additive to natural effects—would be expected to be less severe than effects of previous arctic developments. The frequency of such disturbance is expected to be highest in the vicinity of primary support facilities. Overlap between future project schedules could increase disturbance effects. Eider populations—currently declining at a non-significant rate (spectacled) or unknown rate (Steller's)—could decline at an accelerated rate and would be slow to recover from small losses or declines in fitness or productivity. No significant overall population effect would be expected to result from small losses. However, for species such as the spectacled and Steller's eiders with low total population sizes, which may be declining, recovery from any short-term losses associated with oil and gas development could be hindered by lowered productivity resulting from natural occurrences.

Most disturbance associated with commercial activities could be controlled by mitigation. Although it is likely that behavioral effects resulting from disturbance associated with oil and gas development would be additive to naturally occurring disturbances, there is no evidence for synergism, in which the combination of effects from natural and/or development-related factors would be greater than their additive effects.

If a large oil spill were to occur in or reach the marine environment during high-use periods, some mortality of eiders would be possible; any substantial loss of eiders could represent an important obstacle to full population recovery. Mortality resulting from the cumulative effects of oil and gas projects would be additive to natural mortality and would interfere with the recovery of these species' Arctic Coastal Plain populations. Recovery from substantial mortality would not be expected to occur while the population exhibits a declining trend, but determination of population status could be obscured by natural variation in population numbers and difficulty in obtaining precise survey data. Onshore spills (also considered unlikely to occur) would be expected to be contained and cleaned up; however, a spill entering a lake could cause some loss of brood-rearing eiders, plus smaller losses of nesting individuals. Any tanker spill in the Gulf of Alaska could result in the loss of wintering Steller's eiders that use Arctic Coastal Plain habitats during the breeding season.

The overall contribution of CPAI's proposal to the cumulative effects on spectacled and Steller's eiders is likely to be limited to occasional disturbance from aircraft overflights resulting in temporary, nonlethal effects. The activities discussed above may cause localized effects with the Colville River Delta but are unlikely to cause significant cumulative population effects.

4G.6.6 Essential Fish Habitat

Cumulative impacts to EFHs across the North Slope would be expected to be similar to those for fish habitat described in Sections 4A.3.2 and 4G.6.2. However, the salmon fishery is present at only very low levels across Alaska's North Slope, as described in Section 3.3.2.5. Furthermore, given that essentially all of the Plan Area is north of 70°N latitude and there is marginal habitat to sustain populations, EFH is unlikely to be affected by future actions.

4G.6.7 Cumulative Biological Impacts for Alternatives B, C-1, C-2, D-1, D-2, and F – CPAI Development Plan

Cumulative effects to biological resources under Alternatives B, C-1, C-2, D-1, D-2, and F for development of the 5 pads proposed by CPAI are expected to be similar to those described for Alternative A. However, under Alternatives B, D-1 and D-2, where less overall acreage will be disturbed by construction of new facilities than under Alternative A, cumulative impacts associated with the loss of tundra habitats will be marginally reduced, while under Alternative C-1 and C-2, impacts related to tundra habitat, and especially that of the lower Colville River Delta, will be increased. Impacts from disturbance will also vary among alternatives, with greater impacts from aircraft associated with Alternative D-1 or D-2, and to a lesser extent, Alternative B. There may also be added potential impacts from subsistence hunters and other visitors to the area, especially under Alternative C-

2, the Colville River Road would connect Nuiqsut to the Dalton Highway via Prudhoe Bay, though this may not be the case if the state prohibits other than local residents and industry traffic on the road.

4G.6.8 Cumulative Biological Impacts of Alternative E – No-Action

Under Alternative E, no action is proposed. To the extent that cumulative impacts are currently occurring, these impacts would continue. Impacts related to oil production would be expected to continue but then decline in the future if reasonably foreseeable future production projects do occur in Alaska's North Slope. Impacts related to disturbance or displacement would only decline in the future if facilities are removed and the sites are reclaimed. However, cumulative impacts on the North Slope could occur from other foreseeable future development**,** such as the state's proposed road between the Dalton Highway and Nuiqsut

4G.7 ANALYSIS OF CUMULATIVE IMPACTS TO SOCIAL SYSTEMS

4G.7.1 Socio-Cultural Characteristics

4G.7.1.1 Evaluation

The cumulative development and operation of oil and gas production facilities on the North Slope may affect the socio-cultural organization of Native populations who inhabit the North Slope. The effects include changes to social organization, impacts on cultural values, and impacts on general community welfare. Cumulative effects have been addressed in other recent documents (such as the Northwest National Petroleum Reserve-Alaska EIS [BLM and MMS 2003b]) and are herein incorporated by reference and summarized in this section.

SOCIAL ORGANIZATION

In the cumulative case, effects on social organization could result from additional industrial development, changes in population and employment, and changes in subsistence-harvest patterns, social bonds, and cultural values. Such changes exert stress on social systems (see Impact Assessment Inc. 1990a,b,c; State of Alaska, ADF&G 1995). These effects as they relate to Alternative A – CPAI are described in Section 4A.4.1. In the cumulative case, which increases the level of future development impacts would be similar to those described for Alternative A, but the cumulative level of effects would increase because, collectively, the level of development is increased. Increased air traffic and the presence of non-Native workers in the North Slope region could increase the interaction and perhaps conflicts with Native residents. In the past, non-Native workers have stayed in isolated enclaves (work camps), which minimized interactions with local residents. However, recent development in the Alpine Field has brought non-Natives directly into the Native village of Nuiqsut and increased the demand for community services. Increases in local population and employment could cause long-term disruptions to (1) the kinship networks that organize the Inupiat communities' subsistence production and consumption, (2) extended families, and (3) informally derived systems of respect and authority (mainly respect of elders and other leaders in the community). In response to these types of social system disruption, the NSB, the Alaska Eskimo Whaling commission (AEWC), regional and tribal governments, local governments, and village corporations have instituted efforts to institutionally foster and protect Inupiat cultural traditions. Cumulative effects on subsistence-harvest patterns (which also would be long term) would affect Inupiat social organization through disruptions to kinship ties, sharing networks, task groups, crew structures, and other social bonds. Effects on sharing networks and subsistence-task groups could break down family ties and threaten the communities' well-being, creating tensions and anxieties that could lead to high levels of social discord. The NSB, the AEWC, and local whalers have set precedents for negotiating agreements with the oil industry to protect subsistence-whaling practices. Such cooperation is expected to continue. Negotiated agreements exist for development effects onshore at the Alpine Unit north of Nuiqsut. The BLM has convened a SAP for the Northeast National Petroleum Reserve-Alaska IAP/EIS that consists of community members. This group is tasked with investigating conflicts between subsistence activities and oil exploration and development, verifying the levels of conflict, and making recommendations proposing actions to the lessee and the BLM for resolution (BLM and MMS 2003b).

CULTURAL VALUES

Cumulative effects on cultural values also could result from future industrial activities, changes in population and employment, and changes in subsistence-harvest patterns. These effects as they relate to Alternative A are described in Section 4A.4.1.

Cumulative effects on social organization could include decreasing importance of the family, cooperation, sharing, subsistence as a livelihood, and increasing individualism, wage labor, and entrepreneurship. Long-term effects on subsistence-harvest patterns also would be expected. Chronic disruption could affect subsistence task groups and displace sharing networks, but it would not displace subsistence as a cultural value. Socio-cultural cumulative effects of changing norms and values would be expected to affect all five social institutions (family, polity, economics, religion, and education), but the NSB's institutional infrastructure, the AEWC, community whaling organizations, regional and tribal governments, regional and village corporations, and the SAP work diligently to develop programs to protect these cultural values (BLM and MMS 2003b. Impact Assessment Inc. 1990a,b,c 1998; State of Alaska, Dept. of ADF&G 1995b).

GENERAL COMMUNITY WELFARE

As a result of cumulative activities, there could be an increase in social problems, such as increased alcoholism and drug abuse, domestic violence (wife and child abuse), violent crime (rape, homicide, etc.) and suicide. The NSB already is experiencing problems in the social health and well-being of its communities, and additional development (including offshore oil development) on the North Slope would disrupt them further. Historically, increased income in these communities has been associated with increased abuse of alcohol and violence. Increased dysfunctional behavior occurred during the peak of the commercial-whaling era and then again during the height of the fur trade. Drinking and violence seem to ebb when incomes decline. Recent evidence of the effects of employment during and just after World War II also loosely supports these views. Although this evidence is not clear, the strong association of these trends makes it appropriate to assume that further oil development that results in cash flow infusion to the local economy and culture will continue to foster significant social changes. These social changes on the North Slope are likely to have influenced the extremely high rate of suicide among the Inupiat (90.8 per 100,000 for the Inupiat versus 35 per 100,000 among the Yup'ik) (BLM and MMS 2003b).

In terms of cumulative effects, long-term changes will continue to threaten displacement of existing social systems; however, the NSB is vigilantly protecting the rights and culture of the Inupiat. Health and social services programs have tried to respond to alcohol and drug problems with treatment programs and shelters for wives and families of abusive spouses, in addition to providing greater emphasis on recreational programs and services and restricting the possession of alcohol. These programs, however, often have limited funding, and assistance to the NSB city governments is constrained by the limitations of funds available from the State of Alaska. Tribal, city, and borough governments in partnership seek to provide programs, services, and benefits to residents (BLM and MMS 2003b).

The relationship of oil and gas development to aberrant behavior and social pathologies might be seen more clearly in terms of social change and associations than in direct causality. Oil and gas development has affected all communities in Alaska, and for this reason, finding control communities with no impacts (as a basis to assess impacts) is difficult. In general, the accumulation of effects occurs in parallel to modernization. As change happens, these alterations spread through the social fabric (BLM and MMS 2003b).

Such change can be both negative and positive and can be measured to an extent with objective indicators of the opportunity structure or the stratification system such as education, income, occupation, social networks, and social mobility (created through income, education, etc.). Positive impacts may come from higher incomes (for example, ability to purchase better equipment for subsistence), better health care, and improved educational facilities. However, some of the apparent positive impacts of oil development may have related counterveiling impacts such as increased state of apathy toward, or disinterest in, older cultural norms known as anomie. Certain negative effects from social change are inescapable. As technology and opportunity develop, younger

individuals readily accept these changes. This is easily seen in less developed countries where rapid change is evident or in the desertion of rural America by young people.

Both positive and negative impacts from oil and gas development exist in the NSB. Whether they are more positive impacts such as increased funding for infrastructure or education or more negative impacts associated with a lack of interest by younger people in traditional ways, both have added to social change. Oil and gas development has been one catalyst for such cumulative change on the North Slope; though it needs further study, it is not the single causal agent.

Another source of stress in communities in proximity to oilfield development is fear of the effects from potential oil spills, especially large spills. Fear among community members is focused on:

- Inundation during cleanup with outsiders who could disrupt local cultural continuity
- Short and long-term damage from spills to the natural environment and subsistence resources
- Contamination of subsistence foods
- Drawn out oil-spill litigation
- Lack of local resources to interact and mobilize for advocacy and activism with regional, state, and federal agencies
- Recurring steps (and the frustrations involved) taken to oppose offshore development
- Repeated response to questions and information requests posed by researchers and regional, state, and federal outreach staff
- Need to employ and work with lawyers in drafting litigation in the attempt to stop proposed development (BLM and MMS 2003)

An ADF&G survey on social effects administered by the Division of Subsistence Management in 1994 in Nuiqsut included questions on effects from OCS development. Approximately 60 percent of the respondents did not believe a small oil spill could be contained or cleaned up, and 80 percent did not believe a large oil spill could be contained or cleaned up. An overall study on 21 Alaska communities concluded that impacts from the Exxon Valdez oil spill on subsistence use, and the social and cultural system that subsistence activities support, persist to this day (BLM and MMS 2003b; Fall and Utermohle 1995; Impact Assessment, Inc. 1998; Field et al. 1999).

Impacts in the first year following the Exxon Valdez spill included dramatic declines in harvest levels, reduced diversity of resources used, reduced sharing, and disruption in opportunity for young people to participate and learn the cultural values associated with subsistence. Fear of contamination of food resources was identified as a major factor in these reductions. In the following three years, harvest levels, sharing, and subsistence involvement rebounded, though not uniformly across and among communities. By 10 years after the spill, analysis concludes that subsistence uses have largely recovered to previous levels, but that some long-term changes remain, notably in fish species making up a larger portion of total subsistence, while marine mammals, marine invertebrates, and birds are a smaller portion of total subsistence than before the spill. Resource scarcity is now cited as the reason for changes, rather than fear of contamination. Hunters also reported that additional effort is required to achieve desired harvest levels, because some resources are scarcer (Fall and Utermohle 1999). The Impact Assessment, Inc. (year) study adds additional consideration of psychological and identity impacts from the spill. This study emphasizes that for Alaska Natives, the early impacts of the spill were compounded by the sense of "fear" about resource safety, and the "alienation" from culturally valued activities this causes. This study also notes that continuing litigation contributes to continuing psychological impacts of the spill (Impact Assessment, Inc. 2001). While their review does not include new data from the 10-year post-

spill time period, some of the reported impacts will have been mitigated by the general recovery in subsistence harvest practices (BLM and MMS 2003b).

4G.7.1.2 Conclusion

Overall, both additive and synergistic impacts to the socio-cultural characteristics of North Slope communities associated with Alternative A – CPAI Development Plan and past, present, and reasonably foreseeable future development may occur. Changes to community structure, cultural values and community health and welfare, predate oil and gas development on the North Slope. However, change in community socio-cultural characteristics has continued during the period of oil development. As the area impacted by oil development in the future increases, especially in proximity to local communities, cumulative impacts are likely to increase. For example**,** Nuiqsut, Barrow, Atqasuk, and Anaktuvuk Pass are currently dependent on subsistence caribou harvest from the CAH and TCH; additional future development may have additive impacts to subsistence harvest from these herds leading to synergistic impacts on subsistence-harvest patterns (including disruption of community activities and traditional practices for harvesting, sharing, and processing subsistence resources), social bonds, and cultural values.

4G.7.2 Regional Economy

4G.7.2.1 Evaluation

Oil and gas production is the dominant economic activity on Alaska's North Slope. It is also a significant portion of the state's economy. In 2001, oil and gas represented 17 percent of the state's economy as measured by Gross State Product (www.bea.doc.gov/bea/regional/ qsp/action.cfu).

Cumulative effects have been addressed in other recent documents, including the Northwest National Petroleum Reserve-Alaska Draft IAP/EIS (BLM and MMS 2003a), and are herein incorporated by reference and summarized in this section.

Even with the past, present, and reasonably foreseeable activities considered in this cumulative effects analysis, the oil industry in and near Prudhoe Bay is anticipated to decline over time. An authoritative source, DOE's Energy Information Administration (U.S. Dept. of Energy 2001a), projects North Slope oil production to decline from 1.084 MMbbl per day in 2005 to 0.208 MMbbl per day in 2034. This decline would encompass oil exploration, development, and production and its associated direct employment. Associated indirect employment in South Central Alaska, Fairbanks, and the NSB and revenues to federal, state, and NSB governments are also anticipated to decline. However, development within the Plan Area would extend the economically useful life of existing Alpine production facilities.

The regional economic effects below are expressed (in most cases) in annual averages over the next twenty years. However, the effects generally would be higher in the early years and lower in later years, corresponding to the decline in production. (The projected revenues from Table 4A.4.2-2 were revised to be consistent with the National Petroleum Reserve-Alaska future revenue projections made assuming $30 per bbl.) CPAI's proposal would generate the following average annual revenues for the period 2007 to 2020:

- $7 million revenue average annual to the NSB
- $40 million average annual to the State of Alaska
- $17 million average annual to the federal government

Other reasonably foreseeable actions could generate the following additive annual revenues:

- $15 million as the state share of royalty receipts

- $7 million as state income tax
- $4 million as state spill and conservation tax
- $41 million as the federal share of royalty receipts
- $56 million as federal income tax

In total, the cumulative effects would generate the following additive average annual revenues:

- $7 million to the NSB
- $66 million to the State of Alaska
- $114 million to the federal government

This is in comparison to the year 2000 revenues for the NSB of $245 million, year 2001 state operating budget of $4.3 billion, and year 2001 federal receipts of all types of $1.7 trillion.

Cumulative gains in direct employment would include additive jobs in petroleum exploration, development, and production, plus oil-spill cleanup activities. Direct employment would generate indirect and induced employment and associated personal income for all the workers. Cumulative effects are projected to generate additive employment and personal income increases as follows (BLM and MMS 2003a, Liberty Final EIS MMS 2002b, Beaufort Sea Draft EIS MMS 2002a):

- 152 jobs annual average for NSB residents during development, declining to 28 during production. These include direct oil industry employment, indirect, and induced employment.
- $11.5 million in total average annual personal income for workers residing in the NSB during development, declining to $2.2 million during production.
- 6,680 jobs annual average during development, declining to 3,410 during production. These jobs are for workers on the North Slope who reside in South-central Alaska and Fairbanks. These include direct oil industry employment and indirect and induced employment.
- $479 million in total average annual personal income for workers residing in South-central Alaska and Fairbanks during development, declining to $213 million during production.
- 60 to 190 jobs for 6 months for cleanup of unlikely oil spills in the Beaufort Sea.

In addition to the North Slope workers who reside in South-central Alaska and Fairbanks, additional workers commute from residences outside the State of Alaska. Approximately 70 percent of current North Slope workforce in the classification of oil and gas workers commute from locations within the state, but outside the North Slope (30 percent to locations outside the state). Workers commuting to residences outside the state would not generate economic effects of indirect and induced employment or expenditure of income in the state and would have a negligible effect on the economy of the rest of the United States.

4G.7.3 Subsistence-Harvest Patterns

4G.7.3.1 Evaluation

Cumulative development of oil and gas production facilities on the North Slope may affect subsistence harvest patterns of the North Slope Native communities. Current development in and adjacent to the Prudhoe Bay and

Kuparuk oilfields is primarily to the east of North Slope communities and their associated subsistence areas, although the subsistence use area of Nuiqsut does extend into areas of existing development. Future lease sales and projected development in the National Petroleum Reserve-Alaska could extend development to the west into subsistence use areas of the communities of Barrow, Wainwright, Point Lay, and Atqasuk. Because little baseline biological, habitat, or subsistence-harvest data have preceded oil development on the North Slope, it is difficult to disassociate the cumulative effects of oil development in the region from the relatively recent processes of significant local social change.

SOURCE OF IMPACTS TO SUBSISTENCE USE

The overall impact to subsistence and subsistence harvest patterns can occur from direct impacts to the viability of the resources that the Native communities rely upon and impacts to the hunting/harvesting efforts. These potential impacts are described in detail in Section 4A.4.3 and generally include the following:

- Exploration and development activities can directly affect subsistence resources because of potential oil spills; noise and traffic disturbance; or disturbance from construction activities associated with ice roads, pipelines, and landfalls. Noise and traffic disturbance might come from building, installing, and operating production facilities and from supply efforts.

- Activities associated with exploration, facility construction, operation and maintenance, and oil spills have both disturbance and habitat impacts on terrestrial mammals, freshwater and marine fish, birds, bowhead whales, and beluga and other marine mammals. Direct effects include delay or deflection of movements and mortality of resource populations; indirect effects include destruction or degradation of habitat and changes in productivity (BLM and MMS 2003b).

- Access to subsistence-hunting areas and subsistence resources (and the use of subsistence resources) could change if oil development were to reduce the availability of resources or alter their distribution patterns. Major factors considered in the effects analysis of subsistence-harvest patterns of the communities of Nuiqsut, Barrow, Atqasuk, and Anaktuvuk Pass are (1) heavy reliance on caribou, fish, birds, and bowhead whales in the annual subsistence harvest; (2) the overlap of subsistence-hunting ranges for many species harvested by these Native communities; and (3) subsistence hunting and fishing as central cultural values in the Inupiat way of life. Chronic cumulative biological effects to subsistence resources would affect their harvests. Potential effects from oil spills and noise disturbance could affect seal hunting during the winter; whale, seal, bird, and caribou hunting in spring; and whale, seal, bird, walrus, and caribou hunting during the open-water season (BLM and MMS 2003b).

Sparse monitoring data limit assessment of cumulative subsistence-resource impacts, resource displacement; changes in hunter access to resources; increased competition; contamination levels in subsistence resources; harvest reductions; and increased effort, risk, and cost to hunters.

NATIVE VIEWS CONCERNING CUMULATIVE EFFECTS ON SUBSISTENCE-HARVEST PATTERNS

Cumulative effects from oil development have been, and continue to be, paramount concerns for North Slope residents. The concerns have been expressed in a number of different forums including scoping meetings held as part of the preparation of recent IAP/EISs and for this ASDP EIS. There is an extensive public record of comments from members of the community concerning subsistence resources and subsistence harvest and use. A number of representative comments have been selected from this record and listed in Table 4G.7.3-1. A more comprehensive selection of comments and testimony is included in Appendix A. Other notable comments concerning cumulative effects to subsistence harvest and use have been received.

In a 40-page, March 2002 letter to the USACE, Nuiqsut's Kuukpik Corporation, the Native village of Nuiqsut, the City of Nuiqsut, and the Kuukpikmiut Subsistence Oversight Panel voiced strong opposition to CPAI Alaska's proposed development of the Fjord and Nanuq satellite fields near the Alpine Development Project.

They called for the USACE to prepare an EIS to address the multitude of potential impacts they believe will occur from this expansion, particularly a proposed north-south connecting road in a development scenario that had been promoted as "roadless." They also wanted the USACE and CPAI to address broken agreements and permitting lapses with Kuukpik Corporation over: (1) exceeding employment ceilings and aircraft flights at the Alpine Development Project and winter drilling activity on the Colville River Delta, (2) the proposed building of additional VSMs for satellite developments when existing VSMs were supposed to be adequate, (3) yet-to-be-delivered studies on caribou in the Colville River Delta and the Alpine Socio-cultural Study report, and (4) poorly projected and analyzed drilling activity and pipeline impacts from the Tarn and Meltwater Projects. In its letter to the USACE, Nuiqsut concluded: "In essence, this whole letter is about cumulatively significant impacts, ranging from the manner in which Alpine impacts have exceeded projections..." (BLM and MMS 2003b; Kuukpik Corporation 2002).

Comprehensive subsistence harvest and resource studies, monitoring, and stipulations are needed for assessing impacts on subsistence resources and hunter access to those resources. The SAP formed under the leasing effort for the Northeast National Petroleum Reserve-Alaska Planning Area is one group that may resolve some of the on-going monitoring, mitigation, and enforcement concerns with subsistence (BLM and MMS 2003b).

Concern was also expressed about the potential increase in roads**,** including the proposed Colville River Road interconnecting Nuiqsut and the National Petroleum Reserve-Alaska with the Dalton Highway. Any local or more extensive interconnecting road system could bring impacts from increased access to subsistence resources. More specifically, increased access could increase hunting pressure and increase competition for subsistence resources from both subsistence and non-subsistence hunters. Increased harvest levels could potentially make game scarcer near the road proper. Reduced abundance and distribution of caribou and other terrestrial mammals would be expected along the road corridor from hunting, trapping, recreation, and tourist traffic associated with an interconnecting road. Increased hunting pressure in areas of high goose concentration could lead to declines in bird use of these areas. As a result of increased hunting pressure and reduced abundance, hunts could take longer as hunters would have to travel farther from the road corridor to successfully reach game, or be forced to hunt in nontraditional areas. Access could be diminished for subsistence hunters in developed oilfields if subsistence access was curtailed by enforced no-fire zones (BLM and MMS 2003b).

TABLE 4G.7.3-1 SELECTED TRADITIONAL KNOWLEDGE AND LOCAL KNOWLEDGE OBSERVATIONS REGARDING CUMULATIVE EFFECTS OF OIL AND GAS DEVELOPMENT

RESOURCE CATEGORY	SUMMARY OF EFFECTS AND LOCATION	TESTIMONY
Weather/ Climate/ Environmental Changes	When I [was] growing up, the weather and the ocean and the currents, something like that, it's a lot of changing. When I was young and the ice piling right up to the cliff down here, sometimes the ice piling up and no wind, just push it from the current, and the piling is sometimes 20 feet, 10 feet. And around about 20, 30s, and 40s, and up to that, we never seen it anymore. The weather did change. The oceans is warmer.	Isaac Akootchook 2001 Liberty Kaktovik (MMS 2001a)
Freshwater Resources	Nuiqsut has not experienced, neither has Alpine, what we call the 100 year Colville flood. We've only experienced a 25 year flood and with that 25 year flood, it came very close affecting those areas. Now, with the 100 year flood that hasn't occurred -- and I know you have data of what a 100 year flood might look like, but when we first moved here in Nuiqsut, that 100 year flood -- the whole plains down there was covered except for the hill down there. And we haven't seen that ever since we've been here in the 30 some years we've been here.	Leonard Lampe 2003 ASDP Nuiqsut (BLM 2003c)
	All drilling operations will take a lot of water. That means the same thing will happen Sagavanirktok, like they did in the Sagavanirktok (ph) River. They ran it dry, completely dry twice in one year. And, if that happens in the Colville River or any of these places that are printed up here--like the lakes, the big lakes and river -any one of those go dry, the animals are goi [sic]-the fish are not going to be there.	Raymond Neakok 1982 NPR-A Barrow (BLM 1982c)
	He's concerned about why a lot of these lakes and rivers are getting too shallow. He's found where they, these seismic graphic testing. He's even seen them at the edge of Tsukpuk [Teshekpuk] Lake and he's - he can't help but blame something like that because there's lakes where they just could put part of a fishnet and they will get fish. When they stop for lunch, they can pick up lots of fish for lunch with just part of a net in the water but now even people try with two hundred foot nets and still don't get that much; there is one lake where you can't find any fish at all. There is one that were a few but he has seen the tests going on over there too and he's afraid that there won't be any more fish there again. Tsukpuk [Teshekpuk] Lake is another he's wondering about that's getting shallower over there. The streams, little rivers, whatever-you call them, where they shoot out from Tsukpuk [Teshekpuk] Lake, they used to be able to go in boats in those but they can't even go on them. Some of them less than half an inch of water on them. He's wondering why the water in the lakes is so shallow and he blames it on the tests that keep happening after promising that they wouldn't do it anymore, they still keep doing it.	Daniel Leavitt 1979 Sale BF Barrow (MMS 1979a)
Ice	If it gets heavy enough, if this gets heavy enough, that ice is not going to do nothing else but just pile up. Instead of trying to get on top. Whereas here, (in the proposed design) it's ready to go on top. There's snow drifting that could build up in here. Cause the snow drifts start in October. ... Those are the most serious months he's talking about now. .... That's very important that they should know that the critical months are October, November, and December. After the first of the year, the ice is solid enough that you'll start moving further north from the shore flat ice. It moves out.	Thomas Napageak, Nuiqsut Whaling Captains Meeting 1996 Northstar Nuiqsut (Napageak 1996)

TABLE 4G.7.3-1 SELECTED TRADITIONAL KNOWLEDGE AND LOCAL KNOWLEDGE OBSERVATIONS REGARDING CUMULATIVE EFFECTS OF OIL AND GAS DEVELOPMENT (CONT'D)

RESOURCE CATEGORY	SUMMARY OF EFFECTS AND LOCATION	TESTIMONY
Ice	When there's -- like Isaac says, there's a lot of ice movement. The temperature of the ocean has changed quite a bit. I was going to say "drastically" but I won't use that. But temperature of the ocean has changed. I oppose offshore lease sales, period, and I've told you why, and I will continue to oppose offshore lease sales in our area.	Susie Akootchook 1995 Sale 144 Kaktovik (BLM 1995a)
	We went on a trip to Thetis Island, around the world route. The ice road at Jones Island grounded out and blocked the other ice from leaving, we almost got stuck. The wind changed and the ice started coming towards us. We had to really hurry to get to the main channel.	2003 Field Interviews Nuiqsut (SRB&A 2003)
Noise	Also on your project, how are you going to resupply the project? Like you have to bring in supplies, so how are you going to do that? By helicopter, by air? So that doesn't ease me that you are going to have a lot of noise disturbance if you are going to be supplying by air, or by boat.	Leonard Lampe 1996 Northstar Nuiqsut (USACE 1996)
	Of all the animals that I've known, the wolves are, when you are hunting them, they're very noise sensitive, but more so are the bowhead whales. Any noise that they hear, they respond to that by going, moving away from it. A lot of times polar bears are different. Their curiosity can kill them very easy. They go toward the noise or anything that moves, they go for that.	Thomas Napageak, Nuiqsut Whaling Captains Meeting 1996 Northstar Nuiqsut (Napageak 1996)
	These wildlife folk that see it - they've witnessed, I guess they are wildlife folks, that walk in the country and looking at birds and things in the Colville River delta, maybe the east side, down by Ulumniak (ph), that's next to - - not far from the old Nuiqsut site, they're monitoring these birds and go to and fro to these places with a chopper. It upsets, disrupts, displaces, perhaps some of their only opportunity to go get their game, especially caribou, in the area are scared and may their run off because of these impediments that arrive are not natural. Naturally, they would walk along the coast where they're at and be able to harvest their caribou. Fishing, or (Inupiaq) have been plenteous and caribou has been plenteous this year because with the advent of late start of industrial work, this year has - - may have to cause that but the caribou has been plentiful in around Nuiqsut this fall. But she's suspect that if activity persists throughout the year, it will alter the hunting and game will no longer be visible and maybe -- may cause hunters to go much farther. This has regards to the harvest their subsistence and additional resources safety of hunters when they have to go that much farther for to their subsistence and additional resources.	Ruth Nukapigak 1998 NPR-A Nuiqsut (BLM 1998c)
	He would -- that would be right, you know, since with all these noise around here, they scare the animals. You know? The day I fly, I never seen nothing except about ten, five miles away from the mountain. That's the only caribous I seen. We fly in the open, and I didn't see nothing. He's thinking about that. If that happened, if the animals wouldn't come around here no more, what's going to replace them? That's their living. That's their way of their making a living. You know. That's what they live on. They hate to see them animals be driven out of here.	Johnny Ahtuangaruak 2001 Liberty Nuiqsut (MMS 2001c)

TABLE 4G.7.3-1 SELECTED TRADITIONAL KNOWLEDGE AND LOCAL KNOWLEDGE OBSERVATIONS REGARDING CUMULATIVE EFFECTS OF OIL AND GAS DEVELOPMENT (CONT'D)

RESOURCE CATEGORY	SUMMARY OF EFFECTS AND LOCATION	TESTIMONY
Physical Oceanography and Coastal Water Quality	Ocean currents are erratic. The further inland you go in, the more erratic the currents are. If the current tide is incoming, it'll bring the oil into the channels, rivers. If it's outgoing, it'll dissipate out in the ocean, but it'll bring up the hydrocarbon level to a point where it's toxic to biota, plankton, and up the ladder of the ocean cycle.	Thomas Nusunginya 1982 Sale 71 Barrow (BLM 1982a)
	Archie's testified that around Tern Island are the strongest currents, now are behaving in that -- the currents are now very strong, and that the north side is now deep and is used by the migrating arctic cisco, which goes into the Kukpuk River and are caught through nets by the subsistence hunters when they get to the village of Nuiqsut.	Archie Ahkiviana (read by Maggie Ahmaogak) 2001 Liberty Barrow (MMS 2001b)
Visual/ Aesthetic	I am also concerned about a few things like if we are going to have flames out on the project, if there is going to be any flames flaring out on the project. Because it's very close to the whaling base of Nuiqsut called Cross Island, so I am very concerned on the migration and the impactment on the whales when we are out there. Because it makes whales more spooked and more dangerous for the crews, so I am very scared for the crews on the behavior of the whale. On the lights, I want to see -- you know, it might disturb migration. I want to make sure, if there are going to be any flames out there as well as discoloration to the environment, different colors.	Leonard Lampe 1996 Northstar Nuiqsut (USACE 1996)
	I see that protective measures, exploratory drilling is not allowed within 1,200 feet of any cabin or known long-term campsite. To me I don't have any scientific data, but I know if we would have had a drilling rig within 1,200 feet of our honeymoon it sure wouldn't have been as great of an experience as it was. And I hope that my children can someday experience the solitude, the feeling of being out there on your own.	Jim Vorderstrasse 1998 NPR-A Barrow (BLM 1982c)
	And the coating of the pipe, the outside layer, you know, it's just like a reflection especially during the summer hot months. I mean you could see that, you know, the pipe having reflection. I think they should put better, you know, coating or something that wouldn't reflect. I think that's where the problem -- maybe -- I don't know. Maybe that's one of the issues that needs to be addressed, that it's deferring the caribou. I mean there's some studies, I think, that needs to be done.	Isaac Nukapigak 2003 ASDP Nuiqsut (BLM 2003e)

TABLE 4G.7.3-1 SELECTED TRADITIONAL KNOWLEDGE AND LOCAL KNOWLEDGE OBSERVATIONS REGARDING CUMULATIVE EFFECTS OF OIL AND GAS DEVELOPMENT (CONT'D)

RESOURCE CATEGORY	SUMMARY OF EFFECTS AND LOCATION	TESTIMONY
Other Environment	When I started as a health aide in 1985 I had one asthma patient. By the time I went to the University of Washington for my physician assistant certificate in 1989, I had 20 to 25. When I came back in '91, there were 35. When I quit in 2000, there were over 60. The village make-up has not changed; it is still mostly Inupiat. What was contributing, the most overwhelming issue, was that oil development around the community had increased and gotten closer. The worst nights on call were nights with many natural gas flares occurring. We could see it in the flares or in the fields around us. They release particles and they travel to us. The chance of an inversion will affect us. An inversion is a bowl- like air trap with cold air trapped by warm air. Increased concentrations of particulate matter occurs during these episodes. I fear what has been reinjected into the ground. The oil percolates up through the land. One of our elders said: we new about the oil; it made a good light source. We could not carry enough of it as we followed our resources. When the substances that were put down come back up, what will be the effects? Are we just beginning to see them? What will happen with the global warming and the sink hole shows up and the erosion continues and the permafrost decreases? Has the permafrost protected us so far?	Rosemary Ahtuangaruak, Mayor 2003 ASDP Nuiqsut (BLM 2003e)
	When the seismic has been, we have seen the caribous with the seismic wire. Is there a possibility for BLM to identify, or color code their seismic wire so we could identify who has not coincided (ph) with the stipulations of cleaning up after the seismic operations?	Othniel Oomituk 1982 NPR-A Barrow (BLM 1982c)
Fish	Thomas Itta, Sr. was born and raised in the vicinity of Teshekpuk Lake, Cape Halkett is the place were he was born. Ever since he could remember he used that area for subsistence hunting. And all those lakes that are there visible, all of them, have fish in them. And he also stated that all the rivers that are around Teshekpuk Lake all flow into that lake and , therefore, they do have fish also. That Teshekpuk Lake from the beginning that we could remember that's been passed on by--from generation to generation. Our forefathers had stated that there's fish there that nobody knows that exist in that lake.	Thomas Itta, Sr. 1998 NPR-A Atqasuk (BLM 1982c)
	And, he said the fish, when they're drilling by the rivers, the oil seepage from the --If there should be oil struck and there is damage --When something happens to oil rigs and there's spillage, then he said the same thing will happen to the fish. The rivers will all be filled with oil spills and he said that the fish wouldn't be there like they used to be.	Amos Morry 1982 NPR-A Barrow (BLM 1982c)
	And I have an opposition, if NPR-As gonna be drilling in those areas where we live by subsistence mainly and we give what we catch, I'm wondering if tomorrow we're going to be giving these fish away to my people, whoever needs them.	Johnny Aiken 1997 NPR-A Barrow (BLM 1997a)

TABLE 4G.7.3-1 SELECTED TRADITIONAL KNOWLEDGE AND LOCAL KNOWLEDGE OBSERVATIONS REGARDING CUMULATIVE EFFECTS OF OIL AND GAS DEVELOPMENT (CONT'D)

RESOURCE CATEGORY	SUMMARY OF EFFECTS AND LOCATION	TESTIMONY
Fish	They will let us run out of fish by doing this. When observing during any time of the year, where they have used explosives, there's not a fish in (sight), wherever they relocate. And then the next year, after they have used explosives in that (certain) area and have moved a little ways, one hears reports of our land acquiring fish again, fish which are fleeing from where they are using explosives. The (people) that are using explosives are getting closer to Barrow, when we were out whaling this year, even though (they) are not talking about the ocean, I will talk about the ocean.	Joash Tukle 1982 NPR-A Barrow (BLM 1982c)
	If the Seismic exploration happen to violate or did not follow the stipulations that they have, we need a protection, too for our rivers, nesting areas. I do not oppose the seismic exploration on land, but I don't want to see violators while they are exploring right on the river or on the lakes where the fish are. And, I want to clarify one I want to ask you a question that -- If the violators happen to start exploring right on the fishing areas, do they have some kind of a punishment?	Rossman Peetook 1982 NPR-A Barrow (BLM 1982c)
	Thomas Napageak No we don't go out for cod or anything. No we don't go out in the open. But I was thinking of taking my 5 1/2 inch net to Cross Island to test it out because he was saying that salmons were being caught in Fish Creek now. Used to be no salmons around here that much, but he's getting them. So, I'm kind of... Jon Isaacs: Ya I've heard too that, 10 years ago we were working on the coastal management plan for the Borough and the salmon were kind of colonizing the streams and populations were moving east. Archie Ahkiviana: I got dog salmon too, chum, the big one. I never got those before in Fish Creek and then those silvers started to come in now. All those years since I started fishing down there...	Nuiqsut Whaling Captains' Meeting 1996 Northstar Nuiqsut (Napageak 1996)
Birds	He remembers that oil, that oil spill in Valdez, and when that happened, there was hardly no small birds around here, that they never come back up here, even the pren (ph), you know, the keys (ph). The few come, but not like they used to. Lots of that killed the animals that used to come up here, too, you know. He remembers that. That's what he would like to see you guys do your drilling in those only three months. 'Cause in March, the animals start coming back out this way, and he'd much rather see that area be quiet for the animals to be back to, so they wouldn't have to wait for them when they disappear.	Noah Itta 2001 Liberty Nuiqsut (Itta 2001)
	Thomas Napageak: I wish all the white people in Prudhoe Bay would be gone and take their seagulls with them. (Laughter) Karen Shemet: Did they bring them? Thomas Napageak: They bring them. There's too many of them.	Nuiqsut Whaling Captains' Meeting 1996 Northstar Nuiqsut (Napageak 1996)

TABLE 4G.7.3-1 SELECTED TRADITIONAL KNOWLEDGE AND LOCAL KNOWLEDGE OBSERVATIONS REGARDING CUMULATIVE EFFECTS OF OIL AND GAS DEVELOPMENT (CONT'D)

RESOURCE CATEGORY	SUMMARY OF EFFECTS AND LOCATION	TESTIMONY
Birds	There used to be some these stellar eiders just bunched up in one spot, another bunch, another bunch, in the summer months, after they nesting in the in the up inland. They stayed along this coast line in a big bunch, you know, in bunches, bunch, bunch. But for the last years that I have known have seen my personally, I haven't seen any flock along this shoreline for the last few years. I don't know what became of those ducks. I got two years that I have hear that the barges have lost and lost some oil, transporting oil down south. I don't know what happened. It must be maybe the ducks got caught by this oil. I don't know. Who knows? I don't. Maybe some of, know somebody denying from down south. Maybe these scientists would know. But they are I haven't heard any maybe the people deny for some reason, maybe. Same way with these little birds, snipes. Used to be in the fall, along the beach, just hundreds of it, along the beach, you know in the ocean. But same thing. They're gone. Maybe you'll see one or two there, this and there, but not hundreds anymore.	Kenneth Toovak 1982 Sale 71 Barrow (BLM 1982a)
Caribou	...presently there's been a lot of sick caribou being harvested. They don't know where this sickness comes from and why the meat is infected from whatever. If the industry would be allowed to have a possible, maybe some type of a scientific research on that type of a species that are affected by oil and gas.	Luke Kagak 1998 NPR-A Atqasuk (BLM 1998b)
	I think what caused the caribou from diverting from the Prudhoe Bay, Kuparuk area is the height of the pipeline due to the fact, the requirement, a minimum of 5 feet, and especially when there's winter months, where snow starts building up, I mean there's absolutely no way that caribou can go underneath the pipeline, I think that's what's causing some of the caribou to come towards the west, especially the part of the central herd. That's something to be considered strongly, and if there is to be development, within the NPR-A, there's a lot of ...(inaudible)... that needs to be looked into and identified.	Isaac Nukapigak 1997 NPR-A Nuiqsut (BLM 1997b)
	They claim that the caribou herd is healthy with numbers, but the only caribou I got last year was bad. Twenty caribou were harvested in October when we could access areas not accessible by boat. Seventeen were sick. When I went camping last year, I waited three days for the herd, to have a helicopter to divert them away from us. When they were diverted, we went without. We have had to deal with harassment. We had over-flights three times while trying to cut the harvest. It is disturbing. The next year we had a helicopter do the same thing, but it was worse. They were carrying a sling going from Alpine to Meltwater, another oilfield. It went right over us three times. The herd was right there and it put us at risk. I had my two young sons with me and it made me very angry. What am I to do when the activities that have been handed down for thousands of years to our people are being changed by the global need for energy? What if there is a severe icing event that the caribou die off by the thousands? What if the only way for us to have a chance is by reindeer herding? What if we have no resources to turn to because multiple resources are affected?	Rosemary Ahtuangaruak, Mayor 2003 ASDP Nuiqsut (BLM 2003e)

TABLE 4G.7.3-1 SELECTED TRADITIONAL KNOWLEDGE AND LOCAL KNOWLEDGE OBSERVATIONS REGARDING CUMULATIVE EFFECTS OF OIL AND GAS DEVELOPMENT (CONT'D)

RESOURCE CATEGORY	SUMMARY OF EFFECTS AND LOCATION	TESTIMONY
Caribou	...with these animals already being displaced, now it's starting to be from Cross Island to Teshekpuk that I've noticed these animals, over a period of time, going away. And then there -- right now, we're having a real hard time 'cause of the pipelines from Oliktok to Kuparuk. There's a 13-mile pipeline that's about three-feet high that, itself, already has displaced our caribous in the village. In addition to this 13-mile pipeline I'm talking about, with the new discoveries that already occurred south of the Kuparuk field, we have about another over 10-mile pipeline again, that that's three feet high. And then you look at the caribous when they -- when they're trying to get to the ocean side, they're always migrating, keeping away from these bugs and everything. They stop right at Oliktok. They -- we don't see those anymore, these thousands of migrating caribous. Now, at the same time, we're seeing hundreds.	Frederick Tukle, Sr. 2001 Liberty Barrow (MMS 2001b)
	So it's got a lot of potential there. And CD-5 is an area where caribou migrate on the coastal plain during summer. If we go that route and CD-5 and the bridge is down there, we will have the same problem we did in the Prudhoe Bay and the Kuparuk area with our caribou. Right now I call our caribou that are existing around here that don't go nowhere our "industrial dope addict caribou." They already sick and nobody's doing anything about them, although they done 10,000 pieces of study. Nobody studies sick animals nor sick people.	Frank Long, Jr. 2003 ASDP Nuiqsut (BLM 2003e)
Moose	And sometimes he also knew that someone got a moose and just take head instead of the whole carcass. He said there are some people that comes around and hunt the animals in their area and they've seen this thing happen.	Amos Morry 1982 NPR-A Barrow (BLM 1982c)
	When the moose season opens in 26(A), the village here goes for moose hunting, but in accordance with that EIS, it stated that the people hunt moose from July to October. The regulations states in 26(A), under Alaska Fish and Game, that the village residents would hunt moose in the month of August by boat only and then in September. But when September comes around, the people here usually don't hunt by boat because the winds are so severe that the river is not available to go hunting up in that area. They don't hunt if the river is shallow. They don't hunt by packing what they have all the way up to the mouth or the creeks up there. They don't do that.	Nelson Ahvakana 1998 NPR-A Nuiqsut (BLM 1998c)
Furbearers	Trapping was abundant east of here. Now, we don't go over because of the oil field. Just recently, it is known that the foxes are very dirty, discolored and rabid in that area. Trapping is done elsewhere. We used to see grizzly bears around. Now, they are not around. Where's the caribou now? One summer we when we used to walk miles looking for caribou, came across two dead caribou for unknown reasons. The animals have faced a change. We have faced a change since activity began.	Bessie Ericklook 1979 Sale BF Nuiqsut (MMS 1979a)

TABLE 4G.7.3-1 SELECTED TRADITIONAL KNOWLEDGE AND LOCAL KNOWLEDGE OBSERVATIONS REGARDING CUMULATIVE EFFECTS OF OIL AND GAS DEVELOPMENT (CONT'D)

RESOURCE CATEGORY	SUMMARY OF EFFECTS AND LOCATION	TESTIMONY
Furbearers	You know I just wanted to mention what some of my personal observations with what's happening with that seismic out there and that seismic displacing the animals, I just wanted to pass this on for your information and I didn't see any furbearers except for the foxes, the red foxes and the different faces (phases) anyway. I didn't see no wolves out there, no tracks or anything like that. I was on my way back home just this Saturday and met up with my cousin and he just said, yeah I just ran into a set of wolverine tracks and followed them 26 miles one direction, and he didn't take a close look at the tracks and he started following the trail and it had just been scared away from where the activity was occurring, which was up on the tops against that southeast side of Teshekpuk up in this Pikes dunes out there and he found the den and the rig had just gone by. I just happened to be there when he was following the trail and coming back, he said he just followed the trail 26 miles one direction and the wolverine had just made a bee line from where the seismic activity was going on, it had been scared away from its den, it was just moving out.	Harry Brower, Jr. 1997 NPR-A Barrow (BLM 1997a)
Muskox	Thomas Napageak: The musk oxen. When they wanted to transplant the musk ox, I told them to outlaw them automatically, shoot them on sight. They are, caribous and musk ox don't get along peaceful. They don't fight, but they don't get along. If a caribou see a musk ox a mile away, they'll head the other direction. I mean they're not… Archie Ahkiviana: Pretty much territorial	Nuiqsut Whaling Captains' Meeting 1996 Northstar Nuiqsut (Napageak 1996)
Marine Mammals	Thomas Napageak: When we have any left over meat at Oliktok Point, they're there tearing up our boxes and everything. They're a nuisance. I wish federal government would open this doorway with the sea mammal bill where we could sell the hide. We would like to get rid of them and make money at the same time. Archie Ahkiviana: They're getting too many. Just like the brown bear they're getting too many.	Nuiqsut Whaling Captains' Meeting 1996 Northstar Nuiqsut (Napageak 1996)
	Our whaling activities in Barrow have not been looked into. From that point, because any oil spills are going to affect them. Like the seal, for an example, when I had gone seal hunting in '72 and got me a 2 year old seal and it was tagged in Baffin Island in Frobisher Bay. Now it was less than, what, six months and he was able to make it to Barrow where I killed him. I reported it, I got the tag and then I got $50 for that. I think I got I don't know what else a jaw, I think. They asked $100 for the skin, but I said I use it. Now, the activity of that seal tells us exactly how much migration these seals are doing. Then the bearded seal, the walrus, and the whale. They're already being contaminated in Canada, and here they're going to do it again in Barrow.	Raymond Neakok 1982 NPR-A Barrow (BLM 1982c)
	He is aware that the whales are going around the area. They are not seen as they used to be any more. Helicopters are interfering and also ships are. After commenting that the helicopters would go by land, they still don't do that. The ships are still going through the migration route. All these activities are still going on. Even the ships are coming toward them when they are out whaling and after they said that they wouldn't interfere with their whaling.	Patsy Tukle 1986 Sale 97 Nuiqsut (BLM 1986b)

TABLE 4G.7.3-1 SELECTED TRADITIONAL KNOWLEDGE AND LOCAL KNOWLEDGE OBSERVATIONS REGARDING CUMULATIVE EFFECTS OF OIL AND GAS DEVELOPMENT (CONT'D)

RESOURCE CATEGORY	SUMMARY OF EFFECTS AND LOCATION	TESTIMONY
Marine Mammals	Lot of seals; Belugas, we know that they are out there but we never run into them. I've seen one at west dock, but I never get one yet. (Inupiaq) … We know they are out there, because they come through too early. Like at Barter Island, they come through Barter Island about August, that's too early for us to be out there.	Thomas Napageak, Nuiqsut Whaling Captains' Meeting 1996 Northstar Nuiqsut (Napageak 1996)
	They wouldn't want any oil spilled in the ocean 'cause they won't be whaling down near where the spill was 'cause it's very, very bad to taste the oil on any kind of animal. It doesn't taste good at all. They wouldn't want that to happen, even to the fish. You know, since you guys are finding oil and taking it out of Alaska, around this area, it's just like taking some from them. And you guys use all the land, drilling here and there, keeping animals away from this area from -- with the noise and everything. The fish out there (indiscernible) and the whales out in the ocean down there, if that happened, if the animals going to come around here no more. You know, if you -- if they keep drilling around this area, where would they go to go get their meat?	Johnny Ahtuangaruak 2001 Liberty Nuiqsut (MMS 2001c)
	First of all, I'll tell you this: that I'm opposed to any kind of oil activity in the east side of Cross Island, of any kind, 'cause we had some problems when they had activity around Camden Bay area 'cause the whales were devoted -- chasing out about 25 miles. We had to go to some small island out, and we had difficult time. And I also lost my whale that year 'cause we couldn't tow it in 'cause it was too far out, and we got catched in the storm in that area. If there's any kind of activities on the east side of this for whaling, any kind of activities on the east side of Cross Island, it would divert whale out from the coast line, from their migrating route. If there's no activities, we get -- you know, like last year, we stayed only -- stayed out only eight days to get our quota. See, if there's any activities in the area, we might spend two or three weeks 'cause we have to go way out. And then trying to tow those with a small boat is very hard, I mean, very hard, especially when it's stormy, kind of stormy, you know. But you could try to tow it, with a small boat, it's very hard. That area is a critical area for whales, 'cause the small whales will go into that bay, I mean, into those – in the inside of those Barrier Islands. We have seen them, not only whales, but we seen some belugas, porpoises that goes on that area, some -- seen some walruses up in that area, I mean, up where they go through. See, if there's any activities in that area, we would have a hard time again whaling with our small boats. We don't have a big ship or any kind.	Archie Ahkiviana 2001 Liberty Nuiqsut (MMS 2001c)
Socioeconomics/ Environmental Justice	We the people of Nuigsut, when we look around our village, we see the white people are circling our villages with their drilling.	Ruth Nukapigak 1982 Sale 71 Nuiqsut (BLM 1982a)

TABLE 4G.7.3-1 SELECTED TRADITIONAL KNOWLEDGE AND LOCAL KNOWLEDGE OBSERVATIONS REGARDING CUMULATIVE EFFECTS OF OIL AND GAS DEVELOPMENT (CONT'D)

RESOURCE CATEGORY	SUMMARY OF EFFECTS AND LOCATION	TESTIMONY
Socioeconomics/ Environmental Justice	And it's a hardship to live here. She would like to help the residents because she is concerned. ... But the main point is the oil industry has developed so rapidly and yet Nuiqsut is so close to the development, why has not the oil industry accommodated the energy need to make the community an easier place to live in. Because it's so hard to heat the homes. It's so hard for economic employment opportunities, and that's a concern that she has. And she's speaking now because these are concerns that she's got that they've experienced since there- establishment of the community. Why does not the oil industry provide an alternate energy source so that life herein Nuiqsut could be made easier. And I hope that I haven't missed anything.	Mae Ahtuangaruak 1986 ANILCA Nuiqsut (BLM 1986a)
	And another concern should be the addressing of the Inupiat people. We're part of the habitats of this area. I don't believe that whoever is writing the EIS should b e concerned just--just of the animals and the species that are here in the North Slope; they should be concerned about the Inupiat people as well because presently, we're surrounded here in this village, and before too long, once the total sale is completed and drilling takes place, there's going to be some restrictions that will be handed out to us again. Like a good example is Prudhoe Bay. They say that that area is open for subsistence, and it's not. It's written on paper that it is, but the actuality, you go and take a rifle over there, the first things -- first thing that you're going to find out is -- is that the security's going to take care of you. They're not going to let you go anyplace, even though that you may say that I'm out here on subsistence hunt. They don't have no concern whatsoever about that; their concern primarily is the protection of that field, and this is exactly what's going to happen down there. And our people here, they're, like I said, is surrounded (sic). The only area, hunting area, that we have during the summer is down there to the ocean and up the river. Now, you can go both ways because a person that's going to be getting food for the family for that day cannot get food for that day if he's walking. You try and walk and see how far you can go. I don't -- I don't think nowadays we could -- we could be able to do that. We're not like our forefathers; we're different. Everything changes, and we changed along with it.	Rev. Nelson Ahvakana 1990 Sale 124 Nuiqsut (BLM 1990)
	Ruth Nukapigak: (translated here by Arnold Brower Jr.) She's concerned about her existing allotment up by Itkillik, that every year, seismic tracks her allotment, and she doesn't consent to it and nobody's asked her, and how can she find out who these people are and that she would prefer to be asked and compensated for tracking and using her allotment. MORKILL: The seismic crews are actually... Arnold Brower, JR.: Annually. This winter she's already recognized there's tracks, seismic tracks already. In 1974 an incident happened 6 times that winter and they were able to track these people down and find out they were the united group and they've been trying to get compensated, and they have not heard or received any compensation. I don't know who has been issuing those permits for seismic and I think that they, whoever drafts these might address her personally.	Ruth Nukapigak 1997 NPR-A Nuiqsut (BLM 1997b)

TABLE 4G.7.3-1 SELECTED TRADITIONAL KNOWLEDGE AND LOCAL KNOWLEDGE OBSERVATIONS REGARDING CUMULATIVE EFFECTS OF OIL AND GAS DEVELOPMENT (CONT'D)

RESOURCE CATEGORY	SUMMARY OF EFFECTS AND LOCATION	TESTIMONY
Socioeconomics/ Environmental Justice	I see that's the process that's too fast. Especially with so many issues that needs to be analyzed and addressed, I definitely hate to see that after the final draft of the EIS and have to come back to the community and say, I'm sorry we messed up, but that's what happened. Who's going to be blamed and who's going to fully impacted? I mean these are some of the issues that needs to be considered strongly.	Issac Nukapigak 1997 NPR-A Nuiqsut (BLM 1997b)
	Impact one. (Translating into Inupiat.) But we are fortunate that we have state government aides here today. Because you see, it is about state and this community, still have honey buckets, no running waters – no adequate running waters. And here there is subsistence flat areas are just being pulled out and sold at random to all companies. Big funds go to the federal government. What about the local people? I mean, the people that reside here, the people that will be here when all industry is gone. I mean, are we going to have to be on honey buckets and three dollars a gallon to heat our homes for heating fuel, when there is alpine big development. They don't know what they're going to -- they're telling us no money. I mean, it gets to be a heartache, a headache, sleepless nights.	Thomas Napageak 1997 Sale 170 Nuiqsut (BLM 1982a)
	His feeling is that the oil companies, to his eyes, it's more like the oil company is ripping these people off the money. It's more like they're throwing the money away from Alaska, you know, from the Natives. When they get the oil out of the well, the big money is going somewhere else other than these people that lives around here. And yet he is very thankful that they are helping him, giving him a job. Only thing that he don't like is that the flow of that oil out of the village of the Natives, you know, when they should get so many percentage of that money that the oil company is making out of -- you know, he would be happy if they would share some of that money with these people around here 'cause these people have been living around here seven – since 1700 years or even more. You know, they've been living around here, and it's their land. It's their -- they are sharing with the oil company, but the oil company doesn't seem to be sharing the oil with these people. It just flows out of here. They just let it go someplace else where the other people, you know, Lower 48 doesn't -- you know, white people make more money than these, and, you know, he would be glad if they could share a little bit more money out of that oil when they find it around here.	Noah Itta 2001 Liberty Nuiqsut (Itta 2001)
Cultural Resources	My name is Sarah Kunakanna and I have lived in this area since 1921. Our family stayed at Kanigluq at Prudhoe Bay till the late 1930s. Our old sod house is still standing today. When I visited last summer, I saw that the pingos we used for duck blinds was a burning pit. Our place is a barge landing place instead of a fishing, camping site, There are lot of old sites, camping sites, fishing sites along the coast line. They are there and are being threatened by development.	Sarah Kunakanna affidavit 1979 Sale BF Nuiqsut (MMS 1979a)
	Just a few items I want to bring out. We have such a short notice, less than a month to bring items out. Some of the items that were not mentioned on your presentation were Native allotments, subsistence cabins, cultural sites, burial sites, et cetera. They weren't brought up on the proposed area.	Nate Olemaun 2003 ASDP Barrow (BLM 2003f)

TABLE 4G.7.3-1 SELECTED TRADITIONAL KNOWLEDGE AND LOCAL KNOWLEDGE OBSERVATIONS REGARDING CUMULATIVE EFFECTS OF OIL AND GAS DEVELOPMENT (CONT'D)

RESOURCE CATEGORY	SUMMARY OF EFFECTS AND LOCATION	TESTIMONY
Cultural Resources	By around Colville Island Colville, there are islands that you don't show on the map and there are, are about, there are houses that are about five or six feet down that are still there, and he really wants to keep that area intact. He was born and raised in Kupig River. His grandparents, his parents, and his grandparents have graves that are over there too. And his relatives that are buried there, is his main concern too.	Joash Tukle 1982 Sale 71 Barrow (BLM 1982a)
Subsistence	Displacement of caribou is expected during drilling activities. Caribou are the main staple of the diet of the proposed lease sale area inhabitance. The impact of dis- displacement would be addressed as the subsistence hunter will have to go further to be able to catch the caribou. If and when there is drilling activities, the subsistence hunter should be compensated for extra gas and food that they will need to get the caribou.	Charlie Okakok 1995 sale 144 Barrow (BLM 1995c)
	I have read those parts of the impact statement that blithely assume that village stores and the federal government will easily fill the void, created by a cutback in subsistence, through outside food sources. As someone who was involved in the previous attempt by government to provide a substitute protein supplement when caribou hunting was curtailed, I can only be highly skeptical of this. The government provided the equivalent of two small roast beefs per family in Barrow. In our smaller villages, the allotment provided for no more than a couple of canned chicken per family. This was our government's response to replacing a family's winter meat supply of caribou. I found it highly insulting as well as extremely expensive.	Elise Patkotak 1979 Sale BF Barrow (MMS 1979b)
	Naturally, they would walk along the coast where they're at and be able to harvest their caribou. Fishing, or (Inupiaq) have been plenteous and caribou has been plenteous this year because with the advent of late start of industrial work, this year has -- may have to cause that but the caribou has been plentiful in around Nuiqsut this fall. But she's suspect that if activity persists throughout the year, it will alter the hunting and game will no longer be visible and maybe -- may cause hunters to go much farther. This has regards to the harvest their subsistence and additional resources safety of hunters when they have to go that much farther for to their subsistence and additional resources.	Ruth Nukapigak 1998 NPR-A Nuiqsut (BLM 1998c)
	And the cost of the equipment that was stated in that EIS indicated that one household cost for the equipment to be used for subsistence averaged to $10,000 per family. That is completely wrong because you cannot get anything for that amount no more. To get an outboard motor, you have to spend at least 12 to $15,000 just for that motor. For a snowmachine, you have to spend more than 10,000 to do that. Everything that has been stated in accordance with Mr. Napageak had stated is completely wrong!	Nelson Ahvakana 1998 NPR-A Nuiqsut (BLM 1998c)

TABLE 4G.7.3-1 SELECTED TRADITIONAL KNOWLEDGE AND LOCAL KNOWLEDGE OBSERVATIONS REGARDING CUMULATIVE EFFECTS OF OIL AND GAS DEVELOPMENT (CONT'D)

RESOURCE CATEGORY	SUMMARY OF EFFECTS AND LOCATION	TESTIMONY
Subsistence	I have heard many times, especially this last year, of hunters going out every day during our high subsistence harvests, July, maybe August, of not harvesting one caribou for their family. If we're not able to harvest and prepare our food during the season when it's readily available, it's not going to be in our ice cellars during the long, dark months of the winter.	Rosemary Ahtuangaruak 2001 Liberty Nuiqsut (MMS 2001c)
Hazardous Materials	Like last summer, there was a herd of caribous coming out from the east and they were crossing the Nerluk (ph) Channel, and some people were killing some caribous. And they find that the-- the skinny ones they found were discolored on their meat. And what would cause that discoloration of the meat they found? And what I guess would be caused by that laying around over there by Prudhoe Bay where all that burning that gas with their chemical mixed with it may have caused that or something. And some of these -- when the people go out to Prudhoe Bay for a clean-up job, you know, volunteer type, you know, with small pay, they always have something to say about these birds being dead out there.	Joe Kasak 1990 Sale 124 Nuiqsut (BLM 1990)
	Now, I've seen them when they are extracting and dumping baroid bar (ph), caustic soda. That's the most deadliest toxin that can be mixed in with the drilling mud. And I've seen them mix that Macobar (ph) gel, and then you're mixing it with hydrocarbon, which is oil, then you got 20 different various toxic chemicals that you add onto your drilling mud. And I've seen them dump all of that drilling mud over the causeway right onto the path of the cisco fish. I don't know if anybody's aware of what effect it would have, but I'm sure there is somewhere along the line on our bottomfish here in the Beaufort Sea. And there's another good example, too, that there's a hydrocarbon fallout that is going on that Frank Long has mentioned. I've seen it; it's just like smog out there. The cold weather sets in from the air, and it keeps that hydrocarbon fumes coming out, and it falls out to the tundra and the waterways. Now, these are some of the research that never has been done, and it's affecting our caribou, and it's affecting our fish.	Joseph Akpik 1995 Sale 144 Nuiqsut (BLM 1995a)

TABLE 4G.7.3-1 SELECTED TRADITIONAL KNOWLEDGE AND LOCAL KNOWLEDGE OBSERVATIONS REGARDING CUMULATIVE EFFECTS OF OIL AND GAS DEVELOPMENT (CONT'D)

RESOURCE CATEGORY	SUMMARY OF EFFECTS AND LOCATION	TESTIMONY
Hazardous Materials	ISSAC NUKAPIGAK: I've got another good question, I think keeps popping up, this is Isaac here again, as you all know we've had pollution that's been identified and that needs to be cleaned up, in part of the NPR-A. There's a potential pollution, contaminating material that were buried by the Air Force, needs to be considered looking at too, the possibility of the whole Colville, cause of that possible of effecting all of our species, there's been some areas, you probably heard a couple, last year, they had found pretty close to over 30 moose carcasses that were unknown causes of death. And I'm kind of wondering if it's coming from that contaminated site. And these are some of the issues that need to be clarified before the proposed NPR-A lease. MORKILL: That was in Umiat? ISSAC NUKAPIGAK: Yes, cause I know once if we'd got some material information about the Umiat contaminated, so much material that'd been buried during the time that the United States Air Force used that as their, one of their stations. MORKILL: The concerns about contamination getting in the river? ISSAC NUKAPIGAK: Cause of the fast motion of the Colville, that's getting close to where the contaminated buried sites, cause each year, the erosion on the Colville seems to be faster every year. I travel a lot on the Colville during the summer months, especially when the moose season's opened up and we noticed that the erosion, every year it's faster.	Issac Nukapigak 1997 NPR-A Nuiqsut (BLM 1997b)
	One packet, prepared by the military, outlines the tremendous amount of contamination, toxic and hazardous waste, in many cases, extremely hazardous materials left by the military in the wake of oilfield exploration.	Bill Tegoseak 1998 NPR-A Barrow (BLM 1998a)
	As I look through your proposal, I notice that you anticipate, over time here, small oil spills averaging to about 29 gallons of fuel. I assume, in reading your document here, offshore or onshore oil spills, we find 53 spills equaling to 29 gallons. That's small, but when you're looking at the large oil spills, this is one of the most dangerous effects that will -- (clearing throat) excuse me -- that will impact our marine mammal systems.	Ronald Brower Sr. 2001 Liberty Barrow (MMS 2001b)

TABLE 4G.7.3-1 SELECTED TRADITIONAL KNOWLEDGE AND LOCAL KNOWLEDGE OBSERVATIONS REGARDING CUMULATIVE EFFECTS OF OIL AND GAS DEVELOPMENT (CONT'D)

RESOURCE CATEGORY	SUMMARY OF EFFECTS AND LOCATION	TESTIMONY
Hazardous Materials	And it came out in the newspaper several weeks ago that these mercury -- that the mercury they're finding around the Arctic is a direct result of the industrial activities that our animals are ingesting. And we're eating those animals. There's people dying from cancer, this cancer-causing agent. I heard testimony a while ago, a little bit of the Colville River being contaminated. I was one of those people, the Mayor of Nuiqsut selected me to go see that contaminated site where the oil exploration, one of these where the rigs were dismantled. An estimated 10,000 barrels, dismantled rigs, all the vehicles that were used to find the oil up here got buried alongside of the Colville River. Over a period of time, by luck, I ran into the dinosaur diggers up there, and I happened to start asking questions with one professor, Olan Ganglof (ph) out of the University of Fairbanks. He's been observing the Colville eroding -- with satellite photographs -- eroding to this contaminated site, and the result is two of these pipelines are now under the Colville. And it's not proven yet whether there was a mile-and-a-half lake -- a mile-and-a-half-long streak of oil monitored by aircrafts flying over the Colville. Part of this -- it's part of this oil exploration that that occurred. Now we have DDTs and PCBs flowing right into the river, and then we're starting to see contaminated fish. The contaminants are now being found in our fish in the Colville. You look at our geese, our caribous, our fish, our whales, that they are being affected dramatically. They're not being killed, they're being displaced, and no one knows the outcome of this.	Frederick Tukle Sr. 2001 Liberty Barrow (MMS 2001b)
	ARCHIE AHKIVIANA: There's two locations where we buried some old barrels, oils and whatnot there on the Chandler River, there's one close to the mouth and one upper, that was way back about 10, 15 years ago. ARNOLD BROWER, JR.: Who were you working for? ARCHIE AHKIVIANA: I don't want to tell. (laughter) ARNOLD BROWER, JR.: He was working for a company that did this. MORKILL: They were buried there? ARNOLD BROWER, JR.: Some waste and stuff in barrels that I guess they just buried them by the river. By the Chandler River, by the mouth of the river and upper Chandler. ARCHIE AHKIVIANA: They were close by the river too, at Kuparuk, we did it in the winter time, where we had to…	Archie Ahkiviana 1997 NPR-A Nuiqsut (BLM 1997b)

TABLE 4G.7.3-1 SELECTED TRADITIONAL KNOWLEDGE AND LOCAL KNOWLEDGE OBSERVATIONS REGARDING CUMULATIVE EFFECTS OF OIL AND GAS DEVELOPMENT (CONT'D)

RESOURCE CATEGORY	SUMMARY OF EFFECTS AND LOCATION	TESTIMONY
Hazardous Materials	There was a report that came out. It was called "The Health Consultation." It was discussed in Barrow and it trickled back to the community. What we got was very different. It was suggested that we not consume more than six burbot in a year as there are contaminants. They did not come to our village for a whole year after this report was released to discuss this. When they did come back, they said go ahead and eat the fish. We have other foods that have higher levels. They did not take into consideration the way we eat the fish, the quantities we eat, and how the liver is a delicacy that is shared with the elders and the children. We could serve six livers with one meal setting. The highest concentration of contaminants PCB and DDT was in the liver. The efforts of our people to share this delicacy was giving it to the people most at risk. We need to have independent interpretation of this consultation with our consumption styles and rates to see what our true exposures are. Not only that, but there are other persistent organic pollutants that are concentrating in our animals. There are studies of the polar bears that are showing these concerns. These pollutions from industry developed elsewhere are coming to our lands with the way the air currents are and the precipitation, they are coming to our lands and we did not have to identify the issues, but we have to deal with it. This adds to what is coming from the fields of Prudhoe Bay, Alpine, and Kuparuk. There are changes to the animals which are our resources for survival, the fish, the caribou, the whale, and others. I started commenting at our meetings about the concerns I had as a health aide. I saw increased rates to asthma, problems with thyroid disorders and I saw the lifestyle changes such as social ills. When I started as a health aide in 1985 I had one asthma patient. By the time I went to the University of Washington for my physician assistant certificate in 1989, I had 20 to 25. When I came back in '91, there were 35. When I quit in 2000, there were over 60. The village make-up has not changed; it is still mostly Inupiat. What was contributing, the most overwhelming issue, was that oil development around the community had increased and gotten closer. The worst nights on call were nights with many natural gas flares occurring. We could see it in the flares or in the fields around us. They release particles and they travel to us. The chance of an inversion will affect us. An inversion is a bowl- like air trap with cold air trapped by warm air. Increased concentrations of particulate matter occurs during these episodes. I fear what has been reinjected into the ground. The oil percolates up through the land. One of our elders said: we new about the oil; it made a good light source. We could not carry enough of it as we followed our resources. When the substances that were put down come back up, what will be the effects? Are we just beginning to see them? What will happen with the global warming and the sink hole shows up and the erosion continues and the permafrost decreases? Has the permafrost protected us so far? In areas throughout the state, there were DEW line sites being cleaned up. The early defense warning sites. I notice that the worst levels of contamination are further south. Is that what we have to look forward to? When I asked about what was brought here, they do not compare with what the workers have stated what is there. What is there will come back to us through our resources, through our land and our water. The contaminants concentrate in us through our consumption of our food. They accumulate in our bodies, our livers, our kidneys, our breast milk into our children.	Rosemary Ahtuangaruak, Mayor 2003 ASDP Nuiqsut (BLM 2003e)

TABLE 4G.7.3-1 SELECTED TRADITIONAL KNOWLEDGE AND LOCAL KNOWLEDGE OBSERVATIONS REGARDING CUMULATIVE EFFECTS OF OIL AND GAS DEVELOPMENT (CONT'D)

RESOURCE CATEGORY	SUMMARY OF EFFECTS AND LOCATION	TESTIMONY
Environmental Consequences	What are we going to do in the area of cabins? Is BLM restricting the land? Are they calling us trespassers? These are some things that we have to take into consideration and BLM is taking onto consideration for land rights, not just for people from here, but from California, Florida, wherever they're from. They are making policies for that land right for the United States, not just Atqasuk and Barrow, but for everybody. What is our part going to be in the process? You have to be mindful of this and I thank that the Mayor's comments are very strong, but we haven't had this public workshop as much as we need to because of the short duration of the EIS. We have not produced maps that we can do a workshop with the public. They're laid out back there.	Arnold Brower, Jr. 1998 NPR-A Atqasuk (BLM 1998b)
Hazardous Materials	I don't agree with those who say don't explore or develop, but we have seen an area greatly devastated and ruined by the oil spill, there was major impacts to wildlife and the land a documenting what populations actually were so that we could maintain a way of life and the ocean and we have to have in place ways to address this kind of thing should it happen. I recall one year somewhere there was a spill because Steller's and eiders, those two bird populations, they a result of a spill that happened somewhere (and then there was a case he referred to when they were doing that seismic activity where they saw that fish populations disappeared for 3 years and they don't do it like that anymore). I'm told that techniques have improved and they don't have to resort to those techniques anymore that have such devastating impacts on fish populations.	Noah Itta 1997 NPR-A Barrow (BLM 1997a)
	One of the big things I see in the village ever since Alpine was built is a sociocultural impact. No one has ever adversely addressed the issues of the impacts of this village. People in this village are starting to label each other, label one another, label other organizations. This is not the Inupiat way of life we grew up to be. This is not the lifestyle that we learned. But we're learning that because that is your way. That is your way of getting ahead in the world, being competitive, and that's what we're learning to be. It's very hard to learn your society way of competing in jobs. When Alpine first started, we were promised jobs, we were promised programs from our -- assured by our corporation that this wouldn't be a significant impact on our village. It has. It has been a significant social, cultural impact on the village. Not only the residents, but the resources, the natural resources: the caribou, the Arctic cisco. I could go on and on. These are impacts that nobody is addressing. Alpine, when it first started, everybody painted it as a footprint, a minimum impact to the environment. With these satellites, this is no longer a footprint. This is now becoming a trail of footprints, connecting to the sidewalk of Prudhoe Bay of all the footprints up over there, which I call sidewalk, where whole bunch of people tramp all over over there. And now Alpine is going to be just like that; we're just going to be a suburb of what's happening out here.	Leonard Lampe 2003 ASDP Nuiqsut (BLM 2003e)

TABLE 4G.7.3-1 SELECTED TRADITIONAL KNOWLEDGE AND LOCAL KNOWLEDGE OBSERVATIONS REGARDING CUMULATIVE EFFECTS OF OIL AND GAS DEVELOPMENT (CONT'D)

RESOURCE CATEGORY	SUMMARY OF EFFECTS AND LOCATION	TESTIMONY
Hazardous Materials	Take for example, the area in Umiat. All they did was clean up the surface before they left. What happened was the whole area was damaged and started leaking to Kuukpik river. We have also heard that the fish in that area were affected. When they went to examine the area, it had already done some damage to the fish that were in that area.	Karen Burnell 1998 NPR-A Anaktuvuk Pass (BLM 1998d)
	The people of the North Slope should be guaranteed to have access to the hunting and fishing area that Inupiat have used for centuries. Sometimes when there's oil development, the access to those lands are no longer accessible to our people because of a variety of reasons that oil companies may have imposed on us. Access to those lands should not be compromised by federal government to appease the oil industry. It should be part of the stipulation that we, the Inupiat people of the North Slope, are always guaranteed to those lands to hunt and fish.	Joe Nukapigak 1998 NPR-A Nuiqsut (BLM 1998c)
Hazardous Materials	Because of these oil and gas related events, Inupiat subsistence users do not hunt in areas where people, gasoline, and diesel fumes are present. Our hunters and trappers have been displaced from traditional trails, which has become harder and dangerous due to oil and gas activities and had to be redirected to avoid these traditional hunting areas. Abandoned seismic camp and human waste are present around their abandoned camping areas. Traveling hunters have encountered the seismic lines and have to wonder whether or not they should have crossed these lines. Now they say it's okay to cross them, but our hunters would rather not even enter an area that's being explored. There's so much traffic there, it's not going to provide good hunting until there's been snow blown over the track and the air has been dispersed so the fumes are no longer strong.	Rosemary Ahtuangaruak 2001 Liberty Nuiqsut (MMS 2001c)
	One of the biggest issues that affects our community is the loss of control. In addition to the loss of subsistence opportunities, the major severe impacts result from the petroleum development in other areas of the Arctic. It is the lack of control over these events experienced by the village. Nuiqsut residents state they are the last to find out what's happening to them. They are never asked or generally considered about the pattern or course of the industry's development. They are merely informed after major decisions are in place. They would not spend the money making these studies if they were not planning to develop them. So it's a moot issue, after the fact. You're coming for the meeting, but you're already spending the money because you know this project is happening. This perception causes enormous social stress and tension. It is reflected in the increased community social ills, such as the alcoholism, the domestic violence, and the drug abuse. Thus, existing and potential activities further exacerbate and destabilize stress and tension resulting from almost 20 years of petroleum activities in the region. And since development would complete the pattern surrounding our traditional whaling site, it poses the most significant and long-term adverse social and cultural impacts of all the development of the North Slope, the potential for permanent reduction and/or loss of subsistence reserves, and thus, the viability of the Inupiat way of life.	Rosemary Ahtuangaruak 2001 Liberty Nuiqsut (MMS 2001c)

TABLE 4G.7.3-1 SELECTED TRADITIONAL KNOWLEDGE AND LOCAL KNOWLEDGE OBSERVATIONS REGARDING CUMULATIVE EFFECTS OF OIL AND GAS DEVELOPMENT (CONT'D)

RESOURCE CATEGORY	SUMMARY OF EFFECTS AND LOCATION	TESTIMONY
	He is aware that the whales are going around the area. They are not seen as they used to be any more. Helicopters are interfering and also ships are. After commenting that the helicopters would go by land, they still don't do that. The ships are still going through the migration route. All these activities are still going on. Even the ships are coming toward them when they are out whaling and after they said that they wouldn't interfere with their whaling.	Patsy Tukle 1986 Sale 97 Nuiqsut (BLM 1986b)
	But she's suspect that if activity persists throughout the year, it will alter the hunting and game will no longer be visible and maybe -- may cause hunters to go much farther. This has regards to the harvest their subsistence and additional resources safety of hunters when they have to go that much farther for to their subsistence and additional resources.	Ruth Nukapigak 1998 NPR-A Nuiqsut (BLM 1998c)

4G.7.3.2 Effects of Disturbance and Oil Spills on Subsistence Resources

The following is a summary of the potential cumulative effects on subsistence resources from oil spills, disturbance, and habitat loss on resources currently exploited for subsistence by North Slope communities:

TERRESTRIAL MAMMALS

Cumulative oil and gas development on the North Slope could result in a long-term displacement and/or functional loss of habitat for CAH, TCH, and WAH caribou over the life of CPAI's development. At present, cumulative oil development in the Prudhoe Bay-Kuparuk area has caused displacement of CAH caribou from a portion of the calving range, with a shift in calving distribution away from the oilfields. Future state oil-lease sales on the Arctic Slope between National Petroleum Reserve-Alaska and the ANWR and in the foothills of the Brooks Range would increase the amount of activity associated with oil exploration and development within the CAH range. Future oil and gas development in National Petroleum Reserve-Alaska could impact the TCH and WAH**.** Future state offshore leases in the Beaufort Sea could expose TCH and CAH caribou to additional activities related to oil and gas development through onshore facilities to support offshore leases (BLM and MMS 2003b).

The existing alteration of tundra habitat in the Prudhoe Bay area has not had any apparent effect on the distribution and abundance of other terrestrial mammals, with the possible exception of arctic foxes that apparently have increased near the oilfields. Muskoxen have continued to expand their range westward across the North Slope from an introduced population in the ANWR. There are no apparent effects on grizzly bears, wolves, and other terrestrial mammal populations associated with this development.

FRESHWATER FISH

Wide-ranging increases in impacts to arctic fish populations found on the North Slope would not be anticipated based on the cumulative analysis. Also, synergistic impacts to fish from disturbance related to oil and gas production in this plan would not be anticipated. Countervailing effects related to extraction at gravel sites would be possible in certain situations. Past reclamation of deep pits that have been mined has proved beneficial when new habitat for arctic fish species has been established (BLM and MMS 2003a).

MARINE FISH

The additional effect of seismic surveys and construction-related activities above those expected from Alternative A would be anticipated to be proportional to the number of future activities. Effects on marine fish populations could be greater if there were insufficient time for full recovery between these activities. Offshore cumulative case oil spills would be expected to have mostly sublethal effects on marine fish populations. Spills that might enter coastal waters would be expected to affect a greater percentage of fish for the cumulative case than estimated for Alternative A. Assuming sufficient recovery time between spills, the recovery from each cumulative case spill would be expected to be within three to five years (BLM and MMS 2003b).

BIRDS

Overall cumulative effects of oil industry activities on birds could be substantial in the case of loon species and king eider, and significant in the case of long-tailed duck and king and common eiders, primarily as a result of mortality in the unlikely event a large oil spill were to occur. Although the chance of an oil spill occurrence is relatively small, the potential would be highest for contact with bird concentrations in the vicinity of primary support facilities. Also, as a result of the apparent decline in populations of some species (for example, several sea duck species), and the challenge of recovering spilled oil (particularly in broken-ice conditions) there is uncertainty as to the ultimate effect of any spills on bird populations. Disturbance could cause a small loss of productivity and lowered fitness or survival of birds occupying areas with high levels of industry activity, but these effects would not be expected to be significant. Effects resulting from oil and gas development activities

likely would be additive to naturally occurring effects or those occurring as a result of other activities in the Plan Area (BLM and MMS 2003).

BOWHEAD WHALES

Exposure of bowhead whales to noise from normal oil and gas operations could cause temporary, nonlethal effects and no mortality is expected. Whales exposed to spilled oil would likely experience temporary, nonlethal effects although prolonged exposure to freshly spilled oil could cause mortality in some individuals. The incremental contribution of effects from oil and gas development in the Plan Area to the overall effects under the cumulative case, would not likely result in adverse effects to the bowhead whale population.

Whales exposed to increased noise could be deflected from their normal migration route and displaced from traditional hunting areas, interrupting the whale harvest. Most projected reasonably foreseeable development projects would be expected to be close to shore and away from traditional bowhead whale migration and harvest areas.

Any actual or perceived disruption of the bowhead whale harvest from oil spills and any actual or perceived tainting anywhere during the bowhead's spring migration, summer feeding, and fall migration could disrupt the bowhead hunt for an entire season, even though whales still would be available (BLM and MMS 2003b).

BELUGA WHALES AND OTHER MARINE MAMMALS

In the Beaufort Sea, noise and disturbance from on-ice seismic surveys during any one year would affect breeding ringed seals in that area for no more than one year, because only a small fraction (less than one percent) of the population would likely be exposed to and potentially disturbed by the operations. Subsequent surveys in other areas during other years have disturbed different seals and would be expected to in the future. A few pups could be lost because mothers might abandon maternity lairs or because seismic vehicles might destroy snow lairs along the shot line. Past seismic exploration on the sea ice over several years might have killed some pups and displaced some seals locally, very near seismic lines (within 150 meters) during operations for that ice season. However, these additive effects probably were not significant to the seal population above changes in distribution associated with changes in sea ice (BLM and MMS 2003b).

The effects of noise and disturbance from an estimated total of more than 450 helicopter round trips per month and at least 200 vessel round trips per month on seals, walrus, beluga whales, and gray whales in the Beaufort Sea should last only a few minutes to less than an hour for any one disturbance event. Disturbance reactions of seals, walrus, beluga whales , and gray whales would be brief; they would return to normal behavior patterns and distribution shortly after the boat or aircraft left the area. Effects would not be expected to be additive or synergistic because disturbance reactions would likely involve different animals and occur in different areas. Seals and walrus could also get used to aircraft and vessels, if they were to encounter them routinely.

Ringed seals, bearded seals, walrus, beluga whales, and gray whales have been exposed to oil-exploration activities in the Beaufort Sea, including seismic surveying, drilling, air and vessel traffic, dredging, and gravel dumping. Activities in the Beaufort Sea—as well as barge traffic to the North Slope, and some icebreaker activity to support oil exploration—might increase in the future. These activities could affect how seals are distributed near the activity for one season (or less than one year) during high levels of activity. However, some seals would habituate to marine traffic, air traffic, industrial noise, and human presence. Displacement from cumulative industrial activities would not likely affect the overall abundance, productivity, or distribution of ringed seals, bearded seals, walruses, and beluga whales in Alaska's Beaufort Sea (BLM and MMS 2003b).

Cumulative noise sources that could affect beluga and gray whales would be from seismic activities and drilling (and other noise associated with exploration, development, and production operations); vessel and aircraft traffic; construction; and oil-spill cleanup. Underwater industrial noise, including drilling noise measured from artificial gravel islands, has not been audible in the water more than a few kilometers away. Because the beluga whale's migration corridor is far offshore of the barrier islands, seismic exploration, drilling, development, and

production noise from most development in the nearshore area, would not likely reach many migrating beluga or gray whales. Noise also would be unlikely to affect the few whales that could be in lagoon entrances or inside the barrier islands because of the rapid attenuation of industrial sounds in a shallow-water environment. Because island and pipeline construction would occur during the winter and be well inside the barrier islands, it would not likely affect beluga or gray whales (BLM and MMS 2003b).

An important habitat for marine mammals is the active-ice (or ice-flow) zone. Seals, walrus, and beluga whales would be most vulnerable to spills contacting this zone; polar bears would be most vulnerable to spills contacting the flaw zone or the coast. Offshore spills would obviously pose a higher risk to marine mammals than onshore spills, but along the coast of the Plan Area, some aggregations of seals and walrus and a small number of polar bears could be contaminated by onshore spills that reach marine waters and could suffer lethal or sublethal effects. The most noticeable effects of potential oil spills from offshore oil activities would be through contamination of seals, walrus, and polar bears, with lesser effects on beluga whales. Losses from an estimated one to three oil spills of 1,000 bbls could be fewer than 1,000 seal pups and adults, fewer than 1,000 walrus calves and adults, and fewer than 30 polar bears (out of a population of 2,272 to 2,500 bears). These losses would likely be replaced within one generation or less (with a generation of approximately five years for ringed seals and at least seven years for polar bears). Beluga whales would likely suffer low mortality (fewer than 10 whales), with population recovery expected within one year (BLM and MMS 2003b).

4G.7.3.3 The Effects of Disturbance on Subsistence Resource Habitats

The continual loss of subsistence resource habitat associated with oil and gas development on the North Slope has been documented (Walker et al. 1987a; Walker et al. 1987b; Walker and Walker 1991). The Walker et al. (1987) geobotanical mapping study concluded that by 1986, the Prudhoe Bay Oilfield occupied approximately 500 km^2 between the Kuparuk and Sagavanirktok rivers, which included 359 km of roads, 21 km^2 of tundra covered by gravel, and 14 km^2 of area flooded because of road and gravel-pad construction. Expansion of disturbed areas since 1968 has been continua, although at a reduced rate (see Figure 4G.5.3-1). The study considered these to be major landscape impacts, and recommended that implications to wetland values, wildlife corridors, and caribou calving grounds be addressed.

Development of all types has directly impacted approximately 17,770 acres (including all oil and gas activities and the portion of the Dalton Highway on the North Slope). Of this, approximately 9,640 acres are impacted from exploration and production facilities (pads, roads, airstrips, etc.). The second largest disturbed area is for gravel mines, which cover 6,365 acres (including both tundra and riverbed mines). The total affected acreage is a small part of the Arctic Coastal Plain; the proposed CPAI alternatives will increase disturbance by approximately 1.7 percent of the areas currently disturbed and 1.4 percent of all areas currently or likely to be disturbed in the future (see Table 4G.4.7-1). This relatively small increase in disturbance is not expected to cumulatively affect the overall productivity of tundra plants on the North Slope. Recent, current, and expected future development will utilize technology advancements that require a much smaller acreage footprint than past projects on the North Slope.

Alterations from offshore production platform-island construction, trench dredging, and pipeline burial would be expected to affect some benthic organisms and some fish species within one kilometer for less than one year or season. These activities also could temporarily affect the availability of some local food sources for these species up to one to three kilometers (0.62 to 1.9 miles) during island construction, but these activities would not be expected to affect food availability for seals over the long term. The effect of future onshore facilities siting (dust fallout, thermokarst, and hydrologic change) on bird populations, though additive, would be significantly less severe, because they would be restricted to much smaller areas and result in less habitat loss. Pads, gravel quarries, pipelines, pump stations, and gravel roads that cross much of the CAH calving range actually have destroyed only approximately three to four percent of the tundra grazing habitat for caribou.

An increase in abundance of deciduous shrubs (less favorable caribou forage), especially birch, and a decline in the abundance of grasses/sedges such as *Eriophorum vaginatum* (an especially important food of calving caribou) would be predicted if a significant increase in average temperature were to occur in the Arctic, an

effect that could reduce the productivity of caribou habitats on the Arctic Slope (Anderson and Weller 1996). Over decades, warming temperatures could result in the invasion of tundra habitat by taiga woody plants (taiga forests), a less favorable habitat for tundra mammals and some bird species, thereby adversely affecting their populations and subsistence uses (Anderson and Weller 1996).

CUMULATIVE EFFECTS TO SUBSISTENCE USERS

The Inupiat people of Nuiqsut have expressed concern about the cumulative effects of petroleum exploration and development on subsistence resource harvesting since the Prudhoe Bay Oilfield was announced (ISER 1983). These concerns include access to desired use areas and resources, changes in the quality and availability of subsistence resources for harvest, the perception that subsistence resources may be tainted by pollution, and changes to the character (e.g., solitude and remoteness) of areas used for subsistence harvests caused by industrial occupation and activity. Since the early days of the resettlement of permanent communities near the Plan Area, the desire to pursue a subsistence way of life has been an explicit motivating factor for local residents, as expressed in this 1979 excerpt from scoping testimony for Sale BF:

> "The Draft Environmental Impact Statement makes assumptions that we are moving away from our subsistence into a cash economy. … I would like to point out to you that maybe that is the desire of the government, but it is not ours. We, here in Nuiqsut, by our own personal choice, left homes and jobs in Barrow to return to our ancestral lands to live in tents like our grandparents and to live off the land. We re-established the area that has always been used by our people. The land and coastal region provides us with subsistence, which is the foundation of our culture. We cannot live without our Native food, nor would we want to if we could." – Thomas Napageak 1979 Sale BF Nuiqsut. (MMS 1979a)

The key elements of subsistence access include the ability to get to favored subsistence harvest locations to harvest particular species when they are available in that area, at times when there are particularly favorable seasonal aspects to the resources. Caribou, for example, are hunted for general consumption in July and August, but are the fattest and most desirable in October (SRBA 2003). Social rules may affect access, such as traditional or regulatory prohibitions against shooting near people, oil production facilities, and pipelines. As oil and gas infrastructure and permanent facilities are built in traditional subsistence harvest areas, hunters could consider those areas off-limits to hunting (NRC 2003, Pedersen et al. 2000, Pedersen and Taalak 2001). Areas of vital importance for all Nuiqsut subsistence users, including the Nigliq channel corridor from Nuiqsut to Fish Creek, are now in the vicinity of proposed onshore development.

Other factors, such as the sights, smells, noise, light, and activity associated with oil and gas exploration and development may reduce access. The current mayor of Nuiqsut notes these factors in the following statement:

> "Because of these oil and gas related events, Inupiat subsistence users do not hunt in areas where people, gasoline, and diesel fumes are present. Our hunters and trappers have been displaced from traditional trails, which have become harder and dangerous due to oil and gas activities and had to be redirected to avoid these traditional hunting areas." – Rosemary Ahtuangaruak 2001 Liberty Scoping, Nuiqsut. (Ahtuangaruak 2001)

The existing effects of oil and gas activity have spread from Prudhoe Bay to an area encompassing the north and west approaches to Nuiqsut. Nuiqsut residents have been concerned for many years that the community would be surrounded by pipelines, pads, and roads, excluding them from important subsistence use areas (ISER 1983, IAI 1990a, Pedersen et al. 2000, NRC 2003). This concern has become more immediate with further development being proposed in their traditional subsistence use areas. By 1990, the perception that access to subsistence use areas was already limited, arose during scoping as further restrictions became an issue of concern associated with future development, as noted in the following excerpt:

> "Like a good example is Prudhoe Bay. They say that that area is open for subsistence, and it's not. It's written on paper that it is, but the actuality, you go and take a rifle over there, the first things -- first thing that you're going to find out is -- is that the security's going to take care of you. They're not going

> to let you go anyplace, even though that you may say that I'm out here on subsistence hunt. They don't have no concern whatsoever about that; their concern primarily is the protection of that field, and this is exactly what's going to happen down there. And our people here, they're, like I said, is surrounded (sic). The only area, hunting area that we have during the summer is down there to the ocean and up the river. Now, you can go both ways because a person that's going to be getting food for the family for that day cannot get food for that day if he's walking. You try and walk and see how far you can go."– Rev. Nelson Ahvakana 1990 Sale 124 Scoping, Nuiqsut. (Ahvakana 1990)

The term, "availability" as used in this subsistence analysis incorporates aspects of access (as described above) and subsistence species behavior and biology. In strictly biological terms, "availability" has meant that population numbers of caribou are high enough to support a harvest without significantly reducing herd numbers when considered in conjunction with predator take, sports harvests, and other factors that would reduce the population. For subsistence, the number of a particular species is important as a basic attribute of availability. However, in some cases there may be suitable numbers of a species, but the species (resource) may change migration patterns, be diverted or occupy an area considered by hunters to be off-limits to harvest activities because of real or perceived regulation, perceived contamination, or difficulties in physical access, rendering the resource inaccessible for the purposes of subsistence. In other cases, the animals may be present in their usual harvestable locations but only while hunters are unable to hunt (e.g. conflicts with work schedules, poor travel conditions). An example of the latter aspect of availability follows:

> "We have our first generations of people living in formally structured houses that require a new lifestyle of a cash economy to meet the costs of them. This restricts our harvest by not allowing us to follow the animals. We are facing many problems by this, for our men have been the providers of our families, and they must step between both worlds. They require the guns and the snowmachines to allow them to harvest in the narrow windows of time that exist due to commitment to work. They are torn by the traditional needs of providing from the land and the stresses of needing cash to purchase items that save on time."– Rosemary Ahtuangaruak 2001 Liberty Nuiqsut. (Ahtuangaruak 2001)

An aspect of oil and gas development that could divert or deflect terrestrial mammals, is the growth of infrastructure into new areas, in particular roads, pipelines, airstrips, and gravel pads. These structures interfere with the passage of hunters and their harvests, and as noted in NRC (2003), gravel roads and pads are not likely to be removed once abandoned. A North Slope Inupiat expressed concerns about changes in migration behavior he attributed to pipelines when he said,

> "If you—with these animals already being displaced, now it's starting to be from Cross Island to Teshekpuk that I've noticed these animals, over a period of time, going away. And then there—right now, we're having a real hard time 'cause of the pipelines from Oliktok to Kuparuk. There's a 13-mile pipeline that's about three-feet high that, itself, already has displaced our caribous in the village. We already had a hard time with the geese already going away from these facilities. I watched these firsthand over a 15-year period, and this is what got me to move from Nuiqsut to Barrow, is observing these oil activities that's occurring. In addition to this 13-mile pipeline I'm talking about, with the new discoveries that already occurred south of the Kuparuk field, we have about another over 10-mile pipeline again, that that's three feet high. And then you look at the caribous when they—when they're trying to get to the ocean side, they're always migrating, keeping away from these bugs and everything. They stop right at Oliktok. They—we don't see those anymore, these thousands of migrating caribous. Now, at the same time, we're seeing hundreds."– Frederick Tukle Sr. 2001 Liberty Scoping, Barrow. (Tukle 2001)

If the change in caribou group size (noted above) is a persistent phenomenon, it could require increased time, fuel costs, wear and tear to hunters and equipment, and hunting effort on the part of hunters to harvest sufficient numbers of caribou during the summer insect relief period, effectively reducing the availability of the resource to subsistence users.

A similar concern for subsistence fishing was attributed to the construction of causeways at Oliktok and West Dock by one speaker.

> "But they used to be up, before these causeways, used to be plentiful. And then people just quit fishing when they have enough. Now you can have your net out there until you can't get anymore, and you still don't get enough supply for winter." – Thomas Napageak 1996 Northstar Whaling Captains' Meeting. (Napageak 1996)

Subsistence fish availability issues are sometimes associated with more difficult-to-pursue causes (e.g., global warming, upriver pollution, river crossing pipeline vibration, water withdrawals, seismic testing). Because of the present lack of definitive answers regarding fish availability and resource health issues, some hunters have expressed concern that the NEPA process is not addressing some effects from oil and gas activities adequately. Concerns about subsistence resources and the future availability of those resources are perceived as threats to the continued existence of the Inupiat people and their way of life. Causes that are more concrete may be proffered in light of these conditions, as presented in the following recent excerpt from the Point Thomson scoping hearing in Nuiqsut.

> "You know, things have been going on in this village for many years and none of you agencies have ever given us real reasons of why things are changing around us. Everybody tells us global warming. That's why things are happening in your village, that's why you're not getting your Cisco, that's why you're not getting your caribou migration regularly. Well, there's things that are happening that everyone else doesn't want to take responsibility for. Thousands of millions of gallons are extracted from lakes and ponds throughout the region. Maybe that's a reason why fish aren't coming here no more. Ice bridges that are built on rivers ground down to the bottom of the rivers making ice walls, maybe that's why Ciscos aren't coming in."– Leonard Lampe, Mayor, 2002 Point Thomson, Nuiqsut. (Lampe 2002)

Contamination, and the perception of contamination, of subsistence resources may also affect the use of subsistence foods through reduced or abandoned harvests, increased stress about the effects of consuming possibly tainted food, concerns about future availability of subsistence resources, and a decline in the satisfaction of eating subsistence resources. Responses to known pollution reflect the importance of subsistence foods even in the face of measurable contamination, as one interviewee noted,

> "The ADF&G told us the burbots have mercury, pcbs in the liver, but I eat 'em anyway" (SRB&A 2003).

It is possible that local responses to concerns about contamination could resemble that noted for the Exxon Valdez oil spill (Fall, Miraglia, Simeone, Utermohle, and Wolfe 2001).

Concerns about contamination extend beyond the study of measurable pollutants to the perception that there are as-yet unknown or unmeasured levels of contaminants in the environment affecting both the Inupiat and the resources they harvest. Contaminants may be present in small quantities deemed harmless, but may accumulate and have serious, long-term, and ongoing health consequences yet unstudied, for both the Inupiat and the species they on which they rely for subsistence (NRC 2003). Behavioral responses to the perception of contamination are as real as responses to measurable pollution. The current mayor of Nuiqsut, Rosemary Ahtuangaruak, outlines stresses placed on resource users in response to real and perceived contamination:

> "There has been many problems with various developments. And there is byproducts left all around, areas where you have worked and got your oil and it's left over. We go out and we travel around our land. We go hunting in this land. The by-products of these developments are definitely hurting us. We state that. But yet, in your book it says it's not to a level that's acknowledged as being harmful. Well, we are definitely being harmed by this development." – Rosemary Ahtuangaruak 1997 Sale 170 Nuiqsut. (Ahtuangaruak 1997)

In addition to concerns regarding access and contamination, some Inupiat have taken issue with the use of wilderness designation programs to regulate land use, and in some cases have spent significant sums to counter designations that reduce their access to traditional subsistence use areas (Hall, Gerlach, and Blackman 1985). Recent proposed activities in the National Petroleum Reserve-Alaska have raised concerns that subsistence uses will be eliminated if non-productive management regimes are applied, as this extract from 1998 outlines:

> "With these Alternatives of B, C, D and E, the reason why am I opposing them is what do I know about designating the Colville River, a wild and scenic river. Are they going to stipulate fishing regulations on it? How do I know it's not on the dotted line of your EIS draft there? What about this proposing of a bird conservation area? Is that going to limit me from hunting the geese and ducks that I do so freely? And the 50 percent of the area where it's covered, it's not even close to where we should be. I mean, where are we protected?" – Bernice Kaigelak 1998 National Petroleum Reserve-Alaska scoping, Nuiqsut. (Kaigelak 1998)

The desire for a solitary experience in open, uncrowded country as a form of relaxation and renewal for Inupiat people is mentioned directly as a stress reliever but more often as part of the solitary hunt for furbearers. Many hunters discussed the enjoyment from covering vast territories with their snowmobiles and in some cases, facing challenges and hardships during prolonged hunts for wolves and wolverines (SRB&A 2003). This solitary endeavor has a spiritual value to these hunters. Solitude and isolation is also mentioned in the context of offering privacy, a sometimes rare commodity in small communities, as follows:

> "I see that protective measures, exploratory drilling is not allowed within 1,200 feet of any cabin or known long-term campsite. To me I don't have any scientific data, but I know if we would have had a drilling rig within 1,200 feet of our honeymoon it sure wouldn't have been as great of an experience as it was. And I hope that my children can someday experience the solitude, the feeling of being out there on your own." – Jim Vorderstrasse 1998 National Petroleum Reserve-Alaska Barrow. (Vorderstrasse 1998)

Conflicts caused by differential employment, coupled with changes in subsistence resource availability over time could threaten social cohesion. If future oil development should surround Nuiqsut, for example, it will be increasingly difficult for more subsistence oriented users to maintain their way of life if they have to travel for several hours to harvest subsistence resources and then return quickly to go to work.

The central role of subsistence activities in the social and communal lives of the Inupiat overlaps with other spheres of their existence. Subsistence supplies preferred foods, encourages interactions and relationship building within and between communities, structures relations and institutions (e.g., AEWC and KSOP) and draws people back to ancestral homelands and culturally important places. While oil and gas exploration and development activity may alter the patterns of subsistence land use, it is unlikely to cause the abandonment of subsistence activities. However, a feeling of alienation from traditional use areas due to oil and gas exploration and development activities reduces the quality and spiritual value of being out on the land for Inupiat land users (NRC 2003).

Perceived threats to subsistence may reinvigorate subsistence pursuits, as the formation of the AEWC in response to proposed International Whaling Commission regulation demonstrated (NRC 2003). Harvest failures in the past have resulted in increased sharing of subsistence foods between communities and the hosting of hunters from communities experiencing a shortage at communities with relative abundance for that resource. Thus, concerns about non-pollution cumulative effects on subsistence in the communities may reinforce and invigorate traditional responses to these effects, and as a result, renew the traditional relationships between subsistence users and their use of the environment. The cumulative effects of pollution, both local and global, will likely both reinforce and inhibit traditional subsistence practices.

Ongoing processes related to the management of subsistence and land use in areas open or proposed for oil exploration and development activity have affected the communities that directly impact the character of local involvement in present and future undertakings. Among these effects are anxiety due to a feeling of loss of

control over their traditional subsistence lands: a perception of degradation of, and alienation from subsistence use areas and resources: the belief that local testimony and traditional knowledge are ignored in favor of development: and institutional overload to deal with oil and gas exploration and development issues caused by a lack of funding, personnel, time, and expertise in the communities (BLM 1997, NRC 2003). As Rosemary Ahtuangaruak testified in 1997,

> "These types of meetings are important. We do see a lot of information, but where is it? I've spent so many hours coming to these meetings. And I'm not paid for any of this. You want us to work with you, but you haven't hired anybody in this community to do this local work. How many individuals do you have in your division outside of this area? How about your division or your division or all of your division? There are people working to make decisions about that land. That land is what I depend on to feed my family."– Rosemary Ahtuangaruak 1997 Sale 170 Nuiqsut. (Ahtuangaruak 1997*)*

The National Petroleum Reserve-Alaska Subsistence Impact Analysis Workshop repeatedly outlines a similar array of ongoing local impacts related to subsistence use and land management in Nuiqsut's key use areas (BLM 1997). Under the heading "Panel Discussions in Nuiqsut" are listed numerous issues, pertinent examples of which are listed below:

- They feel that 18 months is too short [to review NEPA undertakings].
- The community is tired of [attending] meetings and giving [the] same information.
- They feel frustration with increasing restriction on access.
- [There is a] Lack of human resource in community to analyze documents and represent local concerns. The NSB needs to provide assistance.
- They give a sense of being overwhelmed by external influences and events.
- Community feels it is a victim, not a participant. Over years, faces and names and proposals change, but [community] concerns aren't met. Need opportunity to participate in what goes on around them-[BLM] must set stage for that to happen. [The community] Need(s) to be able to influence planning process and continue [that influence] into leasing.
- People feel 90 percent of subsistence use is in Northeast Planning Area want development left to occur outside this area.
- Government keeps coming back until community is worn down and gives up. Asked to trust government but they are seeing impacts the government/industry said wouldn't happen.
- Need to empower local subsistence advisory panel.

These issues are ongoing and cumulative, and are magnified by the possibility of expansion into the Northeast National Petroleum Reserve-Alaska planning area, where much of the community's subsistence harvest and use takes place.

Nearshore and offshore development, which the Inupiat have long feared and opposed, is again being proposed for the Beaufort and Chukchi seas (Ruskin 2004). As noted in 1983, 1990, 2000, and 2003 reports, nearshore and offshore development are considered to be potentially catastrophic to subsistence users in the NSB whaling communities (ISER 1983, IAI 1990a, Pedersen et al. 2000, NRC 2003). A Nuiqsut elder expressed this concern at the recent hearings held there for the Liberty Development and Production Plan EIS:

> "He sure hates to see some drilling being done in the ocean right now, and he hates for the mammals to be disturbed because they live off of them from generation to generation. And then he opposes drilling

> down in the ocean while there is oil on land. He very much opposes it. He's not happy with it. Like the rest of these people here, they're not happy with it. They go far down there to -- you know, way far from their home to catch the whale, and then how far would they have to go if they -- you know, if the whales are disturbed from the drilling right now? How far do they have to go get the whale? That's what he's worried about." – Noah Itta 2001 Liberty Nuiqsut. (Itta 2001)

Anxiety about the possibility of nearshore and offshore oil exploration and development activity is itself an accumulating effect (NRC 2003:148). As proposed development with long term occupation and changes to the landscape take place, there may be unavoidable impacts that must be addressed in a culturally sensitive and timely manner to mitigate effects where possible and compensate for those effects that cannot be mitigated.

4G.7.3.4 Conclusion

Development has already caused increased regulation of subsistence hunting, reduced access to hunting and fishing areas, altered habitat, and intensified competition from non-subsistence hunters for fish and wildlife (Haynes and Pedersen 1989).

Additive impacts that could affect subsistence resources include potential oil spills, seismic noise, road and air traffic disturbance, and disturbance from construction activities associated with ice roads, production facilities, pipelines, gravel mining, and supply efforts. Based on potential cumulative, long-term displacement and/or functional loss, habitat available for caribou may be reduced or unavailable or undesirable for use. Changes in population distribution due to the presence of oilfield facilities or activities may affect availability for subsistence harvest in traditional subsistence use areas. The communities of Barrow, Atqasuk, Nuiqsut, and Anaktuvuk Pass would be most affected.

Overall, impacts to subsistence harvest and use may have synergistic impacts with community health, welfare, and social structure. To the extent that subsistence hunting success is reduced in traditional use areas near Nuiqsut because of the presence of oilfield facilities and activities, subsistence hunters will need to travel to more distant areas to harvest sufficient resources in order to meet community needs. Greater reliance on more distant subsistence use areas will result in greater time spent away from the community for some household members and competition for resources with members of other communities. These changes in subsistence patterns may result in stress within households, family groups, and the community.

4G.7.4 Environmental Justice

4G.7.4.1 Evaluation

Alaska Inupiat Natives, a recognized minority, are the predominant residents of the NSB, the area potentially most affected by cumulative oil and gas development on the North Slope. Disproportionate impacts from oil development could occur because of their reliance on subsistence foods, and potential effects could impact subsistence resources and harvest practices. Potential cumulative effects from noise, disturbance, and oil spills on subsistence resources, subsistence harvest practices, and socio-cultural patterns would focus on the Inupiat communities of Nuiqsut, Barrow, Atqasuk, and Anaktuvuk Pass within the NSB. These impacts include: (1) effects on subsistence resources, activities, and communities and (2) other environmental justice effects.

EFFECTS ON SUBSISTENCE RESOURCES, ACTIVITIES, AND COMMUNITIES

Potential cumulative impacts to subsistence resources and subsistence harvest have been previously discussed (See Section 4G.7.3). Subsistence activities are important to providing dietary sustenance and cultural cohesion to North Slope residents. As a consequence, any cumulative activities that could directly impact subsistence resources and access to those resources may also have disproportionately high adverse effects to minority and low-income populations. Actions identified in the ANILCA 810 analysis as having a potentially significant impact on subsistence also would have a significant impact on minorities and low-income populations and communities. Those stipulations and other protective measures that help to mitigate impacts on Inupiat Natives

are the same as identified in the subsistence and socio-cultural analyses in Section 4G.7.3 on Subsistence Harvest Patterns.

The 2000 U.S. Census counted 7,385 persons resident in the NSB; 5,050 identified themselves as American Indian and Alaska Native for a 68.4 percent indigenous population (U.S. Bureau of the Census, Census 2000). Alaska Natives comprised 88 percent of Nuiqsut's population, 56 percent of Barrows, 94 percent of Atqasuk's, and 88 percent of Anaktuvuk Pass's residents

With the North Slope Borough's largely homogenous Inupiat population, the identification of a "reference" or "control" group within the potentially affected geographic area—for the purposes of analytical comparison to determine if the Inupiat are affected disproportionately—is not possible. This is because a non-minority group does not exist in a geographically dispersed pattern along the potentially affected area of the North Slope (BLM and MMS 2003b).

North Slope Borough income figures determined an average household income of $54,645 and a per capita income of $15,218 in 1993. When calculated for ethnicity, the average Inupiat household income was $44,551 and for non-Inupiat it was $74,448. The average Inupiat per capita income was $10,765 and the non-Inupiat per capita income was $29,525. Of all the households surveyed in the NSB, 23 percent qualified as very low-income households, and another 10 percent qualified as low-to-moderate-income households. As 66 percent of the total households surveyed were Inupiat, it would appear that a large part of the households falling in the very low- to low-income range are Inupiat. Poverty-level families in the NSB numbered 88, or 6 percent of all households. Poverty level thresholds used by the NSB were based on the U.S. Bureau of the Census, March 1996 Current Population Survey; low income is defined by the U.S. Census Bureau as 125 percent of poverty level (BLM and MMS 2003b; NSB 1995, 1999).

The NSB 1998/99 Economic Profile and Census Report showed household income increasing from $54,645 in 1993 to $63,884 in 1998. The average Inupiat household income increased by an average of $11,685, from $44,551 to $56,236. The average Inupiat per capita income rose from $10,765 in 1993 to $12,550 in 1998. A total of 125 households qualified as poverty level, and 37 qualified as very low income. This translates into a total of 381 individuals living below the poverty level—an increase of 12 individuals since 1993 (NSB 1999). The 2000 U.S. Census found an average per capita income of $20,540, and a median household income of $63,173. The 2000 U.S. Census found 132 families (8.6 percent of a total 1,538 NSB families) in poverty status in 1999 (397 individuals 18 years and over) (BLM and MMS 2003b; U.S. Bureau of the Census, Census 2000).

Sources for cumulative effects include potential oil spills, noise and traffic disturbance, and disturbance from construction activities associated with drilling, production facilities, pipelines, and landfalls. In addition, habitat reduction, and increased local population pressure have combined as cumulative factors that continue to challenge the survival of many traditional subsistence practices (BLM and MMS 2003b).

Potential effects focus on the NSB Inupiat communities of Atqasuk, Barrow, and Nuiqsut. The socio-cultural and subsistence activities of these Native communities could be affected by disturbance to key subsistence species that leads to disruption, displacement, or long-term changes in species' populations. Communities could also be affected by accidental oil spills. Possible oil-spill contamination of subsistence foods is the main community concern regarding potential effects on Native health. As a point of reference, after the Exxon Valdez spill, 1989 to 1994 testing of subsistence foods for hydrocarbon contamination revealed very low concentrations of petroleum hydrocarbons in most subsistence foods. In fact, the U.S. Food and Drug Administration concluded that eating food with such low levels of hydrocarbons posed no significant risk to human health (Hom et al. 1999), though they recommended avoiding shellfish, which accumulates hydrocarbons. While human health could be threatened in areas affected by oil spills, these risks can be reduced through timely warnings about spills, forecasts about which areas may be affected, and even evacuation of people and avoidance of marine and terrestrial foods that might be affected. Federal and state agencies with health-care responsibilities would have to sample the food sources and test for possible contamination.

OTHER ENVIRONMENTAL JUSTICE EFFECTS

The BLM acknowledges the cumulative socio-cultural impacts on the North Slope and the significant change that Inupiat culture has undergone. The influx of money from wage employment has added many benefits and raised the standard of living, but these influences have also given rise to a number of social pathologies, including increased alcoholism and drug abuse.

Any realistic analysis of cumulative effects on the North Slope needs to consider both onshore and offshore effects. Although onshore and offshore cumulative effects are difficult to separate, most cumulative effects are thought to result from onshore development. To date, no adequate onshore monitoring or comprehensive baseline data gathering has ever been undertaken by responsible federal and state agencies and industry; the most obvious cumulative effects have occurred and continue to occur onshore as oilfield development expands westward from the initial Prudhoe Bay/Deadhorse area of development. Proposed and ongoing studies that will contribute to a more comprehensive understanding of cumulative effects to the Native population of the North Slope are discussed in the remainder of this section.

Based on Native stakeholder concerns about cumulative impacts, the BLM and the Research Monitoring Team held meetings and consulted with the SAP to refine a study proposal to better assess the cumulative impacts of petroleum exploration and development on subsistence activities of local communities across the North Slope. Efforts are currently underway to develop a North Slope Science Initiative (NSSI) to replace the Research Monitoring Team (The Research Monitoring Team currently operates under the auspices of BLM's Resource Advisory Committee). The NSSI will comprehensively coordinate studies across the North Slope and provide a consistent approach to high caliber science. The first, of what will be bi-annual NSSI public workshops, were held in Anchorage, Fairbanks and Barrow in January 2004 to discuss strategy development and information exchange related to the regions inventory, monitoring and research needs.

There are ongoing studies of caribou and waterfowl habitat use and behavior on the North Slope. Other researchers are looking into how exploration and development on the North Slope could impact traditional lifestyles and values. For further discussion of environmental justice effects, see the cumulative effects analyses for subsistence-harvest patterns (Section 4G.7.3).

Ongoing and proposed MMS studies also address environmental justice concerns pertinent to the National Petroleum Reserve-Alaska development and will provide valuable data for the assessment of cumulative impacts of oil and gas activities. Monitoring efforts for the Northstar and Liberty Projects (such as the 14-year aerial Monitoring of the Distribution of Arctic Whales Project) will provide long-term information on area wide and cumulative effects of oil and gas activities on the fall migration of the bowhead whale and will help in the development of mitigation measures to protect this pivotal Inupiat subsistence resource. A top priority, 5-year, $3.7 million ANIMIDA study was established in response to Inupiat requests to gather long-term monitoring data that will provide a basis for evaluating potential effects from upcoming development and production activities in the Beaufort Sea. A portion of this study will assess the historic and ongoing subsistence use of the area surrounding Cross Island by working with local whale hunters. (BLM and MMS 2003b). The MMS Study 2001-032 Socio-Cultural Consequences of Alaska OCS Activities: Data Analysis and Integration, a cooperative agreement with the State of Alaska, Department of ADF&G, Subsistence Division, analyzes and integrates subsistence, socioeconomic, and socio-cultural time-series data from previous MMS-sponsored projects to assess the occurrence and implications of socio-cultural change from OCS activities

The Exxon Valdez Oil Spill, Cleanup, and Litigation: A Community-Based Collection of Social-Impacts Information and Analysis, 1989-2001 produced an analytical tool (from a synthesis of the Exxon Valdez literature) that assists DOI analysts in preparing NEPA-documents; designing mitigation measures; facilitating the review of oil-spill-contingency plans; and paving the way for dialogue with coastal communities regarding the DOI's offshore programs. The Quantitative Description of Potential Effects of OCS Activities on bowhead Whale Hunting Subsistence Activities in the Beaufort Sea study was developed in response to concerns raised by the AEWC and the NSB. This study involves a systematic analysis of residents' observations and perceptions about how their lives—and especially subsistence whale hunting activities—have been (and might be in the

future) affected by oil industry activities and other forces of modernity. An MMS study titled, Subsistence Mapping of Nuiqsut, Kaktovik, and Barrow: Past and Present Comparison, will map geographic patterns of subsistence use near important North Slope communities. MMS will use this comparative time series information to assess cumulative socio-cultural effects in the Beaufort Sea region (BLM and MMS 2003b).

The ongoing Alaska Marine Mammal Tissue Archival Project (AMMTAP) field sampling and long-term storage of frozen tissues archive has provided a wealth of information on contaminants. Another ongoing study called The Alaska Marine Mammal Health and Contaminants Database will make this tissue archival information available to management agencies and subsistence villages, that by necessity must make timely decisions about the safety of the environment and their subsistence foods. The North Slope Borough Economy, 1965 to Present study will provide a comparative basis for assessing potential economic effects of upcoming offshore oil and gas activity to better understand potential cumulative effects of offshore oil and gas development (BLM and MMS 2003a).

On April 5-6, 2001, MMS held The Bowhead Whale Subsistence Hunt and Outer Continental Shelf Oil and Gas Activities Research Design Workshop in Anchorage. This workshop was requested by NOAA Fisheries and the AEWC to focus scientific research on the cumulative effects of OCS activity on bowhead whales and their migration, as well as the socio-cultural dimensions of the subsistence whale hunt. Recommendations from the workshop identified: 1) the need for extensive funding to effectively study the complex relationship between OCS and onshore socioeconomic effects; 2) that effective monitoring is necessary to document and analyze industry and whaling activities and the many factors of change in local communities; 3) that defining and disaggregating (onshore and offshore) cumulative social effects will be a difficult process; and 4) that defining the relative causal effect of any given factor—such as OCS oil and gas activity—on social issues is problematic. Participants agreed that available resources would be better applied to researching means of prevention, intervention, and treatment of social problems in North Slope Native communities (BLM and MMS 2003b).

While these research and monitoring efforts in themselves will not resolve the larger problems of ongoing cultural challenge to Inupiat traditions from increasing development in the region—and from such powerful influences of modernity as cable television, the Internet, and an increasing dependence on a wage-based economy—they will provide processes for information sharing and opportunities for mutual decision-making and remediation of cumulative social and subsistence impacts.

4G.7.4.2 Conclusion

Alaska Inupiat Natives, a recognized minority, are the predominant residents of the NSB, the area potentially most affected by ASDP development and other past, present, and reasonably foreseeable projects on the North Slope. Environmental justice effects on Inupiat Natives could occur because of their reliance on subsistence foods, and cumulative effects may affect subsistence resources and harvest practices.

Potential effects would focus on the Inupiat communities of Nuiqsut**,** Barrow, Atqasuk, and Anaktuvuk Pass. Development as contemplated in the cumulative case could cause long-term displacement and/or functional loss of habitat to CAH, TCH, and WAH caribou over the life of CPAI's proposed development. This could result in a significant impact on access to, and perhaps the availability of, this important subsistence resource**.** Such impacts would be considered disproportionately high adverse effects on Alaskan Natives. Access to subsistence-hunting areas and subsistence resources, and the use of subsistence resources could change if oil development were to reduce the availability of resources or alter their distribution patterns.

In the unlikely event that a large spill were to occur, and if it were to contaminate essential whaling areas, major effects could result from the combined factors of shoreline contamination, tainting concerns, cleanup disturbance, and disruption of subsistence practices. Such impacts would be considered disproportionately high adverse effects on Alaskan Natives. Oil-spill contamination of subsistence foods is the main concern regarding potential effects on Native health.

Any potential effects on subsistence resources and subsistence harvests would be expected to be mitigated, though not eliminated.

4G.7.5 Cultural Resources

4G.7.5.1 Evaluation

Past, present, and future oil and gas exploration and development on the North Slope are the primary activities contributing to impacts on cultural resources because of their geographic extent. However, other activities which may contribute to cultural resource impacts, and which may in some cases have greater site-specific impact, include permitted activities such as non-oil and gas-related overland moves, scientific data gathering, recreational use by the public, and activities ancillary to BLM's land management mission.

Cultural resources are not ubiquitous across the North Slope. Because of the circumstances associated with their creation, the presence and location of cultural deposits (the physical remains of past human activity) are predictable only to a limited degree. As a result, most of the locales where cultural resources exist, remain unknown. To the extent that oil and gas exploration and production and related ground disturbance increases on the North Slope, the chance that cultural resources would be affected would also be increased.

Cultural resources, because of their surface or near-surface stratigraphic contexts, are vulnerable to activities that disturb the surface or subsurface. These resources would more likely be affected by exploration than development activity because exploration activities, such as seismic surveys, ice road and pad construction, and overland travel, affect a greater surface area than does the actual construction associated with development. Although snow cover and frozen ground may offer some protection to cultural deposits, it disguises the surface, making cultural manifestations difficult to recognize and avoid. Winter operations in low light, when most exploration activities occur, also makes recognition and avoidance of potential cultural resource sites difficult. Thus, surveys of proposed activity areas (e.g., ice roads and ice pads) and overland travel routes are advisable during the snow-free months preceding the initiation of winter exploration activities.

The potential cumulative effects of the three most likely sources of impacts to cultural resources are:

- **Effects of Gravel Extraction** – A source of significant potential impact to cultural resources could be the excavation of gravel for well pads, roads, and airstrips associated with development. Most prehistoric and historic sites are on well-drained ground. On the North Slope, well-drained ground generally contains gravel deposits and is of limited extent. As a result, a gravel deposit that has some degree of surface exposure would likely be associated with cultural resource sites. Therefore, to the extent that existing gravel deposits are extended, or new gravel deposits on well-drained ground are developed, there is a high likelihood that cultural resources may be affected and such impacts could destroy or significantly degrade an individual resource. While development of oil and gas facilities on the North Slope is expected to generate the requirement for additional gravel resources (see Table 4G.4.7-1), only one new gravel extraction site is expected to be developed as part of CPAI's current proposal. Instead, additional gravel resources are expected to be extracted from existing sites. To the extent that existing sites are used, the potential for impacts to cultural resources is reduced.

- **Effects of Natural Events** – Most cultural deposits in the National Petroleum Reserve-Alaska are revealed as the result of natural weathering processes. For example, locales having only a thin layer (or no layer) of organic soil, which results in sparse vegetation, are susceptible to wind erosion. As a result of wind erosion, artifacts may be revealed. In most cases, this type of impact is viewed as positive rather than negative, as it reveals the presence of cultural sites with little or no adverse effect to the resource. The action of flowing water, seasonal freezing and thawing (cryoturbation), thermokarsting, and solifluction are other natural processes that can reveal cultural deposits. However, these processes may cause adverse impacts to the resources.

- **Effects of a Large Oil Spill** – The effects of a large terrestrial oil spill on a cultural deposit would be directly related to the time of year and the context of the resource. If the spill were to occur during the non-snow/unfrozen surface months, then the potential level of impact would be significantly higher. In an unfrozen context, surface or near-surface cultural resources could be easily impacted, primarily by being contaminated so that radiocarbon and other elemental assays would be valueless. In this case, it is assumed that the majority of the impacts would occur as the result of the cleanup rather than the actual spill. During the frozen months, both a spill and the resulting cleanup would be considerably less impacting.

4G.7.5.2 Conclusion

The cumulative effects of the Alternative A – CPAI Development Plan and other reasonably foreseeable future development which include disturbance impacts from oil and gas exploration and the Colville River Road would be expected to impact cultural resources to some degree; these impacts would be additive. Because of the nature of cultural deposits (their generally unpredictable location and context, on surface or near surface), the magnitude of the impact is difficult to estimate. However, it is expected that if current procedures for survey and inventory before exploration and development activities were to be continued, the impact to the resource would be minimal**.** Prior to any ground disturbing activity, industry would be required to perform an evaluation and assessment of possible cultural resources in the immediate areas of the proposed disturbances.

4G.7.6 Land Uses and Coastal Management

4G.7.6.1 Evaluation

LAND USE

As stated in Section 3A.4.6, land uses for the Plan Area and for the areas considered for future development are regulated under BLM and state lease stipulations, the ACMP, and the NSB Coastal Management Program (CMP). Application of these stipulations and regulations is expected to reduce impacts associated with individual projects that might otherwise combine to create cumulative effects.

While few cumulative impacts are anticipated to occur, one cumulative impact that will not be avoided is the geographic expansion of oil and/or gas development into currently undeveloped areas zoned for conservation. Under these plans, portions of the existing area considered for the CPAI proposed plan and for the foreseeable future development are zoned as conservation and would require rezoning to the Resource Development classification and permitting of activities through NSB approval of a Master Plan. In addition, development of CPAI's proposal and/or the FFD would include construction of a production facility, road, and pipeline within the Fish Creek and Judy Creek buffer zones, the raptor buffer area around the Colville River Delta, areas identified for special caribou stipulations or restricted from surface developments near the Kogru River, and in the area near the Kogru River designated for no surface activities. These geographical extensions of industrial land use represent a cumulative and large-scale change to the land use of this area.

Reasonably foreseeable development includes further industrial expansion into undeveloped areas requiring additional rezoning and development. Construction of the state's proposed Colville River Road would also increase the development footprint and could result in additional use of nearby areas due to the increased access. These geographical extensions of industrial land use and access represent an additive and cumulative large-scale change to the land use of Alaska's North Slope.

COASTAL ZONE MANAGEMENT

Cumulative effects on Alaska's North Slope stem from activities occurring under the alternatives in this EIS; federal and state offshore oil development; state onshore oil development; and oil and gas transportation. The associated activities coupled with additional exploration, facility construction, operation and maintenance, and oil spills are the most important elements for the cumulative analysis because of their disturbance, habitat, and subsistence impacts.

Although additive impacts could cause the overall level of effect to increase, the ACMP Statewide standards and NSB enforceable policies that are relevant to the analysis of impacts for this EIS remain relevant and future development under the cumulative case would not be expected to conflict with the statewide standards or the district policies. A portion of the activities associated with the proposed plan would occur on federal land within the National Petroleum Reserve-Alaska**.** Other proposed actions, as well as most activities considered for cumulative analysis, would occur on non-federal land and will not have been previously permitted. Although federal lands are not considered to be within the coastal zone, activities on federal lands that could affect coastal resources must comply with state coastal management programs to the extent possible. Therefore, all additional development and activities in the cumulative case would be expected to be in conformance with the enforceable policies of the state and district coastal management programs. In addition, future development outside the National Petroleum Reserve-Alaska would require areas to be rezoned to the Resource Development classification and permitting of activities through NSB approval of a Master Plan. .

ENERGY FACILITIES (6 AAC 80.78) AND TRANSPORTATION AND UTILITIES (6 AAC 80.080)

Cumulative impacts from CPAI's proposal and from future development are additive and would contribute to expanded footprints from these activities. Placement of facilities would occur both within the National Petroleum Reserve-Alaska and outside, and would be expected to be brought into conformance with state and district coastal policies and standards. Placement of facilities outside of National Petroleum Reserve-Alaska will require rezoning and NSB approval of a master plan as described above. Applicable coastal standards would be addressed through an approval process and permitting would be dependent upon adherence to these policies. Stipulations and conditions placed on development would decrease overall cumulative impacts. Cumulative impacts on the North Slope from both CPAI's proposal and from foreseeable future development are not anticipated to conflict with these statewide standards.

HABITATS (6 AAC 80.130) AND SUBSISTENCE (6 AAC 80.120)

Continued development of the North Slope also brings cumulative impacts to habitats and subsistence. Placement of additional roads, bridges, pipelines, and supporting facilities will affect previously undisturbed areas adversely affecting natural habitat. In particular, those alternatives, with the exception of Alternative B, proposing development within specific habitats identified for protection in the Northeast National Petroleum Reserve-Alaska IAP/EIS, have potential to disturb important species in those areas. Stipulations are in place to minimize the cumulative impacts of the development proposed in the Northeast National Petroleum Reserve-Alaska IAP/EIS, and future development would be expected to meet the state and district coastal management standards minimizing impacts to important habitats. Therefore, the cumulative effects of development are expected to remain in conformance with the habitat standards.

In addition to cumulative impacts on habitats of the North Slope, future development will likely affect those areas used for subsistence. Cumulative impacts to subsistence will occur on two levels: (1) access, and (2) disturbance. Development could change access through increased road availability and through alteration of existing habitat use patterns. Although access through some areas may be improved due to new roads, development and activity in historic subsistence resource habitats may result in decreased use of these habitats, requiring subsistence hunters to travel further to acquire subsistence resources. Sources of disturbance likely to affect subsistence resources and access include noise disturbance; traffic disturbance; and disturbance from construction activities associated with ice roads, production facilities, pipelines, gravel mining, and supply efforts. These sources create additive impacts on subsistence; however, areas of impact are likely to be limited to those areas in the close vicinity of surrounding development. Again future development and activities will be required to comply with state and district coastal policies that require impacts to subsistence to be minimized. Impacts will have to be effectively addressed through stipulations and other protective measures required by the NSB, land management agencies, and regulatory agencies. Since current and future activities under the cumulative scenario would need to conform with state and district coastal policies, the cumulative effects on subsistence are expected to be minimized.

4G.7.6.2 Conclusion

Additive cumulative impacts on land use, habitats and subsistence on the North Slope would be expected to occur from current and future development and operation of energy, transportation, and utility facilities. The continued development of previously undisturbed areas on the North Slope will change the character of land use, cause increases in noise and disturbance, and potentially adversely affect habitats and subsistence. Most of the cumulative impacts from future development are likely to be localized to the widely dispersed facilities. Long-term impacts on land use and coastal resources are expected to be decreased effectively through stipulations, existing regulations and management practices, coordination, and future permitting processes including federal, state, and local processes and regulations.

4G.7.7 Recreation Resources

4G.7.7.1 Evaluation

In addition to the impacts described under Alternative A – CPAI Development Plan, the construction of reasonably foreseeable developments**,** including the Colville River Road, would result in cumulative impacts to solitude, quietude, naturalness, primitive/unconfined recreation, and wilderness-type values. Short-term or transient loss of the area's naturalness and solitude from such impacts as green pads/trails and noise from aircraft and equipment would not accumulate as would impacts from permanent facilities. In that respect, their contribution to the cumulative impacts would be momentary.

Under Alternative A, long-term impacts would be expected to affect an area of approximately 306 acres. Considering past, present, and future development across the North Slope, total cumulative impacts could affect an area of approximately 21,402 acres (Table 4G.4.7-1). Even so, a large area of the Arctic Coastal Plain would remain relatively untouched. However, the types of development anticipated would not be uniformly distributed across the Plan Area or the North Slope, nor would recreational and wilderness-type values be perceived to be uniformly dispersed. Cumulative impacts along popular rivers such as the Colville River will be seen as far more significant than impacts elsewhere. Under the cumulative case, the Colville River Delta and the Nigliq Channel could see a pipeline and one or more road crossings, which would change its natural appearance along that stretch of the river.

4G.7.7.2 Conclusion

Short-term impacts, such as green trails and disturbance from noise and other activities, would not accumulate. Impacts from long-term or permanent facilities such as roads, pipelines, and gravel pads would accumulate and would result in the long-term loss of solitude, quietude, naturalness, or primitive/unconfined recreation, and wilderness-type values. These impacts could be locally adverse.

4G.7.8 Visual Resources

4G.7.8.1 Evaluation

Overland moves and scientific studies (with associated camps and excavation), whether or not associated with oil and gas development activities, can impact visual resources. Overland moves, which can create green trails**,** and temporary camps would increase with the need to support oil and gas development. For example, field activities associated with archaeological site clearances (such as camps, excavations, and aircraft activity) would likely increase.

Although the amount of supplies and materials transported by winter overland moves could increase cumulatively, these moves generally follow the same routes. New trails could be developed to reach new staging areas and pump stations; however, once the route was identified, numerous trips over the route could occur without additional impacts.

Seismic survey work would continue, increasing the number of operations. All future development could result in hundreds of miles of intermittent green trails visible from the air during any one-summer season. The natural recovery time for this type of impact would be less than the 15 to 20 years being used for the cumulative case analysis. As production of fields increased, seismic work would tend to decrease and green trails would decline in number and recover naturally.

Past development and production of oil and gas has impacted the visual resources of approximately 10 percent of the North Slope area at one time or another. Present development and production could affect less than 1 percent of the North Slope, while reasonably foreseeable future development could affect approximately 1 percent of the total North Slope area. However, remediation of old drill sites is ongoing, and many of the impacts have a natural recovery rate of less than the 15 to 20 years being used for this analysis. Ring effect from old well sites would also naturally recover in less than the 15 to 20 years being considered under this analysis. Exploration wells would leave behind a marker pipe expected to be no larger than one square foot on the surface and 6 feet tall. This would be essentially a permanent impact, though almost unnoticeable from several hundred feet away.

4G.7.8.2 Conclusion

Short-term impacts such as green trails would not accumulate**,** and would naturally recover. Impacts from long-term or permanent facilities such as roads, pipelines, gravel pads, and pits would accumulate and would result in the long-term loss of scenic quality.

Long-term impacts from future development with a possible life span of over 30 years would affect the visual resources for the North Slope**.** These impacts would be expected to be greatest within a half-mile radius of each developed site. Pipelines could be elevated above ground level. Except during construction and repair of pipelines, there would be no associated on-the-ground activity. Therefore, long-term impacts to visual resources from pipelines would be expected to be minimal beyond approximately a half-mile.

4G.7.9 Transportation

4G.7.9.1 Evaluation

All of the impacting activities associated with oil and gas development require the transport of personnel and materials to future development sites and would cumulatively affect North Slope transportation resources. More recent oilfield developments, such as the Alpine Development Project, are located farther from the central Prudhoe Bay facilities and are not connected by road to these facilities. This results in an increased reliance on air transportation during summer months supplemented with extensive use of low-pressure ground vehicles or ice roads for ground access to the remote sites during winter months. Continued oil and gas development on the North Slope will require construction of additional transportation facilities, particularly roads and airstrips to support both construction and operation activities. New developments are more likely to have roads connecting clusters of remote oil production facilities to central processing facilities, but to not have year-round road access to the Prudhoe Bay area. Thus, future development is likely to result in comparatively higher levels of air traffic on the North Slope than existing facilities.

The transportation effects of the foreseeable future projects, when combined with Alternative A – CPAI Development Plan, include continued development of oil and gas industry roads and airstrips to serve clusters of oil production facilities located across the North Slope and resultant increased road and air traffic throughout the region. Road and air transportation demands are likely to peak during construction of each new field and to decrease as construction ends and the fields become operational. In the cumulative case, however, there may be times when construction and other North Slope prospects may overlap, resulting in higher air and road traffic levels, particularly on the main oil industry transportation infrastructure in the Prudhoe Bay area. In addition, although road and air traffic for any one site is likely to drop after completion of construction, new facilities will continue to be constructed and existing facilities will continue to operate, which could result in cumulative long-term increases in road and air traffic to and throughout the North Slope.

Future developments are likely to have local road networks, but not to be connected to Prudhoe Bay facilities by a year-round roadway. Transport of most materials to proposed future sites would occur via the Dalton Highway to the Prudhoe Bay area. Transport of materials from Prudhoe Bay to remote development areas will peak during winter periods, when overland access to these facilities is possible, by ice road or low-pressure ground vehicle. This could result in more substantial road traffic peaks on existing oil industry roadways during winter periods, as well as concentrated ground traffic peaks to remote areas during short winter access seasons.

The proposed Colville River Road would provide a major overland route for the oil industry to transport personnel and materials to development occurring south and west of Prudhoe Bay**,** including the ASDP area. This would result in significantly lower road traffic levels on the existing infrastructure from Deadhorse to Kuparuk than would occur without the proposed road. Again, the increased overland traffic activity and increased access to currently remote areas on the North Slope could result in adverse indirect effects on wildlife, subsistence, and recreation resources.

4G.7.9.2 Conclusion

Development of Alternative A – CPAI Development Plan along with continued oil and gas development throughout the North Slope will result in substantial increases in both road and air traffic levels throughout the North Slope, and particularly on the central oil and gas transportation infrastructure in the Prudhoe Bay area. However, most of the transportation infrastructure on the North Slope is restricted to industry and local resident use, and is currently operated at well below capacity. Despite the substantial increase in activity levels, the existing infrastructure combined with the proposed roads and airstrips serving remote facilities, is expected to be sufficient to accommodate these increased demands for air and overland transportation. Therefore, there are not anticipated to be any adverse cumulative effects on transportation resources on the North Slope.

4G.7.10 Social Systems Cumulative Effects for Alternatives B, C-1, C-2, D-1, D-2 and F – CPAI Development

Because CPAI's proposed development is a relatively small part of all past, present, and potential future development on the North Slope, the cumulative impacts of development of CPAI's proposal under Alternatives B, C-1, C-2, D-1, D-2, and F are similar to those described in the preceding sections for Alternative A. Because of the difference in disturbed area among the different alternatives, some cumulative impacts would vary. For example reduction in the gravel footprint and requisite extraction of gravel under Alternatives B and D-1 and D-2 would reduce the risk of impacts to cultural resources and subsistence, while the relocation of CD-6 in Alternative B would result in a small decrease in overall North Slope oil contributions to the local and state economies. Alternatives that provide continuous road access to CD-7 (Alternatives A, C, and F) also provide efficiencies and economic benefits to future oil exploration and development in this exploration and development frontier. Similarly, construction of the Colville River Road could have significantly different impacts on the social systems of Nuiqsut under Alternative C than under the other alternatives. The Colville River Road would provide direct access to Nuiqsut via the Prudhoe Bay development area, which could increase interaction between villagers and oil industry workers. It could also increase use of and conflict over subsistence use areas. However, disturbance under any of the analyzed 5-pad development alternatives represents a relatively small contribution to overall cumulative impacts whether comparing it to total disturbance to date or as a component of expected incremental future disturbance. Thus differences between alternatives became an even smaller differentiation between alternatives when considering cumulative impacts.

4G.8 CUMULATIVE SOCIAL SYSTEMS IMPACTS OF ALTERNATIVE E – NO-ACTION

Under Alternative E, no action is proposed. No overall cumulative effects to the social systems environment result from Alternative E – No Action. However, cumulative impacts on the North Slope are anticipated to occur from other foreseeable future development. While impacts from the foreseeable future development could be additive, overall effects on the social systems resources would be negligible.