SECTION IV

ENVIRONMENTAL CONSEQUENCES

IV. ENVIRONMENTAL CONSEQUENCES

A. INTRODUCTION AND BASIC ASSUMPTIONS FOR EFFECTS ASSESSMENT:

The potential effects of the proposed Northeast National Petroleum Reserve-Alaska (NPR-A) Planning Area Integrated Activity Plan (IAP) are assessed in Section IV of this IAP/environmental impact statement (EIS); the order in which the topics of this section are presented is as follows. This assessment includes the potential effects that each of six alternatives (A, B, C, D, E, and Preferred Alternative) might have on the resources in and adjacent to the planning area. The potential impacts of other past, present, and reasonably foreseeable future activities are analyzed in the cumulative case. In addition, Section IV also includes discussions of environmental effects that cannot be avoided should the plan be implemented, the relationship between short-term uses of humanity's environment and the maintenance of long-term productivity, and any irreversible or irretrievable commitments of resources that would be involved in the plan, if it is implemented.

The IAP includes a range of oil and gas leasing options and the potential effects of this action, which focus primarily on oil development. These potential effects are analyzed in Alternatives B, C, D, E and the Preferred Alternative and Sections IV.C, D, E, F, and G and natural gas development and production is analyzed in Section IV.K. Alternative A is the No Action Alternative and does not include an oil and gas leasing proposal. Although no date has been set, it is assumed an oil and gas lease sale would take place, if authorized by this plan, within the next several years. The area that would be available for oil and gas leasing under the various alternatives is shown in Table IV.A-1(a); the size of other survey, geographic, and manmade features and their areal relationship to the alternatives is shown in Table IV.A-1(b).

The analysis of the various areas proposed as alternatives for oil and gas leasing in the Northeast NPR-A Planning Area IAP initially focuses on the potential effects of the first lease sale. This analysis is based on (1) present-day knowledge about the physical characteristics, biological resources, and social systems described in Section III of this IAP/EIS; (2) petroleum resources as estimated from current geological and geophysical data (Sec. III.A.1.a(3); and (3) scenario assumptions that have been hypothesized using current North Slope petroleum-industry technologies and infrastructure (Sec. IV.A.1.b). The levels of activities in the scenario assumptions are based on the estimated ranges of petroleum resources. Given the assumptions that are part of the analysis, the focus on the initial sale provides the best estimate of the potential effects that oil and gas leasing might have in the reasonably foreseeable future.

The analysis of the effects of the IAP focuses on those activities that have some potential impact "on the ground"; these activities are described in Section IV.A.1. For each of the resources analyzed in each of the alternatives and the cumulative case, the analysis for the first sale ends with a conclusion (Conclusion—First Sale); if the potential effects of an alternative on a resource results in a relatively lengthy analysis, the conclusion is preceded by a summary (Summary) of the analysis.

Under Alternatives B through E and in the Preferred Alternative, the Bureau of Land Mangement (BLM) may decide to hold more than one oil and gas lease sale in the planning area. The number of potential sales, the interval between sales, and the period with which the sale may be held are unknown; however sales can be held by tiering off this IAP/EIS so long as the environmental analysis is valid. If there are multiple sales in the planning area, the tracts that may be offered will be restricted to the unleased parts of the area made available for leasing by the selected alternative. For each resource under each alternative, the potential effects of multiple sales are analyzed after the analysis of the first sale (follows the Conclusion—First Sale) and also ends with a conclusion (Conclusion—Multiple Sales).

Alternative B makes 53 percent of the planning area available for oil and gas leasing. Lands identified as important for paleontological resources, recreational use, and habitat for caribou, waterfowl, and fish would not be made available for oil and gas leasing. Lands from which the village of Nuiqsut's Alaska Native Claims Settlement Act (ANCSA) corporation are entitled to select would not be leased for oil and gas until the corporation's entitlement has been satisfied. An area along the Ikpikpuk River

would be recommended as a new Special Area, and the alternative would recommend that the Pik Dunes be added to the Teshekpuk Lake Special Area. A corridor along the Colville River would be recommended as a "wild" river under the Wild and Scenic Rivers (WSR) Act, and BLM would work with adjacent landowners to establish a Bird Conservation Area (BCA) along the Colville River and some of its tributaries.

Alternative C makes 72 percent of the planning area available for leasing. It protects the habitats important to the Teshekpuk Lake caribou herd (an important subsistence resource for area residents) and molting geese, which visit the planning area every summer, by making these habitats unavailable for oil and gas leasing. An area along the Ikpikpuk River would be recommended as a new Special Area, and the alternative would recommend that the Pik Dunes be added to the Teshekpuk Lake Special Area. A corridor along the Colville River would be recommended as a "scenic" river under the WSR Act, and BLM would work with adjacent landowners to establish a BCA along the Colville River and some of its tributaries. This alternative also applies surface-use restrictions and other stipulations to other habitats identified as having high surface resource values.

Alternative D makes 90 percent of the planning area available for leasing. The important goose- molting area north and east of the Teshekpuk Lake, which also encompasses part of the caribou-calving area, would remain unavailable for oil and gas leasing. An area along the Ikpikpuk River would be recommended as a new Special Area and the alternative would recommend that the Pik Dunes be added to the Teshekpuk Lake Special Area. A corridor along the Colville River would be recommended as a "recreation" river under the WSR Act, and BLM would work with adjacent landowners to establish a BCA along the Colville River and some of its tributaries. The alternative also applies surface-use restrictions and other stipulations, including special requirements to minimize impacts to calving and postcalving caribou, in other areas of high surface resource values.

Alternative E makes all BLM administered lands in the planning area available for leasing. However, surface resources would be protected through lease stipulations that restrict oil and gas activities in sensitive areas. Specific restrictions, including siting restrictions on structures and seasonal restrictions on uses, protect caribou and molting geese and their habitats. An area along the Ikpikpuk River would be recommended as a new Special Area, and the alternative would recommend that the Pik Dunes be added to the Teshekpuk Lake Special Area. The BLM would work with adjacent landowners to establish a BCA along the Colville River and some of its tributaries.

The Preferred Alternative protects habitats important to molting geese and the Teshekpuk Lake caribou herd by making them unavailable for leasing or by strict restrictions on oil and gas surface occupancy. In addition, surface-use restrictions and other stipulations are applied to other habitats identified as having high surface resource values, including areas identified by North Slope residents as important subsistence use areas, such as Fish and Judy creeks and the Ikpikpuk and Miguakiak rivers. Similar restrictions and stipulations are applied to the Colville, Kikiakrorak, and Kogosukruk rivers to protect raptor nesting and subsistence. Areas along the latter two rivers are added to the Colville Special Area and the Pik Dunes is added to the Teshekpuk Lake Special Area under the Preferred Alternative. While protecting these resources, the alternative makes 87 percent of the planning area available for leasing. Through the use of stipulations, leasing would be conducted in a manner that is consistent with the protection of the surface resources, including requiring a thorough consultation with affected communities, establishment of a Subsistence Advisory Panel, and creation of an Interagency Research and Monitoring Team. This team would coordinate research and monitoring efforts related to the effectiveness of stipulations and surface resource impacts. No roads connecting outside the planning area (other than temporary ice roads) will be allowed.

The final part of the analysis for each resource under each alternative addresses the effectiveness of the stipulations that are incorporated as part of the alternatives (Effectiveness of Stipulations). The potential risk that petroleum development might have on the resources in the planning area also might be reduced through the implementation of the stipulations as described in Section II. Some of these stipulations could eliminate or restrict certain types of activities in areas available for oil and gas leasing. These restraints also could reduce the estimated amount of resources that could be developed by eliminating some potential prospects, especially the smaller ones, from exploration and development consideration.

1. Ground-Impacting-Management Actions:

The ground-impacting-management actions refer to those types of activities that are managed through BLM's regulatory and permitting processes. These activities may have some level of impact "on the ground" in the Northeast NPR-A Planning Area. For the purpose of this IAP/EIS, the ground-impacting activities have been divided into those that are not associated with oil and gas exploration and development and those that are associated with oil and gas exploration and development. The types of activities not associated with oil and gas exploration and development are described in Section IV.A.1.a. The potential effects of these activities are analyzed in Alternative A, the No Action Alternative (Sec. IV.B). The

Table IV.A-1
Areas: (a) Alternatives and (b) Features

(a) Alternatives

	A		B		C		D		E		Preferred Alternative	
Leasing Availability	Acres (million)	Percent of Planning Area	Acres (million)	Percent of Planning Area	Acres (million)	Percent of Planning Area	Acres (million)	Percent of Planning Area	Acres (million)	Percent of Planning Area	Acres (million)	Percent of Planning Area
Available	0	0	2.43	53	3.31	72	4.14	90	4.60	100	4.01	87
Unavailable	4.60	100	2.17	47	1.29	28	0.46	10	0	0	0.59	13

(b) Features

	Size			Percent of Land Available for Leasing: Alternatives				
Areal Feature	Square Miles	Acres	Percent of Planning Area	B (2.0 Million Acres)	C (3.4 Million Acres)	D (4.2 Million Acres)	E (4.6 Million Acres)	Preferred Alternative (4.0 Million Acres)
Township	36	23,040	0.51	1.17	0.69	0.56	0.51	0.58
Section	1	640	0.01	0.03	0.02	0.02	0.01	0.02
Airstrips (150–200 feet wide by 5,000 to 6,000 feet long)[1]	0.03-0.05	20-30	<0.001	0.001-0.002	<0.001	<0.001	<0.001	<0.001
Field Development Footprint[1]	0.16	100	0.002	0.005	0.003	0.002	0.002	0.002
100 – 1,000 acres	0.16-1.56	100-1,000	0.002-0.021	0.005-0.049	0.003-0.03	0.002-0.024	0.002-0.021	0.002-0.02
9,255 acres[2]	14.46	9,255	0.20	0.46	0.27	0.22	0.20	0.23
Teshekpuk Lake[3]	315	201,600	4.38			4.80	4.38	5/04
Naluakruk Lake[3]	12	7,680	0.17				0.17	0/19

[1] Appendix A2: Reasonable and Foreseeable Development Scenario
[2] Total onshore area affected by gravel extraction and fill for existing oilfields and planned projects on the North Slope — Tables IV.A.5-3 and IV.A.5-5
[3] 105(c) Land Use Study, Physical Profile; 1978.

Lake is located in that part of the planning area that is unavailable for leasing under the alternative.

activities associated with oil and gas exploration and development are described in Section IV.A.1.b. The potential effects of oil and gas explorations and development activities are based on discovery and production of five estimated ranges of crude oil and analyzed in Alternatives B, C, D, E, and the Preferred Alternative (Secs. IV.C, IV.D, IV.E, IV.F, and IV.G, respectively).

a. Activities Other Than Oil and Gas Exploration and Development: The following are activities other than oil and gas exploration and development that BLM may undertake or authorize within the planning area that could have impacts on surface resources. A generic description is given of the types of activities that may occur, the general location where the potentially impacting activity would be likely to occur, the time of year of the activity, and estimates of the frequency of such actions. Table IV.A.1.a-1 summarizes the amount of some of these activities anticipated under each of the alternatives.

(1) Aircraft Use: Light helicopters commonly are used to examine resources in the planning area. Less frequently, people fly light fixed-wing aircraft. Medium fixed-wing and medium helicopters occasionally are used; heavy helicopters are used extremely rarely. These aircraft transport people, supplies, and equipment for fieldwork and fly aerial surveys.

Helicopters normally fly low and slow. They have a negligible physical impact on the ground, but their noise can have measurable impacts on wildlife behavior. Fixed-wing aircraft produce less noise and usually fly higher and faster. They have a negligible ground impact if landed on established airstrips, on lakes during the summer, or on ice

in winter. When used on unimproved landing areas in the summer, however, they can take a toll on vegetation and soils. Point-to-point transportation can be flown to avoid sensitive wildlife and generally is at higher altitudes and of shorter duration over any given area than aerial-survey flying. Therefore, it normally creates less impact on wildlife.

Almost all aircraft activity would take place in summer. While aircraft likely will fly over nearly all of the planning area, some areas will receive greater use. Surveying of resources and monitoring human use will concentrate along the Colville and Ikpikpuk rivers. Cultural and paleontological surveys most likely would involve aircraft in the central part of the planning area. Aerial wildlife surveys will occur most commonly during late June and early July over caribou and waterfowl areas.

(2) Excavation and Collection: Archaeological, paleontological, geologic, and soils assessment excavation and collection take place in summer. All excavation is by trowel or hand shovel and usually is limited to an area of several square feet (ft) and rarely goes deeper than 3 ft. More extensive areas may be excavated, if an archaeological site is being studied in greater detail or if a geologic section is being mapped. Excavations are backfilled and, in most cases, the vegetative layer is replaced atop the excavation. Most of the anticipated excavation probably would occur in the central portion of the planning area.

(3) Ground Activities: Ground activities encompasses such benign activities as small groups of scientists hiking across the land and small groups of recreationists floating along a river. Given the small numbers of such users and the scattered and benign nature of their activity, no impacts are expected from this travel.

Impacts are possible from camps. Camps vary from those associated with an aircraft onsite to those with no more supplies than can be carried in a backpack. The former may include a fuel bladder of up to 5,000 gallons (gal) or fuel in drums and might have approximately 15 persons in the party. Smaller parties use "fly" camps, which are set up and moved every few days or so by boat, raft, or aircraft and have no more than stove fuel. Backpack camps have even fewer supplies and most commonly are moved daily.

Larger camps most likely would be placed at the Inigok airstrip, the abandoned Ikpikpuk well site in Sec. 25, T.13N., R.10W., Umiat Meridian; the Lonely Distant Early Warning (DEW)-Line site in Sec. 17, T.18N., R.5W., Umiat Meridian; and the Ivotuk airstrip, which is outside the planning area in Sec. 13, T.11S., R.17W., Umiat Meridian. Fuel facilities would be associated with each of these camps and, at some of these sites, a fuel cache might be established without a camp. The use of the Inigok airstrip is likely to be greater in the next few years to support Native Allotment fieldwork and endangered-species monitoring than in subsequent years. Small camps may be placed at locations throughout the planning area.

Vegetation trampling is common to all camps, although it increases with the duration of the camp. Some solid wastes can be burned onsite, but all other waste, including human waste, is removed from all but the fly and backpack camps. Human waste at the latter two camps is disposed of in a manner to render effects negligible, as recommended in the National Outdoor Leadership School's "Leave No Trace, Alaskan Tundra" guidelines.

Caches of drums of aviation fuel commonly are established to facilitate more economic aircraft use. All such caches include spill-cleanup material, and caches with more than (>) 500 gal are within a containment, normally a portable containment dike. Vegetation trampling and small fuel spills are associated with fuel caches.

(4) Hazardous and Solid Material Removal and Remediation: A phased approach will be used to address hazardous- and solid-waste material in the planning area. This includes the verification and site evaluation of uncontrolled releases of hazardous substances on BLM land. The process is consistent with guidance and regulations from the Comprehensive Environmental Response, Compensation and Liability Act and the National Contingency Plan.

(a) Discovery and Site Verification: Discovery and site verification is the first phase of the process. The discovery component is when a release or threat of release of a hazardous substance is suspected or has occurred. This information may be generated through an inventory, incidental observation, or report by either the public or another agency.

An initial incident/site examination is performed by trained personnel. This involves the verification of the land ownership and that a release of a hazardous substance is suspected or has occurred. The process involves inspection and verification of existing information and, potentially, the use of helicopter or fixed-wing aircraft to mobilize to the site. Programmatically, 2 to 3 weeks per field season is directed for this kind of activity. Actual time and extent of investigation depends on the number and types of reports or discoveries.

If a release is suspected or has occurred, a risk assessment will be conducted to determine if the situation poses an imminent threat to public health or to sensitive environments. The purpose of this assessment is to

Table IV.A.1.a-1
Summary of Some Anticipated Non-Oil and Gas Related Management Activities

	ALTERNATIVES					
	A	**B**	**C**	**D**	**E**	**Preferred Alternative**
AIRCRAFT USE	(This use does not include that associated directly with oil and gas development or recreation; fixed- wing aircraft and helicopters are used; almost exclusively summer use.)					
Point-to-point	occasional	regular but not daily	regular but not daily	daily	daily	regular but not daily
Wildlife aerial surveys	14 days during June and July	21 days during June and July	21 days during June and July	21 days during June and July	21 days during June and July	21 days during June and July
Other aerial surveys	occasional	several 1-2-week periods	several 1-2-week periods	several 2-3-week periods	several 2-3-week periods	several 1-2-week periods
EXCAVATION AND COLLECTION	≤1 acre disturbed	2 acres disturbed	4 acres disturbed	5 acres disturbed	6 acres disturbed	4 acres disturbed
GROUND ACTIVITIES	(These camps do not include those associated directly with oil and gas development or recreation use; large camps include ≥15 persons and may have 5,000 gallons of fuel; Umiat, Lonely, Inigok, and the Ikpikpuk well-site are likely locations for large camps; all camps occur in summer.)					
Large camps	6 weeks	12 weeks	12 weeks	12 weeks	12 weeks	12 weeks
Small camps	3 weeks	6–12 weeks	6–12 weeks	6–12 weeks	6–12 weeks	6–12 weeks
RECREATION	(Colville River float-trip parties; typically 4 persons per party; SRP=Special Recreation Permits, i.e., guided, regulated by BLM.)					
Above Umiat	6 with SRP's 3 casual parties	7 with SRP's 8 casual parties	7 with SRP's 8 casual parties	7 with SRP's 8 casual parties	6 with SRP's 3 casual parties	6 with SRP's 3 casual parties
Below Umiat	4 with SRP's 1 casual party	9 with SRP's 6 casual parties	9 with SRP's 6 casual parties	9 with SRP's 6 casual parties	8 with SRP's 5 casual parties	8 with SRP's 5 casual parties

determine if the situation warrants immediate action. If so, an emergency response or removal action may be initiated.

If the examination verifies that the release of a reportable quantity of a hazardous substance (40 CFR 302.4) occurred, a threat exists, or a release is suspected, and the situation does not warrant an emergency response, a site evaluation should be conducted. The evaluation process is implemented concurrently with the identification of potential responsible parties and cost- avoidance/cost-recovery process. When a viable potential responsible party is identified, all remaining actions pertaining to the evaluation and remedies should be completed by the individual responsible under the appropriate Federal and State oversight.

(b) Site Evaluation: The objectives of removal evaluations are to determine if a problem exists, identify short-term alternatives to correct the situation, and determine if a remedial evaluation is required for the site. The first step is to document whether the release of a hazardous substance has occurred and identify the potential constituents of concern, principally by the use of nonintrusive samples. Identification of potential targets that may be impacted and pathways by which they may be impacted also is information to be provided. Determining the need and appropriateness of removal actions and whether expanded sampling is required is another component.

Expanded sampling and site characterization generally take about 2 weeks per site. Shovels and hand augers generally are used for this phase of the project. Experience indicates that additional site characterization is warranted in approximately 20 percent of the sites based on analytical results, targets, and pathways of concern. Drill rigs or hydropunches and backhoes for near- surface sampling can be used for studying groundwater and determining the extent of contamination at a site. These advanced studies commonly entail 3 to 4 weeks of field time. Eighty percent of the drilled holes commonly are backfilled immediately. The remaining borings commonly are developed into monitoring wells. Proceeding to a remedial evaluation may be the next investigatory step.

Prioritization for removal actions will focus on areas of greater human contact or biologically sensitive areas. Thus, it is anticipated that most potential removals would occur in the northern part of the planning area and near the Colville River.

A preferred removal alternative minimizes soil disturbance. A fence may be placed around the site to secure it to prevent contact by humans or wildlife. A cap of clean soil or gravel is another measure to minimize contact. Depending on the contaminants, in situ treatments may be a practical alternative.

If necessary, contaminated materials would be excavated and removed for treatment and disposal. Excavation generally would not go deeper than 5 ft below the surface. Disturbed areas would be backfilled and leveled and erosion-control measures engineered. Removal activities would involve the use of heavy equipment such as large and small backhoes, 988-size front-end loaders, bulldozers up to the size of a D-9, dump trucks, pickups, and all-terrain vehicles. This type of equipment would be transported overland in winter. A barge may be used, if the site is accessible by water.

Because cleanup in many cases can be accomplished only in summer, a gravel pad or road may be constructed for use during the operation to protect the underlying soil and vegetation. Such a pad may be removed after project completion.

If further investigation is warranted for a site, a remedial site evaluation may be required. The primary objective of the remedial stage is to determine the relative significance of the site in terms of risk to targets and to select permanent solutions for significant sites that are both cost effective and efficient. These studies generally involve more complex situations that require long-term treatments. There are required regulatory timeframes for submission of remedial reports once the process has been initiated, and sites are published in the *Federal Register* (*FR*).

Most hazardous- and solid-material removal and remediation is a lengthy process in part because of the expense involved. The exception is the occasional removal of fuel drums and scrap metal. Government parties in the area for other purposes with a medium helicopter can use a sling to carry these items to appropriate disposal facilities. Substantial funding, however, would be necessary to undertake any cleanup other than this small-scale removal by helicopter.

(5) Overland Moves and Other Land Use Permits: The BLM issues permits to authorize overland moves and a variety of other activities in the planning area. Vehicles used in overland moves exert low ground pressure and are permitted to travel only over snow-covered ground frozen to a sufficient depth to minimize soil and vegetation impacts. Overland moves typically occur from Prudhoe Bay or Oliktok Point to Barrow. If conditions allow, travel will be exclusively offshore over ice. If the ice is not safe, portions of the trip will be made overland following the shoreline, although moves farther inland are not precluded. The earliest moves normally begin in December, when there is adequate snow cover and the ground is frozen. The last trips generally end in April. Twenty to 100 trains of one to six vehicles and attached sleds travel this route annually. Should oil and gas exploratory drilling and development increase general economic activity on the North Slope, the number of overland moves may tend toward the higher of these numbers. Overland moves associated with oil and gas exploration and development are discussed below in Section IV.A.1.b.

The BLM may issue minimum-impact permits per 43 CFR 2920 for a variety of other uses. For example, the North Slope Borough (NSB) currently is authorized to maintain a wildlife- observation cabin on the north shore of Teshekpuk Lake accessed by airstrip or boat and used year-round.

(6) Recreation: The BLM issues Special Recreation Permits (SRP's) to commercial recreation operators, such as hunting and float-trip guides, all of whom focus their activity along the Colville River. Under current management, up to three of the permittees, accounting for at most six trips, may float from the headwaters area to Umiat. These trips would be for hunting and would take place in August or the first week of September. They would consist of about four persons who probably would not camp within the planning area. Under current management, up to two permittees, accounting for up to four parties of four persons each, may conduct trips below Umiat during the summer to enjoy the scenic, wildlife, and paleontological resources of the Colville. Each party would camp up to three times each in the planning area. A very limited number of SRP's may be associated with other types of use. At least one permittee may operate with floats taking hunters to lakes or sightseers to areas along the Colville River. These flights may result in camping similar to that of fly camps or backpack camps.

Floating parties along the Colville will carry enough fuel for a small stove and their boat engines. They will camp for no more than 1 night in any one place, and their camping practices and likely impacts would be consistent with those of fly camps or backpack camps described above under "Ground Activities."

Alternatives B through E and the Proposed Alternative propose a variety of actions that could increase the number of visitors or add new recreational opportunities for current

users of the area. Creation of an air park at Umiat and associated loop trails probably would not attract many people to Umiat. The 50 to 75 persons who use the airstrip, however, would benefit from those facilities. Designation of the Colville River area as a BCA or as a part of the WSR System would draw new visitors to the Colville. Access to the upper river would be via small airplane from Bettles or Noatak, with landings occurring on gravel bars along the river. Parties interested in only the lower portion of the river could land at Umiat.

b. Oil and Gas Exploration and Development Activities:

(1) Introduction: This section provides a general description of the activities associated with oil and gas operations on the North Slope of Alaska. Current state-of-the-art technologies and project designs are used to project the scenarios for future petroleum development in the NPR-A. Petroleum-related activities include conducting seismic operations; constructing ice roads for transporting equipment and supplies for winter drilling of exploration wells; drilling exploration and delineation wells; constructing gravel pads, roads connecting production pads to main facilities, and landing strips; drilling production and service wells; and installing pipelines. The impact of these activities will be incorporated into the environmental analyses required for a future NPR-A oil and gas leasing program.

The activities described in the following section are applicable in a very general sense, because the actual timing and location of future commercial-sized discoveries cannot accurately be predicted today. Future petroleum projects in the NPR-A are likely to encounter unique geologic and environmental conditions that will require site-specific engineering strategies. The goals are to maximize the safety and efficiency of operations while minimizing the effects of development on the environment. We reasonably can expect that future technologies and designs will evolve from today's state-of-the-art practices to better realize these goals.

The general descriptions of typical petroleum-related activities in northern Alaska are followed by a discussion of possible development scenarios. A fundamental assumption is that the level of future activities is directly related to the petroleum-resource potential made available for leasing and development. However, industry's interest in exploring for new reserves is highly influenced by profit motives, where opportunities for new production in northern Alaska must compete with projects elsewhere. Consequently, future development activities and their associated impacts are controlled by several factors, including the resource potential of the area, the areas available for leasing, industry's ability to identify exploration prospects, and the competitive interest in exploring for new fields.

Two sets of development scenarios are discussed. The first set includes activities estimated to occur as a result of the next lease sale in the NPR-A. This sale, tentatively scheduled for late 1999, is the first sale in a renewed series of future lease sales that could offer various parts of the NPR-A. The total resource potential and associated development activities are scaled down for this "first-sale" scenario because despite their best efforts, industry is not likely to lease and discover all of the commercial accumulations as a result of a single lease sale. The second set of development scenarios includes the activities required to develop and produce the total resource potential. This is referred to as the "multiple-sale" scenario. As indicated by the activity projections, a large fraction of the resource production is expected to occur as a result of the first sale in the series, with progressively lower fractions occurring from each subsequent sale. Petroleum-related activities, and associated impacts, are presumed to follow a similar decreasing trend, because later developments will attempt to use existing infrastructure whenever feasible. The overall spread of petroleum development on the North Slope, including current as well as reasonably foreseeable future activities, is discussed under the cumulative case.

(a) Resource Estimates: Estimates of oil and gas resources provide the basis for identifying high-potential areas for possible leasing and to project reasonable future development scenarios analyzed in environmental impact studies. Development scenarios are general models for future activities, and different scenarios of hypothetical oil development are, perhaps, equally plausible. At this time, there is no guarantee that leasing will occur in the planning area or that commercial discoveries will be made. However, the National Environmental Policy Act (NEPA) process requires that leasing on these Federal lands must consider the reasonable and foreseeable consequences of the proposed action.

Estimates of undiscovered resources are uncertain for numerous geologic, engineering, and economic reasons. An accurate accounting for all oil or gas reserves is possible only after the entire production cycle is completed, perhaps decades into the future. Geologic data is in a nearly constant state of revision, as new concepts are revealed by detailed studies, mapping, and new well information. Engineering technology evolves with experimentation and experience. Economic conditions, such as oil price or worldwide energy supply/demand, are difficult to predict beyond the near future. To account for these uncertainties, resource estimates usually are reported as a range of volumes. A corresponding range of activities,

tied to resource production levels, is generated to represent reasonable scenarios, should leasing take place.

The reported resource estimates represent the range of production at oil prices of $18 to $30 per barrel (in constant dollars). This does not imply that oil prices always will remain in this price range, only that these prices represent reasonable long-term limits to bracket economically viable development scenarios. If oil prices remain below this range, lower (or nonexistent) levels of petroleum activities in the NPR-A would be expected. It also is conceivable that greater volumes of oil could be recovered through advanced technologies that are unknown at present. Because we cannot accurately quantify the effects of future technology, the higher resource level (at $30) could be viewed simply as an upper limit for production rather than as a prediction of much higher future oil prices. In any case, the $18 to $30 price range and corresponding resource estimates provide a reasonable basis for environmental analysis.

For the first sale in the Northeast NPR-A Planning Area, oil production could range from 250 to 1,100 million barrels (MMbbl) from one to five commercial fields, assuming that the entire area is open to leasing and development. The remaining economic petroleum potential is available for discovery and production as a result of subsequent lease sales. The "multiple-sales" scenario could add an additional 250 to 1,100 MMbbl, corresponding to one to five more fields, assuming that the entire area is open. Leasing alternatives that restrict leasing and development will decrease the opportunities for new discoveries and lower the expected levels of activities and petroleum production.

(b) Natural Gas: The foreseeable development scenarios do not include the production and transportation of natural gas outside of the planning area. Only liquid hydrocarbons (crude oil, with minor amounts of gas-condensate) are considered to be viable petroleum commodities recovered from the NPR-A within the foreseeable future. Several reasons are behind this assumption: (1) there is no current transportation system to handle the production of North Slope gas; (2) although numerous systems have been studied, there are no economically viable systems under current price and marketing conditions; (3) when a gas-transportation system is constructed, there are ample proven gas reserves to fill the system for decades; and (4) no exploration and development targeting new undiscovered resources is likely, until excess capacity is eminent in the existing (as-yet unbuilt) system. With proven gas reserves on the North Slope approaching 35 trillion cubic feet (Tcf), 23 Tcf of which is present in the Prudhoe Bay field alone (State of Alaska, Dept. of Natural Resources [DNR], 1997), it is unlikely that new exploration will target additional gas resources in remote areas of the NPR-A.

Although a number of gas-transportation systems for North Slope gas have been proposed, the most likely future gas-transportation system involves a large-diameter gas pipeline from northern Alaska to a liquefied natural gas (LNG) processing plant in southern Alaska. Marine LNG carriers would then transport the gas product to distant markets, largely in the Pacific Rim. The Trans-Alaska Gas Pipeline system (TAGS) currently has the support of both industry and the State of Alaska as the front-runner of future gas-delivery systems. However, with an estimated cost of $12 to $15 billion, the TAGS project is uneconomic under current market conditions.

A new gas-processing technology, termed "gas-to-liquid" (GTL), can convert natural gas to high-purity "white crude." However, this new technology is untested for large-scale operations such as the North Slope. In the future, GTL technology could be used to produce gas from small, remote fields in the planning area, but this situation is beyond the scope of foreseeable scenarios in the present analysis.

Without a large, outside market for gas production, new gas discoveries are likely to be "shut in" (abandoned for an undetermined period), and gas recovered as a byproduct of oil production will be used as fuel for facilities or pumped back into reservoirs to increase oil recovery. Reinjected gas would not be lost as a resource, but gas sales to outside markets would be postponed.

(2) Petroleum Operations under Arctic Conditions:

(a) Past Experience: Oil and gas operations under arctic conditions date back >50 years. Early exploration in Northern Canada resulted in the oil discovery at Norman Wells in 1920, which has been produced intermittently to the present time. The Umiat oil field, located in the southern part of the planning area, was discovered during exploration by the U.S. Navy in 1946 and remains undeveloped today. Extensive exploration in the 1960's resulted in numerous oil and gas discoveries in both northern Alaska and the adjacent Mackenzie Delta in Canada. The largest of these, Prudhoe Bay, was discovered in 1968, with nearly 13 billion barrels (Bbbl) of recoverable oil. After construction of the Trans-Alaska Pipeline System (TAPS) in 1977, oil discoveries on the North Slope were brought into production. The most recent and, perhaps, most important oil-development project to the NPR-A is the Alpine field located in the Colville River Delta. Final permits for the Alpine project were approved in February 1998, and production startup is planned for the year 2001.

Information from decades of experience in arctic exploration, development, and production operations is contained in a variety of government and industry reports. No attempt is made here to cite all literature relevant to the NPR-A, but readers are directed to excellent documentation provided in the 105 Policy Analysis Reports generated for the previous NPR-A leasing (USDOI, BLM, 1979), an operational history of government-sponsored exploration in the NPR-A (Schindler, 1988), the Draft Arctic National Wildlife Refuge (ANWR) Resource Assessment Report for technology and operational aspects of the eastern North Slope (USDOI, 1986), and the Alpine Environmental Evaluation Document containing detailed descriptions of current project designs for a sensitive arctic environment (ARCO Alaska, Inc., 1996).

(b) Technology Advancement: It is important to recognize that numerous technological advancements have been made during the decades of operations on the North Slope, allowing current development activities to proceed at far lower cost and with less environmental impact than previous operations. It has become apparent that lower levels of impact, such as smaller areal footprints for production facilities, translate directly into lower overall development costs. Some of these advancements are listed below, and others will be discussed under subsequent headings of this report.

- Drilling-pad footprints have been reduced >80 percent from older pad designs by using closer wellhead spacings and by eliminating mud-reserve pits (tanks replace pits).
- Winter ice roads are replacing permanent gravel roads to move heavy equipment and supplies to drill sites. Using similar construction methods, ice pads are used for winter exploration drilling. These temporary, seasonal structures minimize long-term impacts to the tundra.
- Spent drilling fluids and rock cuttings are injected into disposal wells. Current practices now have no discharge of drilling fluids or dumping of drilling wastes on the land surface.
- Reservoir targets miles away from the surface pad can be tapped by extended-reach wells. Fewer drilling pads are needed to develop subsurface reservoirs. This leaves a smaller overall footprint on the tundra.
- Multiple completions can be made from a single wellbore to increase well productivity and reduce the number of wellheads. Fewer wellheads at closer spacings allows for a reduction in footprint.
- Advanced seismic-data acquisition and interpretation (3-D seismic workstations) results in more efficient drilling, with fewer dry holes, better pad placement, and higher petroleum recoveries.

(c) Timeframe for Activities: To place the description of petroleum-related activities in a relative timeframe, a generalized schedule for a typical development project in a remote area of the North Slope is presented in Table IV.A.1.b-1. This example indicates that discoveries of commercial fields could take place at any time within a 10-year period (assumed lease term) following the sale. Delineation and development activities could take from 4 to 10 years prior to production startup. Production activities would last between 10 and 30 years, depending on field size. Abandonment activities, including well sealing and site restoration, could last 2 to 5 years more after production ends. This representative timeframe suggests that new oil production should not be expected for at least 5 years following the lease sale, and it is more likely that 8 to 12 years will elapse before production begins from leases sold in the next NPR-A sale. The discovery and development of commercial fields is likely to be staggered over the primary lease term (10 years), and petroleum activities could continue for decades after a lease sale.

(d) Logistics: To explain the long lead time between leasing and production, the logistics of operations on the North Slope must be considered. Other than basic construction materials (gravel, water) and fuel, virtually all personnel, equipment, and supplies must be transported to the North Slope. Heavy equipment, such as production modules, usually are fabricated near ports along the West Coast or in the Cook Inlet and then transported several thousands of miles to the North Slope by marine barge (sealift). Although this mode of transportation is economical, it is restricted to a very short period (few weeks) during ice-free summer months, and the scheduling of fabrication and mobilization is critical.

The infrastructure surrounding the Prudhoe Bay field is serviced by a jet airport and the haul road (Dalton Highway) extending 490 road miles (mi) north from Fairbanks. Although both the airport and haul road generally are open year-round, individual supply loads are restricted by the type of carrier (aircraft or truck), and both are closed during severe winter storms.

Today, the infrastructure on the North Slope provides a variety of supplies and service-industry support. However, all of the components for exploration and development activities must be moved between 35 and 125 mi into the planning area from the westernmost base camp (Kuparuk River Unit [KRU]). Ground transportation is relatively unrestricted in winter months (mid-November-mid-May), but temperatures are extremely cold (commonly -40 °F or colder) and "whiteout" conditions are frequent. It is completely dark for 2½ months (late November-February). Low-ground-pressure vehicles (Rolligons, sleds) are used to establish ice roads traveled by conventional trucks and

Table IV.A.1.b-1
Development Timeframe for a Typical Oil Field

Project Phase	Length of Activity (Years)	Activities
Exploration	1-10 following lease sale	–seismic surveys to define prospects –well-site surveys and permitting –drill exploration wells
Discovery	2-5	–produceable well determination –drill delineation well(s) –additional seismic survey (3-D) –reservoir appraisal and engineering studies –project design and environmental studies –permit applications
Development	2-5	–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	10-30	–continue development-well drilling –production rampup (2-5 years) –peak production plateau (3-8 years) –production declines –well workovers (every 3-5 years) –infill drilling (well spacing reduced) –tertiary recovery methods employed –wells progressively shut in –economic limit reached
Abandonment	2-5	–plug and abandon wells –remove production equipment –dismantle facilities –decommission pipeline –site restoration and revegetation –phase out environmental monitoring

heavy equipment. Remote base camps established for multiyear occupancy typically include airstrips capable of handling large capacity aircraft, such as the Hercules C-130. Staging areas along the coastline are preferred, because barges can be used to transport heavy equipment and supplies by sea. Materials usually are stockpiled during the summer months (mid-July-early October) to supply operations at remote sites during the winter. The difficult logistics of this remote arctic setting will increase greatly the time and cost of operations in the planning area compared to similar activities in the continental U.S.

(3) Exploration: Petroleum exploration is not new to the NPR-A. Seismic surveys and exploration wells were contracted for federally-sponsored exploration programs are covered most parts of this area between 1941 and 1981. The first modern seismic data were collected by Geophysical Services Inc. (GSI) under contract to the U.S. Geological Survey (USGS) between 1972 and 1981. During the past 5 years, an increased number of industry-sponsored seismic surveys have been collected in the northern coastal area, perhaps prompted by the discoveries in the Colville delta immediately to the east. In the planning area itself, approximately 4,000 line-miles of GSI/USGS data and 12,000 line-miles of industry data have been collected to date. Government-sponsored exploration drilling has resulted in several small oil and gas discoveries, three of which lie within the planning area (Umiat, Fish Creek, and Square Lake). A total of 12 Navy-sponsored shallow-well tests, 15 deep exploration wells (Husky/USGS), and 1 industry exploration well (Chevron, Livehorse) have been drilled in the planning area.

Seismic surveys and exploration well drilling in the planning area probably will be conducted during winter months (early December-mid-April). This scheduling is due primarily to the operational logistics of the area, which is poorly drained tundra with abundant shallow lakes. Aerial photos of the planning area during midsummer show that there may be nearly equal proportions of dry ground and lakes. Travel over long distances during the summer is possible only by aircraft (fixed-wing or helicopter), although the use of hovercraft has been proposed. In contrast, after the tundra is sufficiently frozen and snow cover is adequate, travel is relatively unconstrained. This is particularly important to seismic surveys, which are set up on specific grid patterns in new locations each season.

(a) Ice Roads and Drilling Pads: Ice roads provide seasonal routes for heavy equipment and supplies moved to remote staging areas or well locations. These temporary, seasonal roads are constructed by spreading water from local sources (lakes and rivers) to build up a rigid surface. Typically, ice roads are designed to be a minimum of 6 inches (in) thick, usually 30 to 35 ft wide, and could be tens of miles long. Water supplies must be located along the proposed route to supply approximately 1.0 to 1.5 million gallons per mile of road. New ice-road construction methods, such as using aggregate "chips" shaved from frozen lakes, significantly decrease both water demands and construction time for ice roads. For example, under good (very cold) conditions, an ice-road-buildup rate using only liquid water is 1½-in per day, whereas using aggregate chips could increase the buildup rate to 4½-in per day, with equivalent reduction in the volume of water required. Ice "bridges" over rivers and lakes are constructed by similar flooding and composite (aggregate chip) methods, but the ice thickness is increased to rest on the bottom of shallow rivers or lakes. Floating ice bridges are used to cross deep rivers, such as the Colville River.

Ice drilling pads now are commonly used as platforms for winter exploration wells. Ice pads are constructed similarly to ice roads, where the tundra surface is flooded with water to build up progressive layers of ice. As with ice roads, the use of aggregate chips speeds the process while decreasing water demands. A typical ice pad is designed to be a minimum of 1.0 ft thick, covers 6 acres, and requires approximately 500,000 gal of water to construct. Depending on the well site, ice pads could range in size from 3 to 10 acres. Water requirements vary, depending on the pad size and availability of aggregate chips shaved from nearby lakes.

New designs for ice-pad construction have allowed the pads to remain intact over the summer season and subsequently be reoccupied for drilling the following winter. This strategy saves both time and cost. As ice-pad construction techniques improve with experience, it may be possible to construct ice pads to serve as year-round drilling platforms or for long-term production facilities. Although possible as a future technology, long-term ice pads have not been demonstrated.

(b) Seismic Surveys: Seismic-survey work is likely to continue at present levels in the NPR-A and may increase, if a multiple-sales leasing program is initiated. Collection of additional seismic-data is warranted for several reasons: (1) to provide a closer grid spacing for more subsurface detail; (2) to acquire new data using advanced techniques for better resolution of subtle geologic features and stratigraphy; and (3) to delineate fields discovered by exploration wells (usually 3-D seismic).

In contrast to early seismic programs that used dynamite in shot holes as the energy source, seismic programs now use vibrator equipment (Vibroseis) to generate energy into the subsurface. This newer technique provides high-quality data with minimal disturbance to the area.

Typically, three to four seismic crews are active on the North Slope each winter, and one to two crews could be expected to collect seismic data in the northern NPR-A in future winter seasons. A 2-D seismic party typically consists of 40 to 60 persons and can collect 5 to 10 line-miles of seismic data per day. A more closely spaced 3-D seismic program typically consists of 60 to 100 persons and can collect 2 to 4 square miles (mi^2) of data per day. However, winter weather is a constant factor affecting visibility and crew safety, and time is lost in mobilization, camp moves, and downtime during storms. Considering these logistical problems, one 2-D seismic crew typically could collect 250 line-miles of data in one winter season. A 3-D seismic crew typically could collect 150 mi^2 of data in one winter season.

Seismic crews are housed in mobile camps consisting of a "cat train" of trailer sleds pulled by tractors. Seismic-data-collection operations are conducted by all-terrain, low ground-pressure vehicles (both wheel and articulated-track designs). Camp supplies (food, fuel) are transported to the survey area by both ground vehicles and light fixed-wing aircraft.

For additional discussion of the scenario for seismic activities under the various alternatives, see Section IV.a.1.(b)(2).

(c) Exploration and Delineation Wells: Drilling is the only reliable method of verifying the presence of oil in a prospect mapped using seismic data or to obtain direct information on subsurface reservoir conditions. Exploration operations require moving heavy equipment (a drill rig) and large amounts of materials (steel

casing, drilling mud, fuel) to remote locations. Equipment and materials typically are moved to remote drill sites on purpose-built ice roads in midwinter months. Transportation logistics to the drill site also must allow for regular crew changes and resupply. An exploration well crew could consist of 30 to 60 persons, working 1- to 2-week shifts, and transported to the site by aircraft landing on constructed ice runways. Large lakes (1 mi across or more) can be prepared quickly as winter landing strips.

Exploration wells in the northern portion of the planning area (the area of highest oil potential) are likely to range from 6,000 to 12,000 ft in depth. For these depths, most exploration wells can be drilled, logged, and tested within a single winter season. If a discovery is made, a second (delineation) well could be drilled from the same ice pad in a single season, depending on well depth and the efficiency of drilling operations.

To define the limits of reservoirs after a discovery is made, several delineation/appraisal wells are likely to be drilled before a commitment is made towards project development. Additional delineation wells surrounding the discovery well would be planned for the following winter, probably using a new ice pad. Because of high project costs, two to four successful delineation wells may be drilled to define the drainage area of each production pad. For example, a typical field-development project consisting of two production well pads would require a total of seven wells (1 exploration and 6 delineation wells). Delineation-well drilling is likely to be coordinated with a 3-D seismic survey.

When reservoir logging/testing is completed, wells will be plugged and abandoned. Cement plugs are placed in deep zones capable of flowing hydrocarbons and in the near-surface section of the wellbore to prevent migration of fluids. Successful wells (discoveries) may be re-entered and used as production wells at a later time by drilling out the cement plugs, but most exploration wells will be considered "expendable" (not used for later production). If a discovery is made, equipment and materials may be left at the site, supported on pilings (or "sleepers"), to reduce mobilization time the following winter drilling season. Rock cuttings from delineation wells could be either backhauled to existing disposal wells or processed (ground and treated) for subsurface disposal in the abandoned wells. On completion of drilling operations, all equipment and materials would be moved back along ice roads to staging areas. No materials or drilling wastes (mud and cuttings) would remain at the site.

(d) Water Demand and Rock Cuttings: Drilling operations require large amounts of water for blending into drilling mud. These operations also produce large amounts of rock cuttings. For example, a 10,000 ft well could require approximately 850,000 gal of water for drilling in addition to approximately 100 gal per day for each person in the drilling crew (for camp use). Over a typical 4-month drilling season, a one-well drilling operation could require a total of 1,650,000 gal of water obtained (if possible) from a source close to the well site. The use of melted snow could supplement this water requirement. Estimated water requirements are much less for delineation wells, because approximately 80 percent of the drilling mud will be reconditioned and reused.

A typical 10,000 ft well could use 630 tons of drilling mud and produce 820 tons of rock cuttings. The use of slim-hole drilling techniques for exploration wells greatly could decrease both the materials required and cuttings produced. For comparison, slim-hole wells have diameters of 3⅜ in to 4¾ in, whereas conventional wellbores are drilled with bits ranging from 8½ in to 26 in.

(4) Development:

(a) Field Layout: After a field has been discovered and confirmed to be of commercial size by delineation wells and seismic surveys, a number of construction activities are required to establish a permanent production operation. A list of typical activities is provided in Table IV.A.1.b-1. As an example of current North Slope development plans, the project layout for the Alpine field is provided in Figure IV.A.1.b-1. This new field will contain 2 production well pads with a total of 100 to 150 wellheads, a pipeline gathering system to a central processing facility, a 3-mi infield road, a crew support camp, and an airstrip. A new sales-oil pipeline will carry oil production to the Kuparuk River pipeline network. The Alpine field will not be connected to other North Slope oil fields by a permanent gravel road, but instead will use winter ice roads to move heavy equipment and materials. Light loads, such as camp supplies and crew changes, will use fixed-wing aircraft. This concept of "roadless development", perhaps more accurately described as "seasonal road development," is likely to be the preferred strategy for future fields in the NPR-A for both practicality and cost reasons.

(b) Staging Areas: All materials and equipment necessary to develop a new field must be stockpiled, moved, and assembled in remote portions of the NPR-A subject to seasonal constraints to transportation. Consequently, staging areas are very important components to development. Ideally, a staging area contains buildings for warehouses and crew quarters, gravel pads for stockpiling materials, and a serviceable airstrip. If located on the coastline, a causeway or dock is needed for loading materials and equipment transported by barges.

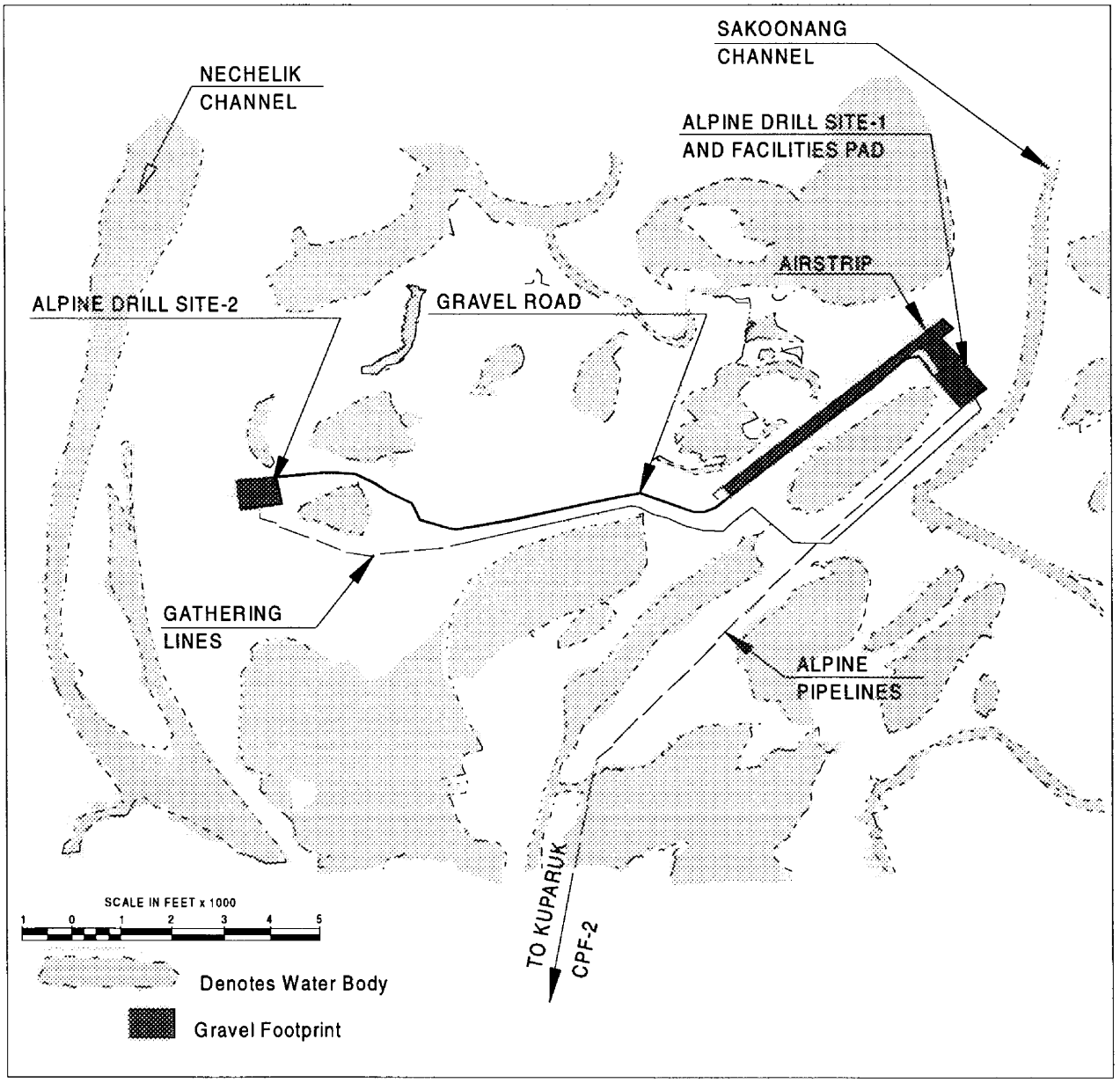
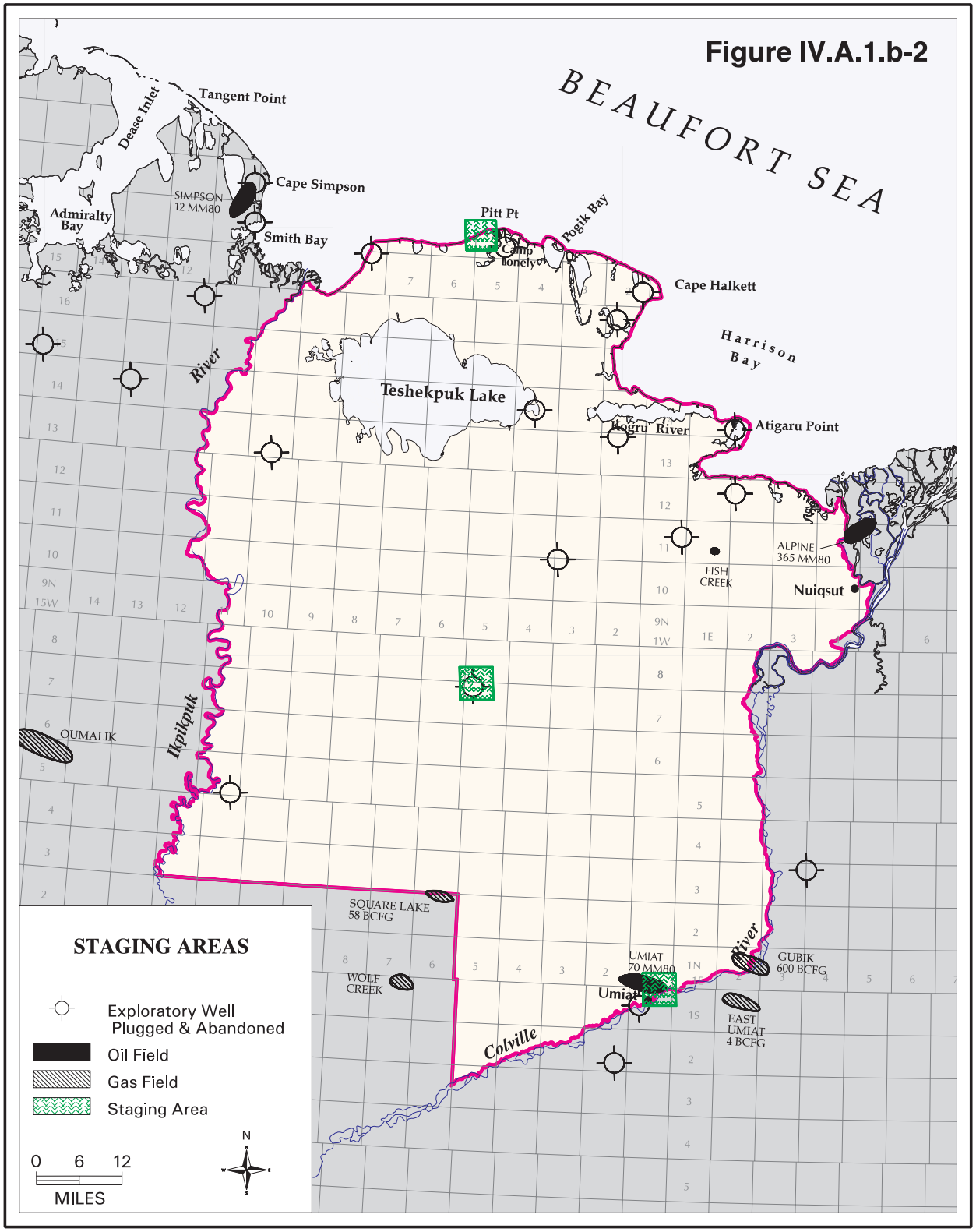


Figure IV.A.1.b-1. Layout of Alpine Field. ARCO's new development project in the Colville River delta could serve as model for future production facilities in NPR-A. The total surface footprint covers 114 acres, which is less than 1 percent of the subsurface drainage area for this 365-million-barrel field. (Figure is from Alpine Development Project: Environmental Evaluation Document, courtesy of ARCO Alaska, Inc.)

Considering the expense to establish a new staging area in a remote site, it is more cost effective to reoccupy existing sites, even if some refurbishing is necessary. Figure IV.A.1.b-2 shows sites in the NPR-A that could be used as staging areas. Both Camp Lonely and Umiat were used as major staging areas for past NPR-A operations. Additional sites, including previous Husky/USGS wellsites or abandoned DEW-Line sites, could be used as future staging areas to serve future NPR-A development.

It is likely that the first development operations in the NPR-A initially will be staged out of the Prudhoe Bay Unit or the KRU facilities. Both of these base camps have all-season airports and are connected by road systems. They also have marine loading sites on the coast (West Dock and Oliktok Point). Materials and equipment likely would be moved to staging areas within the NPR-A using marine transport in the summer months and by trucks over ice roads in the winter months. Aircraft could access remote sites at all times of the year; however, air traffic often is



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restricted by low clouds and fog in the summer and storms with whiteout conditions in winter.

After the tundra is sufficiently frozen in winter, ice roads would be constructed to remote development sites. Earth-moving equipment will then move gravel to the site to establish a construction camp and perhaps a year-round airstrip. Later, drilling equipment and supplies would be moved to the site over ice roads. Production equipment (modules) and pipeline-construction materials would be moved during the final stages of development. The overall development phase, from construction of a staging area and remote base camp to production startup, could take 2 to 5 years, depending on the size and location of the new field.

(c) Gravel Requirements: Much of the initial work for a new project will involve the construction of gravel pads for wellheads, production and support facilities, infield roads, and an airstrip. The development area must be level, stable, and elevated above the wet tundra surface. Because the tundra surface is unstable, subject to flooding in summer and ice-jacking forces in winter, pads are designed to be at least 5 ft above the tundra surface.

Gravel is the preferred material for pad construction, and gravel borrow pits are relatively common east of the Colville River. For developments in the NPR-A, however, gravel is a scarce commodity. A variety of alternate strategies could be adopted, including: (1) extracting gravel from existing sites; (2) developing new sand/gravel mine sites within the NPR-A; (3) barging construction materials to coastal staging areas; (4) processing bedrock for construction materials; (5) designing alternatives (year-round ice pads; composite all-season pads); and/or (6) reusing gravel from previous Husky drillsites. Project plans for new field development in the NPR-A will depend largely on site-specific conditions and the site location relative to sources of construction materials.

For permanent production facilities, pads made up entirely of gravel are the preferred design, although composite pads are a proven alternative (Kachadoorian and Frederick, 1988). Gravel requirements for typical "all-gravel" pads rising 5 ft or more above a wet tundra surface are approximately 8,000 to 12,000 cubic yards (yd^3) per acre of surface footprint. Gravel roads (typically 35 ft wide plus 2:1 slopes) cover approximately 5 to 6 acres per mile, and require 30,000 to 50,000 yd^3 per mile. Airstrips (typically 150-200 ft wide and 5,000-6,000 ft long) cover 20 to 30 acres and could require 140,000 to 300,000 yd^3 of gravel.

Site-specific conditions will dictate the facilities requirements and consequent footprint size of new fields in the NPR-A. Small fields, with a single production pad and airstrip, could have a footprint of approximately 50 acres. Large fields, with multiple pads connected by service roads, could have footprints of up to 200 acres. For purposes of analysis, we will assume that new fields will have footprints of approximately 100 acres. The average gravel requirements for a 100-acre footprint is approximately 1 million square yards, or about 10,000 yd^3 per acre of footprint.

Total gravel requirements for future NPR-A developments can be estimated using the assumed amount of 10,000 yd^3 per acre and an average footprint for a midsized field (200-400 MMbbl) of 100 acres. For the maximum development case under the single-sale scenario, corresponding to oil resources of 250 to 1,100 MMbbl (1-5 oil fields), gravel requirements for all-gravel pads would range from approximately 1 to 5 million yd^3. Other leasing alternatives with lower levels of development would require proportionally less gravel.

Several types of gravel pads were used previously in NPR-A drilling; these alternatives are shown in Figure IV.A.1.b-3. Gravel requirements are reduced significantly by composite pad designs, in which the lower portion of pads are built using blended (or "geotextured") mixtures of sand and silt. This lower lift is overlain by rigid foam (Styrofoam) insulation boards and then covered by a layer (2-ft thick) of clean gravel (Fig. IV.A.1.b-3). Material for the lower portion of pads is common in surficial deposits throughout the NPR-A and could be extracted and blended during winter months from borrow areas near the development site. Using all-season pad designs could reduce the overall gravel requirement to 33 to 50 percent compared to all-gravel pad designs. The use of blended sand-silt mixture for the lower portion of the composite pad would enhance reclamation after abandonment by providing a more natural substrate for revegetation.

Gravel used for developments in the eastern part of the planning area could be extracted from existing borrow sites on lands east of the Colville River and then transported to the development sites by trucks over winter ice roads. For more distant sites in the central and western part of the planning area, gravel could be mined from existing barrow pits and barged to coastal staging areas and stockpiled for later transport by trucks over winter ice roads. Sand and gravel also could be extracted from new sites within the planning area. Investigations to identify gravel sources in the NPR-A have not been conducted but presumably will be initiated, if discoveries are made in the sale area following a lease sale. For new sites, overburden removal and sand/gravel mining could impact areas of 20 to 50 acres, depending on the thickness of the deposit and amount of material extracted. Gravel also could be scavenged from previous USGS/Husky drillsites scattered throughout the NPR-A (Fig. IV.A.1.b-2). Admittedly, we have not studied the economic feasibility of gravel

transportation in the NPR-A. However, it is premature to evaluate the possibilities without knowing the location or scale of future gravel-use activities. Decisions regarding gravel use will be made on a case-by-case basis according to site-specific conditions.

Gravel sources are a major problem for sites in the southern part of the planning area. Surficial gravel sources are rare outside river corridors, so alternative materials are likely to be considered. Bedrock outcrops could be blasted and then crushed and blended with sand to make up suitable construction material. Unconsolidated sand and gravel deposits are available in river systems, but restrictions on extraction are likely. Gravel trucked on long ice roads will add significantly to the cost of developments in the southern portion of the planning area.

(d) Development-Well Drilling: Production-well drilling is a major activity in developing a new field. The number of production wells is controlled by unique characteristics of the reservoir, including thickness, permeability, and lateral continuity (among others). Generally, well-drainage areas range from 40 to 160 acres, where thicker, high-quality reservoirs tend to have broader well-drainage areas. Thinner or more laterally discontinuous reservoirs normally require closer well spacing to achieve effective subsurface drainage. Horizontal wells with long lateral sections drilled in the reservoir can replace several closely spaced vertical wells. Later in the life cycle of a field, well spacing typically is reduced by infill drilling in the attempt to capture more reserves.

Reservoir well spacing should not be confused with the surface spacing between wellheads on production pads. The spacing between surface wellheads has been reduced from 120 to 160 ft (two decades ago) to 10 to 20 ft (today) in North Slope fields.

In addition to production wells, other wells are drilled to inject water or gas into the field to maximize oil recovery. These wells generally are referred to as service (or injection) wells. Numerous injection wells are required for waterflood programs, which routinely are used throughout the production cycle to maintain reservoir pressure. The proportion of producer to service wells can vary for each field, but a typical ratio of producers to service wells is 2:1 (or one-third of the total wells are nonproducing service wells).

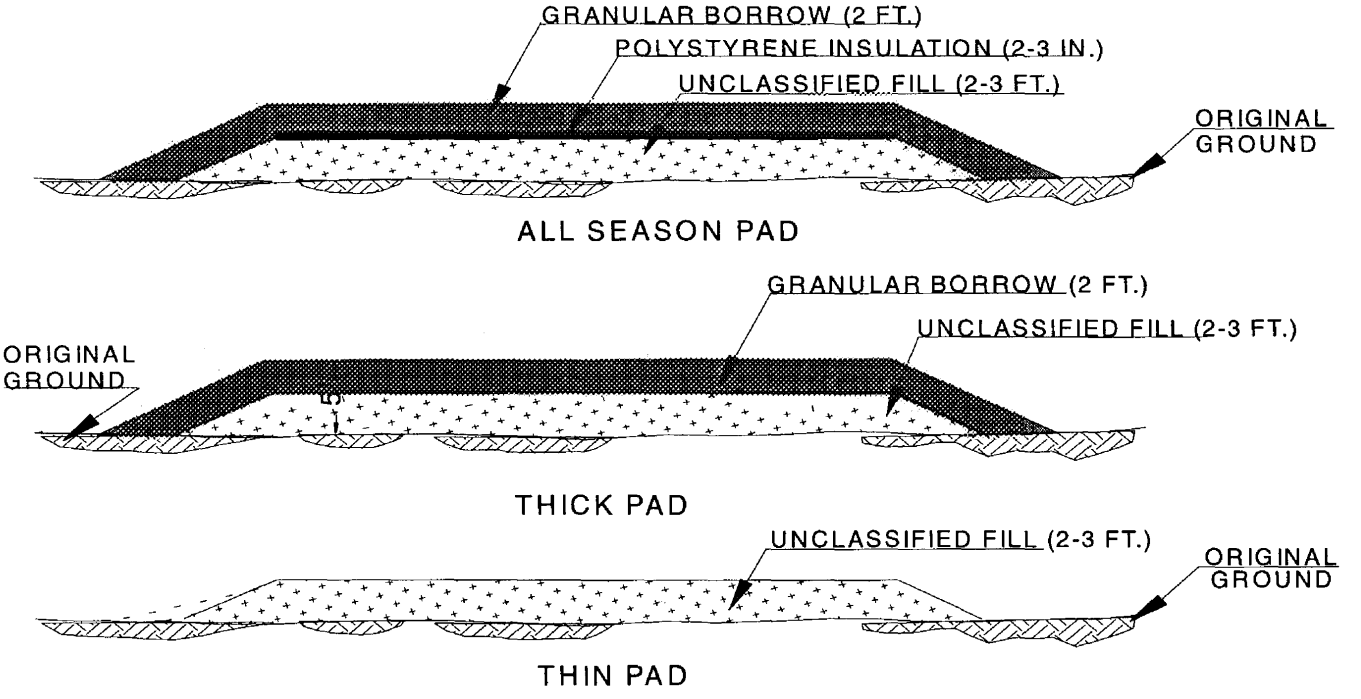
The number of wellheads that could be contained on a single production pad potentially is unlimited, but in practice it is constrained by factors such as reservoir depth and well cost. Most production wells are deviated from vertical to reach subsurface targets at distances from the production pad (Fig. IV.A.1.b-4). By informal definition, conventional wells have departures (or step outs) approximately equal to the depth of the reservoir (or 1:1 reach-to-depth ratio). Extended-reach wells have step-out ratios of 2:1 or higher. Current state-of-the-art drilling technology, under optimum conditions, can drill wells to reach distances of about six times the subsurface depth (6:1 reach-to-depth ratio).

Commonly, extended-reach wells are used to reach distant reservoir targets from existing facilities or to avoid surface constraints. For example, the extended-reach record on the North Slope is a well in the Niakuk field that reaches 18,098 ft to a reservoir at 9,545 ft deep (about 2:1 reach-to-depth ratio). In this case, extended-reach wells are used to reach a reservoir target several miles offshore, allowing field development from an onshore site and eliminating the need for a new offshore production island. Extended-reach drilling methods are rarely employed for exploration wells, because they are far more costly than vertical wells and are more difficult to effectively log and sample by coring.

Over the past decade, worldwide experience has progressively increased the technology of drilling extended-reach wells. However, there are physical limitations, including topside rig power (torque), drillpipe strength, downhole frictional forces (drag), and geology (such as coal beds), which limit the capability of extended-reach wells. The cost of extended-reach wells is considerably higher, largely because of greater distance drilled (measured depth) and problems encountered involving wellbore stability. Alternatives for field design consider the cost tradeoffs between fewer pads with more extended-reach wells as opposed to more pads containing conventional wells.

Because conventional wells typically are less costly to drill and complete than extended-reach wells, production pads are most efficiently spaced at distances from each other of approximately twice the reservoir depth. For example, a reservoir at 8,000 ft requiring two production pads normally would locate the pads approximately 16,000 ft apart (3 mi). Assuming an 8,000-ft step-out radius, approximately 4,600 acres (7.2 mi^2) could be drained from each pad. If each well has a subsurface drainage area of 160 acres, a typical production pad would hold 29 producer wells and 15 service wells, for a total of 44 wellheads. Extra pad space normally would be allocated for additional infill production wells.

Pads designed to hold a maximum of 60 to 80 wellheads would have surface footprints of about 10 acres, although the actual number of wells on a pad will vary according to field characteristics. Conventional, directionally drilled wells can reach wider areas of deeper reservoirs, so fewer pads (with more wells) are needed to produce deeper reservoirs. In contrast, shallow fields usually require more



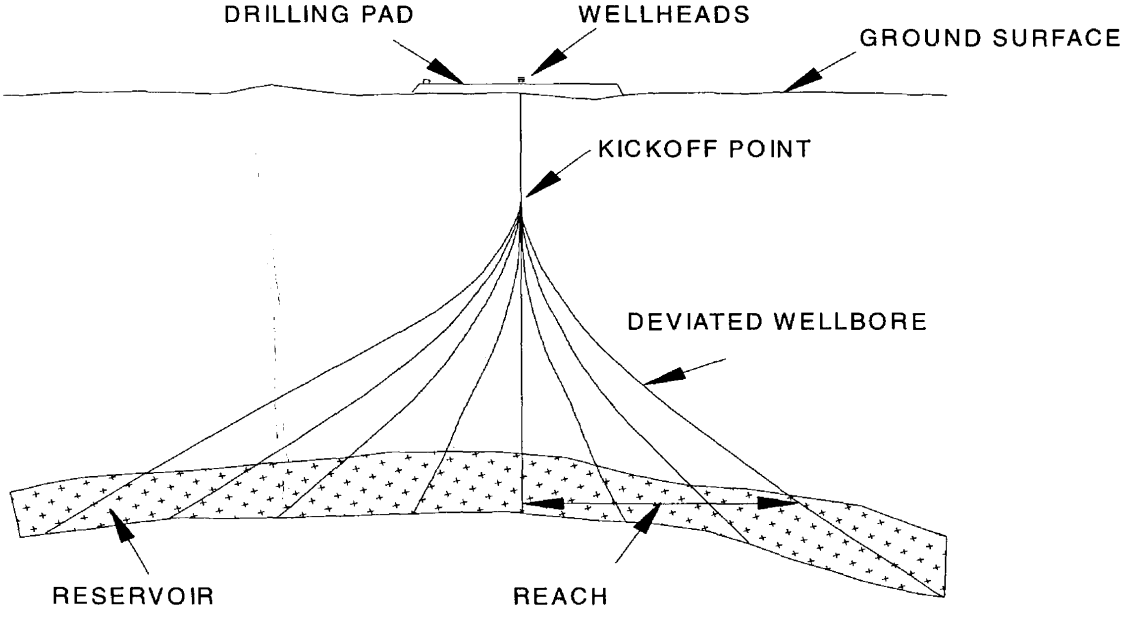


Figure IV.A.1.b-3 (top). Gravel Pad Construction Designs. Elevated pads are essential for all-season operations on the poorly drained tundra of NPR-A. Gravel is the preferred material because of its stability; however, known gravel sources are scarce west of the Colville River. Alternative designs using gravel as a topping material could greatly reduce gravel demands. All-season ice pads have been proposed, but not demonstrated, as a feasible alternative pad design.

Figure IV.A.1.b-4 (bottom). Directional Drilling From a Surface Location. Wells deviated from vertical are standard practice in field development. Conventional wells have reach (horizontal deviation) to depth (vertical) ratios of 1:1. New technology, called *extended reach drilling*, can drill wells to even more distant reservoir targets. Currently, the highest reach-to-depth ratio on the North Slope is 2:1 (Niakuk field, 18,098-ft reach).

pads with fewer wells per pad, although extended-reach wells could be used to drain larger areas in shallow reservoirs. Considering the variety of possible variations in engineering, field-development planning is very site-specific.

The time required to drill and complete a production well largely depends on the drilled (or measured) depth of the well. Current drilling activities on the North Slope normally take approximately 20 to 30 days to drill and complete a 10,000 ft well. This equates to approximately 12 to 18 wells per rig in a 12-month period. Safety considerations normally restrict operations to one rig drilling on each pad at a time. Using the above example, where 44 wells from each pad are needed to for initial reservoir development, drilling operations would take 3 to 4 years to complete (see also Table IV.A.1.b-1). Seasonal restrictions on drilling operations will increase the overall time to develop a field and could adversely affect the economic viability of the project. Another key consideration is the pressure regime and flow dynamics of oil reservoirs. Once production begins, reservoir dynamics must be carefully managed to optimize oil recovery. Discontinuous production is not an advisable engineering practice for oil fields.

(e) Drilling Mud and Rock Cuttings: Drilling operations for each development well requires large amounts of drilling mud and produces large quantities of rock cuttings. Estimates given previously for exploration/delineation wells also could accurately represent development wells of equivalent depths.

New techniques have been refined during the past decade or so on the North Slope to efficiently dispose of drilling wastes (mud and cuttings) in existing wells. Figure IV.A.1.b-5 is a diagram showing the preparation steps before subsurface disposal of drilling mud and rock cuttings. The goal of current North Slope drilling operations is zero surface discharge of wastes. Figure IV.A.1.b-6 is a sketch of a well profile with injection of drilling wastes into shallow, high-permeability formations. Generally, dedicated disposal wells are used for injection of drilling wastes, although it is possible to inject wastes into shallow annulus portions of production wells while allowing oil production from deeper zones. Reconditioning and reuse of up to 80 percent of the drilling mud saves costs for both materials and disposal. Clean sand and gravel processed from well cuttings can be recycled and used for pad and gravel road maintenance.

Generally, all wastewater, spent fluids, and chemicals are disposed off site in U.S. Environmental Protection Agency (USEPA)-approved injection wells. Solid wastes are incinerated and hauled to approved offsite landfills. Normal practices do not allow onsite burial of solid wastes.

(f) Water Demand: Water is needed for both drilling and camp use. For the construction phase of the Alpine field, water demand is estimated to be 100 gal/day per person (ARCO Alaska, Inc., 1996). With 350 persons working on the project, the potable water requirement is 35,000 gal/day. Drilling water demand is estimated at 21,000 to 63,000 gal/day. The total water demand over one winter season (mid-November to mid-April, or 150 days) is 8.4 to 14.7 million gallons.

This volume of water is more easily visualized by comparison to the drawdown of a small lake. Assuming that the lake is circular and ½ mi across, its surface area is 125 acres. A water demand of 12 million gallons equates to 36.8 acre-feet, so the example lake would have a drawdown of 3½ inches. Some recharge to the lake could be expected from snowmelt and surface runoff each spring. In addition to surface water sources (streams and lakes), equipment called "snow melters" could be used to supplement water demands during winter months.

Potable water demand would drop after two to four seasons, when the major construction phase is finished. Only 20 to 40 persons are onsite during the subsequent production phase, and potable water demand would be one-tenth of the development phase. Likewise, drilling-water demand over the 20-year production life of the field (largely for workover operations and infill drilling) is likely to be less than the lower value (21,000 gal/day).

(5) Production:

(a) Production Facilities: A central production facility (CPF) serves as the operational center for long-term production activities in an oilfield. In addition to oil-production equipment, the CPF typically includes living quarters and offices, maintenance shops, storage tanks for fuel and water, power generators, waste-treatment units, and a communications center. For most North Slope projects, many components of the CPF are constructed as transportable modules in offsite locations, perhaps outside Alaska, then moved over winter ice roads to the field and assembled. All buildings are supported on pilings to accommodate ground settling or frost heaving. An airstrip usually is located near the CPF to allow transport of supplies and personnel to the field site.

Oil-production equipment includes three-phase separators (oil, gas, and water are produced in varying proportions from each well), gas conditioning (natural gas liquids are stripped from produced gas), complex pipeline-gathering and pressure-regulation systems, and well-monitoring and -control systems. Oil from production wells is filtered (to remove sand) and processed (removing water and gas) before being piped through a sales meter and into the sales-oil pipeline system. Gas is processed (to remove liquids),

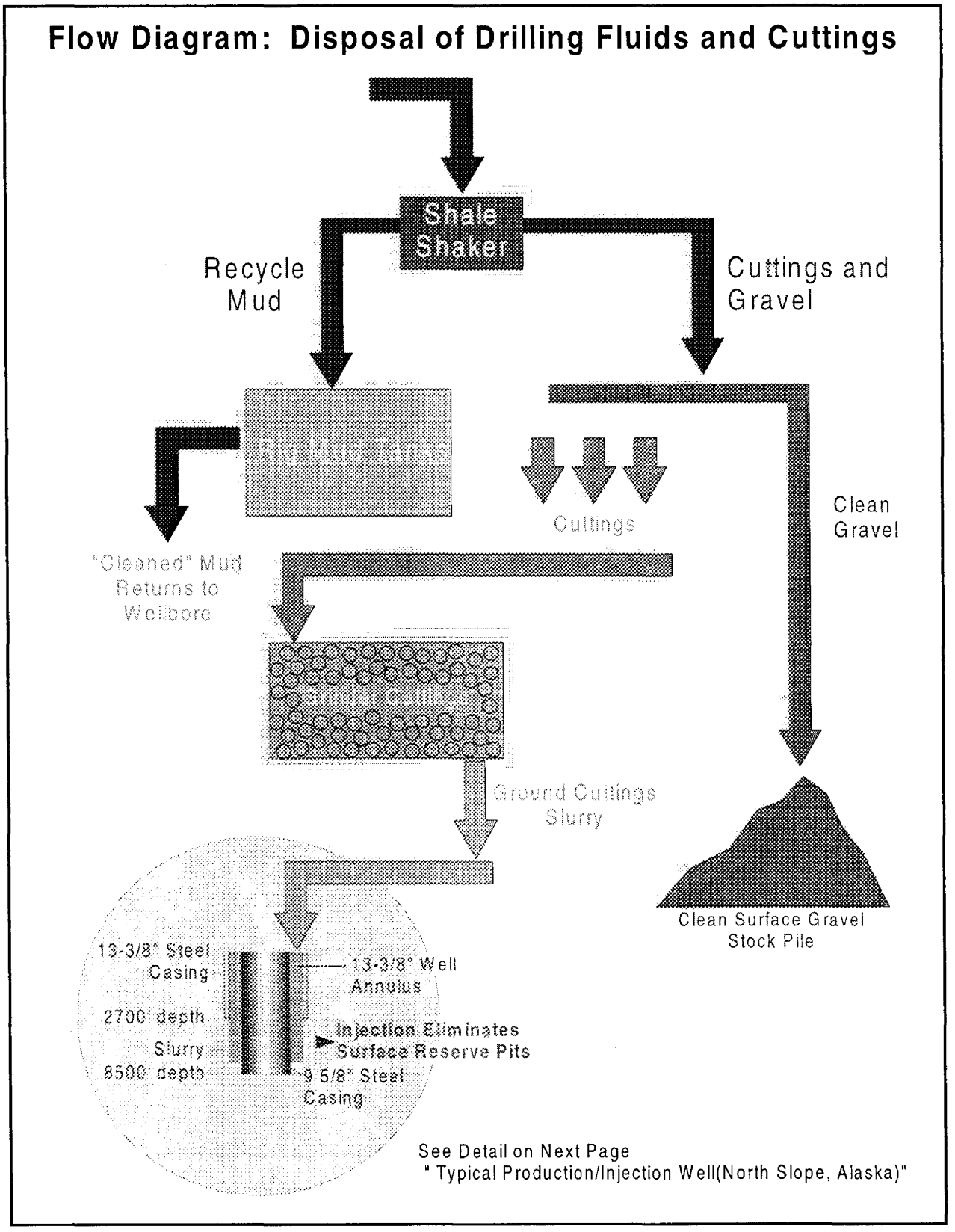


Figure IV.A.1.b-5. Processing Drilling Mud and Cuttings for Disposal. Current approved practices on the North Slope dispose of drilling wastes in shallow portions of production wells. Several steps are taken to recondition drilling mud and recycle rock cuttings to minimize surface disposal of these waste products. Source: State of Alaska, DNR, Div. of Oil and Gas, 1997.

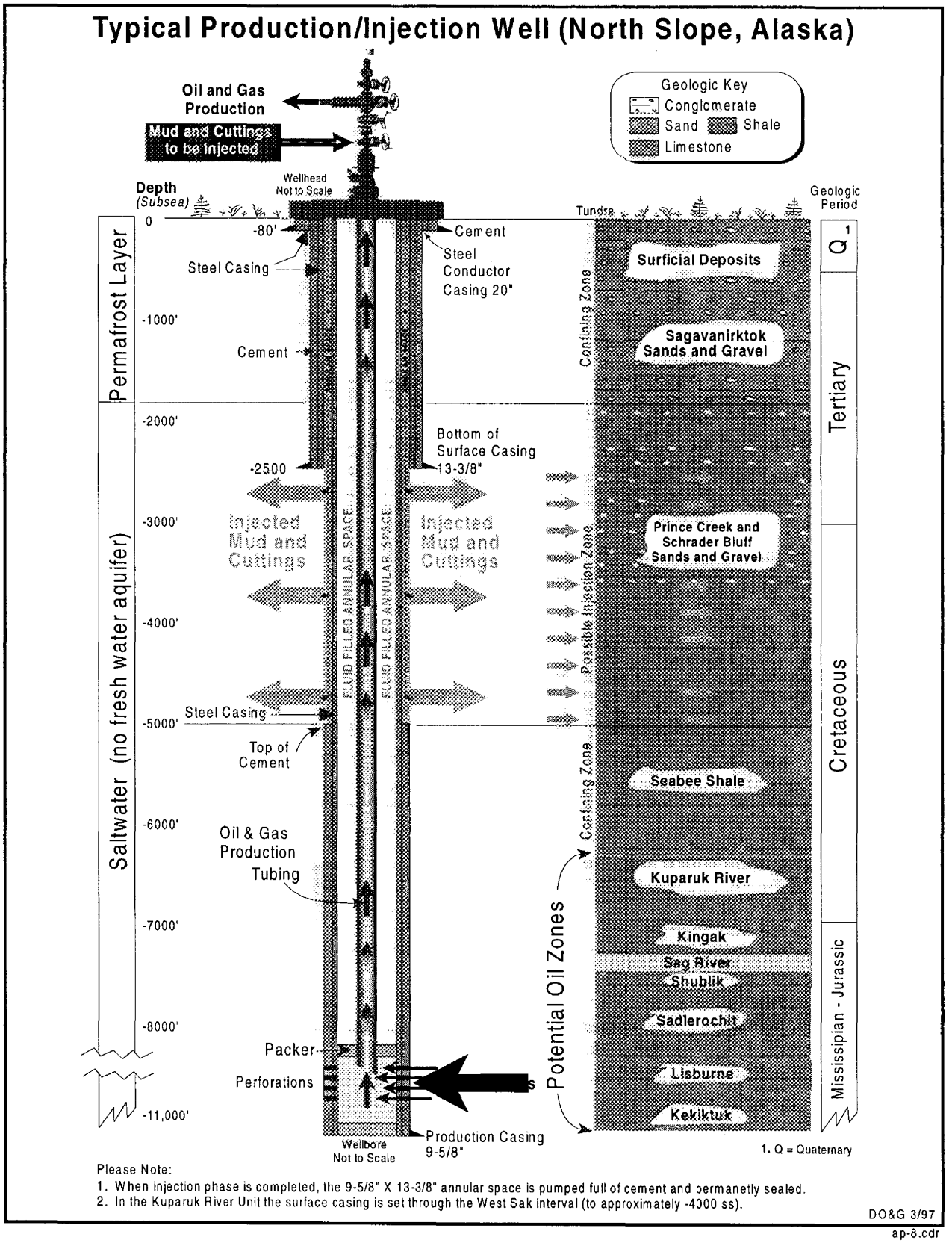


Figure IV.A.1.b-6. Subsurface Injection of Mud and Cuttings. After processing, muds and rock cuttings are injected into the annular space of producing wells. Formations receiving the materials are 2,500–5,000 feet below the surface. When the injection phase is completed, the annular space is permanently sealed by cement. Source: State of Alaska, DNR, Div. of Oil and Gas, 1997.

pressurized (compressed), and reinjected into the reservoir through service wells. Likewise, water is processed (chemically treated) and then reinjected into the reservoir for pressure maintenance. Reinjection of produced gas and water increases oil recovery, and this practice normally is initiated from the onset of production.

(b) Production Rates: Individual well-production rates vary greatly, depending on the characteristics of the reservoir, from a few hundred barrels per day to several thousand barrels per day. Generally, the highest production rates occur in the first 1 to 2 years of a well's life and then declines progressively with time.

As well-production rate drops to near half of the peak rate, operations called "workovers" are conducted to improve well productivity. These operations are designed to correct a variety of potential well problems (e.g., corrosion, plugged screens) and problems in the reservoir itself (e.g., migration of fines, mineral precipitation). Workover operations typically occur at intervals of 3 to 5 years. More severe downhole problems could require reservoir stimulation by pressure fracturing or acidizing methods.

Current well workovers on the North Slope could involve drilling laterally from existing wellbores (or "sidetracks") to recover oil in unswept portions of the reservoirs. Coil-tubing rigs now are commonly used to drill sidetracks from existing wells. Coiled-tubing rigs are smaller, more mobile, and less costly to operate than standard drilling rigs. Coiled-tubing also is more flexible, allowing tight steering of drillbits into small reservoir compartments. Multiple laterals into a reservoir usually increases well-production rates.

Because production-well drilling and completion are spread over several years (2-5 years for a typical field [Table IV.A.1.b-1]), the production profile for the field is much broader than for any individual well. Initial production usually occurs when a certain proportion of the wells are completed, and the production profile will then "ramp up" to peak production when most wells are online. Typical ramp-up periods vary from 2 to 5 years, with plateaus at peak rate lasting 3 to 8 years.

(c) Waterflooding: Waterflooding is a key secondary production practice that significantly can increase oil recovery over primary drive mechanisms. Injecting water into selected areas of the reservoir maintains subsurface pressure and promotes fluid flow to the production wells. To maintain reservoir pressure, the volume of oil withdrawn from the reservoir must be replaced with an equivalent volume of water. This requires large quantities of water. For example, a field with a daily production rate of 50,000 bbl of oil would require approximately 2 million gallons per day of water (1 bbl = 42 gal) for balanced waterflooding, given that some volumetric allowances must be made for each fluid under subsurface conditions. At this example production rate, a waterflood program would require approximately 760 million gallons (2,352 acre-feet) each year.

To meet waterflood demands, a variety of water sources are investigated. These potential sources could include nearby surface waterbodies (large rivers and deep lakes) as well as subsurface aquifers. Normally, there are restrictions to withdrawals from surface water sources that are vital to fish and waterfowl. Drilling water wells below the permafrost layer (up to 1,500 ft thick) and pumping water from subsurface aquifers is costly. All freshwater must be treated so that it is chemically compatible with the formation it is injected into.

Often, local water sources are inadequate to meet the demands of waterflood programs, so seawater is used. Seawater is reasonably compatible (similar chemically) to the brines present in most petroleum reservoirs, and seawater supplies virtually are unlimited. Waterflood systems include a seawater-intake and -treatment plant located on the coast and an insulated pipeline from the seawater plant to service wells in the field. Waterflood programs using seawater are initiated from the onset of production for most North Slope oil fields. As the oil field is produced, the volumes of formation water recovered with oil (water cut) increases. In time (5-7 years), injection water demands are met by produced formation water, and the seawater-waterflood system is shut down. Seawater from the treatment plant then could be used for the next field's waterflood program.

New oil fields in the northeastern portion of the planning area are likely to receive seawater for waterflooding programs from existing facilities now serving fields in the Prudhoe/Kuparuk area. Seawater pipelines will be installed on vertical support member (VSM) pipeline supports that also hold sales-oil and service pipelines. For areas farther to the west, seawater intake and treatment plants are likely to be fabricated on barges and moved into temporary locations along the coast. Because the ability to incorporate waterflooding as a reservoir management strategy greatly improves recovery efficiency, the economics of fields discovered near the coastline could be improved. However, the value of increased oil recovery will be balanced against the increased costs of seawater-treatment facilities and temporary overland pipelines. With increasing distances inland, expensive heat generators and pump stations may be required to deliver treated seawater to remote fields in the severely cold winter temperatures of the North Slope. Small or very remote fields may not be able to justify the costs of startup waterflood programs and will rely entirely on later waterflooding using produced formation water.

(d) Abandonment: At some time in the life cycle of all fields, the revenue from production is insufficient to justify the expenses of operation. The end of economic life nearly always occurs before all of the recoverable oil is extracted from the reservoir. Various factors leading to the decision to abandon a field could differ for each field, but declining production rates and oil price usually are the two key considerations.

Abandonment operations generally include removing all equipment, plugging all wells, restoring the site, and conducting final environmental studies. Abandonment operations could take place over many years, as revegetation and environmental monitoring studies continue to document the long-term effects of past operations at a particular site. A series of permitting and inspection activities are associated with oil field abandonment.

(6) Transportation:

(a) Regional Oil Transportation: A regional oil-transportation system for the North Slope oil fields was established in 1977 upon completion of the TAPS. Oil is transported some 800 mi south through a 48 in pipeline and 12 pump stations (7 are still active) to the ice-free port of Valdez, Alaska. From the storage and marine loading terminal at Valdez, oil is loaded on tankers and transported to U.S. and foreign markets.

The throughput capacity of the TAPS pipeline is a vital factor to North Slope development. The maximum daily throughput capacity of TAPS is slightly over 2.0 MMbbl/day (achieved in 1988). Currently, TAPS throughput is 1.35 MMbbl/day. The minimum throughput for a viable TAPS operation has been widely debated by government and industry. The common perception is that a minimum throughput between 200,000 and 500,000 bbl/day represents realistic mechanical and economic limits to operation. When this minimum throughput rate will be reached also is speculative, because it is difficult to accurately predict the size and timing of new oil field development on the North Slope. However, based on the declining production trends of existing North Slope fields, and without changes to economic conditions or discovery of major new oil fields, the operational limits of TAPS could be reached within the next 20 years. Industry is well aware of this future problem, and aggressive efforts are under way by the North Slope producers to reverse the production decline trend by exploring for new fields and using innovative methods to develop marginal fields. Renewed industry interest in the NPR-A is an important strategy to maintain the throughput of the TAPS within acceptable limits. Without this vital transportation system, continued production from the North Slope is unlikely. All NPR-A development scenarios assume that TAPS will continue to operate and carry North Slope oil production.

(b) North Slope Pipelines: The central portion of the North Slope contains numerous oil fields connected by pipeline-gathering systems to the TAPS Pump Station No. 1. Because of its location, most new oil development projects in the NPR-A will use the main line between the KRU and TAPS Pump Station 1. The 24-in KRU pipeline has the capacity of approximately 350,000 bbl/day and currently is transporting 325,000 bbl/day. As the large fields (Kuparuk, Milne Point) feeding this pipeline decline, excess pipeline capacity could be used by new fields. The current KRU pipeline tariff is $0.21/bbl, far lower than new pipeline construct costs.

For purposes of analysis, we also assumed that the future sales-oil pipeline from the Alpine field will be used by new NPR-A oil developments to connect to the KRU infrastructure. Project plans for the new Alpine pipeline include an innovative technique to cross the Colville River, which is 4,000 ft wide at the selected crossing point. A horizontal directionally drilled tunnel will be lined by a 36-in conduit approximately 100 ft below the river bed that will carry the pipelines serving the Alpine field. Although the Alpine sales-oil pipeline (14-in diameter) is sized for Alpine production of 60,000 to 80,000 bbl/day, additional capacity could be gained by installing pump stations and using drag-reducing agents. ARCO claims that the Alpine pipeline capacity could be increased to as much as 200,000 bbl/day, easily accommodating additional oil from the NPR-A. If the Alpine infrastructure is not operational, a serious hurdle will be imposed on future developments to the west in the NPR-A. Currently, the final permits for the Alpine project have been approved (USDOD, US Army COE, 1998) and construction is now under way at the Alpine site. Projected startup for this new field is in 2001.

The timing of future discoveries and development in the NPR-A also could be accommodated by the Alpine production schedule. Peak production at Alpine (60,000 bbl/day) will last only 3 to 5 years after startup, with production rates declining to about half of peak rate (30,000 bbl/day) in 15 years. The discovery of new fields in the NPR-A is likely to be staggered over some period of time (given variable exploration and success), and long time periods of 8 to 10 years are typical between discovery and production startup for new fields (Table IV.A.1.b-1). Considering the relatively long lead times for development compared to the relatively short periods of peak production, it is likely that the future Alpine pipeline could be used for future NPR-A oil production. Modifications to the Alpine pipeline (adding pump stations) could provide additional capacity to this pipeline system.

(c) Future NPR-A Pipelines: The actual locations of new pipelines that may be constructed in the Northeast NPR-A Planning Area will depend on the location and sequence of commercial-sized discoveries. Today, we have no reliable way of predicting where or when new commercial fields will be discovered and developed. Consequently, it is misleading to speculate on the exact locations of new pipelines in the NPR-A. Fields developed early in the future development cycle could establish the first pipeline corridors connecting new NPR-A fields to existing infrastructure east of the Colville River. Fields developed later in the cycle are likely to use the existing pipelines, if capacity is available. If large fields are discovered late in the exploration sequence, new sales-oil pipelines may be built. It is possible that commercial-sized fields discovered by different companies will be shut in (not produced) until an agreement is reached to share the costs of constructing a pipeline system through the NPR-A.

The diameters and lengths of new pipelines in the NPR-A will depend on the characteristics of new fields (undiscovered at present) and the resource-development scenarios for each leasing alternative. Generally, infield pipelines (flowlines) carry multiphase slurries (oil, gas, water) from wellhead manifolds to central processing plants. Return lines containing gas or water will carry these substances back to injection wells on production pads. Infield flowlines are relatively small in diameter (4-10 in). Somewhat larger sales-oil pipelines (12-16 in) will carry metered sales-quality oil from individual fields to a centrally located main line (16-20 in). This main pipeline would then connect several producing fields to the KRU pipeline (24 in) and then on to the TAPS (48 in).

Based solely on geologic play potential, we can speculate on future pipeline corridors in the NPR-A, as shown in Figure IV.A.1.b-7. No implication regarding specific prospect location is intended. The actual location of undiscovered, commercial-sized fields and the timing of their discovery is impossible to predict. These hypothetical pipeline corridors represent only one idea of future NPR-A infrastructure, and more specific discussions regarding the locations of future development are misleading.

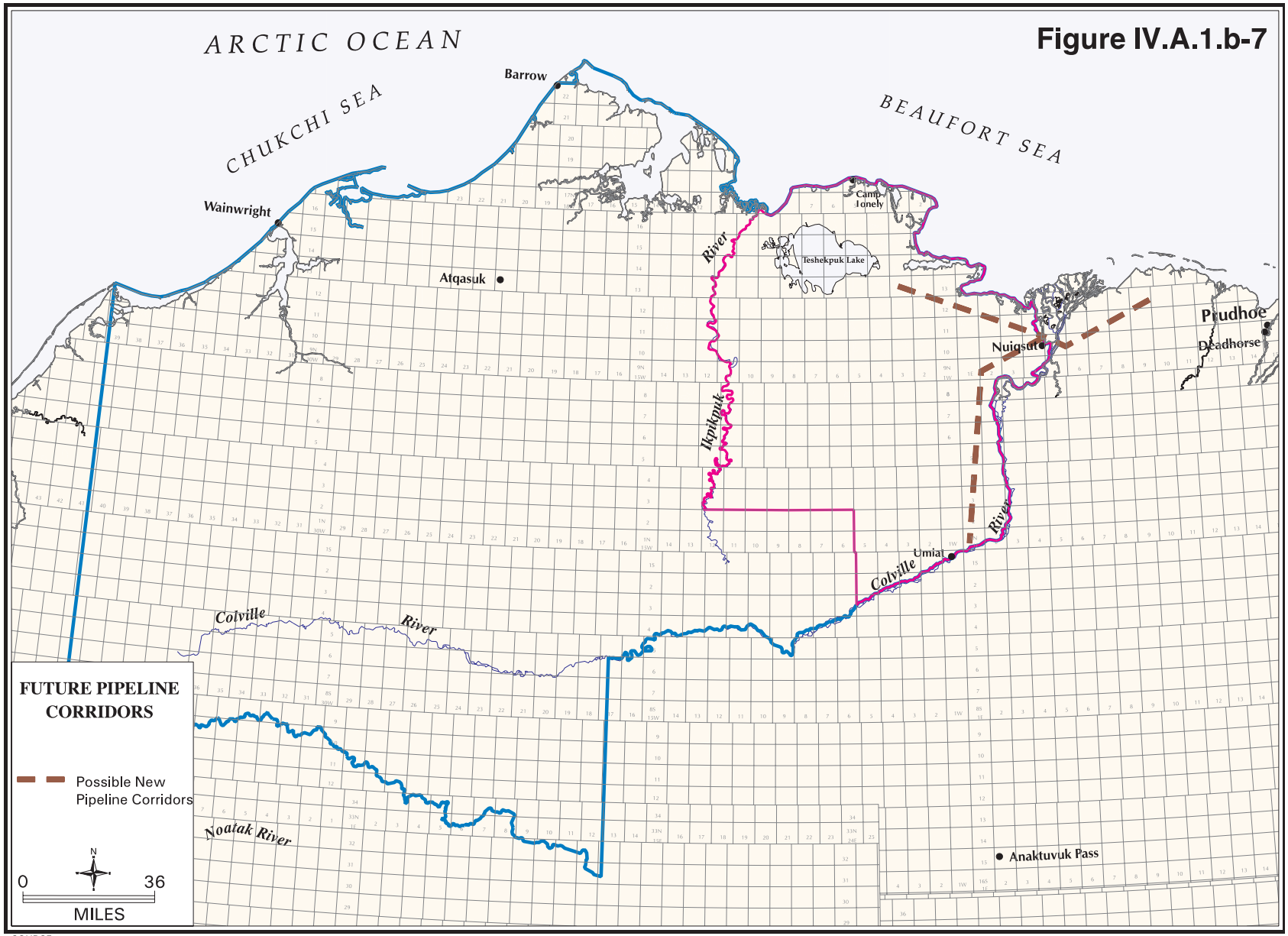
(d) Pipeline Construction: Pipeline-construction techniques have evolved over decades of experience in the arctic environment on the North Slope. The following assumptions cover the general engineering for pipeline design and construction that could be adopted for future NPR-A projects.

- Pipeline crossings of large rivers, such as the Colville River, could use the horizontal directional drilling techniques similar to those proposed by the Alpine project. Permanent bridges across the Colville River are not feasible for practical and economic reasons.
- Relatively wide, shallow rivers could be crossed by trenching and burying insulated pipelines in the river bed. These pipelines would be installed in winter at locations selected to minimize disturbance to overwintering fish habitat.
- Narrow streams could be crossed by elevated pipelines on suspension spans.
- Pipeline alignments will be routed to avoid crossing lakes.
- Pump stations could be required along the new main-line route, depending on distances, pipeline diameters, and production rates.
- Future pipeline routes and installation designs will depend on site-specific conditions evaluated by preconstruction engineering studies.

Typically, pipeline routes are laid out in straight-line segments (alignments) and are installed aboveground on VSM's (Fig. IV.A.1.b-8). This installation method is preferred on the North Slope over buried pipelines, because construction time is less, it causes less disruption to the land during installation, the elevated pipelines are easier to monitor and repair, and the VSM's provide more flexibility for later modification (add new pipelines). The VSM's generally are spaced 55 to 70 ft apart and are installed with minimum heights of 5 ft above the ground to minimize disturbance to caribou herd movements. Pipeline clearance generally is higher (up to 20 ft) over topographic lows (stream valleys), because engineering calls for a nearly level pipeline route. Small, shallow lakes may have elevated VSM's across them, whereas large or deep lakes will have pipeline VSM's routed around their shorelines with some setback.

(e) "Roadless" Development: An important assumption for future NPR-A development is that permanent roads will not be constructed along pipeline alignments or from new fields in the NPR-A to the existing infrastructure east of the Colville River. Despite the name "roadless" development, it should be recognized that most fields will be connected by winter ice roads to allow transport of heavy equipment and supplies to the field location. These seasonal roads could be used for 4 to 5 months during each winter (December-April). In addition to ice roads, remote fields likely will use alternate transportation systems, such as marine barging and/or airstrips. Short gravel roads will connect production pads and facilities within individual fields, and gravel roads perhaps could connect nearby fields to allow sharing of infrastructure.

The concept of "roadless" development is a recent North Slope concept prompted by both economic and environmental reasons. Two new fields under construction on the North Slope (Badami and Alpine) have adopted "roadless" development, because it is cheaper and creates



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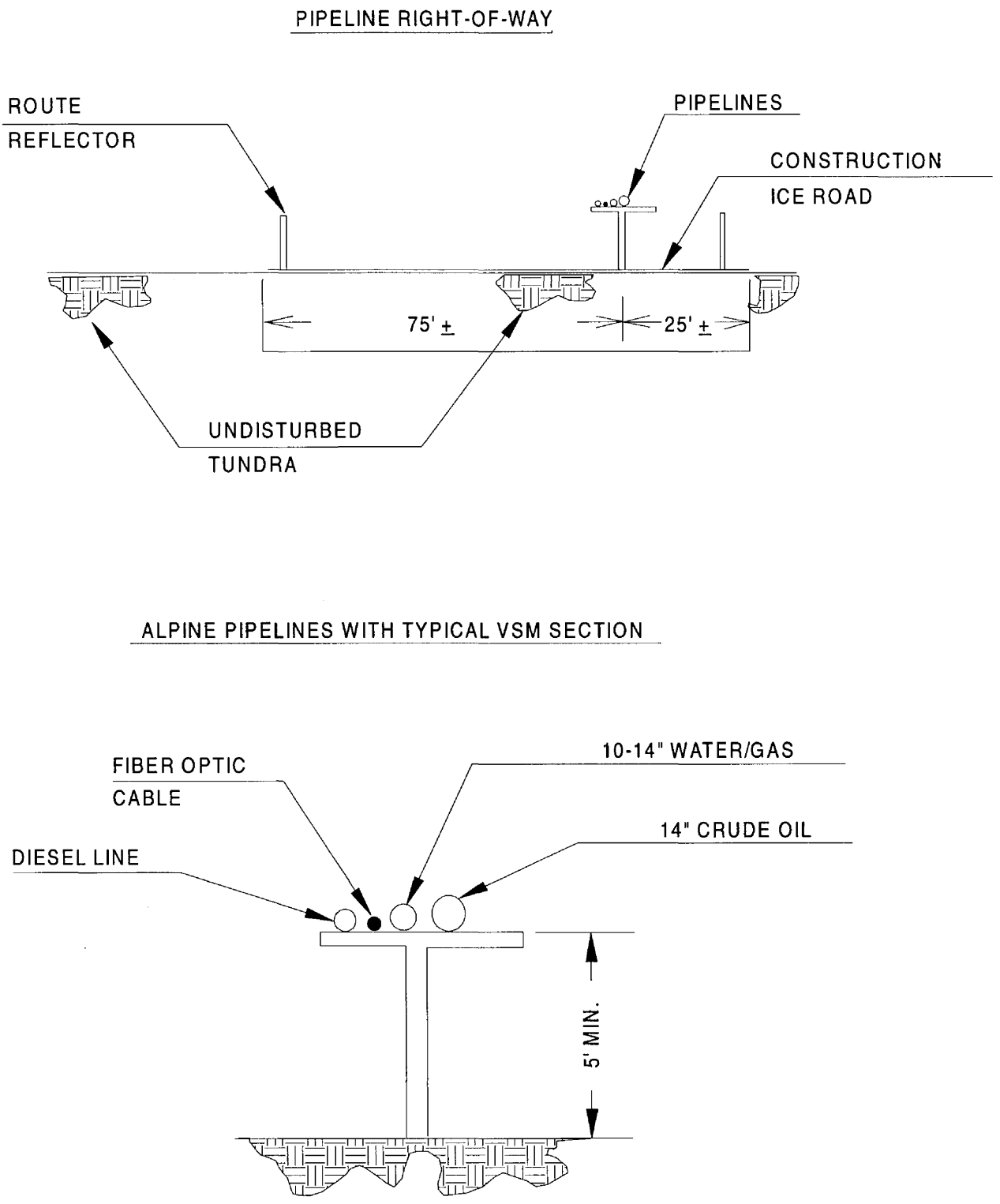


Figure IV.A.1.b-8. Typical Pipeline Construction. Future pipelines in NPR-A are likely to be elevated on Vertical Support Members (VSM). A minimum height of 5 ft is maintained to minimize wildlife disturbance. Pipelines are installed during winter using ice roads, and there will be no permanent gravel road paralleling pipeline corridors. (Figure taken from Alpine Project description, courtesy of ARCO Alaska, Inc.)

less environmental impact. Following the example of these recent development projects, we assumed that future activities in the NPR-A would not involve permanent roads beyond the field boundaries. There are several reasons:

1. The smaller field sizes predicted for the NPR-A probably could not support the high cost of long, permanent roads.
2. The availability of road-construction material (gravel) is likely to be limited in the planning area.
3. Environmental impacts could be greater for permanent roads, which tend to act as barriers to animal movement or surface waterflow.
4. Field- construction activities normally are scheduled for winter months, when overland travel is possible and wildlife presence is significantly lower.
5. Smaller fields in the NPR-A will not require the level of supply/service operations as multibillion-barrel fields, such as Prudhoe Bay and Kuparuk.

From a safety standpoint, permanent roads would allow direct monitoring of pipelines and more rapid response time, should repairs be necessary. However, "roadless" development will not preclude access for pipeline inspection; rather, the mode of transportation will change with the seasons. Over the winter months, visual inspections could be conducted by nearby ice roads, or by snowmobiles if ice roads are not present, and by aircraft. In summer months, visual inspections will be conducted largely using aircraft. Seasonal restrictions on aircraft operations are likely to be enforced to protect waterfowl from disturbance. The response to pipeline repairs likely will use the same forms of transportation. Hovercraft might be used for emergency repair work, particularly during periods when the tundra is wet (as opposed to frozen). Should an emergency pipeline repair be necessary, an on-site coordinator will consider the tradeoffs for various remediation strategies. It should be noted that pipeline monitoring on the North Slope is now done largely using remote instrumentation. Numerous monitoring and safety systems are installed to provide redundancy in these electrical and mechanical safety systems. For example, mechanical shutoff values are being replaced by vertical expansion loops to provide a more failsafe method of controlling pipeline pressures and leaks.

(7) Development Scenarios:

(a) Resource Potential and Related Activities: A variety of activities are associated with petroleum development, beginning with tract leasing and concluding decades later with abandonment of depleted fields. A general timeframe for exploration, development, and production activities is given as Table IV.A.1.b-1. For purposes of environmental analysis, the levels of activities are assumed to be directly related to the available resource potential. However, industry's interest in developing the resources ultimately controls future petroleum-related activity. Industry commitment to exploring any area is driven by profit motives, and each company may view the geologic or economic opportunities of a particular area differently. Some companies pursue high-risk/high-reward ventures, while others prefer safer/lower reward investments. Major oil companies typically take a more global perspective, while smaller independents tend to concentrate on domestic projects. Industry opinions of development potential can change quickly with new data or economic conditions.

Two sets of development scenarios are presented here. The first set includes activities estimated to occur as a result of the next lease sale in the NPR-A. This sale, tentatively scheduled for late 1999, is the first sale in a possible series of future lease sales offering various parts of the NPR-A. Although it is referred to as the "first-sale" scenario in this EIS, it actually is the fifth NPR-A lease offering. All tracts leased in previous sales (1982-1984) have been relinquished. The second set of development scenarios includes the activities associated with developing and producing the total resource potential under the various lease-sale alternatives. This is referred to as the "multiple-sale" scenario. If multiple lease sales are held and industry is allowed to thoroughly explore the area, it is assumed that all of the economic resources eventually will be discovered and developed. As indicated by the activity projections, a large fraction (more than half) of the resource production is expected to occur as a result of the first sale, with progressively lower fractions leased in each subsequent sale.

The resource estimates for the "first-sale" scenario is lower than the total economically recoverable resources estimated for the planning area because, despite their best efforts, industry is not likely to lease and discover all of the commercial oil fields as the result of a single lease sale. A variety of factors were considered in making the subjective reduction for the oil volumes expected to be leased and produced as a result of the next sale in the NPR-A. These factors included previous exploration activities in the NPR-A, new geologic data or play concepts, current technology capabilities in mapping prospects using seismic data, and the proximity of mapped prospects to existing infrastructure. Because all prospects have not been identified and geologic concepts are likely to vary among geologists, it is very important that areas of high potential be open for leasing. In a partially explored petroleum province, such as the NPR-A, *area is equivalent to opportunity*. If leasing is restricted in areas of high geologic potential, the opportunities for commercial success are far lower and industry is not encouraged to take the financial risks to explore for new fields.

The environmental analysis contained in this IAP/EIS is based on several hypothetical development scenarios tied to estimates of *undiscovered resource potential.* There are many assumptions, and inherent uncertainties, in attempting to predict future activities. We fully acknowledge that other scenarios are equally plausible and that changing information could result in a change in resource estimates. An accurate accounting of oil reserves is possible only after the production cycle is completed, perhaps decades into the future. Given that environmental analysis and decisions regarding leasing must be done now, we project these future production estimates based on the available data.

The conventionally recoverable endowment represents the overall petroleum resource potential of an area and, by definition, disregards any engineering, economic, or environmental constraints. The assessment of the conventionally recoverable endowment (also referred to as the geologic potential) is an important first step to focus exploration activities. Efforts to increase exploration success are most effective when focused on areas having the highest resource potential. Areas having low resource potential become secondary objectives pursued in later rounds of exploration. Areas of low potential could contain significant resources in subtle geologic traps that either have not been identified yet or that have been discounted because of uncertain geologic factors.

The conventionally recoverable resource estimate provides a geologic context or framework for exploration but does not accurately portray the activities expected from leasing. Engineering, economic, and environmental factors are critical in evaluating the commercial viability of oil and gas prospects. When economic realities are considered, the amount of resources expected to be leased and ultimately produced are significantly lower than the largely unattainable geologic potential. For purposes of environmental analysis, it is more reasonable to use resource volumes that are commercially viable under the constraints appropriate to the area rather than the geologic endowment.

Although our economic resource estimates are closely tied to oil prices, opinions about future oil prices typically vary among economists making the predictions. The oil prices used to define reasonable limits for environmental analysis are considered to be average, long-term price trends and do not acknowledge short-term spikes. Reasonable levels of activities are assumed to correspond to oil prices between $18 and $30 per barrel. This does not imply that long-term oil prices will average $30, only that this price and the corresponding resource volume provides a reasonable upper limit for activity levels. It is possible that greater volumes of oil could be recovered at normal ($18) prices through the use of advanced technology. Because we cannot accurately predict the effects of advanced technology, the higher price ($30) provides a upper-range indicator of future activities.

The ***exploration-only scenario*** (Table IV.A.1.b-2) is expected after the next lease sale, if oil prices drop to below $18/bbl and remain there for long periods of time or if exploration efforts yield subeconomic quantities of oil. The discovery of gas fields also is considered as an "exploration-only" case, because these resources are very unlikely to be developed in the foreseeable future. With low oil prices, it will be difficult to realize profitability in this remote, high-cost operating area, so industry will lease and explore at a very modest pace. Winter seismic surveys would be infrequent, perhaps one survey crew operating in alternate winter seasons. Exploration drilling could occur selectively on very attractive (large) prospects located near existing infrastructure. If limited drilling and seismic-survey work results in discoveries, it is likely that the fields will be shut in awaiting higher oil prices. We assume that no oil- development activities will occur, because discoveries (if any) would not be profitable to produce.

The ***oil-development scenario*** (Table IV.A.1.b-3) assumes that oil prices will range between $18 and $30 (in constant dollars) in the foreseeable future. Development activities and corresponding resource production are given as ranges to acknowledge the uncertainties in estimating future development of undiscovered petroleum resources.

The following scenarios attempt to portray a reasonable sequence of activities that could occur as a result of the next lease sale in the planning area. Other scenarios are possible and equally likely. No attempt is made to provide a full spectrum of other "what-if" possibilities. For purposes of environmental impact analysis, generalized scenarios based on current practices on the North Slope are formulated.

Table IV.A.1.b-3 represents a maximum level of activities from the next lease sale, if the entire planning area is available for leasing and possible development. The low end of the range is defined by oil-production-related activities for 250 MMbbl and assumes that at least one commercial field will be discovered and produced. The upper end of the range is represented by oil-production-related activities for 1,100 MMbbl, where as many as five commercial fields could be discovered in the planning area. For purposes of analysis, we assumed that these five fields have varying sizes of 150 to 300 MMbbl in recoverable reserves. It also is possible that fewer, but somewhat larger fields, will be discovered and developed. These resource estimates assume that the entire planning area is available for leasing, and that no regulatory restrictions are adopted that would adversely affect leasing interest or the economic viability of any discoveries.

Table IV.A.1.b-2 Exploration-Only Schedule for the First Sale

At prices below $18 per barrel, some exploration will occur, but production would be uneconomic.

	Exploration Wells	Delineation Wells	Exploration/ Delineation Rigs	Production Pads	Production and Service Wells	Production Rigs	Staging Areas	Oil Production	Pipeline Miles
1999	Lease Sale								
2000									
2001	1								
2002									
2003									
2004	1	1	1						
2005									
2006									
2007	1		1						
Total	3	1	1[1]	0	0	0	0[2]	0[3]	0

Notes: [1]Maximum exploration/delineation or production drilling rigs operating in any single year. [2]Assumes exploration operations utilize existing facilities. [3]Discovered oilfields are smaller than threshold for stand-alone economic viability (approx. 140 MMbbl).

Table IV.A.1.b-3 Development Schedule for the First Sale

At prices of $18 per barrel, we estimate that 250 million barrels of oil could be discovered and produced; at prices of $30 per barrel, 1,100 million barrels could be discovered and produced.

	Exploration Wells		Delineation Wells		Exploration/ Delineation Rigs		Production Pads		Production and Service Wells		Production Rigs		Staging Bases		Oil Production		Pipeline Miles	
MMbbl	**250**	**1100**	**250**	**1100**	**250**	**1100**	**250**	**1100**	**250**	**1100**	**250**	**1100**	**CL**	**UM**	**250**	**1100**	**250**	**1100**
1999	Lease Sale																	
2000																		
2001	1	1			1	1												
2002	1	2	1	1	1	2												
2003		1	2	3	1	3												
2004	1	2	2	4	2	4							0.1					
2005		2		1		2							0.1					
2006	1	2	1	2	1	3												
2007		2		3		4	2	3						0.1			50	50
2008	1	2		3		4			24	39	2	3	0.2	0.1			30	30
2009		1		4		3			30	45	2	3	0.2	0.1	16	16		10
2010				2		1		2	21	36	2	3	0.1		21	30		
2011										24		2	0.2		21	36		25
2012								2		24		2	0.1	0.1	21	48		
2013										36		4		0.1	21	56		15
2014										24		2		0.2	21	68		
2015								2		12		2		0.2	19	72		45
2016										30		2		0.1	17	68		30
2017										30		2			15	81		
2018										30		2			13	81		
2019															11	73		
2020															10	67		
2021															9	61		
2022															8	56		
2023															7	49		
2024															6	43		
2025															5	37		
2026															4	33		
2027															3	28		
2028															2	25		
2029																20		
2030																15		
2031																11		
2032																9		
2033																7		
2034																6		
2035																4		
2036																3		
Total	5	15	6	23	2	4	2	9	75	330	2	4	2.0		250	1100	80	205

Notes: (1) Exploration well totals include both dry wells and discoveries. (2) Rig totals are maximum number operating in any single year. (3) Production to service well ratio is 2:1. (4) Staging bases are at Camp Lonely (CL) and Umiat (UM) for the high resource case only. (5) Pipeline miles do not include in-field flowlines, only sales oil gathering lines to the Kuparuk River Unit (KRU).

Table IV.A.1.b-4 Resource Estimates for the First Sale in Each Alternative

At oil prices ranging from $18 to $30 per barrel

	Alternative	$18 Oil Price (MMbbl)	$30 Oil Price (MMbbl)	Number of Fields
A	No Leasing	0	0	0
B	Deletions	65 *	350	0 to 1
C	Deletions	75 *	410	1 to 2
D	Deletions	185	825	1 to 4
E	Open	250	1,100	1 to 5
PA	Preferred	90 *	420	1 to 2

Notes: Resources are economic oil volumes expected to be leased, discovered, developed, and produced as a result of the next NPR-A lease sale in the planning area. * Resources of this size are not economically viable as stand-alone fields. Fields discovered under Alternative B are too far from Alpine to share production infrastructure and are, therefore, noncommercial. Small oil fields discovered under Alternative C and the Preferred Alternative could be located close enough to Alpine to share infrastructure and could be commercial under these circumstances.

Table IV.A.1.b-5 Levels of Activities for the First Sale under Each Alternative

At prices ranging from $18 to $30 per barrel

	Exploration Wells		Delineation Wells		Exploration/ Delineation Rigs		Production Pads		Production and Service Wells		Production Rigs		Staging Bases		Peak Oil Production (MMbbl/yr)		Pipeline Miles	
A	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0	0	0	0	0
B	1	4	0	6	1	1	0	2	0	83	0	2	0.0	0.0	0	35	0	75
C	2	6	2	9	1	2	1	2	23	122	1	2	0.0	0.0	8	41	10	90
D	4	11	5	17	2	4	1	6	56	248	1	4	0.0	1.0	16	61	80	105
E	5	15	6	23	2	4	2	9	75	330	2	5	0.0	2.0	21	81	80	205
PA	2	7	2	10	1	3	1	4	30	132	1	3	0.0	1.0	9	42	20	95

Notes: (1) Exploration well totals include both dry wells and discoveries. (2) Rig totals are maximum number operating in any single year. (3) Production-to-service well ratio is 2:1. (4) Staging bases are at Camp Lonely (CL) and Umiat (UM) for the high resource case only (1,100 MMbbl). Staging for the Preferred Alternative is likely to use a new coastal site near the Kogru River. (5) Pipeline miles do not include in-field flowlines, only sales-oil gathering lines and main lines which will cross NPR-A to the existing pipeline network on State lands to the east.

Table IV.A.1.b-6 Resource Estimates for Multiple Sales Under the Alternatives

At oil prices ranging from $18 to $30 per barrel

	Alternative	$18 Oil Price (Mmbbl)	$30 Oil Price (MMbbl)	Expected Number of Fields	Geologic Resource (MMbbl)
A	No Leasing	0	0	0	0
B	Deletions	90 *	500	0 to 2	680
C	Deletions	110 *	580	1 to 3	1,010
D	Deletions	370	1,650	2 to 7	2,090
E	Open	500	2,200	2 to 10	3,060
PA	Preferred	130 *	600	1 to 3	1,240

Notes: (1) Resources are economic oil volumes estimated to be available in respective alternative areas within the planning area. (2) Oil volumes are rounded to the nearest 10% value. * Resources of this size are not economically viable as stand-alone fields. Fields discovered under Alternative B are too far from Alpine to share production infrastructure and are, therefore, noncommercial. Fields discovered under Alternative C and the Preferred Alternative could be located close enough to Alpine to share infrastructure and could be commercial under these circumstances. (3) Geologic resources are mean conventionally recoverable oil volumes, disregarding economic factors or commercial viability.

Table IV.A.1.b-7 Levels of Activities for Multiple Sales Under the Alternatives

At prices ranging from $18 to $30 per barrel

	Exploration Wells		Delineation Wells		Exploration/ Delineation Rigs		Production Pads		Production and Service Wells		Production Rigs		Staging Bases		Peak Oil Production (MMbbl/yr)		Pipeline Miles	
A	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0	0	0	0	0
B	4	14	0	12	1	2	0	4	0	150	0	3	0.0	0.0	0	42	0	90
C	6	18	2	15	2	3	1	5	33	174	1	4	0.0	1.0	10	49	10	105
D	12	44	12	36	2	4	3	12	111	495	3	8	0.0	2.0	19	73	95	150
E	15	60	12	48	3	5	4	16	150	660	4	10	1.0	3.0	25	97	95	280
PA	6	21	4	17	2	3	1	5	41	180	1	5	0.0	1.0	13	51	20	110

Notes: (1) Exploration well totals include both dry wells and discoveries. (2) Rig totals are maximum number operating in any single year. (3) Production-to-service well ratio is 2:1. (4) Potential staging bases are at Camp Lonely, Umiat, and Inigok for the high case only. Staging for the Preferred Alternative is likely to use a new coastal site near the Kogru River. (5) Pipeline miles do not include in-field flowlines, only sales-oil gathering lines and main lines which will cross NPR-A to the existing pipeline network on State lands to the east.

Leasing Alternatives (Tables IV.A.1.b-4 and IV.A.1.b-5). Six leasing alternatives have been proposed for the next lease sale, each with different measures of restrictions where areas are paced off-limit to development or activities are constrained by lease stipulations. When areas are restricted, exploration opportunities are decreased and progressively lower levels of activities and oil production are expected. Leasing stipulations are likely to impose restrictions on activities that could affect project viability, leading in some cases to the nondevelopment of oil field discoveries.

To generate the activity schedules (Tables IV.A.1.b-2 and IV.A.1.b-3), numerous assumptions are made:

- The next NPR-A lease sale will be held in 1999.
- Industry will be aggressive in leasing and exploration, leading to discoveries of commercial-sized oil fields.
- Several industry groups will independently explore and develop new fields in the NPR-A.
- There will be no long-lasting legal or regulatory delays to exploration or development.
- Activities will not be constrained by the availability of equipment or materials.
- Future oil production from the NPR-A will use TAPS to transport oil to outside markets.
- Exploration and development of new gas fields will not occur until a new regional gas-transportation system is operational from the North Slope.
- Activities are shown on an annual basis, but many operations are seasonal (winter only).
- Commercial fields will be developed on a stand-alone basis; that is, they will have individual production pads, processing facilities, and a sales-oil pipeline.
- New fields in the NPR-A will attempt to use existing pipelines (Alpine and Kuparuk sales-oil pipelines) to transport oil to the TAPS Pump Station 1.
- Individual production pads will recover a total of 150 MMbbl of oil and oil wells will average 5 MMbbl each in ultimate production.
- Production wells average 10,000 ft (drilled depth), and 12 to 18 wells can be completed by one rig each year. We assume that one drilling rig will operate on each pad.
- Two new staging areas (Camp Lonely and Umiat) will be developed for the high-resource case (1,100 MMbbl). For the low-resource case (250 MMbbl), exploration and development will be staged from existing infrastructure east of the Colville River.

(b) Changes in Activity Levels for Leasing Alternatives: Several leasing alternatives are under consideration, each providing different levels of protection for environmental and cultural values. A direct relationship between the levels of protection and the reductions in petroleum development is very probable. Alternative E (the entire area is available for leasing, Table IV.A.1.b-3) is used as a basis for comparison, and activities associated with the other alternatives are reduced from this level.

Future petroleum-related activity ultimately is controlled by industry's perception of the opportunities for profitable operations. Regulatory restrictions (closed areas or lease stipulations) could adversely affect several aspects of future petroleum activities, including lower leasing activity (fewer tracts leased, lower bonus bids), reduced exploration (fewer prospects drilled), delayed production startups, and nondevelopment of oil discoveries. A precise evaluation of the economic impacts of leasing/development restrictions is not possible, because the magnitude of effects will depend largely on the location of commercial oil fields (unknown today). At one extreme, if a prospect is located in an area unavailable for leasing, it will not be leased or discovered. At the other extreme, if the area is available for leasing and compromises can be reached to mitigate impacts, then commercial development is possible. The effects of withholding areas from leasing and regulations on future petroleum activities in the NPR-A could range from minimal to severe, depending primarily on field location.

Alternative A is the no-action alternative. It reflects current BLM management of the NPR-A, where no oil and gas lease sales are scheduled. There would be no industrial development. Summer aerial surveys and occasional field investigations may occur. One option under this alternative would permit continued winter seismic surveys, while another would prohibit such surveys.

Alternative B provides for maximum protection of surface resources. No oil and gas leasing or development would occur in the numerous Land Use Emphasis Areas (LUEA's) except for the Kuukpik Corporation Entitlement LUEA, in which leasing is deferred until the corporation's entitlement is satisfied. River corridors could be protected for future designation as special areas or wild and scenic rivers (upper Colville and Ikpikpuk rivers). Approximately half of the planning area would be available for leasing and development, but only 28 percent of the area of high oil potential along the northern coastal plain would be offered for leasing.

Alternative C focuses on maximum protection of certain wildlife resources (waterfowl and caribou) by withholding large areas of the valuable habitat surrounding Teshekpuk Lake from leasing and development. The remainder of the planning area (approximately 72%) would be available for leasing and possible development, but 35 percent of the area of high oil potential would be offered.

Alternative D focuses on maximum protection of certain wildlife resources (waterfowl and caribou) by withholding

smaller key habitat areas north of Teshekpuk Lake from leasing and applying management practices, in the form of lease stipulations, to mitigate potential impacts of future development in surrounding areas. A complete listing of the stipulations and discussion of the mitigation effects is given in Section II. Under Alternative D, 90 percent of the planning area would be available for leasing, including 73 percent of the area of high oil potential.

Alternative E is designed to allow oil and gas leasing and development of all lands administered by BLM in the planning area. While no areas are unavailable to leasing, future petroleum-related activities would be conducted under the comprehensive regulations (Sec. II). Environmental protection is achieved by establishing management practices and design features consistent with technically feasible petroleum development. The economic impact of regulatory restrictions could range from minimal to severe, depending largely on the location of future discoveries.

The Preferred Alternative is designed to provide maximum protection of certain wildlife resources (waterfowl and caribou) by withholding large areas of the valuable habitat surrounding Teshekpuk Lake from leasing and development. In addition, surface facilities and development activities will not be allowed in a buffer around the closed areas and along important river systems. Special lease stipulations will apply to all of the Northeast NPR-A Planning Area to provide additional mitigation for impacts associated with future petroleum development. Overall, approximately 80 percent of the planning area would be available for leasing and possible development, but slightly more than a quarter of the areas of high oil potential would be relatively unaffected by area withdrawals and leasing stipulations. A complete listing of the stipulations and discussion of the mitigation effects is given in Section II.

Table IV.A.1.b-4 summarizes the estimated petroleum production associated with the first sale under each leasing alternative. Resource estimates were determined by considering several factors, including industry interest, location of identified prospects, regional stratigraphic trends, and relevant well data. Resource reductions were made proportionally on a play-by-play basis and then summed to determine the resources available for leasing under each alternative. Because the northern portion of the planning area is estimated to contain >90 percent of the oil potential, significant reductions in production and related activities are expected if these lands are not opened to leasing and development.

The levels of activities for the first sale under each leasing alternative is provided in Table IV.A.1.b-5. The activities were scaled downward proportionately to the changes in resource estimates. There is at least one economically viable field in all the alternatives except for Alternative A (no action), although Alternative C and the Preferred Alternative were modified with respect to the stand-alone field assumption. At the $18/bbl price level, fields smaller that approximately 120 MMbbl would be commercial only if some infrastructure components could be shared with existing fields. However, a similar relaxation of the stand-alone assumption for Alternative B would not result in a viable field in the $18/bbl case, because tracts offered for leasing would be too far from existing infrastructure (assuming that the Alpine field is operational).

(c) Multiple-Sales Scenario: The principle assumption for the multiple-sales scenario is that the total economic resource potential of the planning area could be discovered and produced given the opportunity for exploration by industry. However, based on past experience, considerable effort could be required to discover all of the resources in this frontier province. Attanasi and Bird (1995) have estimated the number of wildcat wells needed to discover the total undiscovered oil resources in northern Alaska as part of the USGS 1995 National Resource Assessment effort. For the central coastal plain subarea (containing the northern part of the planning area), it is estimated that between 40 and 180 wildcat (exploration) wells would be required to discover all of the resources at prices ranging from $21 to $30 per barrel. Using an areal approximation, the planning area covers 60 percent of this subarea, so a well-number estimate (based on their methodology) would be 24 to 108 wells. In the past, however, usually only the "best" prospects are leased and tested by drilling. If commercial fields are not discovered, the exploration effort moves off into different areas. Many promising areas are underexplored because of changing economic conditions or corporate strategies, which could be unrelated to the undiscovered resource potential. For example, only one industry test well (ARCO, Brontosaurus) was drilled in the NPR-A as a result of three BLM lease sales held in the early 1980's.

For purposes of analysis, the activities associated with multiple-sale scenarios can be formulated by simply scaling the estimates up to develop the full undiscovered economic potential available under each alternative. Several key assumptions are necessary to qualify this approach:

- Multiple lease sales will be held.
- Industry will aggressively lease and explore the tracts offered. This could require large numbers of exploration wells and seismic surveys.
- Economic conditions (particularly oil price) would remain favorable to development in northern Alaska.
- New geologic information will not significantly change the present assessment of resource potential.

High-potential plays will not be condemned by future drilling, and new high-potential plays will not be discovered.

- Learning curves will improve efficiencies over time for both prospect identification and engineering technology. Learning curves lead to higher commercial success rates.
- Future petroleum production will use existing North Slope infrastructure, most importantly the TAPS pipeline.

The timeframes for development under the multiple-sales scenarios are not included, because a future lease-sale schedule has not been established. However, it is safe to assume that the development activities associated with multiple future sales will stretch considerably beyond the schedule for a single lease sale (Table IV.A.1.b-3). It is not reasonable to assume that the schedule generated for the next sale in the NPR-A ("first sale") will be replicated by subsequent lease sales. Historically, leasing and exploration interest tend to drop off during a series of lease offerings of the same area. Industry needs time to thoroughly evaluate existing leases before additional tracts are leased. The complete inventory of petroleum resources in the NPR-A could take many decades.

With these qualifying assumptions clearly in mind, the estimates for alternatives under the multiple-sales scenarios are given in Tables IV.A.1.b-6 (petroleum resources) and IV.A.1.b-7 (petroleum activities).

c. Seismic Operations: Seismic operations will occur under all the alternatives, except for the no-seismic option of Alternative A. The number of surveys and, to some extent, the type of survey will differ. Moreover, given a specific alternative, the number of seismic operations, the area they cover, and the layout of the survey grid is likely to be different from one year to the next. The following discussion recognizes this while giving some general assumptions on typical activities for the purpose of impact analysis. This information supplements the seismic discussion in Section IV.A.1.b(1).

In all of the alternatives, for both the single-sale and multiple-sale scenarios, 2-D seismic would be collected for regional reconnaissance purposes to identify potential prospects for leasing. Three-D seismic sometimes would be used for regional reconnaissance and also would be used on leased tracts to further delineate a prospect for exploration or appraisal drilling. Under all alternatives, nearly all seismic would take place in the area identified as having high oil and gas potential. For purposes of analysis, we estimate that the number of 3-D prospect delineation surveys is approximately equal to the number of commercial fields listed in Table IV.A.1.b-4.

Alternative A: Under the seismic option of Alternative A, it is assumed that one 2-D seismic operation will occur in alternate winter seasons in the planning area. No 3-D seismic is anticipated, because no leasing or development will occur.

Alternative B: Under Alternative B, it is assumed that one 2-D seismic survey will occur each winter and up to two 3-D operations will occur in alternate years. All 3-D seismic would occur within about 5 years of holding the first lease sale. Two-D seismic would continue annually for perhaps 10 years or so, after which it would occur in alternate winters.

Alternative C: Under Alternative C, it is assumed that one 2-D seismic survey will occur each winter and one to three 3-D operations will occur in alternate years. All 3-D seismic would occur within about 10 years of holding the first lease sale. Two-D seismic would continue annually for perhaps 15 years or so, after which it would occur in alternate winters.

Alternative D: Under Alternative D, it is assumed that one 2-D seismic survey will occur each winter with additional 3-D surveys occurring in alternate years. A total of two to seven 3-D seismic surveys would occur within about 15 years of holding the first lease sale. Two-D seismic could continue for perhaps 20 years or so, with the frequency decreasing to approximately every other winter in the second decade after the leasing is initiated.

Alternative E: Under Alternative E, it is assumed that one 2-D seismic survey will occur each winter with 3-D surveys occurring in alternate years. A total of 2 10, 3-D seismic surveys would occur within about 20 years of holding the first lease sale. Two-D seismic could continue for perhaps 25 years or so, with the frequency decreasing to approximately every other winter in the second decade after the leasing is initiated.

The Preferred Alternative: Under the Preferred Alternative, it is assumed that one 2-D seismic survey will occur each winter and one to three 3-D operations will occur in alternate years. All 3-D seismic would occur within about 10 years of holding the first lease sale. Two-D seismic would continue annually for perhaps 15 years or so, after which it would occur in alternate winters.

While the winter operating period could be as long as 5.5 months (early December-mid-May), typical seismic operations for an individual survey lasts about 100 days.

Cat trains for both kinds of seismic operations likely would originate from the Kuparuk oil field. Each cat train would consist of survey vehicles and support camp modular units. A train would consist of the approximately 10 (2-D) to 15

(3-D) vehicles that would run the seismic testing (see discussion below) and one or more fuel trucks and strings of trailers comprising the camp modular units pulled by bulldozers. A train typically would include two or three strings of trailers. Each would be pulled by a single bulldozer, and each string would have 4 to 8 trailers. These bulldozers and modular units generally exert greater ground pressure than do the vehicles that run the seismic lines.

Once in the area of operation, camps typically are moved every few days to once a week. The fuel truck or trucks will make runs back to Kuparuk or other fuel-supply depot through the course of the seismic operation. These fuel runs may occur daily or every few days, depending on a variety of factors, including the size of the operation and weather conditions.

A typical 2-D operation will cover about 250 line-miles. The survey lines are in the form of a grid, with typical line spacings of 5 by 10 mi. Each line of 2-D seismic is run by about 10 vehicles. The vehicles run parallel to each other through an area about 200 ft wide. The exterior dimensions of each survey area is variable, but the example survey described above could cover a total of about 600 mi^2.

A typical 3-D seismic operation will collect 150 mi^2 of data in a single winter season and typically would involve about 15 vehicles. Each line-mile consists of a pair of linear areas, each about 100 ft wide, through which the vehicles drive. The grid patterns for 3-D seismic surveys are considerably closer-spaced, with a typical line spacing of 500 ft by 2,000 ft. Although the exterior dimensions of 3-D survey grids is variable, a typical 10- by 15-mi survey area could contain about 1,875 line-miles of data. The techniques of setting up geophone arrays and shot points is very different (and far more efficient) than 2-D survey methods.

2. Oil Spills: The oil-spill analysis uses historical oil-spill databases and statistical methods to derive statistical information about Alaska North Slope and TAPS crude- and refined-oil spills. This statistical information includes estimates of how often a spill occurs for every billion barrels of oil produced (oil-spill rates), the mean (average) number of oil spills, and the mean and median size of oil spills from platforms, pipelines, and flowlines combined. The statistical information is then used to estimate the number, size and distribution of spills that may occur from reasonable and foreseeable development within the planning area. The oil-spill analysis considers the entire production life of the planning area and assumes: (1) commercial quantities of hydrocarbons are present in the planning area, and (2) these hydrocarbons will be developed and produced at the estimated resource levels. Uncertainties exist, such as (1) the estimates required for the assumed resource levels, (2) the actual size of a crude- or refined-oil spill, (3) the approximate location of oil assumed to be produced, or (4) whether production would occur at all. If no hydrocarbons exist, there is no risk of a crude-oil spill occurring in the planning area.

The history of crude- and refined-oil spills reported to the State of Alaska, Department of Environmental Conservation (ADEC) and the Joint Pipeline Office (JPO) is investigated to determine crude- and refined-oil spill rates and patterns from Alaska North Slope oil and gas exploration and development activities and the TAPS pipeline. Refined oil includes aviation fuel, diesel fuel, engine lube, fuel oil, gasoline, grease, hydraulic oil, transformer oil, and transmission oil. The Alaska North Slope oil-spill analysis includes onshore oil and gas exploration and development spills from the Point Thompson Unit, Badami Unit, Kuparuk River Unit, Milne Point Unit, Prudhoe Bay West Operating Area, Prudhoe Bay East Operating Area, and Duck Island Unit. The TAPS pipeline oil-spill analysis includes spills from Pump Stations 1 through 12 and the 3 mi corridor associated with it from Prudhoe Bay to Valdez, but not the Valdez Marine Terminal. The TAPS tanker-oil-spill rates are not investigated here. The TAPS tanker-oil-spill rates are from Anderson and LaBelle (1994) and include all TAPS tanker routes.

The Alaska North Slope oil-spill database is from ADEC. Oil-spill information is provided to ADEC by private industry according to the State of Alaska Regulations 18 AAC 75. The totals are based on initial spill reports and may not contain updated information. The ADEC database integrity is most reliable for the period 1989 to 1996 due to increased scrutiny after the *Exxon Valdez* oil spill (Volt, 1997, pers. comm.). For this analysis, the ADEC database is spot checked against spill records from ARCO Alaska, Inc. and British Petroleum, Inc. All spills greater than or equal to [≥]1 gallon are included in the data set. The time period January 1989 to December 1996 is used in the Alaska North Slope oil-spill analysis for the Northeast NPR-A Planning Area IAP/EIS. For consistency, the same time period, January 1989 to December 1996, is used for the TAPS pipeline oil-spill analysis. The TAPS pipeline spill data are derived from both the ADEC and the JPO data sets. The amount of Alaska North Slope oil produced is derived from the TAPS throughput (Alyeska Pipeline Service Co., 1997; Shatick, 1997, pers. comm.).

A quantitative oil-spill analysis is performed, where the original database base structure provides for rigorous statistical analysis. Alaska North Slope oil-spill rates are estimated without regard to differentiating operation processes. The ADEC database base structure does not facilitate quantitative analysis of Alaska North Slope oil-spill rates separately for platforms, pipelines, or flowlines.

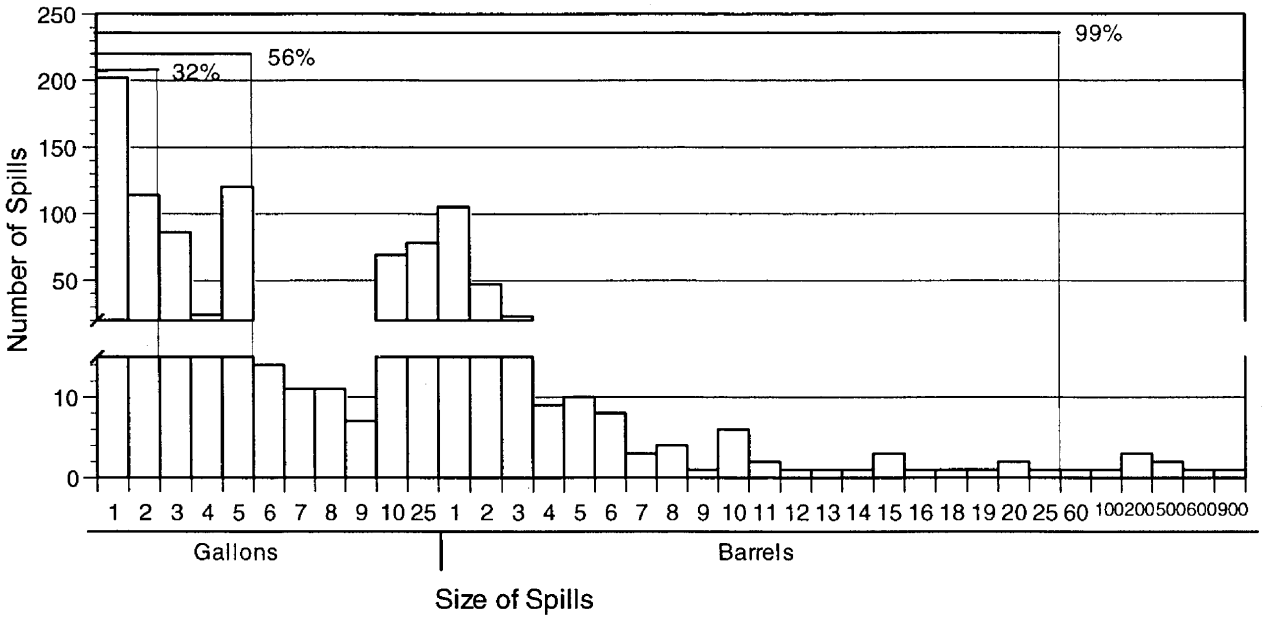


Figure IV.A.2. Alaska North Slope Crude Oil Spill Size Distribution and the Percent of Spills ≤2 Gallons, 5 Gallons, and 25 Barrels for the Period 1989-1996

Where quantitative oil-spill analysis is not possible, the patterns of oil spills are discussed qualitatively based on information from the ADEC database.

a. Estimated Planning Area Crude-Oil Spills:

The three types of crude-oil spills analyzed with oilfield exploration, development, and production in the NPR-A are (1) accidental crude-oil spills from facilities, platforms, pipelines, and flowlines; (2) blowouts of crude oil; and (3) TAPS pipeline and tanker spills.

(1) Accidental Crude-Oil Spills: The analysis of Alaska North Slope crude oil spills is performed collectively for all facilities, pipelines, and flowlines. Figure IV.A.2 shows the size distribution of crude-oil spills from January 1989 to December 1996 on the Alaska North Slope. The pattern of crude-oil spills on the Alaska North Slope is one of numerous small spills. Thirty-two percent of crude oil spills that occurred between 1989 to 1996 were less than or equal to [≤]2 gal. Fifty-six percent were ≤5 gal. Ninety-nine percent of the crude-oil spills were <25 bbl. During that time period, no crude-oil spills >1,000 bbl occurred. The database base spill sizes range from <1 gal to 925 bbl. Only crude-oil spills ≥1 gal are used in the analysis. The average crude-oil-spill size on the Alaska North Slope is 3.8 bbl, and the median spill size is 7 gal. For purposes of analysis, this EIS assumes an average crude-oil-spill size of 4 bbl.

Table IV.A.2-1 shows the estimated crude-oil-spill rate for the Alaska North Slope is 199 spills per billion barrels produced. Table IV.A.2-2a shows the estimated occurrence of crude-oil spills for the first sale for Alternatives A through E. Table IV.A.2-2b shows the estimated occurrence of crude-oil spills over the life of the IAP for multiple-sale Alternatives A through E. Table IV.A.2-3a shows the estimated size distribution of those spills for Alternatives A through E and the total volume of spilled crude oil for Alternatives A through E based on oil resources developed in the first sale. Table IV.A.2-3b shows the estimated size distribution of those spills and the estimated total volume of spilled crude oil for multiple-sale Alternatives A through E based on oil resources over the lifetime of the IAP.

The causes of Alaska North Slope crude-oil spills, in decreasing order of occurrence by frequency, are leaks, faulty valve/gauges, vent discharges, faulty connections, ruptured lines, seal failures, human error, and explosions. The cause of approximately 30 percent of the spills is unknown.

The planning area scenarios include an onshore pipeline. Of greatest concern would be the possible contamination of the Colville River, because a pipeline may cross or underlie the Colville and some of its tributaries. The ADEC Alaska North Slope database base structure does not facilitate a quantitative analysis of pipeline-spill rates. The ADEC database specifically identifies 4 pipeline leaks as a cause out of 975 spill records. The sizes of these pipeline leaks are 0.7, 5, 18, and 125 bbl. Those spills occurring or moving off pads may have some potential to enter a river or waterbody. For purposes of analysis, the percent of crude-oil spills occurring on a pad versus off the pad onto the surrounding environment is estimated. Approximately 65 to 80 percent of all crude-oil spills occur on a pad and have

Table IV.A.2-1 Estimated Alaska North Slope Onshore Crude-Oil-Spill Rate for the Years 1989-1996

	1989-1996	
Total Volume of Spills ≥1 gallon	156,482	gallons
Total Barrels	3,725.76	barrels
Total Number of Spills	975	
Average Spill Size	3.8	barrels
Billion Barrels Produced	4.9	billion barrels
Spills Per Billion Barrels Produced	199	spills/billion barrels

Source: USDOI, MMS, Alaska OCS Region, 1997. Oil-spill databases are from the ADEC, Anchorage, Juneau and Fairbanks. Alaska North Slope production data are derived from the TAPS throughput.

Table IV.A.2-2 Oil-Spill-Occurrence Estimates for Crude Oil Spills ≥1 Gallon Resulting Over the Assumed Production Life of the NE NPR-A Planning Area: (a) First Sale and (b) Multiple Sales

Alternative	Resource Range (Bbbl)[1]	Spill Rate Spills/Bbbl[2]	Assumed Spill Size (bbl)[3]	Estimated Number of Crude Oil Spills[4]	Estimated Total Volume of Crude Oil Spills (bbl)[4]
(a) FIRST SALE					
Alternative A[5]	0.0 – 0.0	199	4.0	0 – 0	0 – 0
Alternative B[5]	0.065 – 0.350	199	4.0	0 – 70	0 – 280
Alternative C	0.075 – 0.410	199	4.0	15 – 82	60 – 328
Alternative D	0.185 – 0.825	199	4.0	37 – 164	148 – 656
Alternative E	0.250 – 1.1	199	4.0	50 – 219	200 – 876
Preferred Alternative	0.090 – 0.420	199	4.0	18 – 84	72 – 336
(b) MULTIPLE SALES					
Alternative A[5]	0.0 – 0.0	199	4.0	0 – 0	0 – 0
Alternative B[5]	0.09 – 0.50	199	4.0	0 – 100	0 – 400
Alternative C	0.11 – 0.58	199	4.0	22 – 115	88 – 460
Alternative D	0.37 – 1.65	199	4.0	74 – 328	296 – 1,312
Alternative E	0.50 – 2.20	199	4.0	100 – 438	400 – 1,752
Preferred Alternative	0.130 – 0.600	199	4.0	26 – 119	104 – 476

Source: USDOI, MMS, Alaska OCS Region, 1998. Notes: [1] The estimation of oil spills is based on the estimated resources likely to leased, discovered, and produced as a result of the IAP, and assumes the existence of economically recoverable hydrocarbons in the planning area. [2] Crude oil-spill rates were calculated using the ADEC spill database and North Slope production data. [3] For purposes of analysis, the mean spill size of 3.8 bbl is rounded to 4.0 bbl. [4] The estimated number and volume of spills is rounded to the nearest whole number. [5] No exploration or development is assumed for Alternative A. The low end of the resource range for Alternative B is assumed to be exploration only.

Table IV.A.2-3 Estimated Crude-Oil-Spill Size Distribution Resulting over the Assumed Production life of the Northeast NPR-A Planning Area: (a) First Sale and (b) Multiple Sales

Size[1]	Alternative A Estimated Number of Spills[2,3]	Alternative B Estimated Number of Spills[2,3]	Alternative C Estimated Number of Spills[2]	Alternative D Estimated Number of Spills[2]	Alternative E Estimated Number of Spills[2]	Preferred Alternative Estimated Number of Spills[2]
(a) FIRST SALE						
1 gallon	0 – 0	0 – 15	3 – 17	8 – 34	10 – 45	4 – 17
>1 and ≤5 gallons	0 – 0	0 – 25	5 – 28	13 – 58	17 – 77	6 – 30
>5 gallons and <1 bbl	0 – 0	0 – 13	3 – 16	7 – 31	10 – 42	4 – 16
Total <1 bbl	**0 – 0**	**0 – 53**	**11 – 61**	**28 – 123**	**37 – 164**	**14 – 63**
≥1 bbl and ≤bbl 5	0 – 0	0 – 13	3 – 16	7 – 31	10 – 43	4 – 16
>5 and ≤25 bbl	0 – 0	0 – 3	1 – 4	2 – 8	2 – 10	1 – 4
> 25 and ≤1,000 bbl	0 – 0	0 – 1	0 – 1	0 – 2	1 – 2	0 – 1
Total >1 bbl	**0 – 0**	**0 – 17**	**4 – 21**	**9 – 41**	**13 – 55**	**5 – 21**
Total Volume (bbl)	**0 – 0**	**0 – 280**	**60 – 328**	**148 –656**	**200 – 876**	**72 – 336**
(b) MULTIPLE SALES						
1 gallon	0 – 0	0 – 21	5 – 24	15 – 68	21 – 91	5 – 25
>1 and ≤5 gallons	0 – 0	0 – 35	8 – 41	26 – 115	35 – 154	9 – 42
>5 gallons and <1 bbl	0 – 0	0 – 19	4 – 22	15 – 63	19 – 84	5 – 23
Total < 1 bbl	**0 – 0**	**0 – 75**	**17 – 87**	**56 – 246**	**75 –329**	**19 – 90**
≥1 bbl and ≤bbl 5	0 – 0	0 – 19	4 – 22	14 – 64	19 – 85	5 – 23
>5 and ≤25 bbl	0 – 0	0 – 5	1 – 5	3 – 15	5 – 20	1 – 5
>25 and ≤1,000 bbl	0 – 0	0 – 1	0 – 1	0 – 3	1 – 4	1 – 1
Total >1 bbl	**0 – 0**	**0 – 25**	**5 – 28**	**17 – 82**	**25 – 109**	**7 – 29**
Total Volume (bbl)	**0 – 0**	**0 – 400**	**88 – 460**	**296 – 1,312**	**400 –1,752**	**104 – 476**

Source: USDOI, MMS, Alaska OCS Region, 1997. Notes: [1] Spill-size distribution is allocated by multiplying the total estimated number of spills by the fraction of spills in that size category from the ADEC database. [2] Estimated number of spills is rounded to the nearest whole number. [3] No exploration or development is assumed for Alternative A. The low end of the resource range for Alternative B is assumed to be exploration only.

Table IV.A.2-4
Oil-Spill-Occurrence Estimates for TAPS Pipeline Crude Oil Spills ≥1 Gallon Resulting from NPR-A over the Assumed Production life of the NE NPR-A Planning Area[1]: (a) First Sale and (b) Multiple Sales

Alternative	Resource Range (Bbbl)[2]	Spill Rate Spills/Bbbl[3]	Average Spill Size (bbl)	Estimated Number of Spills[4]	Estimated Total Volume of Spills (bbl)[4]
(a) FIRST SALE					
Alternative A[5]	0.0 – 0.0	14	1.1	0 – 0	0 – 0
Alternative B[5]	0.065 – 0.350	14	1.1	0 – 5	0 – 6
Alternative C	0.075 – 0.410	14	1.1	1 – 6	1 – 7
Alternative D	0.185 – 0.825	14	1.1	3 – 12	3 – 13
Alternative E	0.250 – 1.1	14	1.1	4 – 15	4 – 17
Preferred Alternative	0.090 – 0.420	14	1.1	1 – 6	1 – 7
(b) MULTIPLE SALES					
Alternative A[5]	0.0 – 0.0	14	1.1	0 – 0	0 – 0
Alternative B[5]	0.09 – 0.50	14	1.1	0 – 7	0 – 8
Alternative C	0.11 – 0.58	14	1.1	2 – 8	2 – 9
Alternative D	0.37 – 1.65	14	1.1	5 – 23	6 – 25
Alternative E	0.50 – 2.20	14	1.1	7 – 31	8 – 34
Preferred Alternative	0.130 – 0.600	14	1.1	2 – 8	2 – 9

Source: USDOI, MMS, Alaska OCS Region, 1997. Notes: [1] The TAPS pipeline crude oil spill rate includes only pipeline spills and does not include the Valdez Marine Terminal. [2] The estimation of oil spills is based on the estimated resources likely to leased, discovered, and produced as a result of the IAP, and assumes the existence of economically recoverable hydrocarbons in the planning area. [3] The TAPS pipeline crude oil spill rate is calculated using the ADEC and JPO databases and North Slope production data. [4] Estimated number and volume of spills is rounded to the nearest whole number. [5] No exploration or development is assumed for Alternative A. Alternative B low end of the resource range is assumed to be exploration only.

Table IV.A.2-5
Oil-Spill-Occurrence Estimates for TAPS Tanker Spills ≥1,000 Barrels Resulting from NPR-A Resources over the Assumed Production life of the Northeast NPR-A Planning Area: (a) First Sale and (b) Multiple Sales

Alternative	Resource Range (Bbbl)[1]	Tanker Spill Rate Spills/Bbbl[2]	Average Spill Size (bbl)	Estimated Mean Number of Spills	Most Likely Number of Spills	Chance of zero Spills (expressed as percent)	Total Volume of Spills (bbl)
(a) FIRST SALE							
Alternative A[3]	0.0 – 0.0	1.10	30,000	0 – 0	0 – 0	na	0 – 0
Alternative B[3]	0.065 – 0.350	1.10	30,000	0 – 0.39	0 – 0	na – 68	0 – 0
Alternative C	0.075 – 0.410	1.10	30,000	0.08 – 0.45	0 – 0	92 – 64	0 – 0
Alternative D	0.185 – 0.825	1.10	30,000	0.20 – 0.91	0 – 0	82 – 40	0 – 0
Alternative E	0.250 – 1.1	1.10	30,000	0.28 – 1.21	0 – 1	76 – 30	0 – 30,000
Preferred Alternative	0.090 – 0.420	1.10	30,000	0.10 – 0.46	0 – 0	90 – 63	0 – 0
(b) MULTIPLE SALES							
Alternative A[3]	0.0 – 0.0	1.10	30,000	0 – 0	0 – 0	na	0 – 0
Alternative B[3]	0.09 – 0.50	1.10	30,000	na – 0.55	na – 0	na – 58	0 – 0
Alternative C	0.11 – 0.58	1.10	30,000	0.12 – 0.64	0 – 0	89 – 53	0 – 0
Alternative D	0.37 – 1.65	1.10	30,000	0.41 – 1.81	0 – 1	66 – 16	0 – 30,000
Alternative E	0.50 – 2.2	1.10	30,000	0.55 – 2.42	0 – 2	58 – 9	0 – 60,000
Preferred Alternative	0.130 – 0.600	1.10	30,000	0.14 – 0.66	0 – 0	87 – 52	0 – 0

Source: USDOI, MMS, Alaska OCS Region, 1997. [1] The estimation of oil spills is based on the estimated resources likely to leased, discovered, and produced as a result of the IAP, and assumes the existence of economically recoverable hydrocarbons in the planning area. [2] Spill rate and average spill size from Anderson and LaBelle (1994). [3] No exploration or development is assumed for Alternative A. Alternative B low end of the resource range is assumed to be exploration only.

little or no effect to the environment. Approximately 20 to 35 percent may occur on or reach the surrounding environment.

Those spills reaching the surrounding environment generally remain restricted to a limited area of the tundra unless they reach a river, stream, or waterbody. The ADEC records are not accurate enough to provide statistical spill-size areas. The following are comments based on the ADEC data. Off-pad spills that occur or reach the environment generally cover a small area (≤500 square feet [ft²]). Larger contamination areas appear to occur by wind blowing a fine oil mist over a large area (up to 4.8 acres). Mueller (1997, pers. comm.) reports that a pipeline spill on December 30, 1993, at drill site 5, well 23, misted a fine oil spray over a tundra area of 100 to 145 acres. Of the off-pad spills that occur, many contact snow, which is cleaned up before the oil reaches the tundra. The ADEC database documents that a spill at Point McIntyre covered approximately 23 acres of snow-covered tundra

Table IV.A.2-6
Oil-Spill-Occurrence Estimates for Refined Oil Spills ≥1 Gallon Resulting over the Assumed Production life of the Northeast NPR-A Planning Area: (a) First Sale and (b) Multiple Sales

Alternative	Resource Range (Bbbl)[1]	Spill Rate Spills/Bbbl	Average Spill Size (bbl)	Estimated Number of Spills[2]	Estimated Total Spill Volume (bbl)[2]
(a) FIRST SALE					
Alternative A	0.0 – 0.0	464	0.7 (29 gal)	0 – 0	0 – 0
Alternative B	0.065 – 0.350	464	0.7 (29 gal)	0 – 162	0 – 112
Alternative C	0.075 – 0.410	464	0.7 (29 gal)	35 – 190	24 – 131
Alternative D	0.185 – 0.825	464	0.7 (29 gal)	86 – 383	59 – 265
Alternative E	0.250 – 1.1	464	0.7 (29 gal)	116 – 510	80 – 352
Preferred Alternative	0.09 – 0.420	464	0.7 (29 gal)	42 – 195	29 – 137
(b) MULTIPLE SALES					
Alternative A	0.0 – 0.0	464	0.7 (29 gal)	0 – 0	0 – 0
Alternative B	0.09 – 0.50	464	0.7 (29 gal)	0 – 232	0 – 162
Alternative C	0.11 – 0.58	464	0.7 (29 gal)	51 – 269	36 – 188
Alternative D	0.37 – 1.65	464	0.7 (29 gal)	172 – 766	120 – 536
Alternative E	0.50 – 2.2	464	0.7 (29 gal)	232 – 1,021	162 – 715
Preferred Alternative	0.13 – 1.2	464	0.7 (29 gal)	60 – 557	42 – 390

Source: USDOI, MMS, Alaska OCS Region, 1997. Notes: [1] The estimation of oil spills is based on the estimated resources likely to leased, discovered, and produced as a result of the IAP, and assumes the existence of economically recoverable hydrocarbons in the planning area. [2] The fractional estimated mean spill number and volume is rounded to the nearest whole number.

with 142 bbl of crude oil. Because this area was snow covered, there was little impact to the surrounding environment. If this spill occurred during the summer, the impacts would have been very different. ARCO Alaska, Inc. reports the largest tundra area impacted from a spill is approximately 1.50 acres (Joyce, 1997, pers. comm.).

(2) Blowouts: Blowouts represent several potential hazards. There is the danger of fatalities or serious injury to workers, equipment loss, and pollution. Blowouts usually are gas and oil combinations, but each type can occur separately. Gas blowouts are more dangerous and explosive but generally have a lesser effect on the environment compared to crude-oil blowouts.

The blowout rate for the Alaska North Slope is reviewed using the available data. The ADEC database does not identify well blowouts as a cause of spills from January 1989 to December 1996 nor at any other time (Stevens, 1997, pers. comm.). On the Alaska North Slope from 1958 to 1996, 2,933 wells were drilled (McManes, 1997, pers. comm.). During that same period, the Alaska Oil and Gas Conservation Commission (AOGCC) reports one crude-oil blowout (Wondzell, 1997, pers. comm.). No crude oil was spilled off the pad during this blowout. Loss of well control has occurred on some operations, resulting in the release of dry gas from high-pressure zones and the consequent showering of rocks and sand over areas reached by the blowout plume (Johnston, 1997).

Based on the Alaska North Slope blowout data, the chance of a blowout during drilling and nondrilling operations in the planning area is considered a very low-probability event. The long- duration, large-volume blowouts of the very early years of oil and gas exploration and development do not occur in the recent record. The present technology associated with blowout prevention and effective well control has reduced the incidence of well blowouts. In the unlikely event of a blowout, several factors reduce the risk to the environment. Most blowouts are gas or bridge themselves naturally in a short period of time. For purposes of analysis, no blowouts are assumed in this EIS.

(3) Crude-Oil Spills Associated with Delivery of NPR-A Crude Oil through the TAPS: The TAPS pipeline crude-oil-spill rate is calculated for the period January 1989 to December 1996. The estimated crude-oil-spill rate for TAPS pipeline spills ≥1 gal is 14 spills per billion barrels produced. The average crude-oil-spill size is 1.1 bbl. The database spill sizes range from 1 teaspoon to 18.3 bbl; however, only spills ≥1 bbl are analyzed. Table IV.A.2-4a shows the estimated TAPS pipeline crude-oil spills for Alternatives A through E from resources developed in the first sale. Table IV.A.2-4b shows the estimated TAPS pipeline spills from resources developed over multiple-sale Alternatives A through E.

The TAPS tanker-spill rate for the period 1977 to 1992 is taken from Anderson and LaBelle (1994). The TAPS tanker-spill rate is 1.10 spills per billion barrels produced. The average crude-oil-spill size is 29,800 bbl, and the median is 4,900 bbl. For purposes of analysis, the average crude-oil-spill size is assumed to be 30,000 bbl. Table IV.A.2-5a shows the estimated TAPS tanker crude-oil spills for Alternatives A through E based on resources developed in the first sale. Table IV.A.2-5b shows the estimated TAPS tanker crude-oil spills for resources developed over multiple-sale Alternatives A through E.

Table IV.A.2-7a
Oil-Spill Rates and Spill-Size Categories used in the Estimation of Oil Spills for the Cumulative Case

Category	Crude Oil Spill Rates Spills/ Bbbl	Crude Oil Spill-Rate Size Category	TAPS Pipeline Crude-Oil-Spill Rate	TAPS Pipeline Spill-Rate Size Category	TAPS Tanker Crude-Oil-Spill Rate	TAPS Tanker Spill-Rate Size Category
Offshore	1.77[1]	≥1,000 bbl	14[3]	≥1 gal	1.10[4]	≥1,000 bbl
Onshore	199[2]	≥1 gal	14	≥1 gal	1.10	≥1,000 bbl
NE NPR-A[5]	199[2]	≥1 gal	14	≥1 gal	1.10	≥1,000 bbl
W NPR-A	199[2]	≥1 gal	14	≥1 gal	1.10	≥1,000 bbl

Source: USDOI, MMS, Alaska OCS Region, 1998. [1]The estimated spill rate for pipelines and platforms on the OCS (Anderson and LaBelle, 1994). [2] The estimated spill rate for the Alaska North Slope onshore platforms, pipelines, and facilities calculated from the ADEC database and North Slope production data. [3]The estimated spill rate for the TAPS pipeline calculated from the ADEC and JPO databases and North Slope production data. [4]The estimated spill rate for TAPS tankers (Anderson and LaBelle, 1994). [5]The NE NPRA resource assumed for the cumulative case is the multiple sale Alternative E.

Table IV.A.2-7b
Resources and Reserves Used in the Estimation of Oil Spills for the Cumulative Case

Categories	Subcategories	Total Reserves & Resources (Bbbl)		Onshore Reserves & Resources (Bbbl)		Offshore Reserves and Resources (Bbbl)	
		Expected	Expected & Possible	Expected	Expected & Possible	Expected	Expected & Possible
Expected Production in the Future	Producing Field Reserves	6.4	6.4	6.15	6.15	0.26	0.26
	Development/Planning Resources	0.8	0.8	0.53	0.53	0.27	0.27
	Total	7.2	7.2	6.68	6.68	0.53	0.53
Possible Production in the Future	Within 10-15 Years		1.31		0.85		0.46
	OCS Projects		1.20				1.20
	Onshore Satellite Fields		1.0		1.0		
	Total		3.51		1.85		1.66
Total		**7.2 – 10.71**		**6.68 – 8.53**		**0.53 – 2.19**	

Table IV.A.2-8
Cumulative Case Oil-Spill-Occurrence Estimates ≥1 Gallon Resulting from Foreseeable Operations over the Assumed Production life of the Northeast NPR-A Planning Area

	Category	Reserves and Resources (Bbbl)[1]	Crude-Oil-Spill Rates Spills/Bbbl	Spill-Rate Size Category	Average Spill Size	Most Likely Number of Beaufort Sea Spills	Chance of One or More Spills Occurring
Offshore	Expected to Expected&Possible	0.53–2.18	1.77	≥1,000 bbl	7,000 bbl	0–3	61–98%
	Total Offshore Spills					0–3	
	Category	**Resource Range (Bbbl)[1]**	**Crude-Oil-Spill Rates Spills/Bbbl**	**Spill-Rate Size Category**	**Average Spill Size**	**Estimated Number of Crude-Oil-Spills Onshore**	**Estimated Volume of Crude-Oil-Spills (bbl)**
Onshore Spills	Expected to Expected&Possible	6.68–8.53	199	≥1 gal	4 bbl	1,331–1,700	5,324–6,800
	NE NPR-A[2]	0.13–0.60	199	≥1 gal	4 bbl	26–119	104–476
	W NPRA	0.13–1.2	199	≥1 gal	4 bbl	26–129	104–956
	Total Onshore Spills					1,383–1,948	5,532–8,232
	Category	**Resource Range (Bbbl)[1]**	**TAPS Spill Rates Spills/Bbbl**	**Spill-Rate Size Category**	**Average Spill Size**	**Estimated Number of TAPS Spills**	**Estimated Volume of TAPS Spills (bbl)**
TAPS Pipeline	Expected to Expected&Possible	7.2–10.71	14	≥1 gal	1.1 bbl	101–150	111–165
	NE NPR-A[2]	0.13–0.60	14	≥1 gal	1.1 bbl	2–8	2–9
	W NPRA	0.13–1.2	14	≥1 gal	1.1 bbl	2–17	2–19
	Total Pipeline Spills					105–175	115–193
	Category	**Resource Range (Bbbl)[1]**	**TAPS Tanker Spill Rates Spills/Bbbl**	**Spill-Rate Size Category**	**Average Spill Size**	**Most Likely Number of Tanker Spills**	**Chance of One or More Spills Occurring**
TAPS Tanker	Expected to Expected&Possible	7.2–10.71	1.1	≥1,000 bbl	30,000 bbl	7–11	>99.99 – >99.99%
	NE NPR-A[2]	0.13–0.60	1.1	≥1,000 bbl	30,000 bbl	0–0	13 – 50%
	W NPR-A	0.13–1.2	1.1	≥1,000 bbl	30,000 bbl	0–1	13 – 73%
	Total Tanker Spills					7–12	

Source: USDOI, MMS, Alaska OCS Region, 1998. Notes: [1] The estimation of oil spills is based on the estimated resources likely to leased, discovered, and produced as a result of the IAP, and Federal and State existing and known reserves and assumes the existence of economically recoverable hydrocarbons in these areas. [2] The NE NPRA resource assumed for the cumulative case is the multiple sale Preferred Alternative.

Table IV.A.2-9
Cumulative Case Summary: Crude Oil-Spill-Occurrence Estimates

Category	Estimated Number of Spills	Estimated Volume of Spills (bbl)	Contribution to the Cumulative Case
Offshore Spills			
Beaufort Sea	0 – 3	0 – 21,000	100 – 100%
NE NPR-A	0 – 0		0 – 0%
Onshore Spills			
Onshore Spills	1,357 – 1,829	5,428 – 7,756	98 – 94%
NE NPR-A	26 – 119	104 – 476	2 – 6%
TAPS Pipeline Spills			
TAPS Pipeline Spills	103 – 158	113 – 184	98 – 95%
NE NPR-A	2 – 8	2 – 9	2 – 5%
TAPS Tanker Spills[1]			
TAPS Tanker Spills	7 – 12	210,000 –330,000	100 – 100%
NE NPR-A	0 – 0	0 – 0	0 – 0%

Source: USDOI, MMS, Alaska OCS Region, 1998. Note: [1] TAPS tanker spills are calculated for the entire TAPS route, and these estimated spills may occur at any location along the TAPS route. The percentage of total shipments, 1986–1992 averages, are as follows: Alaska, 3.3%; Puget Sound, Wash, 25.3%; San Francisco, Calif, 16.2 %; Los Angeles, Calif, 27.1%; Hawaii, 3.2%, Panama, 20.6% and the U.S. Virgin Islands 4.5% (Anderson and Lear, 1994).

b. Refined-Oil Spills: The typical refined products spilled are aviation fuel, diesel fuel, engine lube, fuel oil, gasoline, grease, hydraulic oil, transformer oil, and transmission oil. Diesel spills are 61 percent of refined-oil spills by frequency and 75 percent by volume. Refined-oil spills occur in conjunction with oil exploration and production. The refined-oil spills correlate to the volume of Alaska North Slope crude oil produced. As crude-oil production has declined so has the number of refined-oil spills. From January 1989 to December 1996, the refined-oil-spill rate is 464 spills per billion barrels produced. Table IV.A.2-6 shows the estimated refined oil spills during the lifetime of the IAP for Alternatives A through E. Table IV.A.2-6 shows the estimated refined-oil spills during the lifetime of the IAP for multiple-sale Alternatives A through E.

c. Cumulative Case: The estimated resources and reserves used for analytical purposes in the cumulative case are shown in Table IV.A.5-7. In the cumulative case, the assumed resources for the planning area are a multiple sale Alternative E. The TAPS pipeline, Alaska North Slope, TAPS tankers, and the Alaska outer continental shelf (OCS) all have different spill rates and spill-size categories used in the estimation of oil spills for the cumulative case. Table IV.A.2-7a shows the spill rates and spill-size categories used for each. For the cumulative case, the average pipeline and platform spill in the Beaufort Sea is assumed to be 7,000 bbl (Anderson and LaBelle, 1994). The average spill size for other categories is indicated above or in Table IV.A.2-7a. Table IV.A.2-7b shows how the estimated resources and reserves are used to estimate oil spills for the cumulative case. Tables IV.A.2-8 and 9 show the estimated spill occurrence for the cumulative case in detail and in summary, respectively.

3. Fate and Behavior of Oil Spills: The average crude-oil spill anticipated to occur as a result of the proposed action would be 4 bbl; therefore, the fate and behavior of this size spill is most relevant and is emphasized in this section. The description of general behavior and weathering of oil spills on arctic waters, on ice or snow, or underneath ice cover, as contained in Section IV.A.3 of the Sale 144 Final EIS (USDOI, MMS, 1996a), is incorporated here by reference. A summary, supplemented by additional material, as cited, follows.

Weathering Processes: Several processes alter the chemical and physical characteristics and toxicity of spilled oil. Collectively, these processes are referred to as weathering or aging of the oil and, along with the hydrology and meteorology, the weathering processes determine the oil's fate. The major oil-weathering processes are spreading, evaporation, dispersion, dissolution, and emulsification. Lesser roles are played by photo-oxidation and microbial degradation. The fate of weathering oil spilled into or entering surface waters also involves wind, wave, and current movement of the slick; sedimentation to the bottom; and stranding onto vegetation or shoreline.

Environmental Factors: The type of spill, the time of year, and the environment it occurs in—such as a land spill; a freshwater spill; a marine spill; or spill on, in, or under ice—will affect how an oil spill behaves and weathers. Weathering processes generally would be similar in NPR-A freshwater and coastal marine regimes. Seasonal ice cover can greatly slow weathering in both regimes.

Oil spreading on the water surface (but not necessarily the advection of oil with moving water) would be restricted in most NPR-A waters. In NPR-A lake, river, and marine waters, oil spills would spread less than in temperate fresh-

or temperate marine waters due to the increased oil viscosity in cold water. Spills into shallow, marshy or ponded tundra or into flooded lake margins in summer could spread more rapidly, similarly to a temperate spill. This greater spreading is because these shallower waters can reach temperatures up to 18 °F warmer than other tundra waters (Miller, Prentki, and Barsdate, 1980), which decreases slick-oil viscosity. However, oil spreading of small to large spills in such wet tundra would be restricted by the topography. Although the tundra relief is low, it is sufficient to severely limit the spread of spills. During summer, flat coastal tundra develops a dead-storage capacity averaging 0.5 to 2.3 in (Miller, Prentki, and Barsdate, 1980), which would retain 300 to 1,500 bbl of oil per acre. Even at high-water levels, the tundra vegetation tends to act as a boom, and vegetation and peat as a sorbent, allowing water to filter through, trapping the more viscous oil (e.g., Barsdate et al., 1980) and also making recovery of the oil more difficult. On the other hand, even small spills can be spread over large areas, if the spill event includes aerial, pressured discharge. With the high bidirectional winds on the North Slope, oil can be misted miles downwind of the leak (Knowles, 1998). For example, in December 1993, ARCO Drill Site line failed, and 1 to 4 bbl of crude oil misted over an estimated 100 to 145 acres (Ott, 1997).

An oil spill in broken ice would spread between icefloes into any gaps greater than about 3 to 6 in. During most of "winter," from September until April, an oil spill under lake ice would spread into under-ice hollows and be encapsulated by freezing ice below the oil. In river or coastal marine waters, the oil-contaminated area may be increased through movement of oil by currents underneath the ice, until the oil was encapsulated by freezing ice. Encapsulated oil would not weather until the ice melts or brine channels allow upward oil flow. Water flow under ice in ponds, lakes, streams, and most river sections in the NPR-A should be insufficient to move under-ice oil.

Evaporation of oil generally is linear with temperature change (Fingas, 1996). The lower the temperature, the slower crude oil evaporates. Both Prudhoe Bay and Endicott crudes have this pattern (Fingas, 1996). Oil between or on icefloes evaporates at a rate similar to that on open water at the same temperature. Oil that is frozen into the underside of ice is unlikely to undergo any evaporation until its release in spring. Because freshwater and multiyear ice do not have enough salts to form brine channels, the oil would be released only as the ice surface ablated to the level of the encapsulated oil. For freshwater ice, this would be when the ice became porous within about 2 weeks of meltout, from May to July, depending on weather, ice thickness, and location of the oil in the ice. In multiyear ice, surfacing of the oil probably would not occur until August, and some oil would not be released until a second summer. In first-year sea ice, the encapsulated oil will rise to the surface through brine channels in the ice in May or June, before visible ice degradation occurs. As oil is released to the surface, evaporation will occur. How much oil evaporates is highly dependent on the specific chemistry of the spilled oil and also on competing pathways, such as dispersion. For Prudhoe Bay crude, about 20 percent of spilled oil could be expected to evaporate within 30 days following a summer spill or meltout of a winter spill.

Dispersion of oil into the underlying water requires mixing energy generally supplied by wind, waves, or currents. Some additional oil dispersion occurs in dense, broken ice through grinding action. More viscous and/or weathered crudes may adhere to porous ice, essentially concentrating oil within the icefield and limiting the oil dispersion.

Emulsification of some crude oils is increased in the presence of ice. If wave action grinds ice pieces together, Prudhoe Bay crude forms a mousse within a few hours—an order of magnitude more rapidly than in open water.

The NPR-A Oil-Spill Experiment: On July 16, 1970, 5 bbl (not 4 bbl, Prentki, 1997, pers. comm.) of Prudhoe Bay crude was experimentally spilled in a 0.07-acre tundra Pond E in the NPR-A near Barrow (Miller, Alexander, and Barsdate, 1978; Barsdate et al., 1980; Hobbie, 1982). The general behavior of this experimental spill is instructive in what to expect for both an average-sized NPR-A summer spill or for a winter spill that melts out during thaw.

In this experimental spill, the oil spread over the water surface within a few hours to a 0.06-in thickness. Within 24 hours, the slick thickened, as lighter hydrocarbons evaporated, and shrank into a 10- to 16-ft band on the downwind side of the pond. For about a month, the oil moved back and forth across the pond, shifting sides with changes in wind direction. Gradually, the oil worked part way into the pond's vegetated margins. By the end of summer, all of the oil was trapped along the pond margins either on the water's surface or on the bottom. No oil left the pond during the next spring runoff, despite significant water throughflow. Half of the oil was estimated to be evaporated or degraded within a year, but the rest of the oil remained with little change for at least 5 years. Sedges oiled at the waterline along the pond margins did not suffer visible damage the first summer. However, during subsequent years, their new leaves were unable to penetrate oil mats, which killed the plants under the mats. The waters of the oiled pond remained toxic to more sensitive zooplankton species for 7 years. There also were long-term (several-year) observable effects on phytoplankton and insect population and shorter term effects on benthic algae and microbe populations.

4. Spill-Prevention and Response: Each permittee operating on the NPR-A is required to have an Oil-Spill-Response Plan with trained personnel and cleanup equipment and supplies at each activity site to meet Federal, State, and Borough regulations. An activity site would be the exploration site, drilling site, or production site, each with its ancillary facilities. Federal regulations that need to be met are BLM oil and gas operating regulations 43 CFR 3160 and Onshore Order Numbers 1, 2, and 6. These regulations deal with the prevention and control of oil spills and releases. Regulations 40 CFR 110, 112, and 300, deal with responses to spills or releases of oil and gas. Spill response and requirements would be thoroughly addressed when and if parcels are leased. For example, an Application for Permit to Drill would be evaluated for spill response regarding chemicals onsite and blowout prevention equipment required as well as the size of the containment facilities in relation to hole depth and size. These requirements are all addressed in Onshore Order No. 2. Onshore Order No. 6 would address any anticipated hydrogen sulfide releases. These conditions are all very site specific. State regulations that must be met are covered in AS 46.03.020(10)(A) and are administered by the ADEC.

The response plan includes an action plan and a list of contacts in State and Federal agencies with direct responsibilities in the event of a spill and private companies that can be called on for further information or assistance. The environmental obligations of operators on a Federal onshore lease are described in BLM regulations contained in 43 CFR 3160, Oil and Gas Operating Rules. In addition, parts or all of several Onshore Oil and Gas Orders may apply, as necessary.

By Congressional action, BLM is delegated the authority to ensure that a drilling well on Federal onshore lands is under control. The BLM would work in coordination with the AOGCC who has well-control authority for the State of Alaska to ensure the well is brought under control. The BLM has the authority to cite the operator and bring civil and/or criminal charges to bear. If there is a spill or release of petroleum fluids or chemicals used in the petroleum industry on the lease, unit, or participating area, BLM has the authority to cite the operator. Cleanup of the site will occur under the direction of the Federal and State On-Scene Coordinators (OSC's). Depending on the location of the spill, this could be the U.S. Environmental Protection Agency (USEPA) for inland spills, USCG for coastal zone spills, or the ADEC for State lands and water out to the 3-mi limit. Additionally, a local OSC would be the North Slope Borough.

The BLM requires that all spills or other undesirable events be reported to their authorized officer within 24 hours of the event. The BLM oversees the work of the lessee or operator to ensure that all spills or undesirable events are appropriately cleaned up in accordance with all applicable laws and regulations. (Undesirable events are defined in Notice to Lessees-3A as spills or releases of petroleum fluids or chemicals used in the petroleum industry.)

In Alaska, a Unified Plan for Preparedness to Oil Discharges and Hazardous Substance Release has been developed by the USEPA and USCG with the ADEC. The Department of the Interior is a member of the Alaska Regional Response Team, which has adopted the Unified Plan. The OSC must ensure compliance with all Federal and State laws. The intent of the applicable laws and regulations is to prevent, as much as possible, hazardous materials from entering the water and to ensure the rapid removal of these substances from areas where there is a danger of contaminating water. The OSC monitors and documents the operator's actions and determines when the cleanup is satisfactory, in coordination with the surface-land manager. The OSC instructs those responsible for the spill as to what additional measures are to be taken.

5. Major Projects Considered in the Cumulative Case: Major projects considered in the cumulative case all are related directly to the oil and gas industry. This is due not only to the nature of the plan under review but also because oil and gas development is the principal agent of industrial-related change on the North Slope. The analysis of major oil and gas projects considered in the cumulative case is based on the price of a barrel of oil ranging between $18 to $30 over the life of the proposed action. Projects considered within the cumulative case are those that are both existing and those that can be considered as reasonable. This section focuses on those oil and gas projects that can be hypothesized to have some reasonable chance of occurrence during the life of the proposed planning effort. Tables IV.A.5-1a through IV.A.5-7 present a list of Alaska North Slope oil discoveries, proposed transportation projects, future lease activities, and current infrastructure, among other issues appropriate to the analysis of the cumulative case. Each of the analysts contributing to this EIS also may focus on these or other issues that they feel to be particularly germane to their resource topics.

a. Resource Contribution of the Northeast NPR-A Planning Area to the Cumulative Case: The contribution of planning area resources to the cumulative case is based on a multiple-sale scenario. Should all of the planning area's oil resources be leased and developed, it is estimated that production would range between 500 MMbbl and 2.2 Bbbl. In this event, NPR-A resources could range between 8 percent (at $18/bbl) to as much as 20 percent (at $30/bbl) of current forecasted North Slope oil resources. However, the range of production

Table IV.A.5-1a
Alaska North Slope Oil and Gas Discoveries as of April 16, 1998

Field	Type O - Oil G - Gas	Location of Production Facility	Status (current or *hypothesized*)	Discovery	Production Began	Ranking Criteria
South Barrow	G	Onshore	Producing Field	1949	1950	When Production Began
Prudhoe Bay	O	Onshore	Producing Field	1967	1977	
Lisburne	O	Onshore	Producing Field	1968[1]	1981	
Kuparuk	O	Onshore	Producing Field	1969	1981	
East Barrow	G	Onshore	Producing Field	1974	1981	
Milne Point	O	Onshore	Producing Field	1969	1985	
Endicott	O	Offshore	Producing Field	1973	1987	
Pt McIntyre	O	Onshore	Producing Field	1988	1993	
Sag Delta	O	Offshore	Producing Filed		1989	
Sag Delta North	O	Offshore	Producing Field		1989	
Schrader Bluff	O	Onshore	Producing Field		1991	
Walakpa	G	Onshore	Producing Field	1980	1993	
N. Prudhoe Bay	O	Onshore	Producing Field	1970	1993	
Niakuk	O	Onshore	Producing Field	1985	1994	
Sag River	O	Onshore	Producing Field		1994	
West Beach	O	Onshore	Producing Field	1976	1994	
Cascade	O	Onshore	Producing Field	1993	1996	
West Sak	O	Onshore	Producing Field	1969[1]	1998	
Badami	O	Onshore	Developing/Planning	1990	(1998)	Planned Production Start Date
Tarn	O	Onshore	Developing/Planning	1991	(1999)	
Alpine	O	Onshore	Developing/Planning	1991	(2000)	
Northstar	O	Offshore	Developing/Planning	1984	(2000)	
Liberty	O	Offshore	Developing/Planning	1983	(2000)	
Fiord	O	Onshore	*Development within 10-15 Years*	1992		Estimated Chance of Development From Highest to Lowest
Kalubik	O	Onshore	*Development within 10-15 Years*	1992		
Colville Delta	O	Onshore	*Development within 10-15 Years*	1985		
Sourdough	O	Onshore	*Development within 10-15 Years*	1994		
Gwydyr Bay	O	Onshore	*Development within 10-15 Years*	1969[1]		
Mikkelson	O	Onshore	*Development within 10-15 Years*	1978		
Yukon Gold	O	Onshore	*Development within 10-15 Years*	1993		
Sandpiper	G&O	Offshore	*Development within 10-15 Years*	1986[1]		
Pt Thomson	G&O	Onshore	*Development within 10-15 Years*	1975		
Flaxman I	O	Offshore	*Development within 10-15 Years*	1975[1]		
Kuvlum	O	Offshore	*Development within 10-15 Years*	1987		
Hammerhead	O	Offshore	*Development within 10-15 Years*	1985[1]		
***Umiat**	O	Onshore	*Development after 10-15 Years*	1946		Discovery Date No Information Exists to Estimate Chance of Development
***Fish Creek**	O	Onshore	*Development after 10-15 Years*	1949[1]		
Simpson	O	Onshore	*Development after 10-15 Years*	1950[1]		
Meade	G	Onshore	*Development after 10-15 Years*	1950[1]		
Wolf Creek	G	Onshore	*Development after 10-15 Years*	1951[1]		
Gubik	G	Onshore	*Development after 10-15 Years*	1951[1]		
Square Lake	G	Onshore	*Development after 10-15 Years*	1952[1]		
E. Umiat	G	Onshore	*Development after 10-15 Years*	1964		
Ugnu	O	Onshore	*Development after 10-15 Years*	1969[1]		
Kavik	G	Onshore	*Development after 10-15 Years*	1969		
Kemik	G	Onshore	*Development after 10-15 Years*	1972		
Hemi Springs	O	Onshore	*Development after 10-15 Years*	1984		

*Oil resources for Umiat and Fish Creek were incorporated into the resource estimate for the Northeastern NPR-A Planning Area. Gas production is currently consumed by field facilities or is reinjected to maintain reservoir pressure. No gas is transported to markets outside of the North Slope. [1] Thomas et al., 1996.

Table IV.A.5-1b
TAPS and Proposed Natural Gas Pipelines

Name	Estimated Pipeline Length (miles)	Project Description and Route
Trans-Alaska Pipeline System (TAPS)	800	Approximately 16.3 mi^2 are occupied by the pipeline that runs between Prudhoe Bay and Valdez. Between Prudhoe Bay and Fairbanks, the Dalton Highway was constructed parallel to the pipeline. The design capacity is 2 million barrels per day. With the operation of 12 pump stations and the addition of drag-reduction agents, the capacity could be increased to 2.4 million barrels per day
Trans-Alaska Gas System (TAGS)	800	The TAGS consists of a gas-conditioning plant on the North Slope; an 800-mile, 42 inch, chilled, buried pipeline; a liquified natural gas (LNG) plant and marine terminal at Valdez; and a LNG tanker fleet. The LNG would be transported to Japan and other Pacific Rim countries. The Yukon Pacific Corporation (YPC) has obtained major permits for construction of TAGS and export of Alaska North Slope (ANS) gas to Asia. TAGS has received the Final EIS prepared by the Federal Energy Regulatory Commission for the LNG facility and terminal. The EIS is yet to be prepared for the pipeline. YPC believes the large scale of the project requiring 2.05 BCFD of ANS gas to yield 14 million metric tons of LNG annually will create an economy of scale that will allow this gas to be competitive with other LNG projects that do not have to support the construction of an 800-mile gas pipeline
Alaska Natural Gas Transportation System (ANGTS)[1]	2,102	ANGTS would connect potential ANS gas production through Canada to the Lower 48. The pipeline would run parallel to TAPS from the North Slope to central Alaska and the cross Canada where it would connect to the existing prebuilt section ANGTS that is in service. This section, with a northern terminal at Caroline, Alberta is comprised of 576 miles of pipeline and is used to transport Canadian gas to the U.S. Numerous permits, right-of-ways, and approvals have been obtained for the proposed pipeline route through Alaska and Canada. The cost of service to deliver the gas to market ranges from $2.82 to $4.17 MCF. Based on an average sales price of $2.11/MCF for U.S. natural gas at the wellhead it appears unlikely ANGTS will be pursued any time in the near future.
Natural Gas to Liquids Conversion[2]	Will use existing TAPS Pipeline	Atlantic Richfield Co. (Arco) and Syntroleum Corp announced a joint development project in which Arco will construct a pilot-scale, natural gas to liquids (GTL) conversion facility on the West Coast. In Alaska, Arco is focusing its gas commercialization efforts on development of a large-scale liquefied natural gas (LNG) project. However, continued progress in gas to liquids conversion could make GTL an economic option for commercialization of Alaska North Slope natural gas.

[1] Thomas et al., 1996
[2] Alaska Report, 1997d.

depends on whether the price of a barrel of oil was closer to $18 or $30 (in terms of 1997 dollars).

b. Projected North Slope Oil Production from Current Fields: Oil resources forecast for current State and Native fields and onshore Federal fields on the North Slope range between 7.09 Bbbl and 16.72 Bbbl. The 7.09-Bbbl estimate refers to a production forecast for reserves in known and developed fields as well as fields that are producible and in the development planning stage. The 16.72-Bbbl estimate is composed of the 7.09 Bbbl figure previously referred to, 3.51 Bbbl in possible future production, 6.0 Bbbl in speculative future production and 120 MMbbl of production from the Liberty Project. Table IV.A.5-1a shows those fields that were considered in developing these resource estimates and the likelihood of their development. Table IV.A.5-7 shows the reserve estimates used in the cumulative-case analysis.

Since the first production well was drilled on the Prudhoe Bay structure, North Slope fields produced a cumulative total of 11.57 Bbbl of oil (by the end of 1996). Production on the North Slope peaked in 1988 at 2.0 MMbbl of oil per day and subsequently has declined to 1.35 MMbbl per day. Of the 18 producing fields on the North Slope, the most productive, in order, are Prudhoe Bay, Kuparuk River, Point McIntyre, and Endicott. Figure IV.A.5-1 shows producing field locations and other potential development areas within the North Slope petroleum province. The State of Alaska estimates that the combined production from the presently operating and to-be-developed fields will decline to a daily output of 442 MMbbl in 2015. The State expects that cumulative production of oil from 1997

Table IV.A.5-1c
Future Lease Sales

	Sale	Sale Date(s)	Area/Description	Resources or *Hydrocarbon Potential*
Federal OCS	170	June 1998	1.7 million acres/Offshore — Oliktok Point to Barter Island	350-670 MMbbl Oil (Estimated)
Federal OCS	176	2000	To Be Determined (TBD)	TBD
Federal Western NPR-A		TBD	As much as 18.6 million acres west of the Northeast NPR-A Planning Area.	130 to 1,200 MMbbl Oil (Estimated)
State of Alaska	87 North Slope Areawide	June 1998 (Feb 1999, Feb 2000, Feb 2001)	As much as 5,100,000 acres of State owned lands between the Canning and Colville Rivers and north of the Umiat Base Line (about 69 20'N)	*Moderate to High*
State of Alaska	Beaufort Sea Areawide	October 199 (Oct 2000, Oct 2001)	Unleased state-owned tide and submerged lands between the Canadian border and Point Barrow and some coastal uplands acreage located along the Beaufort Sea between the Staines and Colville Rivers. The gross proposed sale area is in excess of 2,000,000 acres.	*Moderate to High*
State of Alaska	North Slope Foothills Areawide	April 2001	State owned lands lying between the NPR-A and ANWR south of the Umiat Baseline and north of the Gates of the Arctic National Park and Preserve. The gross proposed sale area is in excess of 7,000,000 acres	*Moderate*

Table IV.A.5-2
Production and Reserve Data for Producing Fields

				Production					Reserves	
Unit or *Area*	**Field**	**Type (Oil or Gas)**	**Discovery**	**Began**	**Gas (BCF)**	**1996 Oil (MMbbl)**	**1996 Oil Daily Rate (bbl)**	**Production to**	**Oil (MMbbl)[1]**	**Gas (BCF)[1]**
Duck Island	Endicott	O	1973	1987		27.463	67,000	Endicott	258	
	Sag Delta North	O		1989				Endicott	[2]	
	Sag Delta	O		1989		0.200	548	Endicott	[2]	
Prudhoe Bay	Prudhoe Bay	O	1967	1977		312.609	856,000	Prudhoe	3,443	
	Lisburne	O	1968[1]	1981		5.139	14,000	Lisburne	57	
	Niakuk	O	1985	1994		11.045	30,260	Lisburne	90	
	West Beach	O	1976	1994		0.499	1,400	Lisburne	30	
	N. Prudhoe Bay	O	1970	1993		0.129	350	Lisburne	75[3]	
	Pt McIntyre	O	1988	1993		58.751	161,000	Lisburne	312	
Kuparuk	Kuparuk	O	1969	1981		99.459	273,000	Kuparuk	1,275	
	West Sak	O	1969	1998			300[1]	Kuparuk	279	
Milne Point	Milne Point	O	1969	1985		12.686	35,000	Milne Pt	210	
	Cascade	O	1993	1996				Milne Pt	50	
	Schrader Bluff	O		1991		1.068	3,000	Milne Pt	281	
	Sag River	O		1994		0.346	950	Milne Pt	19	
NPR-A	East Barrow	G	1974	1981	0.064			Barrow		5
	South Barrow	G	1949	1950	0.051			Barrow		4
	Walakpa	G	1980	1993	1.160			Barrow		27
All Units or Areas Total									6.4 Bbbl	36

[1] Unless otherwise indicated information is from State of Alaska, DNR, 1997. Historical and Projected Oil and Gas Consumption, Anchorage, State of Alasks, DNR, 67 pp.
[2] Included In Endicott Field Reserves

Table IV.A.5-3
Infrastructure and Facilities for Existing Producing Fields

UNIT OR *AREA* Field	Gravel Roads, Pads, & Airstrips (acres)	Pipelines: Gathering, Common Carrier, Unspecified (miles)			Gravel Mines		Wells	Pads	Reserve Pits		Facilities					Roads (miles)	River Cross-ings
		G	C	U	Num.	Acres			Num.	Acres	Prod. Centers	Camps Base & Const.	Plants: Power Topping Gas Seawater	Docks & Cause-ways	Airports & Airstrips		
DUCK ISLAND																	
Endicott	392	3	26		1	179	105	2[1]	0	0	0	0[1]	3[1]	2[1]	0[1]	15[1]	1[1]
Sag Delta North																	
Sag Delta																	
PRUDHOE BAY																	
Prudhoe Bay	4,590			145	6	726	1,256	38	106	560	6[1]	4[1]	4[1]	2[1]	2[1]	200[1]	3[1]
Lisburne	213	50			0	0	81	5[1]	10	16	1[1]	1[1]	1[1]	0[1]	0[1]	18[1]	-
Niakuk	22	5			0	0	18		0	0							
West Beach							1										
N. Prudhoe Bay							1										
Pt McIntyre	33	12			0	0	47		0	0							
KUPARUK																	
Kuparuk	1,435	97	37		5	564	835	34[1]	126	161	3[1]	2[1]	4[1]	1[1]	1[1]	94[1]	5[1]
West Sak					0	0	50		0	0	0	0	0	0	0		0
MILNE POINT																	
Milne Point	205	30	10		1	43	110	4[1]	20	19	1[1]	0[1]	2[1]	0[1]	0[1]	19[1]	1[1]
Cascade	31				0	0			0	0							
Schrader Bluff							22										
Sag River							3										
NPR-A																	
East Barrow																	
South Barrow																	
Walakpa																	

[1] Eg&G Idaho, Inc. 1991.

Table IV.A.5-4
Estimated Reserve Data for Possible Future Projects With Current or Applied-For Permits

Unit or *Area*	Field	Type (Oil, Gas)	Discovery	Status	Oil Reserves (MMbbl)
Badami	Badami	O&G	1990	Developing/Planning	**120** [a]
West of Kuparuk	Tarn		1991	Developing/Planning	**50** [b]
Alpine	Alpine	O	1991	Developing/Planning	**365** [c]
Northstar	Northstar	O	1984	Developing/Planning	**145**
Liberty	Liberty	O	1983	Developing/Planning	**120**
All Units or Areas Total					**800**

[a] Alaska Report, 1997a
[b] Alaska Report, 1997b
[c] Alaska Report, 1997c

Table IV.A.5-5
Proposed Infrastructure and Facilities for Developing/Planning Projects

Unit or *Area* / Field	Gravel Roads, Pads, & Airstrips (acres)	Pipelines (miles)	Gravel Mines Num.	Gravel Mines Acres	Wells	Pads	Reserve Pits Num.	Reserve Pits Acres	Facilities: Prod. Centers	Facilities: Camps Base & Const.	Facilities: Plants: Power Topping Gas Seawater	Facilities: Docks & Cause-ways	Facilities: Airports & Airstrips	Roads (miles)	River Cross-ings
Badami / Badami [a]	85	26/35	1	89	50	2	0	0	1	1		1	1	4.5	5
West of Kuparuk /Tarn[b]	72.8	10	0-1[c]		40	2	0	0	0	0	0	0	0	10	2
Alpine / Alpine	97	34	0	0	150		0	0	1	2		0	1	3	5
Northstar / Northstar	18+	28	1	36	23	1	0	0	1	1	1	0	0	0	0
Liberty / Liberty [d]	16	6.1	1	45	23	1	0	0	1	1	1	0	0	0	0

[a] BP Exploration, Alaska, Inc.,1996
[b] USDOD, U.S. Army COE, Public Notice of Application for Permit Reference Number 4-970705
[c] The gravel would come from Mine Site F and should be sufficient. However a future aliquot to the north has already been permitted for expansion. If necessary, this aliquot may need to be opened to support the project.
[d] BP Exploration, Alaska, Inc., 1998

Table IV.A.5-6
Estimated Resources for Projects Which are Currently Uneconomic to Develop But May be Developed Within 10 to 15 Years

Unit or Area	Field	Type (Oil or Gas)	Status	Discovery	Oil (Bbbl)	Gas (TCF)
Colville River Unit?	Fiord	O	*Development within 10-15 Years*	1992		
Kuukpik	Kalubik	O	*Development within 10-15 Years*	1992		
Kuukpik	Colville Delta	O	*Development within 10-15 Years*	1985		
Pt. Thomson	Sourdough	O	*Development within 10-15 Years*	1994		
Gwydyr Bay	Gwydyr Bay	O	*Development within 10-15 Years*	1969 [1]		
	Mikkelson	O	*Development within 10-15 Years*	1978		
	Yukon Gold	O	*Development within 10-15 Years*	1993		
Sandpiper	Sandpiper	G&O	*Development within 10-15 Years*	1986 [1]		
Pt. Thomson	Pt Thomson	G&O	*Development within 10-15 Years*	1975		
Pt. Thomson	Flaxman I	O	*Development within 10-15 Years*	1975 [1]		
Kuvlum	Kuvlum	O	*Development within 10-15 Years*	1987		
Hammerhead	Hammerhead	O	*Development within 10-15 Years*	1985		
All Units or Areas Total (Estimated)					**1.38**	**0**

to 2020 will be approximately 6.47 Bbbl (State of Alaska, DNR, 1997).

During 1996, ARCO announced that the Alpine Prospect, located in the Colville River Delta, was producible and contained an estimated 365 MMbbl of recoverable reserves. It is the closest developing oil field to the area under study. The project is expected to come online as early as 2000, with peak production reaching 18 to 29 MMbbl annually. Alpine resources are to be extracted from two gravel drill pads connected by a 3-mi long road. A 5,420-ft long runway is to be constructed as a wide spot in the highway. Produced crude would be transported via a 34.2-mi pipeline to a Kuparuk oil field processing facility, where Alpine production would be commingled with Kuparuk output. The Alpine pipeline would cross the Colville channel via a bored hole. Ice roads and bridges would support construction and function as winter supply routes; no gravel roads connecting the Kuparuk infrastructure to Alpine will be built (USDOD, US Army COE, 1997).

British Petroleum is developing plans to produce the offshore Northstar Unit. Because of Federal permitting requirements and the fact that some of the production will be from Federal tracts, a developmental EIS is being written for Northstar. British Petroleum estimates that Northstar will produce 145 MMbbl of oil over a 15-year period. Additionally, there are a number of ongoing drilling efforts in the Prudhoe-Kuparuk region.

Table IV.A.5-7
Reserve and Resource Estimates Used for Analytical Purposes in the Cumulative Case

Activity	Oil (billions of barrels)	Gas (billions of cubic feet)	Reference Table
Production to date	11.57	32[1]	Table IV.A.5-2
onshore	11.23	32[1]	Table IV.A.5-3
offshore (Endicott)	0.34	0	
Expected future production	7.21	36[1]	Table IV.A.5-4
onshore–existing fields	6.15	36[1]	Table IV.A.5-5
offshore–existing fields	0.26		
onshore–planned fields	0.53		
offshore–planned fields	0.27		
Possible future production	3.51	—[2]	Table IV.A.5-6
onshore	1.85[4]		
offshore	0.46		
possible OCS projects (unleased)	1.20		
Future NPR-A leasing	0.26–1.80	—[2]	
multiple sales–Preferred Alternative	0.13–0.60		Table IV.A.1.b-6
leasing in western NPR-A	0.13–1.20		Table IV.A.5-1c
single sale–Preferred Alternative	0.09–0.42		Table IV.A.1.b-4
Speculative future production	6.00	29,500[3]	
onshore	4.00[5]		
offshore	2.00[6]		

Notes: Data as of April 1997.
[1] Gas production to-date is from Barrow gas fields supplied for local use to village of Barrow.
[2] Currently, all gas production from existing oil fields is consumed by facilities or reinjected for reservoir pressure maintenance. No gas production is transported and marketed outside of the North Slope.
[3] Future production of natural gas assumes that a transportation system will eventually be constructed to move North Slope gas resources to outside markets. All proposed systems are uneconomic under current conditions.
[4] Includes 1.0 billion barrels in unnamed satellite fields produceable from existing oil facilities. This includes the Alpine field on State and Native lands.
[5] Includes 4.0 billion barrels in currently undiscovered fields on North Slope, most produceable only as satellites through future field infrastructure, including privately owned Native lands.
[6] Includes 2.0 billion barrels of currently undiscovered resources, based on high case of 1995 National Assessment of Beaufort Sea less "possible OCS projects" (also undiscovered) listed in previous category.

c. Projected State Oil and Gas Lease Sales: Since the first State lease Sale in December of 1959, the State of Alaska has held 31 sales involving North Slope and Beaufort Sea leases. Currently, there are 803 active leases on the North Slope and the Beaufort Sea. Production from State leases has totaled 6.4 Bbbl (Table IV.A.5-2). The State is in the process of holding annual, areawide lease sales in the Beaufort Sea and along the Arctic Slope. Table IV.A.5-3 presents infrastructure and facilities for existing producing fields, all of which are State fields. The next State lease sale (Lease Sale 87) is scheduled to be held in June 1998. Beginning in 1999 and continuing through 2001, the State will offer one sale a year on the North Slope and offshore in the the Beaufort Sea. In 2001, the State also will offer the Foothills Areawide Lease Sale. As the term areawide implies, these State lease sales will be extensive. Each time the State Beaufort Sea area is offered, the offering will extend from Barrow to the Canadian border; while onshore Arctic Slope sales will put up for sale on each occasion all unleased State lands between the ANWR and the NPR-A. The Foothills lease sale will extend into the foothills of the Brooks Range. The State of Alaska has no oil and gas resource estimates for its future lease sales (see Table IV.A.5-1c).

d. Projected Federal Lease-Sale Activity and Contribution to the Cumulative Case: Since December 1979, the U.S. Department of the Interior (USDOI) has conducted six lease sales in Federal Beaufort Sea waters. The seventh lease sale, Sale 170, is scheduled for September 1998. The most recent was Sale 144 in September 1996. During the life of Federal leasing in the Beaufort Sea, 660 leases have been sold totaling 2.8 million acres. Some 28 wells have been drilled on Federal leases, with 9 wells determined as producible. All wells have been plugged and abandoned, because field

economics have not been favorable for production. Currently, there are 76 active leases on Federal submerged lands in the Beaufort Sea. Potentially producible prospects within Federal waters lie in the Kuvlum and Hammerhead units (Fig. IV.A.5-1). However, no adequate resource assessment is available for these two units. The Northstar Unit contains some Federal tracts and, although the majority of submerged tracts comprising this unit lie under State waters, the amount of Federal oil to be produced by this development has yet to be determined. Should the Northstar Unit be developed, a pipeline shore-approach abutment may be constructed just west of Point McIntyre to protect the pipe from nearshore ice forces.

Beaufort Sea OCS resources under lease, including Sale 144 and existing leases, are 220 to 550 MMbbl. The low end of the range represents potential development at the $18/bbl estimate and includes the Liberty Prospect (Tern Island). The $30/bbl figure includes discovered but noncommercial fields (e.g., Kuvlum), which are likely to be developed at higher prices. Remaining oil resources that may be available and are estimated to be leased, discovered, and developed in proposed Lease Sale 170 are 210 to 450 MMbbl.

Lease sales and ultimately exploration and development of oil fields eventually may occur in the NPR-A west of the planning area. Although potential lease sales in this area are speculative, this IAP/EIS assumes sales development occur as part of the cumulative analysis.

See Table IV.A.5-7 for cumulative-case resources estimates.

e. Projected Private Lease Sales: Private subsurface owners, particularly the Arctic Slope Regional Corporation (ASRC), have leased lands near Nuiqsut for oil and gas. The Alpine field is in part located on ANCSA corporation lands. The ASRC is likely to conduct additional lease sales on lands around Nuiqsut it currently has selected through the Kuukpik Corporation's surface selections. The ASRC also may conduct lease sales on lands it is entitled to select near Nuiqsut. The IAP/EIS assumes sales and development of oil fields on private lands in addition to those private leases near Alpine as a part of the cumulative impact analysis.

f. Infrastructure and Transportation: Given the decline of the Prudhoe Bay field, it is more than likely that as long as the TAPS is operational, the system will have surplus capacity to process and transport any hydrocarbons produced by NPR-A production or any other projected development activity.

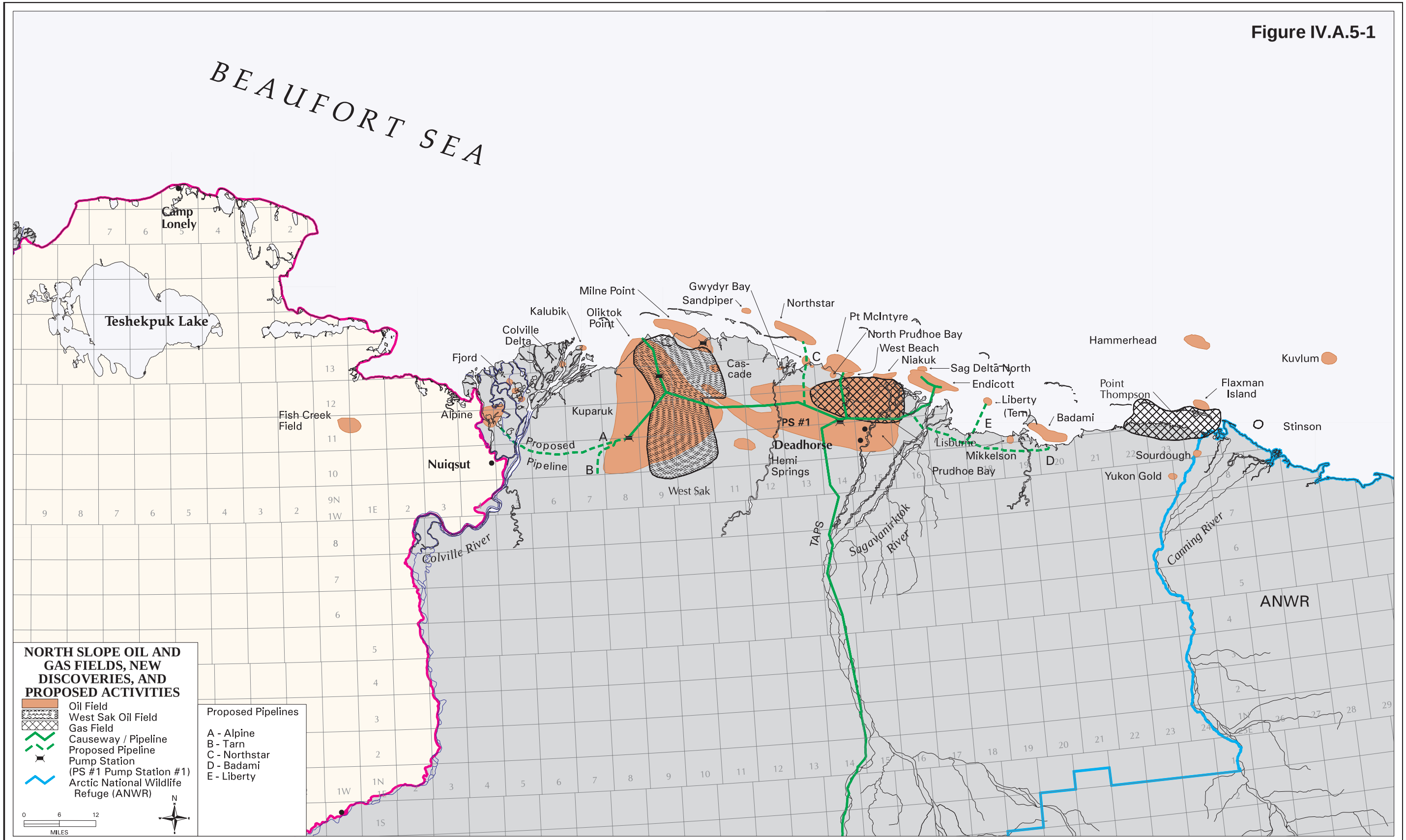
Currently, the TAPS terminal at Valdez handles approximately 1.75 MMbbl of crude daily. Given an estimation of future North Slope production (including offshore) at the high end of current projections, by 2009, oil-tanker traffic from Valdez still could be moving this quantity of oil. The contribution of Valdez tanker-transport traffic resulting from a single 1998 sale from the IAP is expected to range from 4 to 7 percent in 2009 (1 year after field startup) to 10 percent in 2016 (field maximum under the $30/bbl) at the height of production. Should all resources (including those from currently undeveloped sources) be recovered, the percentage of tanker traffic related to the first sale would fall substantially and would become a minor percent of oil-related traffic (see Fig. IV.A.5-2 for oil-tanker routes). Referring to subsection a (above), should multiple sales occur within the NPR-A over the next 15 years, the quantities of crude oil produced from the NPR-A may double; in that case, tanker loadings created by the IAP would form a significant component of Valdez tanker traffic well into the next century.

g. Tanker Traffic and Routes: Potential crude oil (and possibly LNG) tankerage from Valdez to the Far East will join existing LNG tanker traffic from the LNG plant in Nikiski, Alaska. The Nikiski plant is the only facility in the U.S. that liquefies natural gas. Every 10 days, the Nikiski facility loads an 80,000-cubic meter (m^3) LNG tanker for a round trip to Tokyo. The Nikiski facility has been transporting LNG via tanker to Japan since 1968 without significant spillage. Because LNG would boil off and disperse quickly when exposed to normal air temperatures and North Pacific winds, it is not considered a substantive environmental threat along the tanker route.

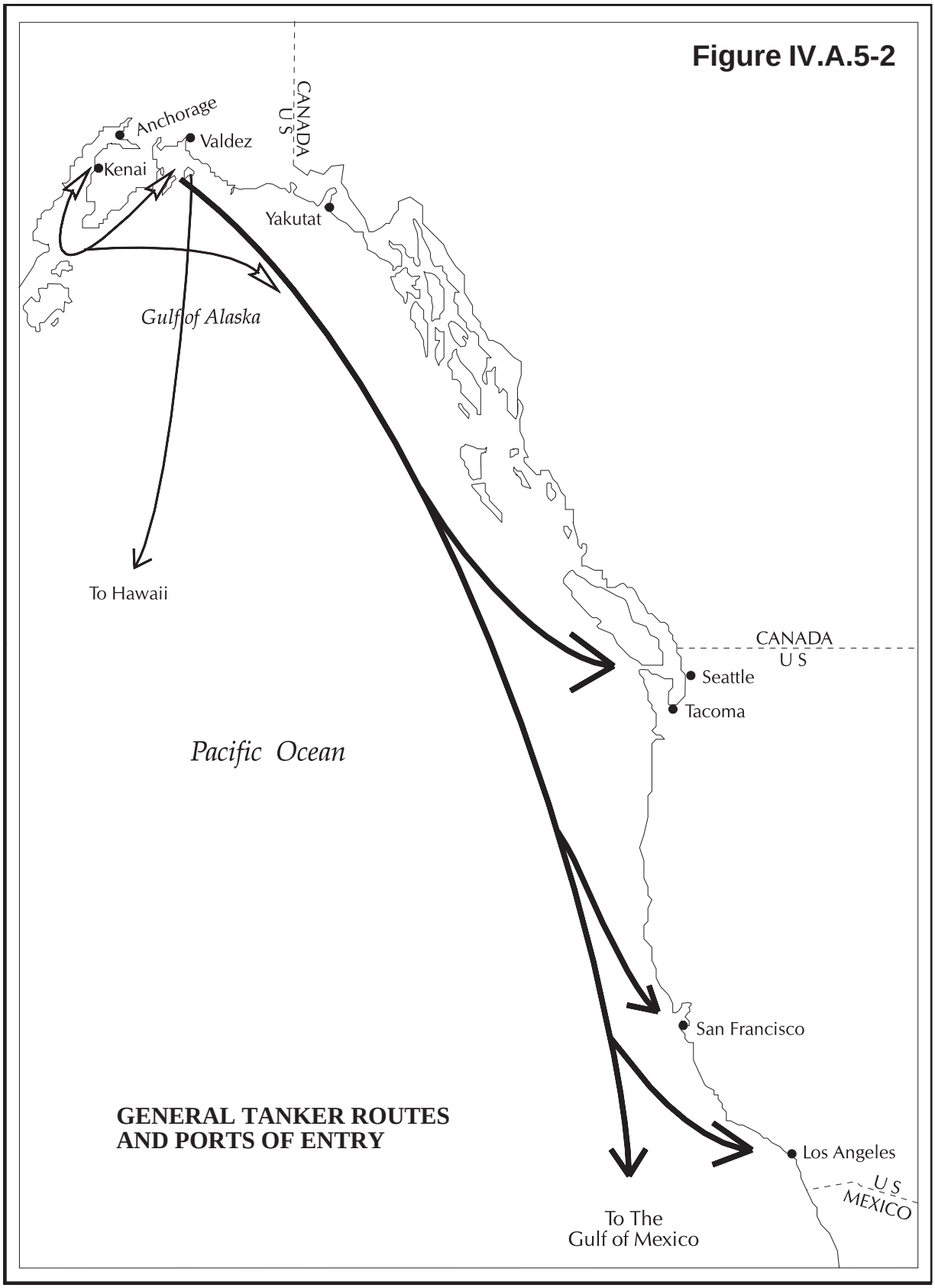
On November 28, 1995, President Clinton signed legislation (30 U.S.C. 185(s) that authorizes the export of Alaskan North Slope crude oil when transported in U.S. flag tankers, unless the President should find such exports are not in the national interest. The lifting of the oil-export ban raises the possibility of some tanker traffic to the Far East from production generated under the IAP. Figure IV.A.5-3 indicates the probable route that tankers bound from Valdez to the Far East would be traveling, including tankers carrying oil produced under the IAP. Alaska-generated crude oil being shipped to the Far East along the indicated tanker route is expected to range between 60 and 90 MMbbl during 1997. By 2000, the annual transported quantity of crude oil could drop to 9 MMbbl; however, such estimates are highly speculative as much of the eastbound oil may rely on opportunistic short-term contracts. The routing indicated in Figure IV.A.5-3 would bring the tankers >200 mi offshore of the Aleutian Islands. At such a distance, any pollution event is expected to have a minimal effect on the biological resources of the Aleutian Chain.

h. Trans-Alaska Gas System (TAGS): If the price per barrel of crude oil reaches or remains close to the

Figure IV.A.5-1



/DATA9/BKR2/GRAPHIC/FIV.A.5-1.GRA (Color Comp)



GENERAL TANKER ROUTES AND PORTS OF ENTRY

/DATA11/RAW_BKR/FIV.A.5-2.GRA (Color Comp)

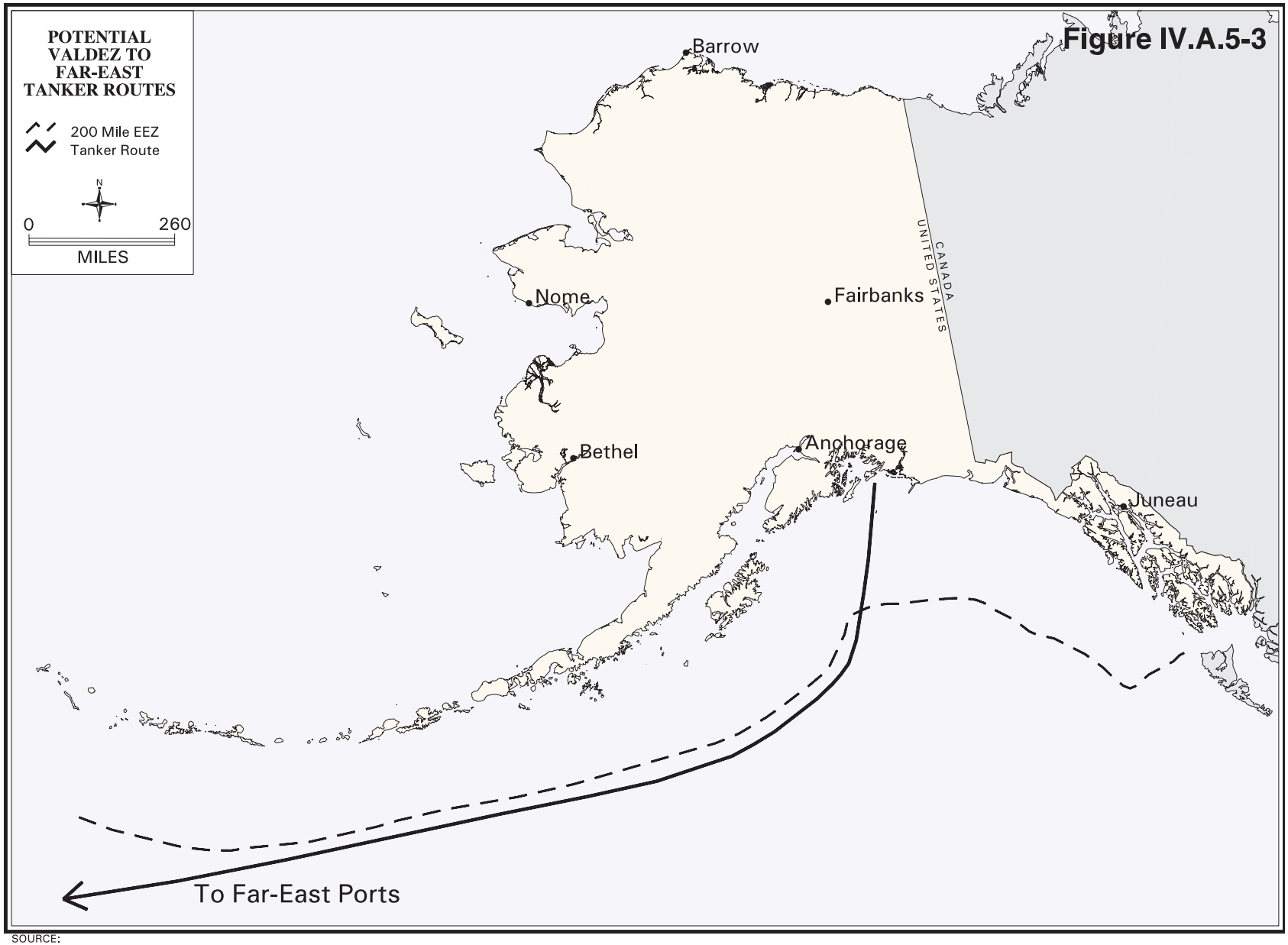


Figure IV.A.5-3

SOURCE:

/DATA11/RAW_BKR/FIV.A.5-3.GRA (Color Comp)

high end of the price range ($30), the economic climate may be such that the TAGS may be constructed. As has been discussed for several years, the TAGS would deliver North Slope natural gas at a rate of 2.3 billion cubic feet per day (bcfd) to a liquefaction plant/terminal located in Valdez. The natural gas would be delivered in a 42-in pipeline that would be constructed across Alaska immediately adjacent to the TAPS. The proposed project would consist of a 2.1-bcfd natural gas-liquefaction plant, four 800,000-bbl LNG-storage tanks, a marine loading facility, and a cargo/personnel loading dock. The proposed LNG plant would be sited in Anderson Bay 3 mi east of the Valdez narrows on the south shore of Port Valdez. The site is 3.5 mi west of the existing TAPS terminal and 5.5 mi from the community of Valdez. When completed, the facility would occupy 390 acres of a 2,630-acre site owned by the State of Alaska. A fleet of 15 LNG tankers, each with a capacity of 125,000 m^3, would transport the LNG to destinations in Japan, Taiwan, and Korea. Full project development would require 275 tanker loadings a year (Federal Energy Regulatory Committee, 1995). A final EIS was issued for the TAGS LNG plant in March 1995; however, no agreements have yet been reached with the resource holders. Please see Table IV.A.5-1b for a further discussion of the TAGS and a presentation on other projects that could move North Slope gas to market.

6. Additional Background Assumptions:

a. Environmental Justice: Executive Order 12898 signed by President Clinton on February 11, 1994, requires Federal Agencies to identify and address disproportionately high and adverse human health and environmental effects of its actions on minority and low-income populations (U.S. Department of Energy, 1997). The intent is to promote fair treatment of all races and the poor, so no person or group of people shoulders a disproportionate share of the negative environmental impacts of Federal actions.

The NSB's 1993 census found that of the 6,538 Borough residents, 73.9 percent were Inupiat. Barrow's population was 61 percent Inupiat, while that of Nuiqsut and Atqasuk were 92 and 94 percent Inupiat, respectively (North Slope Borough, 1995).

Based on U.S. Department of Commerce (USDOC) data, the Alaska Department of Labor has portrayed the NSB as having one of the highest per capita incomes in the State. Based on data it collected for its 1993 census, the NSB takes exception to these figures. The difference in perception depends primarily on different methods used in data collection. Federal data uses a sampling procedure, but the NSB conducts house-to-house surveys of households. Also, Federal figures include "transfer payments" such as unemployment, welfare, Social Security, and Medicare/Medicaid payments. The NSB survey includes all income reported to the Internal Revenue Service, including Alaska Permanent Fund and ANCSA corporation dividends. The NSB figures determined an average household income of $54,645 and a per capita income of $15,218 in 1993. The average Inupiat household income was $44,551; that for non-Inupiat households 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, a substantial portion 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 (NSB, 1994).

As described in Section III.C.3, subsistence activities in the planning area are important to providing dietary sustenance to North Slope residents. As a consequence, impacts to subsistence resources and access to those resources have a direct relationship to the analysis of which alternatives may have a disproportionately adverse effect on the minority and low-income populations. Those alternatives identified in the ANILCA 810 analysis in Appendix D 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 these groups of people for each alternative are the same as identified in the subsistence and the sociocultural analyses in Section IV.

b. Sacred Sites: Executive Order 13007 signed by President Clinton on May 24, 1996, mandates: "In managing Federal lands, each executive branch agency with statutory or administrative responsibility for the management of Federal lands shall, to the extent practicable, permitted by law, and not clearly inconsistent with essential agency functions, (1) accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners and (2) avoid adversely affecting the physical integrity of such sacred sites." A sacred site is "any specific, discrete, narrowly delineated location" on Federal land identified by Native tribes or a representative of a Native religion as "sacred by virtue of its established religious significance to, or ceremonial use by, and Indian religion." To date, no such sites have been identified in the planning area. If any sacred sites are identified during the comment period, BLM will analyze the impacts of the Proposed Action on the sites and address mitigating actions that could protect them.

c. Energy Requirements and Conservation Potential of Various Alternatives and Mitigation Measures: There would be no unusual energy requirements for implementing any of the alternatives.

B. ALTERNATIVE A: The No Action Alternative is designated as Alternative A and reflects BLM's current management of the resources within the NPR-A. Activities that might impact these resources include the presence of humans, aircraft use, and activities associated with ground-based transport of personnel, supplies and equipment; vehicle traffic; resource surveys and camps; overland moves; and recreational activities. Under existing management, seismic activity would continue to be permitted and, for the purpose of analysis of impacts, is addressed in this section. An option under this alternative would be to prohibit seismic activity. The impacts of this no-seismic option are the same as those described for current management except for those impacts identified as being related to seismic activity. Typical seismic operations are described in Section IV.A.1.c. Stipulations to protect the resources under this alternative are described in Section II.C.7.b. Management actions under Alternative A would not include oil and gas lease sales or proposals for new land use classifications such as Special Areas.

1. Soils: Ground-impacting-management actions within the planning area that may affect soils under Alternative A include aircraft use, excavation and collection, ground activities, hazardous- and solid-material removal and remediation, and recreation—all of which occur during summer-early fall (June-September), except for winter activities such as recreation and subsistence. If the vegetative cover remains unaltered, these activities generally would have only a small impact. However, where these activities concentrate surface disturbance (e.g., foot traffic around a landing site or repeated snowmachine crossing of a drainage channel at the same site), there could be damage to the soils. If the vegetative cover is disturbed or the surface organic mat is removed or worn, soil erosion is likely to occur; the effects of disturbing vegetation are analyzed in Section IV.B.6. Until details of project designs and results of the local soil survey are known, site-specific impacts and recoveries are unknown. For more site-specific details, refer to studies that include impacts and long-term recoveries from various activities on soils and related resources (Everett, 1980; Walker et al., 1987). Generally, disturbance of vegetation alters the thermal balance, and those soils containing surplus ice may lose volume when there is thawing; subsidence, thermokarsting, and gullying follow. Removal of the surface organic mat exposes the mineral portion of the soils to the erosive forces. Wind and water will transport sediment from these soils, and this sediment may be deposited in sensitive areas. Excavation and removal activities likely would completely destroy the soils involved. In these instances, the impacts are local only and probably not widely distributed. In other instances with soils containing surplus ice, the impacts can be much broader. The dominantly ice-rich permafrost soils will warm and slump and release meltwater, which will pond. The ponded water will absorb more radiant energy and increase the area of warming soils. The process of warming, melting, and slumping can continue well beyond the area of initial disturbances and may take several years to stabilize, even if the soils are only lightly disturbed.

Oil spills also will impact soils only as the vegetation is altered. 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, and the soils are damaged. Oil-spill cleanup mitigates impacts on soils only if cleanup methods and operations are very carefully controlled; cleanup activities should minimize any surface disturbance.

Conclusion: Soil stability depends closely on vegetative cover; where vegetation is disturbed, impacts on soils follow. Impacts to soils from management actions under Alternative A would involve either disturbance or destruction of relatively small areas. The duration of these impacts may be short term, ranging from several years if the vegetation is disturbed and up to many decades if the soils are destroyed. The overall impact to soils of the 4.6 million acre planning area would be minor (with seismic) to negligible (without seismic).

Effectiveness of Stipulations: Stipulations beyond those required with current management could not reduce the impacts to soils (see Stipulation 71, which shall be complied with by all activities). Emphasis should be on maintaining the thermal properties of the existing vegetation and surface organic mat or substituting other thermal insulation.

2. Paleontological Resources: Paleontological resources (plant and animal fossils) are nonrenewable. Once they are adversely impacted and/or displaced from their natural context, the damage is irreparable.

Under Alternative A, there is one type of activity that has the potential for causing measurable impacts on paleontological resources—excavation and collection. Excavation and collection normally occurs during the summer and usually is the result of archaeological research (Sec. IV.B.12), although the process is sometimes associated with geologic fieldwork. Archaeologists and geologists are trained to properly care for paleontological resources. Most paleontological material is buried considerably deeper than cultural material and, therefore, not regularly encountered by chance. Some Pleistocene-age animal remains may be recovered in archaeological deposits, if the deposit is old enough. In such situations, the bones would represent subsistence use of the animal(s) by humans, and the faunal material would be considered part of the archaeological record as well as belong to the regional paleontological record.

The temporary summer field camps commonly associated with scientific or resource assessment work generally impact only relatively small areas. Therefore, such camps and the activities that are associated with them, such as aircraft use, on-the-ground survey/reconnaissance, hazardous- and solid-material removal and site remediation, and recreation, are not expected to have any significant effect on paleontological resources.

Conclusion: Under Alternative A, impacts to paleontological resources would result from management activities other than oil and gas exploration (except seismic activity) and development. Impacts would include displacement and/or destruction of resources and will be minimal, whether or not seismic activity is allowed..

Effectiveness of Stipulations: Because Alternative A does not allow leasing, exploration (other than seismic) or development, the current Environmental Assessment (EA) review and clearance process and stipulation (#79) attached to all Land Use Authorizations issued for the NPR-A, accompanied by irregular surveillance, generally are adequate to protect paleontological resources.

3. Water Resources: Ground-impacting-management actions within the planning area that may affect water resources under Alternative A include ground activities such as resource inventories, paleontological and cultural excavations, research and recreational camps, seismic surveys, and overland moves—all of which might occur during summer or early fall, except the latter two activities, which occur during the winter on snow-covered, frozen tundra.

Seismic activities have been ongoing during most winters, even though there has been no current leasing since 1984. Seismic activities involve seasonal occupation and transport using sledge-drawn trailers (wanigans) at transitory locations, when stipulations (Sec. II.C.7, Stipulation 20) require that snow cover is sufficient to cover the tundra and lakes and rivers are frozen (Appendix A). With these practices, the effects of seismic activities on the water resources would be minor diversions of shallow water tracks and limited ponding in places where track depression compresses the organic mat sufficiently to alter the thermal regime, melt surficial ground ice, and alter the native vegetation (Emers and Jorgenson, 1997). By widely spacing the trails created by winter seismic and other overland move activities, disturbance to water resources could be minimized..

Because surface disturbing activities, as defined by events of such magnitude, extent, and duration to create the effects discussed in Sec. IV.C.3, are not expected under this alternative, there probably would be no significant long-term effect on water resources. However, there may be some sites that require remediation from earlier exploration or military activities. Temporary camps would be sited on existing pads or on well-drained soils on the inactive floodplain or uplands, sited back from the stream or lake shore, and with minimal surface disturbance. Winter occupation or moves would use sledge-drawn trailers (wanigans) at transitory locations, when adequate snow cover exists (Sec. II.C.7, Stipulation 20). All fuel, waste, and hazardous materials would be stored onsite according to ADEC guidelines and removed seasonally (Sec. II.C.7, Stipulations 2-12).

Small spills would be contained with bermed and lined storage areas, and there would be sufficient absorbents and petroleum containment and removal equipment onsite. No large spills are expected to occur under this alternative, because only small amounts of fuel would be stored onsite.

Conclusion: Impacts to water resources under Alternative A would be minimal. Long-term water resources over a fraction of an acre would be affected by biannual 2-D seismic programs under Alternative A. Without seismic activities, impacts to water resources would be negligible.

Effectiveness of Stipulations: Current management practices and stipulations developed through the permitting process and attached to land use authorizations for temporary facilities, overland moves, seismic operations, and recreational operations are adequate to protect water resources. Specifically, Alternative A-E stipulations that are effective in protecting the water resources require that camps, travel routes, and surface-disturbing activities to be located away from streams and lakes; restrictions on the amount of fuel that can be stored onsite; all fuel and waste material be hauled out annually; overland moves be conducted in the winter when the streams, lakes, and tundra are frozen and covered with snow; and travel routes be altered to avoid snow compaction and excessive freezedown, especially at stream and lake crossings.

4. Water Quality: Seismic trails are the only affecting agent for water quality under Alternative A. Other ground-impacting-management actions within the planning area would not affect water quality.

Alternative A allows seismic operations starting in late fall after the top foot of the active layer freezes and snow cover builds up. Seismic vehicles would be a combination of tracked vehicles from small Nodwell 110's for surveyor travel to Caterpillar tractors for pulling seismic camp trains. Buggy style vehicles such as Rolligons and Deltas are possible (Rice, 1997). Except for a new buggy design that may lessen the need to have a lead snowplow in deeper snow, most of the seismic vehicles in use are types that have been used on the North Slope for one to three decades.

Carefully regulated seismic operations conducted in the ANWR in 1984 to 1986 resulted in damage to vegetation in some tussock tundra and moist sedge-shrub tundra, but not to lower, moist sedge and wet tundra (Felix et al., 1989). Raynolds and Felix, 1989 found "medium-to-high impact" on 29 percent of the seismic trails. This damage occurred in vegetated river terraces, in more bumpy terrain (such as high-centered polygons or tussocks), and in areas with little snow cover. An example of a high-impact area found would be a swath denuded of vegetation 33 ft wide and up to 160 ft long. Wetter, flatter, and more vegetated sites were not impacted. Recovery of damaged seismic tracks takes many years (Walker, 1996).

For Alternative A, complete recovery of vegetative cover damaged during seismic studies could take a year to decades. Persistent high damage has been estimated to occur on 13 acres/per seismic survey, for a total of 130 acres over 10 surveys (see Sec. IV.B.6). Thermokarst erosion and effects on water quality could occur in high impact areas if damage were persistent. Although thermokarst erosion of damaged winter seismic trails made under current practices has not been generally observed, such erosion is possible in the NPR-A, particularly because snow cover is less than in the ANWR. If it is assumed that 1 percent of the persistent high damage area results in thermokarst erosion, then about 1.3 acres could be affected. Thaw settlement also would affect long-term local hydrology, including downflow water quality, perhaps over twice this area, with the total area affected being <3 acres.

Thermokarst erosion can result in water features with high turbidity/suspended-sediment concentrations. Measurements in a small stream near Barrow undergoing thermokarst erosion, and meeting such conditions, found ≤27 milligrams per liter (mg/l) suspended solids and ≤11 Jackson turbidity units (JTU) upstream of the erosional feature, 820 mg/l (610 JTU) at the erosional cut, and 160-280 mg/l (250-470 JTU) farther downstream (Barsdate and Prentki, 1973). Although the applicable State turbidity standards are defined in nephelometric turbidity units (NTU), inconvertible with JTU, the standard for secondary water recreation (e.g.; fishing) generally limits turbidity to a 20-percent increase from the natural level. Both the JTU turbidity and suspended-sediment concentrations increased much more than 20 percent—rather by an order of magnitude across the thermokarst feature.

To get such high turbidity, the peat mat must be sufficiently eroded to expose underlying mineral soils. The mineral soils also must be fine grained. These conditions rarely occur, even where tracked vehicles were used in multiple summer passes. Thus, thermokarst erosion could cause the State turbidity standard to be exceeded within and downflow of thermokarst features in rare cases over small areas, likely on the order of no more than a fraction of an acre total.

Other ground-impacting-management actions within the planning area would not affect water quality. Excavation and collection activities would be by hand shovel or trowel over several square feet, with replacement of the vegetative layer. These activities are required to protect streams and lakes from siltation and to avoid or minimize disturbance to vegetation. No fuel spills are anticipated under Alternative A, and stipulations in place require no storage in active lake floodplains and at least a 500-ft setback from any river, lake, or stream, with impermeable dikes around facilities >660 gal. Black water and sludge are to be incinerated or removed from public lands to ADEC-approved waste-disposal facilities. Recreational activities permitted by BLM are required to follow the National Outdoor Leadership School's "Leave No Trace, Alaskan Tundra" program in regard to minimizing impacts to vegetation, waste water, human waste, and solid waste.

Conclusion: Long-term water quality over a total of less than a fraction of an acre would be affected by biannual 2-D seismic programs under Alternative A. Without seismic activities, impacts to water quality would be negligible.

Effectiveness of Stipulations: Other current management practices and stipulations developed through the permitting process and attached to land use authorizations for temporary facilities, overland moves, seismic operations, and recreational operations protect water quality. However, Stipulation 20h could increase water-quality effects. Stipulation 20h restricts seismic operations from deeply drifted snow along cutbanks within 25 mi of the coastline to protect polar bear denning. However, this stipulation excludes seismic travel over this deeper snow, which would minimize effects on vegetative cover and, thus, risk of thermokarst erosion and water-quality effects. Stipulation 20h allows clearing of drifted snow along a trail or seismic line, as long as the tundra mat is not disturbed, decreasing the likelihood that the seismic operators would have to use tracked rather than wheeled (buggy) vehicles, and decreasing the likelihood of thermokarst erosion and water-quality effects. Stipulation 20j requires that average snow depth be 6 inches prior to starting seismic operations. This depth is sufficient to protect waterbodies, aquatic vegetation, flooded tundra, wet tundra, and moist sedge/grass meadows (see Table IV.B.6-1) and, thus, water quality in such areas. Greater snow depths are required to protect vegetative cover in tussock and moist sedge-shrub tundra (Felix et al., 1989). However, the sort of vegetative damage that occurs—knocking over of tussocks and branch breaking—is less likely to affect water quality.

5. Air Quality: There are no significant activities planned under Alternative A that would affect air quality

within the planning area. Helicopter and light-plane use would have a transitory effect on local air quality; however, no long-term effect would be noted.

Conclusion: Air quality would not be affected by air-impacting actions within the planning area under Alternative A, whether or not seismic activity is allowed.

Effectiveness of Stipulations: There would be no stipulations for air quality for this alternative.

6. Vegetation: Ground-impacting-management actions within the planning area that may affect vegetation under Alternative A include aerial surveys, paleontological and archaeological excavations, camps for research or recreation, overland moves, and seismic surveys. Most of these activities, except for overland moves, seismic surveys, and some aerial surveys, occur during June to September.

Most off-runway landings during management surveys would be by fixed-wing aircraft using skis or floats; fewer would be by wheeled aircraft. Only wheeled aircraft has the potential to affect vegetation. Most wheeled-aircraft landings would occur on sand or gravel bars or possibly on dry, gravelly ridges. These landings have a potential to cause minor, short-term damage to the scattered vegetation present on bars or ridges. Because there are too many unknowns associated with this, the minor impacts anticipated cannot be quantified.

Archaeological digs are most likely to occur on drier soils, where a sod layer has formed. In this case, the sod may be removed and replaced causing a temporary disturbance rather than vegetation destruction. However, the surface vegetation may be destroyed in some archaeological digs and in most or all paleontological digs. The cumulative extent of such activities is not expected to exceed 1 acre per year.

Camps can result in vegetation trampling from foot traffic and tent placement and small spills of stove or generator fuel. This can result in temporary (1 to a few growing seasons) disturbance to vegetation. Most recreational camps are expected to occur on river bars, where vegetative cover is minimal. Large camps for research or resource inventory are likely to occur on existing gravel pads, which also have minimal vegetative cover. The total land surface affected by camps is not expected to exceed 10 acres per year and would be scattered over several sites, with most containing little or no vegetation.

Most overland moves through the planning area involve traffic between Deadhorse and Barrow. Moves would occur in winter only, when the ground is frozen and covered with snow. The impact to vegetation varies with vehicle type, vegetation type, and snow conditions. Low-ground-pressure wheeled vehicles have less of an impact than tracked vehicles or sleds on skids. Less impact usually would be expected in the wetter tundra where the effect, if any, may be the compression of snow and dead matter leaving "green trails" visible for one to a few growing seasons (Sec. IV.B.16, Recreation and Visual). However, if a tracked vehicle makes a tight turn or drops its blade too deeply through the snow, surface vegetation may be disrupted. If this occurs in wet tundra, thermokarsting can cause impacts greater than those commonly experienced in drier tundra. Travel over low shrubs could cause plants to be broken, and travel over tussocks sometimes results in their tops being scraped off. Thus, overland moves may vary from having no observable effects in some situations to damaging vegetation and melting permafrost to the extent that it may take years or even decades (Emers and Jorgenson, 1997; Jorgenson and Martin, 1997) to heal. A trail across the planning area would be about 100 mi in length. If the trail is 12 ft wide, the impact potentially could affect about 150 acres.

Seismic exploration causes the same types of impacts to vegetation as those described for overland moves. There are two options under Alternative A, one of which would allow seismic exploration in the planning area and one that would not. If seismic exploration is allowed, it is assumed there would be one crew active in the planning area in alternate winters, collecting about 250 line miles of 2-D seismic data. The exterior dimensions of each survey area are assumed to be about 600 mi^2 (384,000 acres) and the maximum area impacted by seismic lines to be 6,060 acres (250 mi x 200 ft wide). This figure is presented as a maximum, because not all of the area within a 200-ft wide line actually would be overrun by a vehicle. Trails also are made by camp-move vehicles, which traverse about the same distance as line miles of survey (Emers and Jorgenson, 1997). Also, trails are made through the planning area while traveling to and from the survey area. A camp-move trail is about 12 ft wide, and it is assumed the camp train would involve two or three strings of trailers. These strings could use the same trail, but this would cause greater damage than to use separate trails. For this analysis, it is assumed that on average, 2.5 individual camp-train strings would use different trails to decrease overall damage and, therefore, camp-move trails effectively would impact a path 30 ft wide. With 250 mi of trail within the survey area and an additional 106 mi entering and leaving the planning area, this would impact a total of 1,290 acres. Thus, the total area impacted by seismic surveys would be <7,350 acres every other year because, as stated above, not all the area within a seismic line would be affected.

A study of tundra disturbance by winter seismic surveys on the eastern portion of Alaska's North Slope (Jorgenson, In

press) indicated that 1 to 2 years after a survey, the disturbance level to the affected tundra under seismic lines was little to none for 11 percent of the area, low for 64 percent, medium for 23 percent, and high for 2 percent. After 8 to 9 years, recovery had reduced the disturbance level to little or none on 97 percent of the affected area, and no areas of medium or high disturbance remained. The tundra under camp-move trails did not recover as rapidly. One to two years after the survey, the disturbance level to the affected tundra under camp-move trails was little to none for 22 percent of the area, low for 52 percent, medium for 24 percent, and high for 2 percent. After 8 to 9 years, recovery had reduced the disturbance level to little or none on only 85 percent, with low on 10 percent, medium on 4 percent, and high on 1 percent. Applying these data to the above scenario for the planning area suggests that about 1,850 acres would experience medium to high disturbance every other year and, after 9 years of recovery, that level of disturbance still would be evident on 65 acres.

It is assumed that impacts to vegetation from overland moves and seismic surveys would occur to different land-cover classes in proportion to their occurrence in the planning area (Table III.B.2-1), with the exception of the three water classes. Thus, these impacts, whether or not quantified as to area involved, would occur among the land-cover classes as presented in Table IV.B.6-1.

Table IV.B.6-1
Proportion of Vegetation Impacts to each Land Cover Category

Land Cover Categories MAJOR and Minor	Percent of Impacts
WATER	
Ice	0.0
Clear Water	0.0
Turbid Water	0.0
AQUATIC	
Carex aquatilis	4.8
Arctophila fulva	0.5
FLOODED TUNDRA	
Low Centered Polygons	8.3
Nonpatterned	3.4
WET TUNDRA	6.4
MOIST TUNDRA	
Sedge/Grass Meadow	12.8
Tussock Tundra	37.0
Moss/Lichen	2.0
SHRUB	
Dwarf	19.7
Low	2.2
Tall	0.1
BARREN GROUND	
Sparsely Vegetated	0.6
Dunes/Dry Sand	0.9
Other	1.3

Conclusion: Impacts to vegetation from management actions under Alternative A would involve either disturbance or destruction. If the option allowing seismic exploration is implemented, seismic work would account for most (>95%) of those impacts. The duration of all impacts would be short term, ranging up to 5 months, and complete recovery could vary from 1 year to decades. The overall impact to the vegetation communities of the 4.6-million-acre planning area would be minor (with seismic) to negligible (without seismic).

Effectiveness of Stipulations: Alternative A reflects current management, and the above analysis was done assuming that current stipulations would continue to be implemented.

7. Fish: Fish inhabiting the Arctic region are described in Section III.B.2. As noted in Section III.B.2, arctic fish differ substantially from their counterparts inhabiting warmer regions. In addition to their many differences, arctic fish also have developed unique life-history, behavioral, physiological, and population characteristics that enable them to exist under extremely harsh and fluctuating environmental conditions of both daily and seasonal occurrence. Occasionally, these conditions cause high mortalities, especially to the more sensitive lifestages (eggs and juveniles). Because of this, arctic fish populations have adapted to withstand at least short-term perturbations and fluctuations in the environment, whether natural or human caused.

a. Effects of Disturbance: Actions associated with Alternative A that could cause disturbance to fish include the establishment of large work camps at pre-existing airstrips; small scientific excavations for archaeological, paleontological, geologic, and soils-related information; seismic surveys; the sport harvest of fish by workers; and actions associated with fuel spills at fuel-storage sites. The establishment of work camps, scientific excavations, and the sport harvest of fish by workers are not expected to have a measurable adverse effect on arctic fish populations. Seismic surveys and fuel spills at fuel-storage sites may adversely affect arctic fish.

Seismic surveys use acoustical energy pulses to locate subsurface geological structures that might contain oil or gas. On land, these energy pulses are generated by special vibrator equipment mounted on trailers and towed on sleds. Seismic impulses generated in this way have a much smaller effect on fish than high explosives, which formerly were used to generate the necessary seismic impulses. Because of this, the relatively small number of seismic surveys expected, and the low density of arctic fish in most of the planning area, seismic surveys are expected to have

no perceptible effect on individual arctic fish. The only exception would be if a seismic survey were conducted above overwintering habitat. Because arctic fish are concentrated in these areas all winter and would be relatively close to the vibrator equipment operating above them, it is likely that they would be adversely affected. Likely effects would include avoidance behavior and short-term added stress, possibly resulting in the death of some of the more sensitive lifestages (e.g., juveniles). However, the effects of seismic surveys on most overwintering fish are expected to be short term and sublethal. For this reason and because most seismic surveys are not likely to occur above overwintering habitat (>95% of the planning area is not overwintering habitat), seismic surveys are not expected to have a measurable effect on arctic fish populations.

b. Effects of Spills: Under Alternative A, small fuel spills at fuel-storage sites could occur. The effects of fuel spills on fish are expected to be similar to those of crude-oil spills, although much reduced in duration due to evaporation. The effects of oil spills on fish have been discussed in previous Beaufort Sea EIS's (e.g., USDOI, MMS, 1996a), which are incorporated here by reference and summarized. Oil spills have been observed to have a range of effects on fish (see Rice, 1981; Starr, Kuwada, and Trasky, 1981; Hamilton,Starr, and Trasky, 1979; Malins, 1977, for more detailed discussions). The specific effect depends on the concentration of petroleum present, the time of exposure, and the stage of fish development involved (eggs, larva, and juveniles are most sensitive). If lethal concentrations are encountered, or sublethal concentrations are encountered over a long-enough period, fish mortality is likely to occur. However, mortality caused by a petroleum-related spill is seldom observed outside the laboratory environment. Most acute-toxicity values (96-hour lethal concentration for 50% of test organisms [LC_{50}]) for fish generally are on the order of 1 to 10 parts per million (ppm). Concentrations observed under the oil slick of former oil spills at sea have been less than the acute values for fish and plankton. For example, concentrations observed 0.5 to 1.0 meters (m) beneath a slick from the *Tsesis* spill (Kineman, Elmgren, and Hansson, 1980) ranged from 50 to 60 parts per billion. Extensive sampling following the *Exxon Valdez* oil spill (about 260,000 bbl in size) also revealed that hydrocarbon levels were well below those known to be toxic or to cause sublethal effects in plankton (Neff, 1991). The low concentration of hydrocarbons in the water column following even a large oil spill at sea appears to be the primary reason for the lack of lethal effects on fish and plankton.

The bodies of freshwater in the planning area are substantially smaller in size than the marine environment, where the effects of former oil spills have been observed. However, the size of fuel spills associated with Alternative A also is likely to be much smaller. Hence, the likelihood of lethal effects is expected to be generally similar to that observed for oil spills at sea (i.e., very low). Additionally, most fuel spills are expected to occur on the pad where they are stored and would not come in contact with fish habitat. Sublethal effects are more likely to occur and include changes in growth, feeding, fecundity, and survival rates and temporary displacement. Other possibilities include interference with movements to feeding, overwintering, or spawning areas; localized reduction in food resources, and consumption of contaminated prey. Some fish and food resources in the immediate area of a fuel spill could be lethally or sublethally affected, particularly if the spill occurred where and when fish were migrating, in overwintering areas during winter, or in small waterbodies having restricted water exchange. If a fuel spill of sufficient size occurred in a small waterbody containing fish with restricted water exchange, lethal and sublethal effects would be expected on most of the fish and food resources in that waterbody; and recovery may be ≥5 years. However, due to the small size of the fuel spills anticipated, the low diversity and abundance of fish in most of the planning area, and the unlikelihood of spills blocking fish migrations or occurring in overwintering areas or small waterbodies (containing many fish) with restricted water exchange, fuel spills associated with Alternative A are not expected to have a measurable effect on arctic fish populations in the planning area over the life of the IAP.

Conclusion: Seismic surveys, if allowed, and fuel spills are not expected to have a measurable effect on arctic fish populations in the planning area over the life of the IAP.

Effectiveness of Stipulations: Current management practices and stipulations developed through the permitting process and attached to land use authorizations for temporary facilities, overland moves, seismic operations, and recreational operations are adequate to protect fish resources. Specifically, Stipulations 15, 16, and 20 are the most likely to have a beneficial effect on arctic fish. Others that may benefit arctic fish include Stipulations 5, 9, 11, and 12. With these stipulations in place, there is an increased probability that (1) spawning and overwintering fish would be unaffected by activities associated with Alternative A, (2) fish passage and streamflows would be maintained, and (3) the effects of accidental fuel spills would be minimized. These stipulations may benefit arctic fish populations. However, because there is relatively little activity associated with Alternative A that may affect arctic fish, their absence is not expected to measurably increase adverse effects on arctic fish populations.

8. Birds: This section discusses potentially adverse effects of ground-impacting-management actions on nonendangered birds within the planning area under

Alternative A. The primary effects on birds exposed to such activities would be altered distribution, abundance and/or behavior resulting from disturbance during the breeding, molting, or migration periods; alteration of habitats; and effects resulting from pollution of the environment by refined-oil products. Nearly all of the approximately 80 species of regularly occurring birds are migrants, seasonally occupying a variety of wetland, tundra, riverine, and marine habitats in or adjacent to the Northeast NPR-A Planning Area. Principal bird groups considered include loons and waterfowl, shorebirds, raptors, passerines, and seabirds.

a. Effects of Disturbance: Noise from human activities and visual presence of humans and/or equipment may disturb birds during any phase of the annual cycle. Birds may be disturbed easily during sensitive periods as when attending a nest, broodrearing young, or in a flightless molt condition. Potentially disturbing activities (Table IV.A.1a-1) include aircraft traffic, winter ground transport, seismic surveys, ground-based resource surveys, activities associated with camps, waste removal, and recreational traffic. Attraction of predators to sites of activity may increase predation on birds.

(1) Effects from Ground-Based Activities: It is assumed that ground transport associated with private, industry, or agency activities (Table IV.A.1.a-1) will occur during winter months (December-April), when nearly all birds are absent from the region. If the 20 to 100 trips annually between Prudhoe Bay or Oliktok Point and Barrow take place over offshore ice, there would be no effect on birds. Although there is little direct evidence from winter studies, the effect of occasional (e.g., 1 trip/week) overland traffic along the coast is expected to temporarily displace ptarmigan, gyrfalcons, and snowy owls present in the area for ≤1 day and up to an estimated 700 ft (213 m) from the route (Grubb, et al., 1992; Murphy and Anderson, 1993; Skagen, Knight, and Orians, 1991; Stalmaster and Newman, 1978); if traffic is more routine (e.g., 1 trip/1.5 days), these species may vacate an area of up to 0.6 mi (1 km) from the route. These effects are expected to last the winter-transport season, with recovery to original distribution and abundance following cessation of the activity in late spring.

Although this alternative includes no oil and gas exploration, seismic surveys may occur during winter months (December-April), when nearly all birds are absent from the region. Seismic-survey trains (2-D = 10 vehicles), with crews of 60 traversing gridlines 5 to 10 mi apart, temporarily (3-7 days) may displace small numbers of ptarmigan, gyrfalcons, and snowy owls from within 700 ft (213 m) to 0.6 mi (1 km) of the local activity area around each 5- to 10-mi segment of up to 250 mi (402 km) of survey gridlines covering an approximately 600-mi^2 (1,554-km^2) area. Because both the areas of potential disturbance and birds are dispersed over a large area, there is not expected to be a significant population effect.

Large summer camps (~15 persons) potentially located at Inigok Creek airstrip, Umiat, Lonely DEW Line site (Fig. III.C.7-3), and possibly the abandoned Ikpikpuk well site (Fig. III.A.1.f-1), may result in a local-disturbance area as much as 700 ft (213 m) to 0.6 mi (1 km) from each camp (35-776 acres; 0.14-3.14 km^2) for the 6-week duration of operation. Humans on foot and noise-generating activities are expected to cause responses ranging from moving to the safety of a nearby lake to departure from the area for several hours (Burgess and Ritchie, 1989). Nest attempts and success are expected to decline in any such area, but the effect probably would vary considerably depending on the availability of appropriate habitat for each species comprising the local bird community (there may be little undisturbed habitat in the immediate vicinity of these occupied or formerly occupied sites), the intensity of disturbance factors, the sensitivity of each species to disturbance, and the potential for habituation to particular factors (e.g., Haugh, 1982; Johnson and Noel, 1996).

No known high-density areas for species recorded on the breeding pair surveys (King, 1997, pers. comm.) coincide with any of these sites except for tundra swan, northern pintail, and oldsquaw in the Lonely area (Figs. III.B.4-6, -12, -13), and possibly postbreeding concentrations of shorebirds near the Ikpikpuk site (Fig. III.B.4-17). Density values and waterfowl behavior observations (Murphy and Anderson, 1993) suggest that breeding efforts of a maximum of 3 swans, 11 oldsquaw, and 20 pintail could be disturbed if the area were entirely suitable habitat populated by typical densities of these species. Each of the identified sites has medium- and low-density areas of virtually all species recorded on breeding-pair surveys and, presumably, various shorebirds, passerines, and raptors. Studies in the Prudhoe Bay area indicate that numerical response to development may range from a substantial decrease to a substantial increase in nesting density (TERA, 1993:Fig. 16). Local populations of those species adversely affected are expected to experience only minor declines in breeding success in summers when the camps are occupied, and the lost productivity may not be detectable above the natural fluctuations of the population and survey methods/data available. Likewise, broodrearing or molting birds probably would be displaced from the vicinity of these camps, but the small area and numbers involved is expected to result in negligible loss of foraging habitat for these local groups of individuals and negligible declines in survival and recruitment. Activities at small resource-survey camps along the Colville and Ikpikpuk rivers potentially may disturb nesting passerines for short periods (3-5 days) during a 3-week interval, but the population effect of such short-term presence on

productivity is likely to be negligible. However, raptor nest sites exposed to disturbance of such duration might be expected to exhibit a more significant adverse response, although Ritchie (1987) found that short-term disturbance of peregrine falcon nest sites did not cause significant alteration of activity patterns and no significant change in productivity of fledglings. Paleontological survey camps, occupied for up to 6 weeks in the central planning area, may disrupt some nesting attempts by waterfowl, shorebirds, and/or passerines but are expected to cause only minor local loss of productivity.

Disturbance during hazardous-waste and solid-material removal and remediation activity involving operation of heavy equipment for up to 3 to 4 weeks, or cleanup of fuel spills reaching off-site areas during the breeding season, temporarily may displace a small number of nesting, broodrearing or molting birds from the immediate area, but effects are not expected to extend beyond 700 ft to 0.6 mi. Either activity may cause local disruption of some breeding attempts or foraging activities, but the losses probably would not be detectable above the natural fluctuations of the population and survey methods/data available.

Boat travel from June to September for recreation, hunting, or transport to resource-survey camps on the Colville River, and potentially the Ikpikpuk and Kogosukruk rivers, could expose a substantial proportion of the Alaskan arctic peregrine falcon population, as well as gyrfalcons and rough-legged hawks, to human presence (Ritchie, 1987). The current float-trip traffic (up to 14 parties of ≤5 persons each/season or about 1/week passing peregrine eyries—9 of these occurring above Umiat where peregrine density is lower than below; Fig IV.B.4-18) has not prevented the regional peregrine population from increasing. There is no indication that this level of activity is adversely affecting the other two species. The tall-shrub riparian habitat along these rivers is important habitat for nesting passerine birds. Studies to determine the effect of varying traffic levels in this situation have not been done, but any severe effects are likely to be localized primarily where river parties concentrate their onshore activities.

The attraction of bird predators (glaucous gull, common raven, arctic fox, grizzly bear) to uncontained refuse is well known. It is not certain if predator populations with access to refuse are larger than they would be in its absence. Nor is it certain in most instances what effect predation by these species has on overall reproductive success and local population trends, although some studies have demonstrated a high correlation between presence or absence of predators and reproductive success. Fox and gull predation on island-nesting species or those that are colonial has been implicated in nest losses ranging from substantial to total failure (e.g., snow goose: Burgess and Rose, 1994; Johnson and Noel, 1996; common eider: Quinlan and Lehnhausen, 1982). Several studies have correlated nest success with fox predation pressure (e.g., brant and shorebirds: Underhill et al., 1993). The various camps supporting proposed summer activities in the planning area could attract potential predators, but most will be short-term with small numbers of people present. Seismic trains, operating in winter, are required to remove solid waste from BLM lands by stipulation, hence this activity is not expected to enhance the survival of arctic foxes significantly. The few large summer camps will be in place for sufficient periods to attract all four species but are not likely to cause other than temporary local concentration of predators that may affect breeding success of local bird communities. Such camps also would be covered by solid waste stipulations. The extent of any effect is not known but could specifically involve tundra swan, northern pintail, oldsquaw, and probably other waterfowl species present at lower densities in the Lonely area, and these species or any of several shorebird and passerine species there and at other proposed sites. Overall productivity and recruitment lost from the local area may not be detectable above the natural fluctuations of the population and survey methods/data available.

(2) Effects from Aircraft Operations: Both fixed-wing aircraft and helicopters are used for summer-season (June-September) aerial surveys, support of ground-based surveys and camps, and support of recreational activities. Primarily fixed-wing aircraft would be used for support of seismic surveys.

Establishment and maintenance of large summer camps (see above) requires aircraft support several times per week as well as flights for transport to worksites and for aerial wildlife and other surveys. Routine overflight of high bird-concentration areas by aircraft supplying or operating out of these camps could cause effects ranging from abandonment of nesting efforts or lower survival of young in extreme cases to avoidance of certain areas of favorable habitat for future nesting attempts or excessive activity/weight loss in the case of molting geese. The Ikpikpuk wellsite, between southwest Teshekpuk Lake and the Ikpikpuk River, is located west of concentrations of five species recorded on surveys of the Arctic Coastal Plain near the lake—yellow-billed loon, Pacific loon, greater white-fronted goose, oldsquaw, and king eider areas east of the lake (Figs. III.B.4-3, -4, -9, -13, -14). High-concentration areas of white-fronted goose, northern pintail (Fig. III.B.4-12), and oldsquaw are recorded at the Lonely site. In addition, the second most heavily used goose broodrearing lake (Fig. III.B.4-7) and many of the lakes most heavily used by molting geese occur along eastern approaches to Lonely (Fig. III.B.4-2), and concentrations of the red-throated loon, tundra swan, and Sabine's gull (Figs. III.B.4-5, -6, -19) also occur in the vicinity of this site. Few concentrations of coastal plain survey species

other than scaup (Fig, III.B.4-15) are recorded in the immediate vicinity of the Inigok Creek site, and the survey area does not include Umiat. Any of the sites may have local concentrations or presence of one or more duck, shorebird, and/or passerine species, and pairs of glaucous and Sabine's gulls, arctic terns, jaegers, or raptors may be nesting in the vicinity.

Wildlife aerial surveys based at large camps are expected to involve daily flights for 2 weeks, primarily in late June and early July in several wildlife areas, although caribou tagging may continue through July. Aerial surveys for eiders in early to mid-June and waterfowl-breeding pairs in late June-early July cover much of the Arctic Coastal Plain each year, and 200 lakes north and east of Teshekpuk Lake are censussed for molting geese in mid- to late July. Such flights have a considerable potential for disturbance, because they require low-altitude operation over areas occupied by birds in sensitive phases of the annual cycle (nesting, broodrearing, molting). Occasional BLM resource aerial surveys will occur June to August. Use of aircraft to establish or move small recreational or agency camps and carry out aerial surveys could be additive to routine supply operations. Any surveys for hazardous- and solid-waste sites may concentrate in the Teshekpuk Lake and Colville River Special Areas, where waterfowl and raptor concentrations could experience additional stress from aircraft overflights. An estimated 18 flights/week may result from combined activities in the planning area; more importantly, at least 7 per week are expected to occur in the Goose Molting Habitat LUEA. Peak flight frequency is associated with periods of aerial survey activity in late June and late July.

The overall impact of aircraft would depend on the character of the operations—type of aircraft, flight frequency, altitudes, routes used (lateral distance), season of operation—and the sensitivity of the population segment exposed to characteristics potentially causing disturbance. Studies in the vicinity of Teshekpuk Lake (Derksen et al., 1992) found that molting brant, a species particularly sensitive to disturbance, responding to helicopter altitude and lateral distance during experimental overflights were significantly more disturbed by those below 3,511 ft (1,070 m) within 2.5 mi (4.0 km) than above this altitude, as indicated by the duration of escape behavior. Response to aircraft appeared to be most severe at intermediate altitudes (300-760 m), although results were not entirely clear cut. Beyond a lateral distance of 2.5 mi (4 km), disturbance response declined, irrespective of altitude. Disturbed birds were found to move away from an area at five times the rate of undisturbed birds, suggesting that disturbance could elevate energy expense and may adversely influence the use of preferred habitat by brant. Also, they could be subject to greater predation if they are forced to move between lakes (Derksen, Weller, and Eldridge, 1979). Routine disturbance could cause brant to bypass preferred lakes during the initial settling phase following arrival (Derksen, et al., 1992). Molting brant showed no significant habituation to aircraft (Jensen, 1990). In a study of staging brant at Izembek Lagoon Ward and Stehn (1989) observed that a greater proportion of brant responded to helicopters than most fixed-wing aircraft at comparable altitude and lateral distance .

Displacement of molting birds from preferred foraging habitat suggests two energetic costs as yet not directly measured: (1) added cost of behavior to escape the disturbance area, and (2) the greater cost of accumulating energy required for feather growth and fat deposits for use during migration, in potentially inferior foraging habitat. Brant weight loss in the Teshekpuk Lake area was modeled under various disturbance intensities (frequency, altitude) from aircraft flying between abandoned airstrips at Lonely and Kogru sites (Derksen, et al., 1992; Miller, 1994). Direct flights between the two potentially disturbed about 48 percent of the molting brant population (8,284). With 10 modeled helicopter overflights/day at a 1,001-ft (305 m) altitude, the model predicted light weight loss in about 88 percent of these individuals; aircraft at higher altitudes caused less disturbance, and somewhat lower percentages of the geese lost weight. The model does not predict a weight threshold below which brant could experience significantly reduced survival, successful migration to their staging area, or recruitment. However, theoretical predictions of the model with regard to weight loss or related effects have not been verified experimentally, and it is uncertain if or to what extent brant can adjust their forage intake (Ward and Stehn, 1989). There is some question whether brant can take in enough food to undergo molt without drawing on stored fat reserves, or protein, and thus may not be able to compensate for the added costs of disturbance (Taylor, unpublished data). In the planning area, estimated flight frequency associated with anticipated reasonably foreseeable actions that involve aircraft operations (Table IV.A.1.a-1) mostly to and from large camps plus occasional survey surveys and daily wildlife survey flights over specific areas generally would average between 1.1 and 2.6/day. Based on the results of the Teshekpuk Lake brant study, this level of activity probably would cause only light weight loss in this species in a few local areas. The ultimate result of such an effect in terms of reproductive success or survival of young or adults has not been determined for any species; any lost productivity or recruitment may not be detectable above the natural fluctuations of the population and survey methods/data available. At the Lonely site where access requires aircraft to cross the Goose Molting Habitat LUEA or approach from the sea, any adverse effects of the combination of camp and aircraft activities on productivity and recruitment also may not be detectable above the natural fluctuations of the population and survey methods/data available.

Although bird species vary in sensitivity to disturbance, any breeding or postbreeding birds exposed to routine aircraft disturbance could be displaced from local habitats and/or subject to increased energy demands. For example, helicopter disturbance of one gyrfalcon pair did not cause nest abandonment or reduced productivity, but the pair did not occupy that site the following year (Platt, 1977).

b. Effects of Spills: Birds experiencing moderate to heavy contact of refined-oil products (primarily fuels and lubricants) are not expected to survive. However, because such spills (estimated average volume 0.7 bbl) are likely to occur on pads (or ice roads in winter) where they can be contained and removed, significant exposure of birds is not expected to occur. If fuel reaches a small lake where, for example, relatively low populations of molting geese occur, losses of tens of individuals are possible. A larger fuel release entering a major goose-molting lake may affect several hundred individuals, and there are 21 lakes where a maximum count of ≥1,000 individuals has been made at least once, suggesting even larger numbers could be contacted. However, this worst-case situation is not likely given the small estimated spill size, for 180 of the surveyed lakes maximum numbers observed are <1,000, and the fact that in order to contact large numbers most of the birds would have to be clumped in a downwind area. In any case, recovery to the original population status may not be detectable above the natural fluctuations of the population and survey methods/data available.

Conclusions: Under Alternative A, most disturbance effects associated with ground transport and seismic surveys in winter, moderate flight frequency supporting large and small camps and aerial surveys, moderate increases of boat traffic on the Colville River, air transport of recreational parties, and spill-cleanup activities in summer, are expected to be localized, to within 700 ft to 0.6 mi of the disturbing activity, and temporary, ranging from brief (<1 day) in the case of response to a few aircraft flights or presence of ground or boat activity to several months for extended ground-transport operations. Elimination of seismic activity would result in a minor decrease of disturbance effects on three winter-resident species. More intense activity, such as routine overflights of goose-molting lakes, the combination of large camp activity and associated aircraft operations, substantially increased river-boat traffic, or fuel spills entering lakes with large molting goose populations, is expected to result in more substantial losses, but recovery of lost productivity and recruitment may not be detectable above the natural fluctuations of the population and survey methods/data available. If seismic surveys are not allowed, there would be a small decrease in impacts to birds that winter in the area, including ptarmigan, gyrfalcons, and snowy owls.

Effectiveness of Stipulations: Current management practices and stipulations developed through the permitting process and attached to land use authorizations for temporary facilities, overland moves, seismic operations, and recreational operations, are adequate to protect bird resources.

Specifically, disturbance of birds from ground transport and other activities would be mitigated and essential habitat protected by offsetting ice-road location annually; minimizing and seasonally restricting vehicle use to minimize vegetation-damaging and erosion-causing activities; taking recommended precautions in the Goose Molting and Colville River Raptor, Passerine, and Moose LUEA's (loons, waterfowl, shorebirds raptors, passerines affected); and not removing water from lakes in the Goose Molting Habitat if it would adversely affect lakeshore goose-feeding habitat (loons, waterfowl, shorebirds).

Aircraft disturbance of birds would be mitigated by: seasonal restriction of BLM-authorized fixed-wing aircraft flight frequency in the Goose Molting Habitat LUEA (loons, waterfowl, shorebirds), and maintenance of seasonal minimum flight altitudes and lateral distance over the Teshekpuk Lake and Colville LUEA's (loons, waterfowl, shorebirds, raptors, passerines).

Potentially adverse situations involving hazardous materials and wastewater would be mitigated by: immediate cleanup of fuel spills and other hazardous materials using procedures approved by USEPA, ADEC, and OSHA, and materials stored at all fueling and maintenance areas; storing fuels in lined/diked areas at least 500 ft (152 m) from lakes and streams, not storing fuels on lake or river ice, and not refueling equipment within 500 ft of lakes or streams (loons, waterfowl, shorebirds, passerines).

Other potentially adverse situations would be mitigated by: not disposing of domestic wastewater into freshwater: taking precautions to avoid attracting wildlife (predators) to refuse, and prohibiting the feeding of birds (most birds), and requiring all visitors to adhere to the applicable stipulations.

These stipulations would minimize disturbance from most factors, prevent fuel spilled on pads/roads from reaching surrounding habitats, and help prevent pollution and degradation of critical wildlife habitats.

9. Mammals:

a. Terrestrial Mammals: Among the terrestrial mammal populations that could be affected by ground-impacting-management actions under Alternative A are caribou of the Teshekpuk Lake Herd (TLH) and the Central

Arctic Herd (CAH). Caribou of the Western Arctic Herd (WAH) are not expected to be significantly affected, because their calving range is located far to the west of the planning area (Fig. III.B.9.a.-1). Some WAH caribou may be temporarily exposed to helicopter traffic and other human activities associated with resource inventories and seismic operations, but such exposure is not expected to have any effects on the population. Moose, muskoxen, grizzly bears, wolves, wolverines, and arctic foxes may be locally affected by activities in the planning area.

(1) Effects of Disturbance: Activities that may affect terrestrial mammals include aerial surveys (including those for wildlife) and ground activities such as resource inventories, paleontological excavations, research camps, recreational camps (hunting and river floating), seismic operations, and overland moves. Overland moves and seismic activities occur during the winter on frozen tundra, ice roads, or stable shorefast ice. The other activities occur from summer to early fall (June-September). The primary potential causes of disturbance of terrestrial mammals are helicopter traffic (1-2 round trips/day for 3-6 weeks/survey party), fixed-wing aircraft traffic (2/week/party), and humans on foot. These activities are expected to cause short-term (few minutes to <1 hour) displacements and/or harassments of terrestrial mammals. Recreational camps in some cases may attract bears and result in the shooting of bears that learn to associate humans with food sources. Such losses by themselves are expected to be minor or insignificant to the bear population but will contribute to cumulative adverse effects.

Small rodents (such as lemmings and voles) and their predators (such as short-tailed weasels) are expected to be affected locally (direct mortality and loss of habitat of individuals or small groups of lemmings and voles) at paleontological excavations, seismic operations, and by overland moves. However, these losses are expected to be insignificant to populations on the Arctic Slope of Alaska.

(2) Effects of Spills: Very small fuel spills (probably <1 bbl) may occur in association with resource-inventory surveys, recreational activities, and overland moves. These spills are likely to involve aviation fuel and other light-fraction hydrocarbon fuels that would evaporate and disperse rapidly in the environment with only a local effect on vegetation. Fuel spills are required to be cleaned up immediately, if possible, under current BLM stipulations. Such events are not expected to have any significant effects on terrestrial mammals in the planning area.

Conclusion: The effects of Alternative A, other than seismic operations, on terrestrial mammals are expected to be local, within about 1 to 2 km of activities, and short term, with no significant adverse effects on mammal populations (except the arctic fox, which may increase in abundance near permanent camp facilities). Seismic operations also would have short-term and local effects on terrestrial mammals but would not affect populations or overall distribution.

Effectiveness of Stipulations: Current management practices and stipulations developed through the permitting process and attached to land use authorizations for temporary facilities, overland moves, seismic operations, and recreational operations are adequate to protect terrestrial mammals. Specifically, Alternative A-E stipulations described in Section II.C.7 regarding solid- and liquid-waste disposal, fuel handling, and spill cleanup are expected to reduce the potential effects of spills and human refuse on grizzly bears and other terrestrial mammals. Stipulations on overland moves and seismic work are expected to minimize alteration of terrestrial mammal habitats. The stipulation on aircraft to maintain 1,000 ft above ground level (AGL) (except for takeoffs and landings) over caribou winter ranges from October through May 15, and 2,000 ft AGL over the Teshekpuk Lake Caribou Habitat LUEA from May 16 through July 31, is expected to minimize disturbance of caribou.

b. Marine Mammals: Ground-impacting-management actions along the coast within the planning area that may affect nonendangered marine mammals under Alternative A include aerial surveys (including surveys of wildlife); ground activities such as resource inventories, paleontological excavations, and research and recreational camps (hunting and river floating); seismic exploration; and overland moves. Overland moves and seismic operations occur during the winter on stable sea ice or frozen tundra. The other activities take place in summer and early fall (June-September). The primary potential causes of disturbance of marine mammals are helicopter traffic (1-2 round trips/day for 3-6 weeks/survey party), fixed-wing aircraft traffic (2/week/party), and humans on foot. These activities, if they occur along the coast of the planning area, may cause short-term (<1 hour) displacements or harassments of hauled-out seals and polar bears.

It is assumed that geophysical surveys would use 60 persons and would collect 5 to 10 line miles of 2-D seismic data/day and would be conducted entirely in winter (early December-mid-April). Under Alternative A, seismic surveys conducted near the coast could expose a few denning polar bears to seismic-activity noise and associated disturbances. This activity could result in the displacement of a few maternal polar bears and their cubs, leading to the abandonment of the den site and possible loss of a small number of cubs. Few polar bears are expected to be affected, however, because of the low number of recorded maternal den sites in and adjacent to the planning area (Fig.

III.B.5.b). Seismic surveys also would be prohibited near known polar bear den sites in the planning area (see Effectiveness of Stipulations, below).

Onshore seismic activity is not expected to have any effects on other marine mammals. Ringed seals den during the winter; however, denning ringed seals are not expected to be exposed to the noise and activity associated with onshore seismic operations, because their denning habitat is located in the floating-fast ice zone generally some distance offshore.

Overland moves typically occur each winter, travel from Prudhoe Bay or Oliktok Point to Barrow, follow a route offshore over stable sea ice, and include 20 to 100 trains of 1 to 6 vehicles and attached sleds. These moves could be a disturbance to denning ringed seals, if the routes cross floating fast-ice areas, and may temporarily displace seals within a short distance of the traffic route. Polar bears also may be temporarily disturbed within about 1 mi of this traffic.

Recreational camps in some cases may attract bears, and this could result in the shooting of bears that learn to associate humans with food sources. Such losses by themselves are expected to be minor or insignificant to the bear population but will contribute to cumulative adverse effects.

Very small fuel spills (probably <1 bbl) are expected to occur in association with resource inventories and surveys, recreational activities, and overland moves. These spills are likely to involve aviation fuel and other light-fraction hydrocarbon fuels that would evaporate and disperse rapidly with only local effect on vegetation. Fuel spills are required to be cleaned up immediately, if possible, under current BLM stipulations. Such events are not expected to have any significant effects on marine mammals in the planning area.

Conclusion: The effects of Alternative A, other than seismic operations, on marine mammals, particularly polar bears and seals, along the coast of the planning area are expected to be local and to occur within about 1 mi of resource-inventory-survey activities, survey and recreational camps, and overland moves. These effects are expected to be short term, with no significant adverse effects on the populations as a whole. Seismic operations occurring near the coast could disturb a few polar bear dens, displacing the bears, and may adversely affect the survival of cubs; however, this level of effect is not likely to be significant to the population.

Effectiveness of Stipulations: Current management practices and stipulations developed through the permitting process and attached to land use authorizations for temporary facilities, overland moves, seismic operations, and recreational operations are adequate to protect terrestrial mammals. Specifically, Alternative A-E stipulations to prohibit overland moves and seismic activity near known polar bear dens is expected to reduce disturbance of female bears and their cubs that may be denning in the planning area. However, because the locations of dens vary from year to year, it is possible that a few dens could be disturbed by overland moves and seismic operations that occur near the coast.

The stipulation on aircraft to maintain a 1,000-ft AGL (except for takeoffs and landings) may reduce any disturbance of spotted seals hauled out along the Colville River delta or ringed or bearded seals hauled out on the fast-ice along the coast.

10. Endangered and Threatened Species:

a. Consultation Assumptions: The endangered bowhead whale and the threatened spectacled and Steller's eiders may occur seasonally in or adjacent to the planning area and may be exposed to activities associated with the management plan. Such activities, particularly oil and gas exploration and development/production activities and aircraft traffic associated with wildlife studies, may result in noise and disturbance, altered habitat, and spilled oil or other contaminants and could adversely affect the behavior, distribution, and abundance of individuals or populations occurring in or adjacent to the planning area.

Sections 4(d) and 9 of the Endangered Species Act (ESA), as amended, prohibit taking of listed species of fish and wildlife without a special exemption. "Take" is defined as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. "Harass" is further defined as an intentional or negligent act or omission that creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behaviors that include, but are not limited to, breeding, feeding, or sheltering. "Harm" is further defined as an act that may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering.

In accordance with the ESA, Section 7, regulations governing interagency cooperation, BLM notified the Fish and Wildlife Service (FWS) by letter dated May 6, 1997, of the listed and proposed species to be included in a Biological Evaluation for Section 7 consultation for the IAP/EIS. The National Marine Fisheries Service (NMFS) was requested by letter dated May 6, 1997, to notify BLM of any listed or proposed species or critical habitat that may be present in or affected by oil and gas exploration

activities in the proposed lease-sale area. The NMFS responded by letters dated May 23, June 10, and June 26, 1997, confirming the endangered bowhead whale as the species to be included in the evaluation for the planning area and referenced additional species that could be affected along marine-transportation routes in the Gulf of Alaska/U.S. West Coast. As discussed below, potential effects on a number of species along the marine-transportation routes in the Gulf of Alaska/U.S. West Coast were analyzed in previous biological evaluations and are incorporated herein by reference. The potential effects on species of endangered and threatened salmon, endangered cutthroat trout, endangered and threatened steelhead Evolutionary Significant Units (ESU's), steelhead ESU's that are proposed to be listed, and steelhead ESU's that are listed as candidate species are discussed in Section IV.C.10 (Alternative B). The FWS responded on July 2, 1997, confirming the threatened spectacled eiders and Steller's eiders as the appropriate species to be discussed in the evaluation and referenced additional species that could be affected along marine-transportation routes in the Gulf of Alaska/U.S. West Coast.

Analysis of oil-spill risk on species along marine-transportation routes in the Gulf of Alaska/U.S West Coast, particularly the southern sea otter and marbled murrelet, can be found in the Cook Inlet Planning Area Oil and Gas Lease Sale 149 Final EIS (USDOI, MMS, Alaska OCS Region, 1996b), which is incorporated here by reference and summarized. The Final EIS discusses potential effects of an oil spill on these species as a result of tankers transporting oil from the Cook Inlet lease-sale area to California ports. Potential effects include impairment of their insulative capabilities, resulting in hypothermia; inflammation/lesion of sensitive tissues following oil contact; tissue or organ damage from ingested oil; and emphysema from inhaled vapors. Potential indirect effects from an oil spill include a reduction in available food resources due to mortality or unpalatable prey organisms. Mortality of southern sea otters resulting from any spill of oil (estimated probability of occurrence is 6% in the potentially affected area) tankered from the Cook Inlet area to southern California is expected to be moderate (an estimated 23 individuals) with an estimated 1-year-recovery time (<1 generation), although conditions prevailing at the time of a spill could cause much greater mortality to occur. Mortality of marbled murrelets resulting from any spill of oil (estimated probability of occurrence is 6% in the potentially affected area) tankered from the Cook Inlet area to northern California is expected to be high (estimated 30-144 individuals, 2-9% of the California population), with an estimated 3- to 15-year (2-8 generations) recovery time.

The analysis of oil-spill risk on species along transportation routes to ports in the Far East, including the threatened Aleutian Canada goose, threatened Steller's eider, endangered short-tailed albatross, threatened Steller sea lion, and several species of endangered whales, can be found in the Beaufort Sea Planning Area Oil and Gas Lease Sale 144 Final EIS (USDOI, MMS, 1996a), which is summarized and incorporated here by reference. In Alaskan waters, the probable oil-tanker route lies seaward of the 200-mi Economic-Exclusion-Zone boundary except in the northcentral Gulf of Alaska, where it exits Prince William Sound. Oil spilled along most of this route would tend to be moved parallel to the Alaska Peninsula and Aleutian Islands, particularly by the Alaskan Stream, rather than toward the coast, where vulnerable populations might be contacted. Oil spilled from a tanker soon after exiting Prince William Sound could contact the Kodiak and Alaska Peninsula areas. Aleutian Canada geese, which nest in the Aleutian and Semidi Islands, do not appear to spend significant time in marine habitats during the breeding period, suggesting little risk of oiling from a tanker spill. However, occasional sightings of this goose in the Kodiak area during the spring-migration period, and the presence of Steller's eiders during the winter season in coastal areas from the eastern Aleutian Islands to Cook Inlet, suggest that small portions of these populations could be vulnerable to a spill in the northern Gulf of Alaska during the spring and winter, respectively. Because short-tailed albatrosses are rare anywhere outside the breeding area south of Japan, it is unlikely that significant numbers would be contacted by a spill along the tanker route. Rookeries and haulouts of Steller sea lions are scattered from Prince William Sound to the western Aleutians. Sea lion pups are more vulnerable than juveniles and adults but remain at the rookery and are not likely to be oiled directly. Several species of endangered whales also occur in waters adjacent to the route, but they are not likely to experience any mortality from exposure to spilled oil. It is anticipated that most of the oil produced as a result of lease sales in Alaska will be shipped to southern ports rather than to Far East ports. Overall, for the reasons listed above, the effects on the listed species are expected to be minimal.

The following analysis of potential effects was extracted from pertinent sections of the Biological Evaluation for Endangered and Threatened Species with Respect to the Proposed Northeast NPR-A Lease Sale (included as Appendix C of this EIS).

b. Ground-Impacting Activities: Ground-impacting-management actions within the planning area that may affect bowhead whales and spectacled and Steller's eiders under Alternative A include aerial surveys (including that of wildlife) and ground activities such as hazardous- and solid-material removal and remediation, which occur during the summer/early fall. Overland moves and seismic activities, which occur during the winter on ice roads or frozen tundra, are discussed but are unlikely to have an effect on these species. A more detailed

discussion of all of the actions is found in Section II. No oil and gas lease sale would occur under Alternative A.

(1) Effects on the Bowhead Whale: Bowhead whales may be present in the area offshore of the planning area primarily from August through October during their fall migration from Canadian waters back to wintering areas in the Bering Sea. Under Alternative A, bowhead whales are not likely to be affected by activities associated with the management plan.

(2) Effects on the Spectacled and Steller's Eiders: Spectacled and Steller's eiders may be adversely affected by activities associated with the IAP. In the planning area, spectacled eiders are most abundant in the vicinity of Teshepuk Lake. Most nesting in the planning area occurs within 30 km of the coast in the Teshekpuk Lake area. The highest densities of nesting spectacled eiders in the planning area occur in the Spectacled Eider Breeding Range LUEA (Spectacled Eider LUEA) to the north, west, and east of Teshekpuk Lake (Fig. II.B.3). Postbreeding male spectacled eiders leave the planning area by late June. Females are present in the breeding area from May to September. Females with young typically are found offshore later, when the ice usually is farther from the coast (Petersen, 1997, pers. comm.). Steller's eiders are relatively sparsely distributed throughout the planning area and are essentially absent from the area from late October to May. Males leave the nesting areas in late June to early July. Females with broods are present in the breeding area from early June to late August or early September. A discussion of potential effects on spectacled and Steller's eiders follows.

(a) Effects of Noise and Disturbance: Human-induced noise and activities and human presence may result in disturbance of spectacled and Steller's eiders in the planning area. Noise-producing activities, including aircraft traffic and hazardous- and solid-material removal and remediation, are the activities most likely to affect spectacled and Steller's eiders. Overland traffic and seismic surveys also are discussed but are not likely to affect eiders.

1) Effects from Aircraft Activities: Aircraft will be used to support activities associated with the management plan. Both fixed-wing aircraft and helicopters would be used to transport people, supplies, and equipment for fieldwork and to fly aerial surveys. Light helicopters are commonly used, and medium helicopters and fixed-wing planes are occasionally used. Helicopters normally fly low and slow, whereas fixed-wing aircraft usually fly higher and faster. Almost all aircraft activity would be in the summer. Aircraft likely will fly over nearly all of the planning area, but many flights apparently will be over waterfowl habitat areas in the lake areas to the north, west, and east of Teshekpuk Lake. Some flights, such as point-to-point flights and other aerial surveys, will be flown occasionally. Aerial wildlife surveys, some of which may be low-level flights, are conducted during a 14-day period from late June into early July over caribou and waterfowl areas (Table II.D.3). Helicopters may be used during some of the studies, such as collaring caribou in the lake areas to the north and east of Teshekpuk Lake.

Summertime aircraft flights over onshore areas of the planning area, especially to the north, west, and east of Teshekpuk Lake, may affect nesting females and their broods. The lake areas to the north, west, and east of Teshekpuk Lake are very important areas for waterfowl during the summer months. The highest densities of spectacled eiders in the planning area may use some of these lakes and other habitat in the area for breeding, nesting, and rearing their young. Some Steller's eiders also may use some of these lakes and other habitat in the area and may be affected by these activities. These are areas where helicopters will be used during some of the studies, such as collaring caribou. Both helicopters and fixed-wing aircraft may be used in this sensitive area for aerial wildlife surveys for other survey activities.

Under Alternative A, a substantial portion of spectacled eider LUEA to the north, west, and east of Teshekpuk Lake may be affected by aircraft activities. Balogh (1997) indicated that fixed-wing aircraft flown at an altitude of 150 ft often cause spectacled eiders to flush, although helicopters flown at similar altitudes around Prudhoe Bay do not cause them to flush. Reactions of eiders to aircraft are not well understood. Nests are regularly located in a wetland within 1 km of the Deadhorse Airport (TERA, 1995), and a nest was located <250 m from the Deadhorse runway (Martin, 1997), indicating that some individuals are tolerant of aircraft activity in the vicinity of nests. Behavioral reactions of prenesting birds to aircraft overflights may not be representative of behavior of incubating or broodrearing birds. It is possible that some eiders may be disturbed by these activities and may experience temporary, nonlethal, effects probably lasting less than an hour. It is possible that some displacement of nesting eiders along flight-survey routes near airstrips could occur as a result of the numerous aircraft overflights and landings in the sensitive areas. Relatively few nest sites are expected to be affected, because spectacled eider nest sites are scattered at relatively low density over much of the northern portion of the planning area and at even lower densities in the rest of the planning area. Steller's eiders in other portions of the planning area are less likely to be affected by aircraft flights, because fewer flights are likely to be conducted in those areas, and Steller's eiders are present at low densities. Disturbance of some individuals over the life of the project is expected to be

unavoidable. Disturbance, depending on its nature and duration, could be considered a "take" under the ESA.

2) Effects from Hazardous- and Solid-Material Removal and Remediation: There are three phases to addressing hazardous and solid materials in the planning area—site characterization, removal, and remediation. Site characterization involves access with small helicopters and fixed-wing aircraft. The effects of aircraft disturbance on eiders was discussed previously. Removal and remediation involves activity on the ground at the location. Drill rigs, hydropunches, or backhoes are used to determine and assess the nature and extent of contamination of the site. These activities may continue for as long as 3 to 4 weeks. Because these activities are conducted during the summer months, they could cause disturbance to eiders that are breeding, nesting, or rearing young in the area and may displace a few eiders. Disturbance of eiders due to cleanup activities is likely to be limited to within a few kilometers of the activities but could continue for as long as 4 weeks.

3) Effects from Overland Moves: The BLM issues permits to authorize overland moves. Overland moves typically are conducted from Prudhoe Bay or Oliktok Point during the winter between December and April. There should be no effects on spectacled and Steller's eiders as a result of overland moves.

4) Effects from Seismic Activities: Some 2-D seismic exploration will occur in alternate winter seasons under Alternative A, even though oil and gas leasing would not occur. No 3-D seismic is anticipated. No effects on spectacled and Steller's eiders are expected to occur as a result of seismic surveys, because seismic activities would occur during the winter.

Summary: Under Alternative A, bowhead whales are not likely to be affected by activities associated with the management plan. Spectacled and Steller's eiders are not expected to be affected by seismic surveys or overland moves, both of which will be conducted during the winter. However, some eiders may be affected by activities associated with hazardous and solid material removal and remediation. These activities may continue for as long as 4 weeks. Also, summertime aircraft flights over these sensitive areas may affect nesting females and their broods. Eiders breeding, nesting, or rearing young in coastal habitats north, west, and east of Teshekpuk Lake may be overflown by aircraft (both helicopters and fixed-wing) on a regular basis during the summer months and may experience temporary, nonlethal effects, probably lasting less than an hour. Due to the relatively low density of eiders in the area, substantial disturbance is not expected to occur; and any disturbance is likely to be limited to within a few kilometers of the activities. Such short-term and localized disturbances are not expected to cause significant population effects. However, disturbance of some individuals over the life of the project is expected to be unavoidable. Disturbance, depending on its nature and duration, could be considered a "take" under the ESA.

Conclusion: Bowhead whales are not likely to be affected by activities associated with the management plan. Overall, the effects on spectacled and Steller's eiders exposed to noise-producing activities are expected to be minimal. Eiders breeding, nesting, or rearing young in coastal habitats or other areas within the planning area may be overflown by support aircraft and may experience temporary, nonlethal effects, probably lasting less than an hour. Eiders affected by activities associated with hazardous- and solid-material removal and remediation may be affected for as long as 4 weeks. Because of the relatively low density of eiders in the planning area, substantial disturbance is not expected to occur and is likely to be limited to within a few kilometers of the activities. Such short-term and localized disturbances are not expected to cause significant population effects. However, disturbance of some individuals over the life of the project is expected to be unavoidable. Disturbance, depending on the nature and duration of the disturbance, could be considered a "take" under the ESA. Seismic activities are unlikely to have an impact on threatened and endangered species.

Effectiveness of Stipulations: Current management practices and stipulations developed through the permitting process and attached to land use authorizations for temporary facilities, overland moves, seismic operations, and recreational operations, are adequate to protect endangered and threatened species with the exceptions noted below. No stipulations are anticipated to protect bowhead whales. Section II.C.7 contains a list of stipulations proposed by BLM to protect various waterfowl species from various activities in the planning area. Stipulations included under several categories, such as solid- and liquid-waste handling, hazardous-material disposal and cleanup, overland moves and seismic work, ground transportation, orientation program, aircraft traffic, and other activities should provide adequate protection to eiders from some activities. However, noise and disturbance from aircraft traffic associated with activities other than oil and gas, such as aerial wildlife surveys and other aerial surveys conducted in the lake areas to the north, west, and east of Teshekpuk Lake, have the potential to affect breeding and nesting eiders, because several of the aircraft stipulations pertaining to flight-timing restrictions apply only to oil and gas activities and/or do not apply to Alternative A. Therefore, the stipulations associated with flight-timing restrictions of aircraft probably are not adequate to protect spectacled eiders and Steller's eiders from aircraft disturbance associated with aerial wildlife

surveys and other surveys conducted in the lake areas to the north, west, and east of Teshekpuk Lake. Steller's eiders in other portions of the planning area are less likely to be affected by aircraft flights, because fewer flights are likely to be conducted in those areas. Disturbance of some individuals over the life of the plan is expected to be unavoidable.

11. Economy:

a. Activities Other Than Oil and Gas Exploration and Development: For Alternative A, a 2-D seismic-survey party of approximately 50 persons would work for 4½ winter months, generating 50 jobs for 4½ months. Employment in the recreation field would be generated by 14 float-trip parties of 1-week's duration each per year (Table II.H.3.b), which is equal to one person working for 4 months each year.

b. Oil and Gas Exploration and Development Activities: For Alternative A, there would be no economic effects.

Conclusion: For activities other than oil and gas exploration and development for Alternative A, generating approximately 50 jobs for 4½ months associated with seismic surveys and recreation-field employment, which is equal to one person working 4 months per year. For oil and gas exploration and development activities for Alternative A, there would be no economic effects.

Effectiveness of Stipulations: Stipulations do not change potential economic effects.

12. Cultural Resources:

Cultural resources (the physical remains resulting from the activities of historic or prehistoric humans) are nonrenewable. Once they are adversely impacted and/or displaced from their natural context, the damage is irreparable.

Under Alternative A, there are three types of activity that have the potential for causing measurable impacts on cultural resources—overland moves, seismic data-gathering, and excavation and collection. Because the first two activities normally occur between November and May when the ground is covered with snow and deeply frozen, any subsurface (buried) cultural material usually is safe from disturbance. In locations where cultural material is exposed on the surface of the ground beneath the snow, some minor impact may occur and some material may be slightly displaced from its context, if equipment traverses or operates directly over the cultural material. At greatest risk are cultural resources that are composed of aboveground structures such as cabins, sod houses, caribou corrals, cairns, drying racks, kayak templates, etc. Aboveground structures receive little natural protection from snow or frozen ground and indeed often are hidden from sight by snowfall, making them difficult for equipment operators to see (L. Lampe, as cited in USDOI, BLM, 1997a).

Excavation and collection normally occurs during the summer and usually is the result of archaeological research, although the process is sometimes associated with geologic fieldwork. When an archaeological site is excavated, it is destroyed. Therefore, archaeological excavation and collection is the ultimate destructive impact on cultural resources, although the process is the most common mitigative technique when cultural resources are threatened and avoidance is not an option. Archaeological excavation usually is conducted as either a means of obtaining information for scientific purposes or for documenting the information in a site prior to its destruction by development activities or natural forces.

The temporary summer field camps commonly associated with scientific or resource assessment work generally impact only a relatively small area. Therefore, such camps and the activities that are associated with them, such as aircraft use, on-the-ground survey/reconnaissance, hazardous- and solid-material removal and site remediation, and recreation, are not expected to have any significant effect on cultural resources.

Conclusion: Under Alternative A, impacts to cultural resources would result from management activities other than oil and gas exploration (except seismic activity) and development. Impacts would include displacement and/or destruction of resources and will be minimal. Adopting the no-seismic option would reduce these impacts slightly, because aboveground structures would be at reduced risk.

Effectiveness of Stipulations: Because Alternative A does not allow leasing, exploration (other than seismic), or development, the current EA review and clearance process and the "standard" stipulation (#79) attached to all Land Use Authorizations issued for the NPR-A, accompanied by irregular surveillance, generally is adequate to protect cultural resources. This is done through a site-specific examination and/or assessment process initiated only after a specific locale of activity, e.g., proposed surface-disturbing activity, has been identified. As a result of this process, the presence or absence of cultural resources can be determined and potential impacts, if any, identified and mitigated. Following site-specific identification of potential impacts, appropriate consultation with the State Historic Preservation Officer (SHPO) and, if necessary, the Advisory Council on Historic Preservation, will occur. This assessment and mitigation procedure usually occurs at the permit level of activity rather than the EIS level. In addition, Sections 106 and 110 of the National Historic Preservation Act, E.O. 11593, consultation with the SHPO,

and input from the North Slope Borough Commission on Inupiat History, Language, and Culture also provides guidance for assessment and protection of cultural resources within the NPR-A.

13. Subsistence-Harvest Patterns: This discussion is concerned with subsistence resources and subsistence-harvest patterns of Native communities adjacent to the NPR-A that could be impacted by ground-management actions from the IAP/EIS. These communities are Barrow, Atqasuk, and Nuiqsut. Under Alternative A, no oil and gas leasing would occur, and the current BLM management regime would continue.

The primary subsistence resources and aspects of subsistence-harvest patterns covered in this analysis are (1) a heavy reliance on caribou and fish (and bowhead whales in Barrow and Nuiqsut) in the annual average subsistence harvest for all three villages; (2) the subsistence-harvest areas for Barrow, Atqasuk, and Nuiqsut overlap for many species harvested by these communities; (3) subsistence hunting and fishing are cultural values that are central to the Inupiat lifeway and culture; and (4) the need to guarantee healthy populations of these resources for local subsistence needs. For a more in-depth discussion of the parameters for subsistence-harvest patterns impact analysis, see the discussion for Alternative B (Sec. IV.C.13).

a. Ground-Impacting Activities:

(1) Effects of Disturbance: Ground-impacting-management actions within the planning area that may affect subsistence harvests under Alternative A include aerial surveys (including that of wildlife) and ground activities such as seismic surveys, resources inventories, paleontological and cultural excavations, research and recreational camps and overland moves—all of which occur during summer-early fall (June-September), except for overland moves and seismic activity, which occur during winter. The primary potential causes of disturbance are helicopter traffic, fixed-wing aircraft traffic, and humans on foot. Hazardous- and solid-waste removal and remediation would continue to occur at abandoned USGS/Husky exploration drill sites. As these are normal activities under the existing BLM management regime, little net change is expected in disturbance effects to subsistence resources and the communities nearby the planning area.

(2) Effects of Spills: Because there would be no oil and gas leasing under Alternative A, only potential oil spills from fuel storage at construction sites and camps could occur, but the size of such spills is likely to be small (a few barrels) and areal contamination small. Cleanup activity is not likely to cause great disturbance to normal subsistence-harvest activities or the surrounding environment.

b. Effects on Subsistence Species: Effects from seismic surveys on most overwintering fish are expected to be short term and sublethal and have no measurable effect on arctic fish populations. Disturbance effects to bird populations from ground transport, seismic surveys, and aircraft activity are expected to be localized from 100 yards to 0.6 mi form the disturbing activity and temporary (<1 day for aircraft overflights to several months for extended ground-transport activities). Recovery of lost bird productivity and recruitment is expected to require one breeding season or less. Disturbance effects on terrestrial mammals—caribou, muskoxen, moose, grizzly bears, wolves, wolverines, and arctic foxes—are expected to be local (within about 1-2 km of activities) and local, with no adverse effects on mammal populations. Similar effects are anticipated for marine mammals. Impacts from ground-disturbance activities and oil spills on local subsistence harvests of fish, birds, terrestrial mammals (especially caribou), and marine mammals are expected to be negligible.

c. Effects on Communities: Effects to the communities of Barrow, Atqasuk, and Nuiqsut from impacts to subsistence resources and subsistence-harvest patterns from ground-disturbance activities and oil spills are expected to be negligible. Because the impacts on subsistence species are negligible, there would be no impacts on subsistence users outside the region.

Conclusion: Impacts, other than seismic activity, under Alternative A on subsistence resources range from negligible effects on fish and bowhead whales to short term and local effects on caribou and other terrestrial mammals, birds, and marine mammals. Impacts with seismic activity could displace a few polar bears in dens and affect cub survival but not have a significant effect on the bear population. Short-term and local effects would be expected on caribou and other terrestrial mammals and birds; negligible effects would be expected on arctic fish populations and bowhead whales. Subsistence resources of the communities of Barrow, Atqasuk, and Nuiqsut could be affected periodically from ground-disturbance activities (other than seismic activities) and oil spills, but there would be no apparent effects on subsistence activities.

Effectiveness of Stipulations: Stipulations for general disturbance, general damage, and the chasing of wildlife as well as the wildlife stipulations for polar bears, caribou, and birds appear to afford effective subsistence-resource protection for a no-action alternative. Other stipulations articulate minimum protection against impeding subsistence pursuits as set down in ANILCA (P.L. 96-487).

14. Sociocultural Systems: This discussion is concerned with those communities that could be impacted by ground-management actions from the IAP/EIS—Barrow, Atqasuk, and Nuiqsut. Under Alternative A, no oil and gas leasing would occur, and the current BLM management regime would continue.

The primary aspects of the sociocultural systems that could be impacted are (1) social organization and (2) cultural values, as described in Section III.C.4. For a more in-depth discussion of the parameters for sociocultural-effects analysis, see the discussion for Alternative B (Sec. IV.C.14).

a. Ground-Impacting Activities:

(1) Effects of Disturbance: Ground-impacting-management actions within the planning area that may affect sociocultural systems under Alternative A include aerial surveys (including that of wildlife) and ground activities such as seismic surveys, resources inventories, paleontological and cultural excavations, research and recreational camps and overland moves—all of which occur during summer-early fall (June-September), except for overland moves and seismic activity, which occur during the winter. The primary potential causes of disturbance are helicopter traffic, fixed-wing aircraft traffic, and humans on foot.

Hazardous- and solid-waste removal and remediation would continue to occur at abandoned USGS/Husky exploration drill sites. As these are normal activities under the existing BLM management regime, little net change is expected in disturbance effects to subsistence resources and the communities nearby the planning area.

(2) Effects of Spills: Because there would be no oil and gas leasing under Alternative A, only potential oil spills from fuel storage at construction sites and camps could occur, but the size of such spills is likely to be small (a few barrels) and areal contamination small. Cleanup activity is not likely to cause great disturbance to normal subsistence-harvest activities or the surrounding environment.

b. Population and Employment: With no oil and gas leasing under this alternative, NSB and community population and employment would not be affected and would be expected to grow at normal rates without any additional industry-related employment or population increases.

c. Subsistence-Harvest Patterns: With no oil and gas leasing under this alternative, impacts on subsistence resources would be negligible, and subsistence harvests would continue without industry-related disturbances. The lack of seismic activity could potentially reduce disturbance to overwintering caribou. Short-term, local effects on caribou, muskoxen, moose, grizzly bears, wolves, wolverines, and arctic foxes within 1 to 2 km of resource-inventory survey activities, survey and recreational camps, and overland moves are expected, but they would have no significant adverse effects on these populations. Similar effects from the same sources would be anticipated for polar bears and seals. Disturbance to eiders and other waterfowl from hazardous- and solid-waste removal and remediation activities and survey flights of fixed-wing aircraft and helicopters could have short-term, localized effects.

d. Effects on Barrow, Atqasuk, and Nuiqsut: Impacts from ground-disturbance activities (with or without seismic activity), oil spills, changes in population and employment, and changes to subsistence-harvest patterns on the sociocultural systems of the communities of Barrow, Atqasuk, and Nuiqsut are expected to be negligible, because there would be no oil and gas leasing and no net change in BLM management practices in the NPR-A under Alternative A.

Conclusion: Because there would be no increase in effects to the sociocultural systems of Barrow, Atqasuk, and Nuiqsut from this no-action alternative, impacts are expected to be negligible.

Effectiveness of Stipulations: Stipulations for general disturbance, general damage, and the chasing of wildlife as well as the wildlife stipulations for polar bears, caribou, and birds appear to afford effective subsistence-resource protection for a no-action alternative. Other stipulations articulate minimum protection against impeding subsistence pursuits as set down in ANILCA (P.L. 96-487).

15. Coastal Zone Management: Under the Alaska Coastal Management Program (ACMP), coastal district enforceable policies and State standards for development and natural resource use and conservation within the coastal zone are identified. All activities either occurring within the coastal zone or that may reasonably be expected to affect coastal resources and uses must be conducted in a manner consistent with the ACMP. While Federal lands are defined as being outside the coastal zone, Federal activities and federally permitted activities are to be reviewed for consistency with coastal management programs to the extent practical.

Ground-impacting-management actions under Alternative A are associated with (1) aircraft use to transport personnel, supplies, and equipment for fieldwork and to fly aerial surveys; (2) excavation and collection of archaeological, paleontological, geological, and soil samples; (3) ground activities associated with aircraft use

and camps for field survey and recreational activities; (4) hazardous- and solid-material removal and remediation; (5) overland moves of equipment and supplies and seismic activities; and (6) recreational activities. Management actions do not include any oil and gas lease sales or other special-use designations. There are no significant activities planned under Alternative A that would result in conflict with existing coastal management policies within the planning area.

Although the NPR-A lies entirely within the boundaries of the NSB, Federal lands are not a part of the coastal zone and, therefore, not a part of the coastal district. Four North Slope villages (Barrow, Wainwright, Nuiqsut, and Atqasuk) are located within the NPR-A, with Nuiqsut being located within the planning area. Two other North Slope villages are located near the NPR-A (Point Lay and Anaktuvuk Pass), and their residents make extensive use of NPR-A land and resources. The enforceable policies of the NSB CMP have been incorporated within the zoning ordinance in Section 19.70.050. In areas subject to exclusive Federal jurisdiction, all uses and activities that affect the coastal area must be consistent to the maximum extent practicable with the NSB's approved Coastal Management Program. Therefore, those ground-impacting-management actions affecting subsistence and recreational uses and activities may apply.

Subsistence uses of the coastal resources in the NPR-A have been and will continue to be of the highest priority of the NSB Inupiat, given cultural and historic patterns of existence within NPR-A lands. Activities associated with Alternative A that may adversely affect subsistence activities, including hunting and fishing and resources as arctic fish, migrating birds, caribou, moose, and other fur-bearing animals, cultural and archeological resources, water quality, soils and vegetation, and recreation uses, are analyzed in Sections IV.B.1-14 and 16. Because there would be no oil and gas leasing and no net change in BLM management practices in the NPR-A under Alternative A, impacts from ground-disturbance activities associated with ground transport and seismic surveys in winter, effects of camp activities and aerial surveys, and small spill cleanup are expected to be temporary and minimal to negligible.

At the present time, seismic activities, if conducted as a stand-alone activity and not in conjunction with an exploration or development plan, do not require a separate consistency review under the ACMP and are covered under the State's General Concurrence "B list" of categorically approved activities.

Conclusion: There are no ground-impacting-management actions within the planning area that require coastal consistency reviews by the State, whether or not seismic activity is allowed.

Effectiveness of Stipulations: Under Alternative A, current BLM management practices, enforcement of stipulations (Sec. II.C.7.b) applicable to activities other than oil and gas, including water- resource protection and extraction, handling of solid and liquid wastes and disposals, general environmental and wildlife resource and subsistence protections stipulations (for general disturbance, general damage, and the chasing of wildlife as well as wildlife stipulations for polar bears, caribou, and birds), and land use authorizations issued in the planning area provide adequate protection to surface resources and subsistence-resource protection.

16. Recreation and Visual Resources: Under this alternative, most impacts to recreation and visual resources would result from on-the-ground management activities such as archeological collection efforts, field camps, survey work, and overland moves. Between June and September, three camp, survey, or collection efforts are anticipated at any one time. In winter months, several overland moves may occur during a single season.

Temporary structures (e.g., sleds, tents), vehicles (e.g., rolligons, tractors), noise from generators, aircraft, human presence, and associated activity all would have some minimal short-term impact on scenic quality, solitude, naturalness, or primitive/unconfined recreation. These adverse, short-term impacts would be confined primarily to the activity site viewshed (i.e., approximately ½ mi in any direction from the site) and are expected to affect no more than approximately 1,500 acres at a time.

A longer lasting impact would be "green trails" resulting from overland moves. Green trails are created by vehicles compacting snow and dead vegetative matter that, in turn, results in the greater availability of moisture and nutrients for underlying vegetation the following growing season. These trails do not necessarily develop over the entire route of an overland move but when they do, they can be very detectable from the air for 2 to 5 years and, in some cases, longer. They usually are difficult to recognize from the ground. Another impact along these trails that has occurred in the past is vegetation actually being damaged or broken or the tops of tussocks being scraped off. Current operating procedures make this an infrequent problem but one that can occur in conjunction with green trails (Sec. IV.B.6). Because overland moves are a relative constant year to year and generally follow the same route(s), approximately 100 mi of intermittent green trail (attributable to overland moves) will be visible from the air during any one summer season.

Although no oil and gas development would occur under current management, seismic-survey work would continue. This work would occur in winter using all-terrain ground vehicles supported by light aircraft. Seismic crews are

housed in mobile camps consisting of a train of trailer sleds pulled by tractors. These moving camps, associated noise (e.g., vehicles, aircraft), and activities would result in a short-term, adverse impact on scenic quality and a loss of solitude and naturalness. These impacts would be confined primarily to the activity-site viewshed, or approximately ½ mi in any direction. Assuming one seismic operation per season, seismic operations are expected to affect no more than approximately 500 acres at a time.

A longer lasting impact would be green trails resulting from seismic-survey operations. Unlike overland moves, seismic operations do not follow the same routes every year, and the number of miles of survey line run can vary greatly from year to year. In some years, no surveys would occur. As with green trails created by overland moves, these trails do not necessarily develop over the entire survey route and are visible for about 2 to 5 years and sometimes longer. Because of the many variables involved, it is difficult to make a reliable estimate as to the number of miles of green trail that would be visible during any one summer season as a result of seismic operations. However, given no more than one seismic operation a year, the number of miles of intermittent green trails visible from the air during any one summer season (from seismic operations) is estimated to be several hundred miles.

Impacts to Wild and Scenic River Values: Under Alternative A, outstandingly remarkable river values along the Colville would not receive any special protection under the Wild and Scenic Rivers Act (WSRA). However, under this alternative, no development is anticipated along the Colville River. Therefore, no impacts to outstandingly remarkable river values are expected.

Conclusion: Impacts to recreation and visual resources from activities other than oil and gas would be minimal and short term, affecting about 1,500 acres. Impacts from ongoing oil and gas activities (seismic surveys) also would be short term, affecting about 500 acres. Several hundred miles of green trails from overland moves and seismic surveys also would be visible during summer months.

Effectiveness of Stipulations: No Visual Management Classes are currently established. However, no permanent development is likely to occur under this alternative. Furthermore, current management practices and stipulations developed through the permitting process and attached to land use authorizations for temporary facilities, overland moves, and seismic operations are adequate to protect visual/recreation values.

C. ALTERNATIVE B: Alternative B would include BLM's management actions described for Alternative A and a proposal for making about 2.43 million acres of the Northeast NPR-A Planning Area available to oil and gas leasing. This alternative emphasizes protection of the area's resources by excluding oil and gas leasing in all the LUEA's defined in Section II except the Kuukpik Corporation Entitlement LUEA; leasing in this LUEA will be postponed until the corporation's entitlement has been satisfied. The status of the LUEA's for oil and gas leasing under Alternative B is shown in Table IV.C-1. Seismic activities would be permitted throughout the planning area. Applicable stipulations identified in Section II.C.7.b will be applied to this alternative. In addition, the alternative includes (1) recommending the Colville River be included as a "wild" river in the Wild and Scenic River System, (2) proposing a Bird Conservation Area that would incorporate part of the Colville River valley, (3) urging the creation of a Special Area designated by the Secretary of the Interior along the Ikpikpuk River to protect paleontological resources, and (4) recommending the addition of the Pik Dunes LUEA to the Teshekpuk Lake Special Area.

The types of activities that might impact the resources include those noted for Alternative A and those additional activities associated with oil and gas exploration and development. The level of activities other than oil and gas exploration and development would be similar to or slightly greater for Alternative B than for Alternative A (Table IV.A.1.a-1). The economically recoverable oil resources for the first oil and gas lease sale in the proposed lease-sale area are estimated to range from 65 to 350 MMbbl (Table IV.A.1.b-4). The activities associated with this resource estimate include drilling exploration (1-4) and delineation (0-6) wells and, depending on the economic viability of any discovery or discoveries, constructing 0 to 2 production pads, drilling 0 to 83 production and service wells, and constructing 0 to 75 mi of pipeline (Table IV.A.1.b-5). Pipelines would be permitted to cross all but the Potential Colville Wild and Scenic River LUEA. If the area available for oil and gas leasing under Alternative B results in multiple sales, 90 to 500 MMbbl of oil are estimated to be recovered (Table IV.A.1.b-6). The types of activities associated with multiple sales would be similar to those that might occur as the result of the first sale; the level of activities for multiple sales is shown in Table IV.A.1.b-7.

1. Soils: The types of activities that may affect soils under Alternative B include those analyzed under Alternative A and those resulting from oil and gas exploration and development.

a. Activities Other than Oil and Gas Exploration and Development: The effects of management actions described under Alternative B are similar to Alternative A, except there may be an increase in excavations of up to 2 acres per year (Sec. IV.C.6).

b. Oil and Gas Exploration and Development Activities: Those parts of the planning area subject to

Table IV.C-1
Land Use Emphasis Areas Status for Oil and Gas Leasing Under Alternative B[1]

Land Use Emphasis Area	Fig. No. II.B.	Oil and Gas Leasing Status
Teshekpuk Lake Watershed	1	Unavailable
Goose Molting Habitat	2	Unavailable
Spectacled Eider Nesting Concentrations	3	Unavailable
Teshekpuk Lake Caribout Habitat	4	Unavailable
Fish Habitat	5	Unavailable
Colville River Raptor, Passerine, and Moose Area	6	Unavailable
Umiat Recreation Site	8	Unavailable
Scenic Areas	9	Unavailable
Pik Dunes	10	Unavailable
Ikpikpuk Paleontological Sites	11	Unavailable
Kuukpik Corporation Entitlement	13	Leasing deferred pending completion of Kuukpik Corporation conveyance.
Potential Colville Wild and Scenic River	14	Unavailable

1. Section II.

these activities will have additional impacts on the soils. Sacrificing soils usually is part of development. Soils are destroyed through burial or truncation. Embankments such as work pads, camp pads, and roads made from sand, gravel, or rock fragments completely cover the natural soils. Digging, scraping, and excavation destroy the pedogenic horizons. Off-pad traffic (including foot traffic) and other surface-disturbing activities damage the vegetative cover and surface organic mat. Just as under Alternative A, the exposed mineral portion of the soils will erode. These activities also alter the thermal balance, and the risk of thermokarsting increases. Thermokarsts, gullies, and sediment impact other resources and land uses. Examples are difficult surface travel and access across gullies and thermokarsts. The amount of soil erosion increases with the amount of surface disturbance. Perhaps the most effective mitigation is to keep the areas of surface disturbance (i.e., alteration of the vegetative cover or damage to the surface organic mat) as small as possible. The aereal extent of soil disturbance, based on the estimated areal extent of vegetation destruction, should be similar to that discussed under Vegetation (Sec. IV.C.6).

Impacts to soils from spills and spill cleanup are based on the impacts to vegetation (Sec IV.C.6).

Conclusion—First Sale: Areas of impacts and losses of soils from all activities are similar to those areas discussed under Vegetation (Sec. IV.C.6). More site-specific conclusions will follow project design and detailed soil survey.

Multiple Sales: Additonal lease sales under Alternative B would result in additional exploration and development activities. The area of impacted soils is closely related to that of the disturbed vegetation (see Vegetation, Sec. IV.C.6, for acreage details). However, recovery of soils is much slower than recovery of vegetation—it may take centuries. Soil-forming processes are very slow at these low temperatures.

Conclusion—Multiple Sales: Areas of impacts and losses of soils from all activities in multiple sales are similar to those areas discussed under Vegetation (Sec. IV.C.6).

Effectiveness of Stipulations: The above analysis assumes that those stipulations identified in Section II.C.7.b would be implemented.

2. Paleontological Resources:

a. Activities Other than Oil and Gas Exploration and Development: Paleontological resources (plant and animal fossils) are nonrenewable. Once they are adversely impacted and/or displaced from their natural context, the damage is irreparable. Under Alternative B, the management-action impacts generally are the same as under Alternative A, except the intensity of the actions may increase due to potential oil and gas exploration.

b. Oil and Gas Exploration and Development Activities: Paleontological resources are not ubiquitous in the planning area as are wildlife and habitat, and their locations are much less predictable. As a result, it is quite possible that oil and gas exploration or development activities would have no impact on paleontological resources.

(1) Effects of Disturbance from Exploration: Under Alternative B, the level of activity in the planning area would increase. However, because most of the activity would occur during the winter months, the potential for impact to paleontological resources is extremely low.

Drilling 10 exploration/delineation wells is anticipated under Alternative B. Due to the limited availability of drill rigs, no more than two wells are expected to be drilled at one time. Drilling the 10 wells probably would occur over the span of several winter seasons, and drill pads, camp pads, roads, and airstrips made of ice and snow would be used. Because no permanent pads, roads, or airstrips would be constructed and, therefore, no significant disturbance of the ground would occur, buried paleontological resources would not be impacted. The only significant subsurface disturbance that would occur as a result of the actual drilling would be the drill hole itself. Drilling could impact significant accessible paleontological material, but the likelihood is minuscule.

(2) Effects of Exploration Spills: Sixty-five to 80 percent of all spills are confined to a pad. Spills not confined to a pad usually are confined to an area adjacent to the pad. Therefore, it is assumed that most spills would occur on an ice pad, ice road, or during winter conditions, where cleanup is less invasive than in a summertime terrestrial spill. In any case, paleontological resources usually are so deeply buried that they would not be affected by either a spill or spill cleanup.

(3) Effects of Disturbance from Development: The construction of two production pads (connected by a road), one airstrip, and 75 mi of pipeline is anticipated under Alternative B. Surface disturbance resulting from this work would impact approximately 100 acres, but there would be little subsurface impact associated with these activities. Additional disturbance could occur, depending on the source of the material used to construct the pads, etc. If the pad-material source is terrestrial, then extraction of material could impact paleontological resources. It is anticipated that the pipeline would not have an associated

all-weather road or pads and would be constructed during the winter months from an ice road and pads. Therefore, the only significant impact resulting from pipeline construction would be associated with the placement of vertical support members (VSM's). Depending on the depth at which the VSM's are set it is possible, but highly unlikely, that paleontological resources would be impacted. It is possible that a pump station would be necessary. A pump station would impact about 50 surface acres. The impacts associated with these types of activity have a very low probability of impacting paleontological resources.

(4) Effects of Development Spills: The effects of spills and spill cleanup associated with development would be similar to those associated with exploration activities.

Conclusion—First Sale: Under Alternative B, impacts to paleontological resources from management activities other than oil and gas exploration and development would be similar in nature to Alternative A. Impacts would include displacement and/or destruction of resources and will be minimal whether or not seismic is allowed. Under Alternative B, the potential impacts to paleontological resources from oil and gas exploration and development may be the same as or only slightly increased from the impacts from activities other than oil and gas under Alternative A.

Multiple Sales: Under Alternative B, potential impacts increase by a factor of two to four, depending on a suite of variables, including infrastructure. The scattered nature of paleontological deposits and the fact that the locations of most remain unknown, make it somewhat difficult to assess the likelihood and severity of potential impacts.

Conclusion—Multiple Sales: Under Alternative B, potential impacts to paleontological resources from management activities other than oil and gas exploration and development would be similar in nature to Alternative A, but the probability of impacts occurring might increase. Under Alternative B, the potential impacts to paleontological resources from oil and gas exploration and development would increase dramatically compared to Alternative A, because only seismic activities would be permitted under Alternative A.

Effectiveness of Stipulations: Stipulation 79 is adequate to protect paleontological resources in the NPR-A through the leasing process. However, any postleasing activity engaged in by the lessee will require an action-specific NEPA document tiered off this or other EIS's. The protection of paleontological resources in the planning area will follow the established and proven procedures developed by the BLM during the NPR-A exploration of the late 1970's and early 1980's.

3. Water Resources:

a. Activities Other than Oil and Gas Exploration and Development: Ground-impacting-management actions within the planning area that may affect water resources under Alternative B would be similar to those in Alternative A, except that the number and frequency of camps and moves would increase slightly. The increase would depend on management actions in land, water, and resource monitoring as related to leasing activities. Because Alternative B emphasizes protection of surface resources, the streams and lakes identified as critical habitat would be unavailable to leasing. Therefore, most of the camps would be outside of these critical habitat areas, though some resource inventory and monitoring camps and overland moves could occur through out the planning area.

b. Oil and Gas Exploration and Development Activities:

(1) Exploration:

(a) Drilling Wastes: The preferred and normal means of disposing of drilling wastes, including muds and cuttings, is reinjection into wells. Cuttings may be stored temporarily to facilitate reinjection and/or backhaul operations. Use of mudpits may be allowed by BLM's Authorized Officer (AO). If muds and cuttings are stored on the surface, sediments and other contaminants could be flushed into the watershed. The potential for this impact, however, would be reduced by requiring that wastes be stored in lined and bermed areas and disposed of prior to spring breakup.

(b) Disturbance: Seismic activities probably would increase slightly (Sec. IV.A.1.c) but still would occur seasonally at transitory locations, when snow is sufficient to cover the tundra and lakes and rivers are frozen (Sec. II. C.7, Stipulation 20). Because the proposed exploratory drilling would occur in the winter, the principal effects on water resources would be the construction of ice roads and pads. Construction of ice roads allows winter overland transport of the equipment and material used in exploration- and delineation-well drilling. Ice pads are constructed to support drill rigs and staging activities. While this is preferable to summer surface activities, the ice roads and pads require large quantities of water be available—an estimated 1.0 to 1.5 million gallons per mile of road and 0.5 million gallons per pad. Water supply for drilling as well as for camp use also will be significant, up to 1.6 million gallons per site (Sec. IV.A.1.b). Based on remote sensing (Mellor, 1987) and other surveys, a typical large tundra lake (about a mile or more long and >6 ft deep) used as a winter water source would probably have from approximately 20 to 40 million gallons available for

pumping, with the stipulation that drawdown is limited to 15 percent of the under-ice water depth (Sec. II.C.7, Stipulation 16). Water withdrawal from riverine pools is prohibited (Sec. II.C.7, Stipulation 16). Depending on the areas leased and number of exploratory wells drilled, annual water usage for exploration under Alternative B could vary considerably, as noted in Tables IV.C.3 and III.A.2.a-4. Because not all lakes have sufficient under-ice storage capacity, surface disturbing activities that exacerbate ice formation should be precluded. Removal or compaction of snow cover can increase the depth of freezing, greatly reducing the water quantity within a lake or pool. Altering travel to avoid crossing or clearing frozen lakes and augmenting snow cover by using snow fences would not only reduce ice buildup on lakes and rivers, but melted snow could be used in ice roads. Use of aggregate ice chips created from crushed lake ice could reduce water usage on ice roads but would greatly increase the depth of freezing in the lakes used in this process. Shallow ponds and lakes that normally would freeze to the bottom are a potential source for this ice aggregate.

After each season of use, ice roads are abandoned and allowed to melt when spring snowmelt begins. Stipulations (Sec. II.C.7.b, Stipulation 24) require that ice ramps or bridges that cross streams or lakes be removed or breached prior to spring breakup. While some ponding might occur during a rapid onset of snowmelt, melt-water channels would develop in the ice-road surface, similar to the melt-water channels that cut through naturally occurring river aufeis (overflow icing) and rapidly drain the impounded water (Sloan et al., 1975). Because the location of ice roads will be offset from year to year, the effects of these short-term impoundments should be negligible. Ice roads created to last several years have a greater impact on the underlying tundra mat, compacting and killing larger areas of vegetation (Walker, 1996). Because this could cause more thermokarst and subsequent drainage alteration, multiple-year ice roads should be avoided.

(c) Spills and Spill Cleanup: Under the proposed exploration activities, the most likely spill cleanup would involve refined-petroleum products, probably from fuel-storage areas or during use in the operations. The size of such spills is likely to be small. The types and amounts of spills estimated for this alternative are discussed in Section IV.A.2. Storage of fuel in lined and bermed areas and the onsite availability of absorbents and removal equipment will help ensure that the size of any area affected by a spill and cleanup efforts is kept to a minimum. Because Alternative B allows for the most restrictive leasing area and conditions, spills from exploration activities would be the least of the leasing alternatives considered in this IAP/EIS.

(2) Development:

(a) Effects of Disturbance: The proposed development would involve constructing ice roads to haul equipment and gravel for the construction of production pads, roads connecting pads, and landing strips. The gravel most likely would be extracted from existing borrow sites east of the NPR-A (Sec. IV.A.1.b). While this type of proposal will help minimize adverse effects, the potential impacts of oil and gas development on the water resources in the planning area may include disturbance of stream banks or shorelines and subsequent melting of permafrost (thermokarst), blockages of natural channels and floodways that disrupt drainage patterns, increased erosion and sedimentation, and removal of gravel and water from riverine pools and lakes.

1) Thermokarst: Thermokarst refers to ground subsidence that occurs when the removal of surface cover exposes ice-rich permafrost to a higher temperature regime and subsequent melting. Stream banks and lakeshores are particularly vulnerable to thermokarst, because the wave action of the water will accelerate the removal of the degrading protective cover. Fine-grained sediments are the most likely to contain ice-rich permafrost, resulting not only in extensive thermokarst but also in increased sediment erosion and changes to stream channel and bed morphology. With the exception of the Colville and Ikpikpuk rivers and the largest lakes, most of the streams and lakes in the planning area have banks or shorelines that consist largely of fine-grained sediments.

2) Drainage Disruption: Natural drainage patterns can be disrupted when activities or structures divert, impede, or block flow in stream channels, lake currents, or shallow-water tracks. Blockages or diversions to areas with insufficient flow capacity can result in seasonal or permanent impoundments. Diverting stream flow or lake currents also can result in increased bank or shoreline

Table IV.C.3
Estimated Number of Lakes Required For Exploration And Development

	Exploration			Development		
Alternative	Minimum	Mean	Maximum	Minimum	Mean	Maximum
A	0	0	0	0	0	0
B	0	1	4	0	1	5
C	0	2	4	0	2	6
D	3	4	5	3	4	8
E	3	6	10	3	6	15
Preferred	1	2	4	1	2	5

erosion and sedimentation as well as potential thermokarst. Proper siting and adequate design capacity of culverts, bridges, pipelines, and other structures will minimize drainage problems.

3) Erosion and Sedimentation: In addition to thermokarst and drainage alteration, erosion and sedimentation can be caused by construction activities or vehicular crossings, especially during periods of high stream flow or lake levels. Inadequate design or placement of structures, culverts, or bridges can alter natural sediment transport and deposition, creating scour holes or channel bars. Improper placement or sizing of gravel fill can result in erosion from pads or roadbeds adjacent to streams or lakes. Winter or low-water construction and transport activities and adequate armoring of fill will minimize erosion and sedimentation problems.

4) Gravel Removal: While much of the gravel used for the construction of permanent facilities will be obtained from permitted sites east of the planning area, some material sites may be required within the planning area. Improper siting of gravel-removal operations can result in changes to stream channel or lake configuration, stream-flow hydraulics or lake dynamics, erosion and sedimentation, and ice damming and aufeis formation. Locating gravel pits far enough away from streams and lakes to avoid breakup or storm flooding will greatly minimize these effects to water resources. While gravel sources are scarce in the planning area, sand and silt are more abundant. Composite or All Season pad designs, using a mixture of gravel, sand, and silt layered with styrofoam and geotextiles, significantly can reduce gravel requirements (Sec. IV.A.1.b).

5) Water Removal: Consumptive water use in the summer seldom is a problem on the coastal plain, as water generally is abundant. Exceptions would be in smaller coastal streams or most foothills streams during late summer, when shallow pools might be pumped dry. In the winter, however, all but the largest lakes and riverine pools are subject to dewatering if consumptive use is high. Depending on the areas leased and number of developmental wells drilled, annual water usage for developmental activities under Alternative B would vary considerably, as noted in Tables IV.C.3 and III.A.2.a-4, with the stipulation that drawdown is limited to 15 percent of the under-ice water depth (Sec. II.C.7.b, Stipulation 20). Removal or compaction of snow cover also can increase the depth of freezing, greatly reducing the water quantity within a lake or pool. Augmenting snow cover by using snow fences not only would reduce ice buildup on lakes and rivers, but melting snow also could be used as a supplemental water source.

(b) Spills and Spill Cleanup: Because Alternative B allows for the most restrictive leasing area and conditions, spills from exploration and delineation activities would be the least of the leasing alternatives; the effects of spills on water quality are analyzed in Section IV.C.4.

Under the proposed development activities, spills and spill cleanup would involve both crude oil and refined-petroleum products, probably from fuel-storage areas or handling operations. The types and amounts of spills estimated for this alternative are discussed in Section IV.A.2. Crude- oil-spill cleanup from production operations and pipelines is possible and could adversely affect streams and lakes. Spill cleanup in the watershed would involve containing the spill, diverting or isolating it within the waterbody, skimming off the oil, and treating the remaining oil-contaminated water and sediments. Prevention and rapid response with adequate removal equipment would minimize effects; spill-prevention and -response measures are described in Section IV.A.4.

Spills of chemicals and saline waters would be rapidly diluted in a large lake or river. In small lakes, tundra ponds, and shallow water tracks, spills could be pumped out or neutralized and then diluted with uncontaminated freshwater.

Conclusion—First Sale: The impacts of activities other than oil and gas exploration and development under Alternative B are expected to be similar to those under Alternative A. The potential long-term impacts of oil and gas development activities on the water resources in the planning area include disturbance of stream banks or shorelines and subsequent melting of permafrost (thermokarst) and blockages of natural channels and floodways that disrupt drainage patterns. The potential short-term impacts, primarily during construction, would increase erosion and sedimentation and water removal from riverine pools and lakes. While any surface-disturbing activity could affect water resources, the potential adverse effects of Alternative B, because it excludes the critical lake and river habitat from leasing, while significant, would be the least of all the leasing options.

Multiple Sales: While the effects of oil and gas exploration and development from multiple lease sales may be up to several times greater than a single sale, impacts would not necessarily go up proportionally. Indirect impacts, such as thermokarst and erosion and sedimentation due to channel alteration or gravel removal may not occur until many years after the original development. Shared use of infrastructure such as airfields, roads, camps, and pipelines, significantly could reduce the size of the impacted areas and adverse effects to the water resources. Where infrastructure is not shared, both long and short-term

impacts, as noted above, and recovery times would increase.

Conclusion—Multiple Sales: Adverse impacts from multiple lease sales may be up to several times greater than a single sale, while indirect impacts may take years to develop. Shared infrastructure could reduce the adverse effects to water resources of multiple lease sales, because combined facilities require less water for construction, maintenance, and camp use than separate, independent facilities.

Effectiveness of Stipulations: The stipulations that are effective in protecting the water resources under Alternative B are the same as described under alternative A. Also, measures that ensure proper site selection, design, and construction of structures located near or across lakes would minimize effects. In addition, measures that aid in the prevention of spills and require rapid cleanup response with adequate equipment in the event of a spill would be effective in minimizing impacts of oil and gas exploration and development activities.

4. Effects on Water Quality:

a. Activities Other Than Oil and Gas Exploration and Development:

As discussed under Alternative A, ground-impacting management actions other than seismic operations and other oil and gas activities would not impact water quality.

b. Oil and Gas Exploration and Development Activities:

(1) **Exploration:** Exploration activities within the planning area that may affect water quality under Alternative B are 2-D and 3-D seismic activity beyond that described under Alternative A, ice-road construction, pad construction, and drilling-fluid storage and disposal. Under this alternative, total acres with high damage to vegetation caused by seismic trails would be about 4 times that for Alternative A (see Sec. IV.C.6) and result in parallel 4-times-greater water degradation. That is, water quality would be degraded over perhaps an acre. Spillage is attributable predominantly to development activities, and a discussion of spillage is more appropriately deferred to the following analysis of development impacts.

Use of water for ice-road construction could affect water quality in four ways. Because ice roads would be rerouted every year to minimize tundra disturbance, effects on water quality from any of these mechanisms would be short term, lasting generally one season.

First, the winter extraction of water or ice from NPR-A waters could change the chemistry of those waters. Ice roads require 1.0 to 1.5 million gallons per mile of road, over tens of miles distance. Alternatively, ice chips from frozen lakes could be used in conjunction, lessening the demand for unfrozen water sources. Ice-road construction on the North Slope generally starts no sooner than December to ensure that the tundra is solidly frozen to avoid disturbance, and because ice building requires consistent, very cold temperatures. By December, shallow ponds and lakes, those less than about 3 ft deep, are frozen solid. Water would have to come from deeper lakes. Lakes ≤6 ft deep usually are frozen solid by the end of winter and, therefore, do not contain fish. Thus, ice-road builders could extract the maximum possible from such lakes, with perhaps extraction of most of about the 3 ft of water that would be left unfrozen by December in a 6-ft deep lake. Water could be extracted from deeper lakes, but these lakes are likely to contain fish, which would be put at risk from water removal. The amount of water that could be removed from fish-bearing lakes is limited by stipulation.

As NPR-A surface waters freeze, salts are excluded from the forming ice into the underlying water, increasing salinity. In coastal tundra waters, the alkalinity is associated with the salt content, and increases and decreases in alkalinity parallel those of salinity. Pumping water from a freezing lake would remove the more saline and more alkaline water from under the lake ice. During snowmelt, the removed waters would be replaced by less saline, less alkaline runoff water. In lakes ≤6 ft deep, which freeze to the bottom, the salts normally would be frozen out of the entire water column and extruded into the sediment thaw bulb underlying the lake. These salts are then only slowly and partially leached back into the water column the following summer. For such lakes, the early summer condition would be low salinity, low alkalinity water, regardless of whether or not water was removed for ice-road construction. These lakes are only weakly, but still apparently adequately, buffered against acid snowmelt based on observed lake pH's (Sec. III.A.2.b).

In lakes >6 ft deep, the salts and alkalinity excluded from ice formation normally would remain in the never-frozen bottom water. These lakes start the summer with more saline, relatively strongly buffered waters underneath the melting ice. Winter removal of more saline water underneath the ice would result in less saline, less buffered lake waters in early summer following winter water extraction. Thus, following winter extraction of water, their early summer chemistry would be more similar to that of lakes ≤6 ft deep.

A second way that ice-road construction could affect water quality would be road construction over lakes deep enough not to freeze to the bottom. Many of these lakes are only a foot to a few feet deeper than the minimum 6-ft depth

necessary to maintain some unfrozen bottom water in winter. An ice road across such an intermediate-depth lake would be designed to freeze the entire water column below the road, isolating portions of the lake basin and restricting circulation. With mixing thus reduced, isolated water pools with low oxygen could result. Dissolved oxygen concentrations could be reduced below the 5-ppm dissolved oxygen standard needed to protect resident fish (State of Alaska, ADEC, 1997).

A third way that ice-road construction could affect water quality would be through changes in water chemistry along the roadbed during and after meltout. As described above, the water withdrawn from lakes to construct the roadway is relatively saline, more saline than typical snowmelt waters. In addition, the salts frozen into the ice road would leach out of the ice prior to its melting during snowmelt, increasing initial salt content of the meltwater. This effect may be measurable during initial snowmelt, but the effect on water quality should be minimal and local, most likely expressed as a slight buffering of pH during initial snowmelt.

A fourth way that ice-road construction could affect water quality would be through modification of the local hydrology along the ice road. The minimum ice-road thickness would be 6 inches. Snow drifts against this low elevation would extend only a few feet beyond the road bed with average water content of only a fraction of an inch. However, the 6 inch roadbed would dam waters upslope of the roadway, affect local drainage, and restrict water supply downslope of the roadway. Because snowmelt runoff is in excess of coastal tundra dead-storage capacity (Miller, Prentki, and Barsdate, 1980), the restricted water supply on the downslope side of the ice road should have a very local but otherwise negligible effect.

In Prudhoe Bay, flat, thaw-lake plains have been shown to be the land classification most vulnerable to hydrologic effects of road and pad construction (Walker et al., 1987, 1989; Robertson, 1989). In such terrain, impoundments (ponding) and thermokarst along gravel roads and pads equally covered as much additional area as did the pads and roads, despite drainage culverts. Ice roads can persist through significant portion of the snowmelt period, for perhaps up to a month. However, their ability to impound upslope waters is negligible and any impoundments last only a few days (see Sec. IV.C.3). Because the 6-inch thickness of ice roads is only 4 to 10 percent of the 5- to 13-ft thickness of a gravel road, the impoundments upslope of an ice road should be proportionately less in area than for a gravel road, or ≤10 percent of the area covered by the ice road. Ecology of these less-persistent impoundments along ice roads should be a cross between those of wet tundra and ponded tundra, with no effect on water quality.

The thermokarst erosion along roads and pads at Prudhoe Bay was considered by Walker et al. (1987) to be a delayed, synergistic impact that occurred primarily on thaw-lake plains. It did not occur on river floodplains at Prudhoe Bay because of minimal ground ice. Thermokarst erosion was attributed to vegetative disturbance and to thermal effects of road dust, flooding, and flaring operations. Thermokarst effects are likely to be negligible for one-time use winter ice roads because of the lack of vegetative disturbance (see Sec. IV.C.6), the lack of road dust, and minimal upslope impoundment.

Use of water for construction, drilling, and domestic (crew) needs could affect water quality, as discussed for ice-road construction. Effects during exploration on water quality from any of these mechanisms would be short term, lasting generally one season.

For Alternative B, annual ice-pad and -road construction could cover about 310 acres during each year of exploration, assuming that ice-road length would be similar to the assumed connecting pipeline length for this alternative. This ice-road construction would require winter extraction of water that would affect up to 110 acres of intermediate depth (6-ft)—nearby lakes. Pad construction, drilling, and crew needs together would require water use equivalent to 2 acres of lake. The areas affected would shift each year as the ice roads are realigned and shifted to avoid continued compaction of vegetation. In the unsuccessful exploration scenario, ice-pad and -road construction would occur only in one winter. Temporary upslope impoundment of snowmelt waters could cover another 30 acres for a few days, but without effect on water quality.

The preferred and normal means of disposing of drilling wastes, including muds and cuttings, is reinjection into wells with no impacts to surface water quality. Mud pits and discharge of exploration drilling muds and cuttings will be prohibited. This analysis assumes direct reinjection of drilling fluids. Under this scenario, there likely will be no impact from drilling fluids used in exploration.

Nevertheless, cuttings may be stored temporarily to facilitate reinjection and/or backhaul operations and, in some cases, use of reserve pits may be allowed by BLM's Authorized Officer. Such establishment of temporary reserve pits could degrade nearby water quality. Elevated levels of trace metals in water (zinc and chromium) and sediments (copper, chromium, and lead) have been found in ponds at least as far as 700 ft from reserve pits elsewhere on the North Slope (Woodward et al., 1988). Elevated levels of petroleum hydrocarbons also were found in water and sediment in the same study. Waters from the reserve pits and some ponds within 160 ft but not at greater distances were found to be toxic to a sensitive zooplankton

species in bioassays. Spread of contaminants from these reserve pits was to overflow of the pits during snowmelt, the practice of draining the snowmelt overflow from pits on to the tundra, and to seepage.

Requiring the pits to be lined and bermed would not necessarily protect tundra from this contamination. Berms increase snow drifting, increasing the overflow problem. Historically, because clay is the standard liner for waste pits, the clay in drilling muds has been assumed on its own to be adequate as a pit liner. However, the chemical formulation of drilling muds is designed to keep the drilling mud dispersed, which can eliminate its ability to act as a seal. The potential for impact from pit-stored drilling fluids would be reduced, if fluids were properly disposed of prior to spring breakup.

(2) Development: There would be no development effects on water quality, if exploration efforts found no commercially recoverable oil. Under the high-resource scenario for this alternative, development would occur. Development activities within the planning area that may affect water quality under Alternative B for the high-resource scenario are ice-road and pad construction and spills. There will be no impact from drilling fluids used in development. Mud pits and discharge of drilling fluids and produced waters would only be allowed in emergencies. Muds and cuttings will be either disposed downhole or removed from public lands to ADEC-approved waste-disposal facilities. Produced waters will be reinjected. Some washed cuttings could be used in gravel-road or pad construction. Crude-oil and waterflood pipelines would be aboveground, and their construction and physical presence would have a negligible affect on water quality.

For Alternative B, because of the annual rebuilding of ice roads, annual water use during development would be similar to that for exploration, needing water to construct 300 acres of ice road, with the water being obtained from about 110 acres worth of intermediate-depth lakes. During the seasonal construction phase, annual field-water demand would be on the order of 37 acre-feet, requiring at least a surface water source of 12 additional acres. After major construction is finished, annual field-water demand would decrease to about 15 acre-feet/year, requiring water removal from only about a 5-acre source. Some of this water likely would come from lakes >6-ft deep, because shallower lakes freeze solid by late winter. The areas affected would shift each year as the ice roads are realigned and shifted to avoid continued compaction of vegetation.

Gravel construction of pads and within-field roads with airstrip would cover about a 100-acre footprint for a single field and require a million cubic yards of gravel. The preferred sources for gravel are existing borrow pits on the east side of the Colville River. In recent decades, suction dredges have been used in the NSB to mine sand and gravel from the Colville River Delta at Nuiqsut; the Meade and Kokolik rivers; lakes at Atqasuk and Barrow; and lagoons at Barrow, Wainwright, and Kaktovik (Walker, 1994). Dredged holes took a few to many years to refill. Dredging increased upriver-bottom erosion by steeping river slopes in the Colville River, but the primary environmental effect attributed to NSB dredging has been expansion of fish overwintering areas. Fish populations and, therefore, water quality do not appear to be adversely affected by this dredging activity (Walker, 1994). Because gravel is a scarce commodity, alternative construction technology could be refined to lessen gravel use and associated impacts, but such alternatives are not assumed.

The primary water-quality effect from construction and placement of gravel structures is related to upslope impoundment and thermokarst erosion (Walker et al., 1987). Thermokarst erosion can result in water features with high turbidity/suspended-sediment concentrations, as discussed under Alternative A. The thermokarst erosion is partly because of the thermal effects of dust blown off the gravel onto the tundra. Thermokarst erosion could cause the State turbidity standard to be exceeded within and downflow of thermokarst features. In flat, thaw-lake plains on the North Slope, gravel construction can be anticipated to result in upslope water impoundment and thermokarst erosion equivalent to twice the area directly covered by gravel or over up to 200 acres for development in Alternative B. Ecology of impounded waters appears to be similar to that of similarly sized ponds, but impoundments are more ephemeral (Kertell, 1996).

Although downslope drying of tundra because of upslope impoundment is possible, spring snowmelt generally is expected to be in excess of watershed dead storage in coastal tundra and would limit effect of downslope drying on water quality. Snow drifts develop on the sides of elevated roads, which also limit downslope drying. In addition, most flowing water makes it across the road through culverts; the road-impounded waters are a small portion of the total flow. Standard North Slope practices in gravel road construction includes culverts to limit disturbance of drainage patterns (Robertson, 1989). In defined drainages, multiple culverts are constructed to accommodate breakup flow as well as summer flow. In flatter tundra, single culverts are spaced at intervals to limit ponding of sheet flow during breakup.

Spills are another impacting agent on water quality. A number of small crude spills averaging 4 bbl and smaller fuel spills averaging 0.7 bbl are projected to occur onshore under Alternative B. However, roughly 75 percent of crude spills and likely all fuel spills would occur on pads or roadbeds off the tundra surface. Spill response would remove almost 100 percent of a spill from frozen tundra

prior to snowmelt for two-thirds of the year. During one-third of the year, late May through late September, spills could reach and impact tundra waters before oil-spill response is initiated or completed. Thus, at most, about 8 percent of crude spills (25% x 33%) could be reasonably anticipated to reach tundra waters. For Alternative B, this calculation results in an estimate of six spills, averaging 4 bbl, reaching tundra waters.

Dissolved-oxygen concentrations in tundra waters could be affected by spilled oil in summer. In one NPR-A experiment (Sec. IV.A.1.b.(2), 5 bbl of Prudhoe Bay crude was spilled into a 0.07-acre tundra pond. Dissolved-oxygen concentrations a week after the spill were reduced by about 4 mg/l below levels in a control pond, in some measurements to less than the 5 mg/l State standard for protection of wildlife. In 2 inches of water underneath the spill, oxygen concentrations were measured at 0.7 to 0.9 mg/l versus 5 mg/l in the control pond. At the 3-inch water depth, oxygen concentrations under the slick increased to 3.9 to 6.9 mg/l versus 8.2 to 10.7 mg/l in the control pond. At the 4-inch water depth (average pond depth, Miller, Prentki, and Barsdate, 1980), outside the slick, oxygen concentration was within the expected normal range, 10.8 mg/l versus 11.4 mg/l in the control pond. The oxygen deficit under the slick and also in shallower waters of the control pond were attributable to decreased oxygen influx from the air and the relatively high rate of (natural) sediment respiration in coastal tundra ponds, not to oil-enhanced respiration in the pond.

In winter, even under ice, an oxygen deficit would not be expected to result from a small spill in most waters. In winter, sediment (and water column) respiration rates are negligible. In addition, sediment respiration has a lesser relative effect in the thicker water column of lakes deep enough not to freeze solid in winter. Such lakes, even those that hold fish, tend to be supersaturated with dissolved oxygen in winter, to levels above the State water-quality standard of 110 percent saturation (Sec. III.A.2.b). An exception might be if a spill occurred underneath thick ice cover in very restricted waters holding a concentrated population of overwintering fish that already has depleted oxygen levels. Occasional low oxygen concentrations and kills of overwintering fish have been observed North Slope waters in the past.

However, the primary effect of a small spill on tundra water quality would be from direct toxicity rather than from oxygen depletion or other secondary effects. Long-term toxicity (7 years) can result from a small spill, as shown in the NPR-A experimental pond spill. That spill killed the zooplankton, and the pond water remained toxic to more sensitive zooplankton species for 7 years.

In a real spill, response likely would recover the bulk of spilled oil, but sufficient oil could remain to promote long-term, local toxicity. Over the life of a field, spills could affect the water quality of about six ponds or small lakes, making their waters toxic to sensitive species for about 7 years.

For the purpose of analysis, the effects of a 325-bbl spill reaching the Colville River and Teshepuk Lake in summer also are analyzed.

In the Colville River, the high rate of waterflow would preclude any effects on dissolved oxygen concentrations. Direct toxicity in the water column would be minimal and limited to the first few reservoir pools downcurrent of where the spill entered the river. Some toxicity might persist in these initial reservoir pools for a few days to weeks, until toxic compounds were washed out of the oil trapped in the sediment or the oiled sediment was buried under cleaner sediment.

A similar spill reaching Teshekpuk Lake also would result in a minimal effect on water quality. Dissolved oxygen levels would not be affected. Direct toxicity would be minimal because of the much greater dilution volume in Teshekpuk Lake than in the small ponds and lakes discussed earlier and because of the relatively unrestricted movement of slick and underlying water. The spreading of the spill over about 60 acres (0.03% of the lake surface) could be considered an effect on water quality. This effect would exist for a few weeks, until the slick was either cleaned up or the oil stranded on the shoreline.

With the low development in Alternative B, it is unlikely but possible for a spill to enter the marine environment. A most likely number of zero spills ≥1,000 bbl along the Trans-Alaska Pipeline System (TAPS) tanker route is projected for this alternative.

The description of general effects of oil spills on water quality in Beaufort Sea and along the TAPS tanker route waters as contained in Section IV.B.1 of the Sale 170 Final EIS (USDOI, MMS, 1998), is incorporated here by reference.

Applicable ambient-water-quality standards for marine waters of the State of Alaska are (1) total aqueous hydrocarbons in the water column may not exceed 15 μg/l (0.015 ppm); (2) total aromatic hydrocarbons in the water column may not exceed 10 μg/l (0.010 ppm) and (3) surface waters and adjoining shorelines must be virtually free from floating oil, film, sheen, or discoloration. The State of Alaska criterion of a maximum of 0.015 ppm of total aqueous hydrocarbons in marine waters, about 15-fold background concentrations, provides the readiest comparison and is used in this discussion of water quality.

This analysis considers 0.015 ppm to be a chronic criterion and 1.5 ppm, a 100-fold higher level, to be an acute criterion.

Major crude oil spills generally result in peak dissolved-hydrocarbon concentrations that are only locally and marginally at toxic levels—parts per million or more. Effects of spills <1,000 bbl can be considered negligible. A spill ≥1,000 bbl could temporarily, about a month, contaminate water over a few hundreds of square miles above the chronic criterion of 0.015 ppm. Concentrations above the 1.5-ppm-acute criterion may occur over a few tens of square miles during the first several days of such a spill.

However, such a spill is unlikely under this alternative, and marine water quality is not anticipated to be affected by spillage of NPR-A crude.

A salt water spill, although unlikely, can be hypothesized. Such a spill would greatly exceed State water-quality standards (State of Alaska, ADEC, 1997), which prohibit:

- total dissolved solids or salinity from exceeding 1,500 mg/l (1.5 ‰ salinity), including natural conditions
- increases in salinity exceeding one-third of the concentration of the natural condition of the waterbody.

In a year with high rain fall, some of the salt would be diluted and flushed from the tundra in summer. Some of the salt water would settle into the deepest reaches of the contaminated waters. The freeze/thaw cycle in the Arctic and the depth of any lake reached by the spill would play a controlling role the fate of the remaining contaminating salts from a spill.

In winter, surface waters <6 ft deep freeze solid (Hobbie, 1984). In a saltwater spill into such waters, the remaining salt from the spill water would be excluded from downward-freezing ice in fall and be forced into the underlying sediment (Prentki et al., 1980). Most of the salt would remain trapped in the sediment after the next spring's meltout, giving these waters an initial low salinity. During the summer, salinity slowly would increase as ice in the bottom sediment melts and the sediments compress (Miller, Prentki, and Barsdate, 1980).

In waters >6 ft, freezing of ice would force salt from a spill into the deeper water below the ice, increasing salinity of that water proportionately. During snowmelt, the lakes form moats—a ring of water at the shoreline. For deeper lakes, the winter ice cover persists through spring snowmelt and would protect the more saline water below the winter-formed pycnocline (the plane separating two layers of different density). Snowmelt waters flow just below the ice (O'Brien et al., 1995) or along the moated margins of the lakes, but above the pycnocline. These snowmelt waters pass through and exit over flooded tundra in sheet flow or through shallow outlets without contributing to or diluting concentrations of dissolved solids in the lake. Only after peak snowmelt and waterflow does the protective ice cover of deeper lakes melt and allow the wind to mix the water column, destroying the pycnocline. The net result of this flow regime in deeper lakes would act to preserve the contaminating salts from removal or dilution from snowmelt waters. Elevated salinity above State standards could persist for several years.

A waterflood pipeline could flow at 2.4 to 8.3 million gallons per day of Beaufort Sea water, equivalent to production rate from a single field (see Sec. IV.A.1.b and Table IV.A.1.b-3). If a spill resulted from catastrophic failure of the pipeline, it quickly would be noticed by instrumentation and flow stopped, with perhaps spillage equivalent to an hour's flow. Alternatively, spillage up to 10 percent of throughput from a smaller leak might not be detected from input/output balances for about a day. This less-than-catastrophic spill would spill greater volume, from 240,000 to 830,000 gal. During summer, flat coastal tundra develops a dead-storage capacity averaging 0.5 to 2.3 inches (Miller, Prentki, and Barsdate, 1980), which would retain 13,000 to 63,000 gal/acre. Thus, the spill would spread over 4 to 64 acres.

Storm surges along the NPR-A coast have flooded nearshore coastal tundra in the past, resulting in salt contamination of much greater magnitude than hypothesized here. The lake used as a supply of freshwater at the Naval Arctic Research Laboratory in Barrow was flooded in a fall storm surge in the early 1960's. The laboratory pumped some saline bottomwater out of the lake over the next few years, but a more saline taste and off-flavors affected the potability for several years. However, the water was still used for water supply.

Summary: Primary affecting agents for Alternative B are water extraction, water impoundment, and thermokarst around structures, and roads, and spillage of oil and salt water.

During exploration, annual ice-pad and road construction (310-acre footprint each year), drilling, and domestic needs for water could require winter extraction of the unfrozen water from about up to 110 acres of nearby lakes. Most of this water use is for ice roads. If exploration continues >1 year, the areas affected would shift each year as the ice roads are realigned and shifted to avoid continued compaction of vegetation.

If development occurs (the high-resource scenario), because of the annual rebuilding of ice roads, annual water

use during development would be similar to that for exploration, needing water to construct 300 acres of ice road, requiring water from 110 acres worth of intermediate-depth lakes. During the seasonal construction phase, annual field-water demand would be on the order of 37 acre-feet, requiring water from 12 additional acres of lake. After major construction is finished, annual field-water demand would decrease to about 15 acre-feet/year, requiring water removal from only about 5 acres of lake. The areas affected would shift each year as the ice roads are realigned and shifted to avoid continued compaction of vegetation.

The primary water-quality effect from construction and placement of gravel structures is related to upslope impoundment and thermokarst erosion. The thermokarst erosion is due partly to the thermal effects of dust blown off the gravel onto the tundra. In flat, thaw-lake plains on the North Slope, gravel construction can be anticipated to result in upslope water impoundment and thermokarst erosion equivalent to twice the area directly covered by gravel, or over up to 200 acres for development in Alternative B. Unlike the situation for ice structures, the same 200 acres would be affected each year over the life of the field.

Over the life of a field, spills could degrade water quality of about six ponds or small lakes, with resultant toxicity persisting and eliminating sensitive species in their waters for about 7 years. Water quality could be degraded over a few weeks along a short stretch of the Colville from a 325-bbl spill. The spreading of a similar-sized spill over about 60 acres of Teshekpuk Lake (0.03% of the lake surface) for a few weeks could be considered an effect on water quality.

Conclusion—First Sale: Longer-term (decade-or-more) effects of Alternative B would occur over a few hundred acres, versus a negligible amount for Alternative A because of the introduction of oil and gas activities construction or placement of ice roads. Oil spills could result in waters of about six ponds or small lakes remaining toxic to sensitive species for about 7 years. Water quality could be degraded over a few weeks along a short stretch of the Colville from a 325-bbl spill. The spreading of a similar-sized spill over about 60 acres of Teshekpuk Lake (0.03% of the lake surface) for a few weeks could be considered an effect on water quality.

Multiple Sales: Effects of seismic trails would be similar to those for one sale, over about an acre. During peak exploration, annual ice-pad and ice-road construction could cover about 370 acres, assuming that ice-road length would be similar to the assumed connecting pipeline length for this alternative. This ice road construction would require winter extraction of water from up to 130 acres of nearby lakes. Pad construction, drilling, and crew needs together would require water use equivalent to 2 to 4 acres of lake.

Because of the continued need for ice roads, annual water use during development for ice-road construction would be similar to that for exploration, requiring water from 130-acres worth of intermediate-depth lakes. During the seasonal construction phase, annual water demand would be on the order of 37 acre-feet for each field, requiring water from an additional 12 acres of lake for each field. After major construction is finished, annual water demand would decrease to about 15 acre-feet/year for each field, requiring up to 10 acres of lake for water supply for all fields.

The primary water-quality effect from construction and placement of gravel structures is related to upslope impoundment and thermokarst erosion. Gravel construction of pads, within-field roads, and field airstrip would cover about a 100-acre footprint per field, or 200 acres total. In flat thaw-lake plains on the North Slope, gravel construction can be anticipated to result in upslope water impoundment and thermokarst erosion equivalent to twice the area directly covered by gravel, or 400 acres. Unlike the situation for ice structures, the same locations would be affected by gravel structures each year over the life of the fields. Over the life of development resulting from multiple sales, spills could degrade water quality of about eight ponds or small lakes, with resultant toxicity persisting and eliminating sensitive species in their waters for about 7 years. Water quality could be degraded over a few weeks along a short stretch of the Colville from a 325-bbl spill. Multiple sales would be unlikely to result in marine oil spills. The spreading of a similar-sized spill over about 60 acres of Teshekpuk Lake (0.03% of the lake surface) for a few weeks could be considered an effect on water quality. Multiple sales would not result in additional waterflood pipelines (Sec. IV.A.1.b), and the effect of a waterflood spill would be the same as for one sale.

Conclusion—Multiple Sales: Longer-term (decade-or-more) effects of multiple sales would be similar to those for a single sale. Oil spills could result in waters of about eight ponds or small lakes remaining toxic to sensitive species for about 7 years.

Effectiveness of Stipulations: Stipulation 16 would limit winter water extraction from lakes ≥7 ft deep and prohibit winter extraction from streams, rivers, and lakes <7 ft deep containing fish. The 7-ft water-depth standard for water withdrawal is based on the professional experience and technical position of the State of Alaska, Department of Fish and Game that 7 ft of water is adequate to protect overwintering fish populations and water quality within the planning area. Limiting water withdrawal to lakes ≥7 ft deep protects fish in such lakes from hypersalinity. The 7-

ft standard is consistent with current State of Alaska permitting stipulations for oil and gas operations on the North Slope. Authorization from the BLM Authorized Officer of a withdrawal of water from a nonfish-bearing lake <7-ft deep requires consultation with appropriate Federal, State, and North Slope Borough (NSB) regulatory and resource agencies. Extraction of water from lakes ≥7 ft would be limited to 15 percent of the estimated ice-free volume. The average depth of lakes ≥7 ft deep likely are close to 8 ft on the North Slope; most lakes on the North Slope are <6 ft deep (Sloan, 1987). The average ice thickness by the start of the ice-road building season in December is 3.0 ft, giving a stipulation-allowable extraction of 9 inches of water (15% of 5 ft of water). The stipulation would protect the water quality of fish-bearing lakes and lessen the effect on any single lake. However, it would take a 23-ft deep lake to provide the same amount of water/per unit lake area as a 6-ft deep lake.

Stipulations 20a and 20j are marginally effective in protecting water quality as discussed under Alternative A.

Downhole disposal is identified as the preferred disposal method in Stipulation 13. However, the Authorized Officer has the authority under Stipulation 13 to allow the use of temporary mud (reserve) pits and, therefore, may allow permitted discharge of fluids from temporary mud (reserve) pits. Such discharge from other North Slope pits has caused measurable metal and hydrocarbon contamination in nearby waters (Woodward et al., 1988). This IAP/EIS assumes the preferred procedure, downhole disposal, or direct removal from public lands to ADEC-approved waste-disposal facilities, without storage in temporary mud pits. The use of temporary mud pits is discouraged by the ADEC and is no longer the practice on the North Slope. To allow mud pits, the Authorized Officer would have to both win ADEC and USEPA approval and conduct a site-specific NEPA evaluation.

Stipulations 9, 11, 12, 13, 39, and 40 limit hydrocarbon storage, major fueling activities, and facilities sitings from at least 500 ft up to a half mile from active floodplains of NPR-A rivers, streams, and lakes. These stipulations decrease the likelihood of contamination of these waters from spills.

5. Air Quality:

a. Activities Other than Oil and Gas Exploration and Development: The ground-impacting activities that affect air quality under Alternative B would be the same as those under Alternative A. The impacts of these activities would be the same as those under Alternative A.

b. Oil and Gas Exploration and Development Activities: This discussion analyzes the potential degrading effects on air quality by the activities and developments induced by Alternative B. Supporting materials and discussions are presented in Section III.A.3.b (Description of Air Quality).

(1) Effects of Routine Emissions: The following air pollutants would be produced during activities conducted as a result of this alternative: nitrogen oxides (NO_x), carbon monoxide (CO), sulfur dioxide (SO_2), particulate matter (PM), and volatile organic compounds (VOC).

Nitrogen oxide consists of both nitric oxide (NO) and nitrogen dioxide (NO_2). The nitrogen oxides (No_x) are formed from the oxygen and nitrogen in the air during combustion processes, and the rate of formation increases with the combustion temperature. Nitric oxide, the major component of the combustion process, will slowly oxidize in the atmosphere to form NO_2; NO_2 and VOC perform a vital role in the formation of photochemical smog. Nitrogen dioxide breaks down under the influence of sunlight, producing NO and atomic oxygen, which then combine with diatomic oxygen to form O_3 or with VOC to form various gaseous and particulate compounds that result in the physiological irritation and reduced visibility typically associated with petrochemical smog.

Carbon monoxide is formed by incomplete combustion. It is a problem mainly in areas where there is a high concentration of vehicle traffic. High concentrations of carbon monoxide present a serious threat to human health, because they greatly reduce the capacity of the blood to carry oxygen.

Sulfur dioxide is formed in the combustion of fuels containing sulfur and, in the atmosphere, SO_2 slowly converts to sulfate particles. Sulfates in the presence of fog or clouds may produce sulfuric-acid mist. It is generally recognized that entrainment of sulfur oxides or sulfate particles into storm clouds is a major contributor to the reduced pH levels observed in precipitation (acid rain) in the northeastern U.S.

Emissions of particulate matter associated with combustion consists of particles in the size range <10 microns in diameter (PM-10). Emissions of particulate matter associated with combustion consists of particulates, especially those in a certain size range of 1 to 3 microns, can cause adverse health effects. Particulates in the atmosphere also tend to reduce visibility.

The type and relative amounts of air pollutants generated by operations vary according to the phase of activity. There are basically three phases: exploration,

use during development would be similar to that for exploration, needing water to construct 300 acres of ice road, requiring water from 110 acres worth of intermediate-depth lakes. During the seasonal construction phase, annual field-water demand would be on the order of 37 acre-feet, requiring water from 12 additional acres of lake. After major construction is finished, annual field-water demand would decrease to about 15 acre-feet/year, requiring water removal from only about 5 acres of lake. The areas affected would shift each year as the ice roads are realigned and shifted to avoid continued compaction of vegetation.

The primary water-quality effect from construction and placement of gravel structures is related to upslope impoundment and thermokarst erosion. The thermokarst erosion is due partly to the thermal effects of dust blown off the gravel onto the tundra. In flat, thaw-lake plains on the North Slope, gravel construction can be anticipated to result in upslope water impoundment and thermokarst erosion equivalent to twice the area directly covered by gravel, or over up to 200 acres for development in Alternative B. Unlike the situation for ice structures, the same 200 acres would be affected each year over the life of the field.

Over the life of a field, spills could degrade water quality of about six ponds or small lakes, with resultant toxicity persisting and eliminating sensitive species in their waters for about 7 years. Water quality could be degraded over a few weeks along a short stretch of the Colville from a 325-bbl spill. The spreading of a similar-sized spill over about 60 acres of Teshekpuk Lake (0.03% of the lake surface) for a few weeks could be considered an effect on water quality.

Conclusion—First Sale: Longer-term (decade-or-more) effects of Alternative B would occur over a few hundred acres, versus a negligible amount for Alternative A because of the introduction of oil and gas activities construction or placement of ice roads. Oil spills could result in waters of about six ponds or small lakes remaining toxic to sensitive species for about 7 years. Water quality could be degraded over a few weeks along a short stretch of the Colville from a 325-bbl spill. The spreading of a similar-sized spill over about 60 acres of Teshekpuk Lake (0.03% of the lake surface) for a few weeks could be considered an effect on water quality.

Multiple Sales: Effects of seismic trails would be similar to those for one sale, over about an acre. During peak exploration, annual ice-pad and ice-road construction could cover about 370 acres, assuming that ice-road length would be similar to the assumed connecting pipeline length for this alternative. This ice road construction would require winter extraction of water from up to 130 acres of nearby lakes. Pad construction, drilling, and crew needs together would require water use equivalent to 2 to 4 acres of lake.

Because of the continued need for ice roads, annual water use during development for ice-road construction would be similar to that for exploration, requiring water from 130-acres worth of intermediate-depth lakes. During the seasonal construction phase, annual water demand would be on the order of 37 acre-feet for each field, requiring water from an additional 12 acres of lake for each field. After major construction is finished, annual water demand would decrease to about 15 acre-feet/year for each field, requiring up to 10 acres of lake for water supply for all fields.

The primary water-quality effect from construction and placement of gravel structures is related to upslope impoundment and thermokarst erosion. Gravel construction of pads, within-field roads, and field airstrip would cover about a 100-acre footprint per field, or 200 acres total. In flat thaw-lake plains on the North Slope, gravel construction can be anticipated to result in upslope water impoundment and thermokarst erosion equivalent to twice the area directly covered by gravel, or 400 acres. Unlike the situation for ice structures, the same locations would be affected by gravel structures each year over the life of the fields. Over the life of development resulting from multiple sales, spills could degrade water quality of about eight ponds or small lakes, with resultant toxicity persisting and eliminating sensitive species in their waters for about 7 years. Water quality could be degraded over a few weeks along a short stretch of the Colville from a 325-bbl spill. Multiple sales would be unlikely to result in marine oil spills. The spreading of a similar-sized spill over about 60 acres of Teshekpuk Lake (0.03% of the lake surface) for a few weeks could be considered an effect on water quality. Multiple sales would not result in additional waterflood pipelines (Sec. IV.A.1.b), and the effect of a waterflood spill would be the same as for one sale.

Conclusion—Multiple Sales: Longer-term (decade-or-more) effects of multiple sales would be similar to those for a single sale. Oil spills could result in waters of about eight ponds or small lakes remaining toxic to sensitive species for about 7 years.

Effectiveness of Stipulations: Stipulation 16 would limit winter water extraction from lakes ≥7 ft deep and prohibit winter extraction from streams, rivers, and lakes <7 ft deep containing fish. The 7-ft water-depth standard for water withdrawal is based on the professional experience and technical position of the State of Alaska, Department of Fish and Game that 7 ft of water is adequate to protect overwintering fish populations and water quality within the planning area. Limiting water withdrawal to lakes ≥7 ft deep protects fish in such lakes from hypersalinity. The 7-

ft standard is consistent with current State of Alaska permitting stipulations for oil and gas operations on the North Slope. Authorization from the BLM Authorized Officer of a withdrawal of water from a nonfish-bearing lake <7-ft deep requires consultation with appropriate Federal, State, and North Slope Borough (NSB) regulatory and resource agencies. Extraction of water from lakes ≥7 ft would be limited to 15 percent of the estimated ice-free volume. The average depth of lakes ≥7 ft deep likely are close to 8 ft on the North Slope; most lakes on the North Slope are <6 ft deep (Sloan, 1987). The average ice thickness by the start of the ice-road building season in December is 3.0 ft, giving a stipulation-allowable extraction of 9 inches of water (15% of 5 ft of water). The stipulation would protect the water quality of fish-bearing lakes and lessen the effect on any single lake. However, it would take a 23-ft deep lake to provide the same amount of water/per unit lake area as a 6-ft deep lake.

Stipulations 20a and 20j are marginally effective in protecting water quality as discussed under Alternative A.

Downhole disposal is identified as the preferred disposal method in Stipulation 13. However, the Authorized Officer has the authority under Stipulation 13 to allow the use of temporary mud (reserve) pits and, therefore, may allow permitted discharge of fluids from temporary mud (reserve) pits. Such discharge from other North Slope pits has caused measurable metal and hydrocarbon contamination in nearby waters (Woodward et al., 1988). This IAP/EIS assumes the preferred procedure, downhole disposal, or direct removal from public lands to ADEC-approved waste-disposal facilities, without storage in temporary mud pits. The use of temporary mud pits is discouraged by the ADEC and is no longer the practice on the North Slope. To allow mud pits, the Authorized Officer would have to both win ADEC and USEPA approval and conduct a site-specific NEPA evaluation.

Stipulations 9, 11, 12, 13, 39, and 40 limit hydrocarbon storage, major fueling activities, and facilities sitings from at least 500 ft up to a half mile from active floodplains of NPR-A rivers, streams, and lakes. These stipulations decrease the likelihood of contamination of these waters from spills.

5. Air Quality:

a. Activities Other than Oil and Gas Exploration and Development: The ground-impacting activities that affect air quality under Alternative B would be the same as those under Alternative A. The impacts of these activities would be the same as those under Alternative A.

b. Oil and Gas Exploration and Development Activities: This discussion analyzes the potential degrading effects on air quality by the activities and developments induced by Alternative B. Supporting materials and discussions are presented in Section III.A.3.b (Description of Air Quality).

(1) Effects of Routine Emissions: The following air pollutants would be produced during activities conducted as a result of this alternative: nitrogen oxides (NO_x), carbon monoxide (CO), sulfur dioxide (SO_2), particulate matter (PM), and volatile organic compounds (VOC).

Nitrogen oxide consists of both nitric oxide (NO) and nitrogen dioxide (NO_2). The nitrogen oxides (No_x) are formed from the oxygen and nitrogen in the air during combustion processes, and the rate of formation increases with the combustion temperature. Nitric oxide, the major component of the combustion process, will slowly oxidize in the atmosphere to form NO_2; NO_2 and VOC perform a vital role in the formation of photochemical smog. Nitrogen dioxide breaks down under the influence of sunlight, producing NO and atomic oxygen, which then combine with diatomic oxygen to form O_3 or with VOC to form various gaseous and particulate compounds that result in the physiological irritation and reduced visibility typically associated with petrochemical smog.

Carbon monoxide is formed by incomplete combustion. It is a problem mainly in areas where there is a high concentration of vehicle traffic. High concentrations of carbon monoxide present a serious threat to human health, because they greatly reduce the capacity of the blood to carry oxygen.

Sulfur dioxide is formed in the combustion of fuels containing sulfur and, in the atmosphere, SO_2 slowly converts to sulfate particles. Sulfates in the presence of fog or clouds may produce sulfuric-acid mist. It is generally recognized that entrainment of sulfur oxides or sulfate particles into storm clouds is a major contributor to the reduced pH levels observed in precipitation (acid rain) in the northeastern U.S.

Emissions of particulate matter associated with combustion consists of particles in the size range <10 microns in diameter (PM-10). Emissions of particulate matter associated with combustion consists of particulates, especially those in a certain size range of 1 to 3 microns, can cause adverse health effects. Particulates in the atmosphere also tend to reduce visibility.

The type and relative amounts of air pollutants generated by operations vary according to the phase of activity. There are basically three phases: exploration,

development, and production. For the exploration phase, emissions would be produced by (1) diesel-power-generating equipment needed for drilling exploratory and delineation wells; (2) truck and other vehicles used in support of drilling activities; and (3) intermittent operations such as mud degassing and well testing. Pollutants generated primarily would consist of NO_X (these would consist of NO and NO_2 [nitrogen dioxide]; ambient air standards are set only for NO_2), CO, and SO_2. The impact of exploration and delineation activities conducted as a result of this alternative would be limited between 1 to 10 wells.

For the development phase, the primary emission sources would be (1) piston-driven engines or turbines used to provide power for drilling; (2) heavy construction equipment used to install modules and pipelines; and (3) various vehicles. The principal development-phase emissions would consist of NO_2 with lesser amounts of SO_2, CO, and PM.

For the production phase, the primary source of emissions would be from power generation for oil pumping and water injection. The emissions would consist primarily of NO_2 with smaller amounts of CO and PM. Another source of air pollutants would be evaporative losses (VOC) from oil/water separators, pump and compressor seals, valves, and storage tanks. Venting and flaring could be an intermittent source of VOC and SO_2. The impact of development and production activities associated with Alternative B would consist of the construction of two production pads drilling a maximum of 83 wells and constructing approximately 75 mi of pipelines. Production would reach a peak of 35 MMbbl per year. Clean Air Act standards would be used to establish the maximum concentrations of allowable pollutants for each operation proposed.

Other sources of pollutants related to operations are accidents such as blowouts and oil spills. Typical emissions from accidents consist of hydrocarbons; only fires associated with blowouts or oil spills produce other pollutants.

Federal and State statutes and regulations define air-quality standards in terms of maximum allowable concentrations of specific pollutants for various averaging periods (Table III.A.2-1). These maxima are designed to protect human health and welfare. However, one exceedance per year is allowed except for standards based on an annual averaging period. The standards also include Prevention of Significant Deterioration (PSD) provisions for NO_x, SO_2, and PM-10 to limit deterioration of existing air quality that is better than that otherwise allowed by the standards (an attainment area). Maximum allowable increases in concentrations above a baseline level are specified for each PSD pollutant. There are three classes (I, II, and III) of PSD areas, with Class I allowing the least degradation. Class I also restricts degradation of visibility. This area is a Class II, which allows for an incremental decrease in the air quality of the area. Baseline PSD-pollutant concentrations and the portion of the PSD increments already consumed are established for each location by the USEPA and the State of Alaska prior to issuance of air-quality permits. Air-quality standards do not directly address all other potential effects such as acidification of precipitation and freshwater bodies or effects on nonagronomic plant species.

(2) Effects of Accidental Emissions: Accidental emissions result from gas blowouts, evaporation of spilled oil, and burning of spilled oil. Soot from a fire is considered to be the major contributor to pollution from a fire event. This soot, which would be deposited on plant materials in the vicinity of the fire, would tend to slump and wash off vegetation in subsequent rains, limiting any health effects. Accidental emissions, therefore, are expected to have a minimal effect on onshore air quality.

(3) Effects of Air Pollution: Other effects of air pollution from activities and other sources on the environment not specifically addressed by air-quality standards include the possibility of damage to vegetation and acidification. Effects may be short term (hours, days, or weeks), long term (seasons or years), regional (Arctic Slope), or local.

A significant increase in ozone concentrations is not likely to result from the exploration, development, or production scenario associated with the IAP. Photochemical pollutants such as ozone are not emitted directly but rather form in the air from the interaction of other pollutants in the presence of sunshine and heat. Although sunshine is present in the sale area most of each day during the summer, temperatures remain relatively low (Brower et al., 1988). Also, activities occurring as a result of the field-development scenario of the IAP are separated from each other, diminishing the combined effects from activities discussed in the IAP.

Olson (1982) reviewed susceptibility of fruticose lichen, an important component of the coastal tundra ecosystem, to sulfurous pollutants. There is evidence that SO_2 concentrations as low as 12.0 micrograms per cubic meter ($\mu g/m^3$) for short periods of time can depress photosynthesis in several lichen species, with damage occurring at 60 $\mu g/m^3$. Also, the sensitivity of lichen to sulfates is increased in the presence of humidity or moisture, conditions that are common on coastal tundra. However, because of the small size and number of sources of SO_2 emissions, the ambient concentrations at most locations may be assumed to be near the lower limits of

detectability. Because of the distance of the proposed activities from shore, attendant atmospheric dispersion, and low existing levels of onshore pollutant concentrations, the effect on vegetation resulting from the IAP is expected to be minimal.

Summary: The effects on air quality from Alternative B should result in air emissions that are below the maximum allowable PSD Class II increments. The concentrations of criteria pollutants in the ambient air would remain well within the air-quality standards. Consequently, a minimal effect on air quality with respect to standards is expected.

Conclusion—First Sale: Activity associated with Alternative B would result in a small, localized increase in the concentrations of criteria pollutants. Concentrations would be within the PSD Class II limits and National Air Quality Standards. Therefore, effects from Alternative B would be low. Effects of activities other than oil and gas are negligible, as in Alternative A.

Multiple Sales: The effects on air quality from multiple sales would result in air emissions that remain below the maximum allowable PSD Class II increments. The concentrations of criteria pollutants in the ambient air would remain well within the air-quality standards. Consequently, a minimal effect on air quality with respect to standards is expected.

Conclusion—Multiple Sales: Activities associated with multiple sales would result in sequential effects which would remain small and localized. Concentrations would remain within the PSD Class II limits and effects would remain low.

Effectiveness of Stipulations: Current laws and regulations are assumed to be in place for the analysis of the IAP, and effects levels reflect this assumption.

6. Vegetation:

Ground-impacting actions within the planning area that may affect vegetation under Alternative B include those analyzed under Alternative A and those resulting from oil exploration and development. The impacts of management actions described under Alternative A would be similar under Alternative B, except that the total areal extent of archaeological/paleontological excavations may increase to 2 acres per year and seismic survey activity would increase (see below).

a. Exploration:

(1) Disturbance:

(a) Effects of Construction: Construction with the potential to impact vegetation during exploration would be limited to the construction of ice pads for drilling exploratory or delineation wells, well collars, and ice roads to access some ice pads. Because vegetation is dormant when frozen and the ice pads/roads melt during the spring thaw along with snow and natural ice, this construction may cause "green trails" but normally would have no adverse impact on vegetation. The exception would be if an ice pad were covered to prevent summer melt, so it could be used in a second winter. In that case, the vegetation would thaw underneath the timbers placed around the pad's perimeter to hold the cover down. Because that thawed vegetation would receive no sunlight, it would die (Hazen, 1997). Assuming that the average ice pad is 500 ft by 500 ft, this perimeter death would impact about 2,000 ft^2 or 0.05 acres. Under Alternative B, it is assumed that 1 to 4 exploration wells and 0 to 6 delineation wells would be drilled in the planning area, for a total of 1 to 10 wells on ice pads. If it is assumed that half of all ice drill pads would be maintained over the summer, this scenario could result in the death of 0.0 to 0.2 acres of vegetation spread among 0 to 5 different sites and over 10 years. The vegetation would take 1 to a few years to recover.

Holes are dug in the earth for construction of well collars, causing the destruction of vegetation on the 16 ft^2 of ground (0.006 acres) involved and causing thermokarsting around them, which may change some vegetation cover to a wetter type. For 1 to 10 wells, this could result in the destruction of 0.01 to 0.06 acres of vegetation.

(b) Effects of Seismic Activities: Under Alternative B, it is assumed that one 2-D seismic survey would occur each winter for about 10 years, after which the frequency of surveys would drop to alternate winters. From zero to two 3-D surveys would occur within about 5 years. Thus for 10 years, 2-D surveys would double in frequency from the level analyzed in Alternative A, resulting in 1,850 acres experiencing medium to high disturbance every winter rather than every other winter. Recovery time from this disturbance would be the same as predicted for Alternative A.

It is assumed that a 3-D seismic operation would cover a total area of 150 mi^2 (96,000 acres), or 25 percent of the total area covered by a 2-D survey. However, the number of line miles covered within that area would be much greater, about 1,875. Thus, the tundra area impacted by seismic lines would be about 45,450 acres (1,875 mi by 200 ft wide). As for 2-D surveys, this figure is a maximum, because not all the area within the pair of 100-ft wide lines would be overrun by a vehicle. For 3-D surveys, the distance covered by camp-move vehicles would not be similar to line miles of survey as is the case for 2-D surveys. It is assumed that camp-move trails would approximate 25 percent (62.5 mi) of those for 2-D surveys, because the total area involved in a 3-D survey is only 25

percent of that covered by 2-D. There still would be an average of 106 additional miles traveled when entering and leaving the planning area. Thus, camp-move trails would impact about 610 acres of tundra per survey. Under Alternative B, zero to two 3-D surveys would occur, and about 0 to 1,220 acres would be impacted by camp-move vehicles and 0 to 90,900 acres by seismic line as a result of a first lease sale. Because 3-D seismic involves more tight turns by heavy equipment than does 2-D, the potential for vegetation damage is greater. For this reason, it can be assumed that the medium and high disturbance levels to tundra would occur in greater proportions from 3-D seismic lines than that presented for 2-D in Emers and Jorgenson (1997). The total area within the planning area impacted by seismic surveys would be less than the total acreage of surveys presented here, because individual surveys would overlap one another. However, the decrease in acreage impacted would be countered by the higher level of disturbance possible in those areas of overlap.

(2) Effects of Spills: Spills that might occur during exploratory work are covered under blowouts and refined-oil spills during development (below).

b. Development:

(1) Disturbance: There are four different aspects of development that would impact vegetation—construction of gravel pads, roads and airstrips for each; potential construction of one pump station within the planning area; excavation of material sites; and construction of pipelines.

(a) Gravel Pads, Roads, and Airstrips: It is assumed that the gravel fill for the average in the planning area would cover a total of 100 acres and that under Alternative B, 0 to 1 would be developed. This would result in the destruction of either 0 or 100 acres of vegetation.

The passage of vehicle traffic over gravel pads would result in dust and gravel being sprayed over vegetation within about 30 ft of the pad and a noticeable dust shadow out to about 150 ft or more. Beyond about 30 ft, the effects of dust on vegetation would be subordinate to those described below for changes in snow distribution and moisture regimes (Woodward-Clyde Consultants, 1993). Within 30 ft of pads, the dust and gravel may smother the original vegetation resulting in a shift to weedy species and thermokarsting, with the latter leading to the development of high-centered polygons with deep moats (Jorgenson, 1997, pers. comm.). For this analysis, it is assumed that the average in the planning area would consist of 5 mi of some combination of pads, roads, and airstrip with the potential for dust effects along a 10-mi perimeter. This could result in a total coverage of the above impacts over 36 acres per , corresponding to 0 or 36 acres under Alternative B.

The type of material used for gravel fill also can impact vegetation, because the material sometimes has a saline source. Sources for material to be used in the planning area currently are undetermined. If the material is saline, water draining off or leaching through the pad can pick up the salinity and cause the death of plants near the pad. The area of plant death eventually would be colonized by more halophytic species, resulting in an overall impact of change from one plant community to another.

The construction of gravel pads can result in a change in moisture regime of the nearby tundra through the accumulation of snow by drifting and the blockage of normal surface waterflow in summer. This can cause an increase in the depth of the active layer (soil that thaws during summer), which leads to an increase in graminoid and bryophyte production in wet habitats or a decrease in shrub and lichen production in moist or dry habitats within 164 ft of the pad (Woodward-Clyde Consultants, 1993). In the extreme case, shrubs may disappear altogether and the vascular plant community may become a *Carex aquatilis* monoculture (Jorgenson, 1997, pers. comm.). If all such effects occur within 164 ft of the pads, the total area impacted could be up to 200 acres per , or 0 to 200 acres under Alternative B.

Flooding caused the greatest indirect effect of construction on vegetation during the first 15 years (1968-1983) of development in the Prudhoe Bay (Walker et al., 1986, 1987). Flooding resulted when roads and pads intercepted the natural flow of water and caused ponding. Conditions of development in the NPR-A would require that natural drainage patterns be identified prior to and maintained during and after construction. Even if such conditions were not required or were not completely successful, the acreage of land impacted would not be greater than that affected by dust and snow drifting, as described above. However, the change in vegetation type could be different, resulting in more aquatic grasses and sedges.

(b) Pump Station: Depending on the number of fields produced, their location, and the diameter of pipe used to transport oil, one pump station may be needed within the planning area. A pump station with associated airstrip would result in about 40 acres of gravel fill. For this analysis, it is assumed the perimeter of this gravel fill would be 3 mi, resulting in 11 acres of potential dust effect or 60 acres of moisture-regime change.

(c) Material Sites: Any need for gravel fill resulting from proposed development may be met by existing borrow sites east of the NPR-A. However, if excavation of fill material occurs within the planning area,

vegetation would be destroyed over the area of the borrow pit itself as well as where the overburden is stockpiled. For this analysis, it is assumed that there would be one material site within the NPR-A for each developed, with a total surface disturbance of 30 to 50 acres (average 40 acres). It also is assumed that all associated work would occur in winter, resulting in no dust. Any moisture-regime changes as a result of snow drifting would be confined to <20 acres per material site. Under Alternative B, this would result in the destruction of 0 to 40 acres of vegetation and the alteration of the vegetation community over 0 to 20 acres. If some or all of the gravel resources come from outside the planning area, the total acreage affected would be the same or less, but correspondingly distributed between the planning area and other lands to the east. Material sites outside the planning area would most likely be within the Colville River floodplain where vegetative cover may be naturally reduced or absent.

(d) Pipelines: For this analysis, it is assumed that pipelines would involve a single VSM per pipe-supporting rack. The VSM would have a diameter of 12 in and would be placed 55 to 70 ft apart. Each developed would contain about 5 mi of flowline within it in addition to the transport pipeline carrying crude oil from it. Each VSM would have an approximately 20-in wide zone of disturbance around it in addition to the vegetation displaced by the VSM (Jorgenson, 1997, pers. comm.). The zone of disturbance would result from deposition of spoil material and thermokarsting and would result in a change in plant species composition. The total area disturbed by each VSM would be about 14 ft^2, 6 percent of which would be vegetation destruction/replacement by the VSM. This would result in 0.03 acres being disturbed per pipeline mile, or 0 to 2.5 acres under Alternative B.

Pipelines also could impact vegetation indirectly through snow drifting or shading. There is conflicting information about the occurrence of snow drifting associated with pipelines that have no parallel road. Jorgenson (1997, pers. comm.) has not seen drifting in such situations, but residents of Nuiqsut have said that it occurs. Insufficient information exists to describe any potential effects to vegetation.

Any vegetation under a pipeline would receive less direct sunlight during the growing season, potentially leading to a more shallow active layer in the soil and reduced photosynthesis by the plants. No data exist to address this possibility. Most existing pipelines are associated with a parallel road, and any effects of snow drifting, gravel spray, or dust would mask an effect of shading.

The assumptions for this analysis of impacts by pipelines would be invalidated by a decision to bury any portion of a pipeline under the tundra. In that case vegetation would be destroyed above the trench and altered in the adjacent areas due to temporary storage of earth on top of vegetation and impacts from earth-moving machinery. The latter impacts would be ameliorated by winter construction, but would still occur. If the zone of impacts from pipeline burial is assumed to be 12 feet wide, then the total impacts to vegetation would affect 1.5 acres per pipeline mile. It is assumed that pipeline burial under tundra would be the exception rather than the norm, meaning the additional acreage of vegetation disturbance would be minimal in comparison to the total acreage of vegetation impacts from petroleum development.

(2) Effects of Spills: Most oil spills occur on gravel pads and, consequently, their effects do not reach the vegetation. About 20 to 35 percent of past crude-oil spills have reached areas beyond pads. The corresponding proportion for refined oil spills probably is much less, but for this analysis it is assumed that 27 percent of all spills (except blowouts; see below) occur or reach beyond gravel pads. Because winter spans the majority of each year, most spills happen when there is sufficient snow cover that cleanup efforts occur before the oil reaches the vegetation; this situation occurs during about 60 percent of the year. Thus, for this analysis, it is assumed that 11 percent of all oil spills (except blowouts; see below) will affect vegetation.

Most oil spills cover <500 ft^2 (<0.01 acres) with a maximum coverage of 4.8 acres if the spill is a windblown mist. For this analysis, it is assumed that the average spill would cover 0.1 acre (98% at 0.01 acre, 2% at 4.8 acres). Under Alternative B, the total area of vegetation that would be impacted by spilled oil over the lifetime of developed s would be 0.0 to 2.6 acres. Overall, past spills on Alaska's North Slope have caused minor ecological damage, and ecosystems have shown a good potential for recovery (Jorgenson, 1997).

From 1958 to 1996, 2,933 wells were drilled on Alaska's North Slope. During this period, one blowout was reported, and no crude oil was spilled off the pad during that blowout. The chance of a blowout occurring in the planning area, with subsequent damage to vegetation beyond the drill pad, is considered low.

A pipeline spill of seawater used for waterflooding also has the potential to affect vegetation. The size of the area affected would depend on the terrain and landcover at the spill site and would be proportional to the amount of seawater spilled. If such a spill occurred within a community of halophytic plant species, there may be little effect. Otherwise, depending on the specific situation under which the spill occurred, the result may vary from little impact to total plant death in the area affected with

eventual replacement of the vegetation community by halophytic species.

Summary: Under Alternative B, minor impacts to vegetation may occur from aircraft landings, archaeological or paleontological excavations, camps, and overland moves. The duration of these impacts would be short term, ranging up to 4 months, and recovery could vary from 1 year to decades. Impacts also would occur from seismic work and the construction of well collars during exploratory drilling. The duration and recovery for seismic work would be similar to those for overland moves. The effects of well-collar construction would be permanent. The effects of development include the destruction of vegetation under gravel pads; material sites; pipeline VSM's and spilled oil; and the alteration of vegetation communities resulting from dust, salinity of gravel fill, snow drifts, and blockage of normal surface waterflow. These impacts are considered permanent except for those of oil spills, which are cleaned up immediately, allowing recovery within a few years to two decades.

Conclusion—First Sale: Impacts to vegetation from activities other than oil exploration and development under Alternative B would be the same as those under Alternative A, except that the effects of archaeological excavation might increase from 1 to 2 acres. The impacts of oil exploration would include vegetation disturbance on about 7,350 acres per year from 2-D seismic work and 0 to 92,120 acres from 3-D surveys. About 17 percent of the disturbance from 2-D would be medium to high, with perhaps 20 percent at that level for 3-D. After 9 years, recovery would be about 90 percent for 2-D seismic work and probably somewhat less for 3-D. Exploration activities also would result in minor vegetation destruction and alteration from the construction of exploration well collars that would be permanent. The activities of development that would impact vegetation include construction of gravel pads, roads, and airstrips for each ; potential construction of one pump station within the planning area; excavation of material sites; and construction of pipelines. The combined effect of these activities would cause the destruction of vegetation on 0 to 180 acres and the alteration in plant species composition of another 0 to 280 acres, for a total of effects over 0 to 460 acres. The duration of these impacts would be permanent, assuming that the gravel pads would remain after oil production ends, and recovery thus would be moot. Oil spills are inevitable during exploration and development and would affect 0.0 to 2.6 acres of vegetation within the planning area. Spills would be cleaned up immediately, would cause minor ecological damage, and ecosystems would be likely to recover in a few years to 2 decades.

Multiple Sales: It is assumed that additional lease sales under Alternative B would result in additional exploration activities and a total of 0 to 2 s being developed. More acreage would be impacted by seismic surveys, but it would be over a longer period of time. It is expected that recovery from at least 90 percent of the impacts from the earliest surveys would be complete before additional seismic operations would commence as a result of multiple sales. The total number of exploratory wells is assumed to increase to 4-14 from 1-4, and delineation wells to 0-12 from 0-6, for a total of 4 to 26 wells drilled from ice pads. Vegetation destruction from well collars would then increase to affect 0.02 to 0.2 acres, and vegetation death around ice pad perimeters would increase to 0.1 to 0.7 acres. Tundra would recover from the latter in 1 to a few years.

With the assumption of 0 to 2 s developed, the vegetation that might be destroyed by burial under gravel fill would increase to 0 to 200 acres. The area of vegetation around gravel pads that would undergo change from dust- or moisture-regime impacts would be 0 to 400 acres. The impacts of developing material sites would increase correspondingly to the number of s. This would mean the destruction of vegetation on 0 to 80 acres and effects of moisture regime changes on 0 to 40 acres. It is assumed that the number of pump stations would remain at 0 to 1, resulting in the burial of 0 to 40 acres and dust- or moisture-regime changes on an additional 0 to 60 acres. The number of pipeline miles would increase somewhat under multiple sales, with a total of 0 to 100 mi resulting in the destruction or alteration of a total of 0 to 3.0 acres. The incidence of oil spills also would increase, affecting 0.0 to 3.7 acres of vegetation. The probability of a blowout would remain low.

Conclusion—Multiple Sales: The impacts of oil exploration would include more vegetation disturbance from seismic work than under a single-sale scenario, but the extended period of time over which it would occur, coupled with the recovery time for disturbed areas, would result in only a small increase in the amount of disturbance that would be evident at any one time. Exploration activities also would result in 0.02 to 0.2 acres of permanent vegetation destruction around well collars and alteration of 0.1 to 0.7 acres around ice pads. The activities of development that would impact vegetation include construction of gravel pads, roads, and airstrips for each ; potential construction of one pump station within the planning area; excavation of material sites; and construction of pipelines. The combined effect of these activities would cause the destruction of vegetation on 0 to 320 acres and the alteration in plant species composition of another 0 to 500 acres, for a total of effects over 0 to 820 acres. The duration of these impacts would be permanent, assuming that the gravel pads would remain after oil production ends, and recovery thus would be moot. Oil spills would affect 0.0 to 3.7 acres of vegetation within the

planning area. Recovery from spills would take a few years to two decades.

Effectiveness of Stipulations: The above analysis assumes that currently implemented stipulations on overland moves and seismic surveys (Stipulation 20; Sec. II.C.7) would continue to be employed. It also assumes that standard dust-abatement practices, as currently used in North Slope s, would be implemented in the planning area. Snow fences also are currently employed in places. Their purpose, however, is to reduce drifting on pads; the resulting amount of drifting over vegetation would be the same or more.

7. Fish:

a. Activities Other Than Oil and Gas Exploration and Development: Actions associated with Alternative B that may affect fish include the establishment of large work camps at pre-existing airstrips; small scientific excavations for paleontological, geologic, and soils-related information; the sport harvest of fish by workers; and those associated with fuel spills at fuel-storage sites. The establishment of work camps, scientific excavations, and the sport harvest of fish are expected to have no measurable adverse effect on arctic fish populations. Fuel spills at fuel-storage sites may adversely affect arctic fish populations.

b. Oil and Gas Exploration and Development Activities: Alternative B also involves several management actions associated with oil and gas development. These include seismic surveys; the construction of gravel drill pads, roads, airstrips, pipelines; and oil spills (drill pad, pipeline, and supply barge). The individual effects of these actions and the chemical agents associated with them have been discussed in previous Beaufort Sea EIS's (e.g., USDOI, MMS, 1996a), which are incorporated here by reference. The remainder of this analysis focuses on the amount of exposure arctic fish are likely to have to each of these actions under Alternative B. Approximately 53 percent of the planning area could be exposed to oil and gas development under Alternative B.

(1) Effects of Disturbance:

(a) Effects from Seismic Surveys: Arctic fish are likely to be adversely affected by seismic surveys located above overwintering areas. Likely effects would include avoidance behavior and short-term added stress but also could include the death of some of the more sensitive lifestages (e.g., juveniles). However, the effect on most overwintering fish is expected to consist of only short-term, sublethal effects. While Alternative B is likely to involve more seismic surveys than Alternative A and thereby would increase the probability of seismic activity occurring above overwintering habitat, such events are likely to be infrequent. Hence, seismic surveys associated with Alternative B are expected to have the same overall effect on fish as discussed for Alternative A (i.e., no measurable effect on arctic fish populations). While Alternative B is likely to involve more fuel spills than Alternative A, the amount of fuel entering fish habitat is not expected to significantly increase. Hence, fuel spills associated with Alternative B are expected to have the same overall effect on fish populations as discussed for Alternative A (i.e., no measurable effect on arctic fish populations).

(b) Effects from Construction: Construction-related activities that may affect arctic fish include the construction of drill pads, roads, airstrips, and pipelines; and possibly gravel extraction. During exploration there will be no pipelines; and drill pads, roads, and airstrips (if needed) will be constructed of ice. Depending on where the construction and the freshwater withdrawals needed for construction occur, these activities could adversely affect arctic fish. For example, some overwintering areas are relatively shallow (<10 ft) and have a very limited supply of freshwater and dissolved oxygen below the thickening winter ice. The construction of an ice road or airstrip through such areas would freeze to the bottom and form a barrier to water circulation, resulting in reduced levels of dissolved oxygen. This could have lethal effects on the overwintering fish affected by the barrier. Also, freshwater withdrawals may adversely affect fish if the water is taken from areas where they are overwintering. During winter, arctic fish concentrate in overwintering areas, which are relatively small in size and few in number. Their survival at these overwintering sites depends on an adequate supply of freshwater and dissolved oxygen. Each mile of ice road requires up to 1.5 million gallons of water to construct. Another .5 million gallons are required for each drill pad. Sources of freshwater within the planning area vary greatly in the amount of under-ice water available for construction during winter. Most waterbodies are relatively shallow (≤6 ft), do not support resident fish populations, and are frozen to the bottom in winter. Those deep enough to permit under-ice withdrawals for construction also are likely to support overwintering fish. Under-ice withdrawals from areas having water and dissolved-oxygen levels barely to moderately sufficient to support overwintering fish would be likely to kill many of the fish overwintering there. The recovery of affected fish populations would be expected in 5 to 10 years. However, withdrawals from freshwater sources that do not support resident fish populations, or from areas having sufficient under-ice reserves of water and dissolved oxygen, are not likely to adversely affect overwintering fish. Because 95 percent of the planning area is not overwintering habitat, and because Alternative B precludes any oil and gas activity in most of the planning area inhabited by fish, ice-road and airstrip construction and freshwater withdrawals

during exploration are likely to occur in nonoverwintering areas with densities of low to no fish. Hence, these activities associated with Alternative B are expected to have no measurable effect on arctic fish populations in the planning area.

During production, drill pads, roads, and airstrips (if needed) would be constructed of gravel. While the planning area supports relatively large numbers of small, resident freshwater fish (e.g., ninespine stickleback), species diversity in most of the planning area typically is very low, and large resident fish often are absent. As discussed in Section III.B.2, this is due to inadequate overwintering, feeding, and spawning areas; the frequent inaccessibility of these areas to migratory species; or some combination of the above conditions. Pad and road construction in these low-density areas may kill some of the smaller resident fish in the immediate area, but most are likely to move into other areas during construction; and overall effects are expected to be insignificant. Construction in high-density spawning and overwintering areas, or in access corridors used by migratory fish, would be likely to adversely affect a relatively large number of freshwater and migratory fish. The probable results of these actions include the degradation or loss of overwintering habitat, partially blocked access to and from summer feeding and overwintering areas, and siltation in or near these habitats. The resulting effects on arctic fish are likely to be spawning failure and/or mortality of many fish. Recovery would be expected in about 10 years. However, pad and road construction is likely to have no measurable adverse effect on arctic fish population (1) in low-diversity areas sparsely inhabited by large fish, (2) during times when migratory fish are not moving to and from freshwater, and (3) when construction is performed in such a manner that siltation is minimized and fish passage is not impaired.

During production, up to 75 mi of pipeline would be constructed under Alternative B. New pipelines constructed on land and around the shoreline of deeper lakes would be suspended on VSM's. Those crossing wide, deep rivers would be horizontally tunneled approximately 100 ft beneath the riverbed. Pipelines constructed in this manner are not likely to have an effect on arctic fish. New pipelines crossing wide, shallow rivers will be trenched and buried within the streambed during winter. Pipelines constructed in this manner could adversely affect fish if the trenching is done in or near overwintering or spawning habitats. Because overwintering and spawning habitats normally are located in deepwater environments, the trenching of shallow rivers during pipeline construction is not likely to adversely affect these habitats. If they were affected by trenching, the expected adverse effects would be the degradation or loss of overwintering and spawning habitat, resulting in spawning failure and mortality for many fish. Recovery would be expected in 5 to 10 years. Pipeline trenching through non-overwintering and/or spawning areas (>95% of the planning area) is not expected to have a measurable effect on arctic fish populations. Because of the relatively small number of pipeline miles associated with Alternative B, the small amount of overwintering and/or spawning habitat within the planning area, and the fact that Alternative B precludes any oil and gas activity in most of the planning area inhabited by fish, trenching for pipeline burial is expected to occur in areas with densities of low to no fish. Hence, pipeline construction associated with Alternative B is expected to have no measurable effect on arctic fish populations in the planning area. Alternative B also may involve the construction of a coastal docking facility to offload supply barges into the planning area. The effect of a docking facility on arctic fish would depend on its location, size, and design characteristics. The construction of a large docking facility in offshore waters, requiring a long access road, could adversely affect the movement of some coastal marine and migratory fish. However, the construction of a facility that provides for the movement of these fish is not likely to adversely affect them. Because supply barges are shallow draft vessels, the docking facility for Alternative B is expected to be constructed in shallow nearshore waters. Additionally, the size of the facility for Alternative B is expected to be relatively small (up to several hundred feet), and to provide for the movement of coastal fish. Hence, the construction of a coastal docking facility associated with Alternative B is not expected to have a measurable effect on arctic fish.

Because of a lack of gravel resources within the planning area, gravel extraction for the construction of roads, pads, and airstrips is likely to occur outside of the planning area (i.e., east of the Colville River). However, there is a possibility that gravel extraction could also occur within the planning area. Gravel extraction from or near overwintering and spawning habitat is likely to adversely affect arctic fish by reducing the amount and quality of habitat available to them. Because overwintering and spawning habitat represents <5 percent of the planning area, gravel removal from these areas would be likely to result in spawning failure and mortality for many fish within the affected area. Gravel removal from non-overwintering or spawning areas of low resident-fish density would be likely to have little to no adverse effect on arctic fish populations. The same applies to gravel extraction activities that might occur outside of the planning area.

(2) Effects of Spills: The individual effects of oil on fish have been discussed in Alternative A. As discussed therein, lethal effects on fish from a petroleum-related spill are seldom observed outside the laboratory environment. Sublethal effects are more likely and include changes in

growth, feeding, fecundity, and survival rates and temporary displacement. Other possibilities include interference with movements to feeding, overwintering, or spawning areas; localized reduction in food resources; and consumption of contaminated prey. The specific effect of oil on fish generally depends on the concentration of petroleum present, the time of exposure, and the stage of fish development involved (eggs, larva, and juveniles are most sensitive).

The oil-spill analysis estimates that 65 to 80 percent of the crude oil spills associated with NPR-A oil production would occur on a drilling-pad. Because drilling pad oil spills typically are small in size and easily cleaned up, they are not expected to come in contact with fish habitat and would have no perceptible effect on arctic fish. The oil-spill analysis also estimates that 20 to 35 percent of the oil spills would occur off drilling pads in the surrounding environment. More specifically, for Alternative B, the oil-spill analysis estimates that 76 percent of all oil spills would be <1 bbl, 19 percent would be between 1 and 5 bbl, 5 percent would be between 5 and 25 bbl, and the total amount of oil spilled during the entire production life of the field would be 280 bbl. While oil spills in the surrounding environment may adversely affect arctic fish in the immediate area, their small size is likely to preclude them from traveling far enough to get into large rivers and subsequently into coastal waters. Even if they did get into large water bodies, such as the 325 bbl oil spills that are being assumed to occur in Teshekpuk Lake and the Colville River, the studies mentioned under Alternative A indicate that they are likely to have no measurable effect on arctic fish populations. Hence, no effects are expected on arctic fish populations in large waterbodies or coastal waters from oil spills associated with Alternative B. Some fish in the immediate area of an oil spill may be lethally or sublethally affected, particularly if the spill occurred where and when fish are migrating, in overwintering areas during winter, or in small waterbodies having restricted water exchange (an estimated 3 to 5 year recovery). However, because of the small size of the oil spills anticipated, the low diversity and abundance of fish in most of the planning area (particularly large resident fish), the unlikelihood of spills blocking fish migrations or occurring in overwintering areas, and the fact that Alternative B precludes any oil and gas activity in most of the planning area inhabited by fish, oil spills associated with Alternative B are not expected to have a measurable effect on arctic fish populations in the planning area over the production life of the field.

The effects of a seawater pipeline spill on freshwater fish populations would depend on the specific location, size, and timing of the spill. No effect would be expected during the winter period when the surface is already covered by ice. During the spring and summer large quantities of seawater entering a fish bearing freshwater environment would have from no effect on freshwater fish to lethal effects, depending on the specific waterbody involved, the size of the seawater spill into that waterbody, and the rate of freshwater exchange within that waterbody. Migratory fish are not likely to be affected by seawater spills because of their higher tolerance to seawater, and the probability that most would have already left the freshwater environment by spring in their migration to sea. In large water bodies seawater spills are expected to have from no effect to sublethal effects on freshwater fish. In small water bodies with restricted water exchange, lethal effects are more likely to result from a medium to large seawater spill. Recovery would be expected within 1 to 3 years depending on the rate of freshwater exchange. However, because of the small size of the seawater spills anticipated and the low diversity and abundance of freshwater fish in most of the planning area, seawater spills associated with Alternative B are not expected to have a measurable effect on arctic fish populations in the planning area over the production life of the field.

Conclusion—First Sale: Based on the discussion in the text, fuel spills associated with Alternative B are expected to have a similar effect on arctic fish populations as discussed for Alternative A. Seismic surveys, construction related activities (drill pads, roads, airstrips, pipelines, and gravel extraction); and fuel, oil, and seawater spills associated with Alternative B are not expected to have a measurable effect on arctic fish populations in the planning area over the production life of the field.

Multiple Sales: While additional lease sales in the planning area would involve more seismic surveys than the first sale, and thereby would increase the probability of seismic activity occurring above overwintering habitat, such events are likely to be infrequent. Seismic surveys associated with multiple sales in Alternative B are expected to have the same overall effect on arctic fish populations as discussed for the first sale (i.e., no measurable effect on arctic fish populations). For additional sales in the planning area, the number of production pads and pipeline miles are estimated (Table A.2-8) to be about twice the number of gravel pads as the first sale (Table A.2-6). Gravel pads for multiple sales are likely to have about twice the effect on arctic fish as the first sale. Because there is little difference in the estimated number of pipeline miles for multiple sales (up to 90) and the first sale (up to 75), they are expected to have a similar effect as discussed for the first sale. It is estimated that up to 400 bbl of crude oil would be spilled, or about 1.4 times that of the first sale (estimated at up to 280 bbl). On the basis of this estimate, crude oil spills for multiple sales are expected to have a slightly greater effect on arctic fish populations than the first sale. However, if there were not enough time between sales to allow for full recovery, or if the level of activity of the selected alternatives were

significantly greater than that of the first sale, the effect of each additional sale on arctic fish populations is likely to be greater than estimated herein for multiple sales.

Conclusion—Multiple Sales: Seismic surveys and pipelines associated with multiple sales are expected to have the same overall effect on arctic fish populations as the first sale. Gravel pads are expected to have about twice the effect as the first sale. Fuel and oil spills are likely to have a greater effect on arctic fish populations than the first sale. Insufficient recovery time between sales and/or greater levels of activity would be likely to result in greater effects than estimated herein for multiple sales.

Effectiveness of Stipulations: Stipulations 15, 16, 20, and 39 through 42 are the most likely to have a beneficial effect on arctic fish. Others that may benefit arctic fish include Stipulations 5, 9, 11, and 12. With these stipulations in place, there is an increased probability that (1) spawning and overwintering fish would be unaffected by construction-related actions, (2) fish passage and streamflows would be maintained, and (3) the effects of accidental oil and fuel spills would be minimized.

8. Birds: This section discusses potentially adverse effects of ground-impacting-management actions on nonendangered birds within the planning area under Alternative B. Such actions, including oil and gas exploration and development, potentially may result in disturbance , habitat alteration or loss, and fuel or oil spills. Effects on birds exposed to such factors would be similar to those discussed under Alternative A, with the addition of effects specifically associated with oil and gas activities.

a. Activities Other than Oil and Gas Exploration and Development: Management actions for activities other than oil and gas exploration and development under Alternative B, and their potential effects, differ from those discussed for Alternative A as follows:

1. The Colville River would be recommended for designation as a "wild" river in the WSR System, with stipulations protecting existing wild values. Most importantly, in the riparian corridor area: (a) flood-control development and major diversions are prohibited; (b) mineral leases within ¼ mi are prohibited and mining activities should be conducted to minimize surface disturbance, sedimentation, and pollution; (c) roads/trails for motorized travel, and most motorized travel would be prohibited (possible exceptions); (d) major public use areas/facilities are prohibited; (e) designation of new rights-of-way (e.g., pipeline) is discouraged.

2. A portion of the Colville River Raptor, Passerine, and Moose Area LUEA would be proposed as a Bird Conservation Area.

3. There would be no surface occupancy for industrial development within ½ mi of the Colville, Kogosukruk, or Kikiakrorak rivers. Stipulations (Sec. II), and any of these actions (see items 1 and 2) that are successfully concluded, may enhance raptor and passerine habitat protection along the rivers and potentially decrease the level of noise and visual disturbance of nesting birds. However, recreational boating would be encouraged, and this potentially could increase visitation and associated disturbance and/or habitat degradation in this area. The estimated visitation above Umiat under this alternative is 15 parties per summer (9 under Alternative A); below Umiat, where most raptor nesting occurs, also 15 parties (5 under Alternative A). This increased amount of visitation actually may decrease the reduction of such effects from this and other factors (e.g., overland motorized travel) expected to occur with the stipulations in place. As a result, the effect of visitation on breeding success of raptors (or passerines) is expected to increase from that discussed under Alternative A, but information that would allow quantified predictions is lacking. Presumably, effects could include nest abandonment, interruption of incubation or brooding, and/or decreased provisioning of young, any of which could result in lower productivity. Although Ritchie (1987) found no nest abandonment or lower productivity at nest sites along the Sagavanirktok River, and all were reoccupied subsequently, peregrine falcons did display strong reactions (flight, calling) to boats at an average distance of 1,540 ft (469 m) from nest sites.

4. Some ground activities are focused on the central and southern planning area where lower densities of most waterbirds, but not the Pacific loon, oldsquaw, scaup, scoters, and jaegers, are found; however, such activities are expected to occur at scattered localities and, thus, effects are likely to be similar to Alternative A, a minor loss of productivity.

5. Some ground activities (surveys) and presence of camps would be prolonged two to four times as long as under Alternative A, but this is not expected to significantly increase the extent of displacement, predation by attracted predators, or minor declines in productivity by local bird populations, which may not be detectable above the natural fluctuations of the population and survey methods/data available.

6. Aircraft activities (transport, surveys) would be regular rather than occasional and continue for longer periods

(up to 3 weeks) than under Alternative A (Table II.H.3.b). As a result, effects of aircraft traffic on breeding success of various species and/or survival of molting geese are expected to increase from those discussed under Alternative A, but information that would allow quantified predictions is lacking. Presumably, they could include nest abandonment, interruption of incubation or brooding, and/or decreased provisioning of young and, potentially, adverse energetic responses by molting geese, which could result in lower productivity by breeding birds or survival of molting geese. These effects are not expected to be significantly greater than under Alternative A, but lost productivity of breeding birds and decreased survivorship of molting birds may not be detectable above the natural fluctuations of the population and survey methods/data available.

b. Oil and Gas Exploration and Development Activities: Oil and gas leasing would be allowed on approximately 53 percent of the planning area (Fig. II.C.1-2; Table IV.A-1), including lands outside the LUEA's (these may be crossed by pipelines) and in the Kuukpik Corporation Entitlement LUEA near Nuiqsut (Sec. II). Infrastructure and associated construction required for development and production is expected to be substantially greater than that for exploration—two approximately 10-acre production pads separated by about 3 mi of connecting road/airstrip (60-110 acres in total) and pipeline system for oil transportation. Exploration would occur during the winter season for up to 10 years and involve about 60 persons, while development and production activity would be year-round for 2 to 5 years and require about 350 persons during the construction phase. Potential effects of disturbance, habitat alteration or loss, and oil pollution are discussed in USDOI, MMS (1996a), which is incorporated by reference and summarized below.

(1) Effects of Disturbance: Noise from human activities and visual presence of humans and/or equipment and facilities may disturb birds during any phase of the annual cycle; birds are particularly sensitive when attending a nest, accompanying fledged young, or in a flightless molt condition. Disturbance may cause individuals to abandon local nesting, feeding, broodrearing, molting, or staging areas; to expend energy stores essential for completing the annual cycle; and to experience higher rates of predation by predators attracted to facilities, all of which may contribute to decreased productivity, survival, and/or recruitment. Habitat alteration or loss may result in many of these same effects. Potentially disturbing activities include seismic surveys, aircraft operations, marine-vessel traffic, drilling operations, construction activities, vehicle traffic, oil-spill-cleanup operations, and movement of personnel near facilities. Natural disturbance factors include potential predators and other individuals of the same or closely related species.

(a) Effects from Seismic Surveys: It is assumed that seismic surveys will occur during winter months (December-April), when nearly all birds are absent from the region. Effects of seismic surveys are expected to be as discussed for Alternative A (brief, <1 day, local disturbance and no significant population effect). Use of a more tightly spaced 3-D seismic grid (Sec. IV.A.1.c) potentially may cause ptarmigan, gyrfalcons, or snowy owls to vacate a 10 by 15 mi (16 x 24 km) area for the winter season (1+ mi^2 surveyed/day), a more significant result than typical seismic operations but still expected to cause minor local rather than population-level effects.

(b) Effects from Aircraft Operations: Oil and gas activities in the planning area will be supported primarily by fixed-wing aircraft, with helicopters used mainly for emergencies and pipeline inspection.

Under this alternative oil and gas activities would occur only in approximately the southern half of the planning area as indicated above. Because one flight every other day would be required to service either seismic or exploration-drilling operations, the potential level of disturbance may be greater near a single exploration pad than at each succeeding seismic location. Potential effects of this activity could range from minor temporary (<1 day) behavioral alterations or displacement in a few ptarmigan, gyrfalcons, or possibly snowy owls near survey gridlines or drill-sites, to avoidance of the immediate area of routinely used airstrips for the winter season. No population- level effects are expected.

If a commercial oil discovery is made, drilling operations and associated activities supported by aircraft may occur throughout the year, with one to two flights/day anticipated at up to four sites. The overall impact of aircraft would depend on the character of the operations—type of aircraft, flight frequency, altitude, lateral distance to individuals, route used, season of operation—and the sensitivity of the population segment exposed to characteristics potentially causing disturbance. If aircraft supplying or operating out of these sites overfly bird-concentration areas routinely, an adverse noise/visual aspect to the environment could be introduced potentially causing abandonment of nesting efforts or lower survival of young in the vicinity, and may contribute to avoidance of the immediate area for future nesting attempts. Several areas where 1 to 4 species of 12 routinely recorded on waterfowl breeding pair surveys occur at high density (especially the Pacific loon, yellow-billed loon, tundra swan, king eider, oldsquaw, scoters, jaegers) are located within the area proposed for oil and gas leasing (Fig. III.B.4-1) .

Lateral distance at which observable responses occur or percent individuals responding have been quantified for few species: twin engine fixed-wing aircraft (e.g., twin otter) approaching within 0.6 mi (1 km) of nesting snow geese on Howe Island east of Prudhoe Bay elicited minor responses of alert posture and short movements in 9-57 percent of individuals (Burgess and Ritchie, 1989); most (81-100%) Canada, greater white-fronted, and snow geese in the Lisburne area at Prudhoe Bay showed no reaction when approached within 0.3 mi (0.5 km); most brant (84%), a more sensitive species, moved away from their position under the same circumstances (Murphy, et al., 1990); at Izembek Lagoon, 31, 73, and 79 percent of staging Canada, emperor geese and brant, respectively, responded to similar test conditions (Ward and Stehn, 1989).

As a result of these levels of response to aircraft, nesting activity for most waterfowl is expected to variably decrease within 0.3 to 0.6 mi (0.5-1 km) of any corridor used by routine air traffic, especially under takeoff and landing corridors near the facility, for the duration of each well drilled (approximately 3 months), and subsequent maintenance activity. Estimated numbers of individuals exposed along such a corridor, for example, could include 1 to 11 yellow-billed loons, 0 to 20 king eiders, or 5 to 358 oldsquaw, depending on the specific facility location. Low-level pipeline-inspection flights are expected to displace a small number of nesting attempts away from the immediate vicinity of a pipeline for <1 day. Overall effect of aircraft operations on bird populations at such sites is expected to be localized displacement and minor decrease in reproductive success, but any lost productivity or recruitment may not be detectable above the natural fluctuations of the population and survey methods/data available.

Raptors also are sensitive to close approach by humans, other raptors, and potential predators, but exhibit more variable response to aircraft and vehicles (Awbrey and Bowles, 1990; Haugh, 1982; Platt, 1977; Ritchie, 1987). Ritchie (1987), recording peregrine falcon reactions to potential disturbance along the Sagavanirktok River, found no nest abandonment or reduced productivity and all sites were reoccupied the following year. He found that peregrines displayed (1) moderate reaction (preflight intention behavior) to helicopters averaging 2,358 ft (719 m) from a nest and mild or no reaction at 3,684 ft (1,123 m); and (2) moderate reaction to fixed-wing aircraft averaging 1,750 ft (533 m) distant and mild/none at 2,768 ft (844 m). These data suggest a ½-mi (2,640 ft; 805 m) setback along the Colville and other rivers would be sufficient to eliminate moderate or more severe reactions of peregrines to potential aircraft disturbance. Hunting range of a pair of peregrine falcons nesting along the Sagavanirktok River was estimated to be over 124 mi^2 (320 km^2) and the distance from nest to a foraging area was 9.1 mi (14.6 km) (White and Nelson, 1991). This suggests that such an expansive habitat will not be altered enough in any single foraging range to jeopardize successful raptor reproduction. Near Umiat, Haugh (1982) found that peregrine falcons nesting within 3 mi (4.8 km) of the airstrip apparently were not affected by activities associated with drilling an exploratory well, including supporting air traffic (nest site was not overflown). During construction and drilling one pair nested at a previously unoccupied site within 1 mi (1.6 km) of the airstrip even though more suitable isolated sites were available. Likewise, a pair of gyrfalcons moved their nest site between years to within 1.2 mi (1.9 km) of a wellsite airstrip and successfully raised young. Also, peregrine falcons nest successfully in some of the largest cities of the U.S.

(c) Effects from Vessel Operation: Some heavy equipment, supplies, or gravel may be transported by barge from existing infrastructure to coastal staging areas during the open-water season, but the probability of interaction with eiders, oldsquaw, or other waterfowl staging in lagoon or offshore waters, or broodrearing geese in coastal fringe areas, is considered low. No species is expected to experience significant displacement from foraging areas as a result of exposure to vessel traffic.

(d) Effects from Drilling Activities: Noise and activity associated with exploration drilling in winter potentially could displace small numbers of ptarmigan from within an estimated 700 ft (213 m) of the site, and any gyrfalcons and possibly snowy owls present may be displaced 0.6 mi (1 km) or more by the activity. Because such sites would affect a small area (3-10 acres), there is not expected to be a significant population effect. If a commercial discovery is made, noise and activity of summer drilling may disturb a small number of nesting and/or molting waterfowl or other species within a kilometer of the activity. Data obtained in the vicinity of facilities in the Prudhoe Bay area indicate that spectacled eiders, for example, are quite tolerant of noise and activity (TERA, 1996a). Some localized displacement of nesting birds from the vicinity of such sites may occur, but significant affects on reproductive success are not expected. Oil exploration offshore from an ice island and subsequent development of facilities on the coast of the NPR-A in Harrison Bay south of Atigaru Point in winter is not expected to affect resident species. Onshore development should be placed to avoid important habitats used by broodrearing geese such as tidal sloughs, tideflats, and saltmarshes. Year-round operation of such facilities could disturb waterfowl foraging along the coastal shoreline of lagoons or shorebirds and waterfowl breeding in the vicinity. This activity is expected to cause minor

effects by exposure of only limited numbers of birds to additional noise and visual disturbance.

(e) Effects from Construction Activities and Vehicle Traffic: No construction activities are expected to occur in marine areas, so no effects on birds occupying marine habitats are anticipated. Onshore construction likely will occur in winter and result in effects similar to those caused by drilling. If development and production occur, construction on pads and vehicle traffic on roads connecting drill pads in the is expected to result in minimal displacement of nesting birds from within an estimated 700 ft to 0.6 mi (213 m-1 km) of routinely used pads and roads, depending on tolerance to noise and activity of potentially affected species. Summer traffic will be limited to transport and maintenance within the fields, because no road access to the s from existing systems is planned. Gravel extraction is expected to take place primarily at permitted areas east of the planning area and be transported to pad- and pipeline-construction sites via ice road in winter, causing effects similar to those discussed for seismic activities—displacement of winter-resident birds from within 700 ft to 0.6 mi (213 m-1 km) of roads and storage sites.

(f) Effects from Spill Cleanup: No spills are expected to occur in marine areas, and no effects on birds occupying marine habitats are anticipated. Approximately 65 to 80 percent of onshore crude-oil spills averaging 4.0 bbl occur on pads and are contained before entering the surrounding area; thus, most potentially disturbing cleanup activity would be confined to the immediate pad area. Because routine activities occurring on the pad during the breeding season are likely to have displaced sensitive species at least several hundred feet (a few hundred meters) away from the pad area, the incidental spill-cleanup activity is expected to cause minimal additional disturbance effect among remaining birds nesting, broodrearing, or molting in the pad vicinity—potentially a few clutches or broods could be lost to predators if adults are disturbed and leave the nest unprotected, but the most likely effect would be brief behavioral responses. Mueller (1997, pers. comm.) reports that a pipeline spill on December 30, 1993, at drill site 5, well 23, misted a fine oil spray over a tundra area of 100 to 145 acres. Of the off-pad spills that occur, many contact snow, which is cleaned up before the oil reaches the tundra. The ADEC database documents that a spill at Point McIntyre covered approximately 23 acres of snow-covered tundra with 142 bbl of crude oil. Because this area was snow covered, there was little impact to the surrounding environment. If this spill occurred during the summer, the impacts would have been very different. Any spills that reach the surrounding environment may spread more widely, especially if aquatic habitats are involved, and require greater cleanup effort that may cause more widespread disturbance effects.

(g) Effects from Predator Attraction: The attraction of predators on birds (glaucous gull, common raven, arctic fox, grizzly bear) to uncontained refuse is well known. The extent to which conditions that attract such wildlife would occur at the proposed facilities is uncertain and is expected to be closely regulated. Although some studies have demonstrated a high correlation between presence or absence of predators and reproductive success, it is uncertain in most instances what effect predation by these species has on overall reproductive success and local population trends. Nor is it certain if predator populations with access to refuse are higher than they would be in its absence. Fox and gull predation on island-nesting species or those that are colonial has been implicated in nest losses ranging from substantial to total failure (e.g., snow goose, Burgess and Rose, 1994; Johnson and Noel, 1996; common eider, Quinlan and Lehnhausen, 1982). Several studies have correlated nest success with fox predation pressure (e.g., brant and shorebirds, Underhill et al., 1993). Oil and gas development and production facilities could attract all four species if conditions are not closely controlled, but in the short term this is not expected to cause other than local concentration of predators affecting local breeding success. The extent of any effect is not known but could involve any of the species likely to occur in the planning area. If an artificial food source becomes available where development occurs, long-term effects may include increased predator survival and breeding success. Depending on the scale of predator dispersal, such effects on predator populations could result in some adverse effects on birds over a relatively wide area. Overall effect on populations is not expected to be detectable above the natural fluctuations of the population.

(2) Effects of Habitat Alteration and Loss: Habitats underlying ice pads and roads are temporarily altered/lost for bird use as a result of delayed thaw, soil compaction, and vegetation disturbance. In the summer following pad/road use delayed melt would make the area unavailable until after most species begin nesting. This would be expected to affect species with strong nest site fidelity (e.g., shorebirds, ptarmigan), although displaced individuals may use other available habitat in the vicinity (Troy and Carpenter, 1990). Compaction of soil and vegetation (decreased concealment) or drainage effects (Sec. III.A.2.a) could persist for a longer period. Pads range from 3 to 10 acres and roads from 5 to 6 acres/mi; the length of road required is uncertain at present, but several hundred acres in the planning area could be unavailable for a season, with some degradation persisting several years. For example, an ice road from the planning area boundary to an exploration site south of Teshekpuk Lake might remove 370 acres, equivalent to 0.008 percent of the planning area. Areas subject to such minor disturbance are expected to recover almost fully within a relatively few years (Jorgenson and Joyce, 1994) and to

support the original plant and animal communities. Effects on bird productivity are expected to be minor, because adjacent undisturbed habitat would be available for most species, and recovery of the area would be relatively rapid.

Gravel pad, road, and airstrip construction and gravel mining would result in loss of habitat for the duration of production; this alteration would be permanent unless restoration is completed successfully. Current techniques are expected to restore such areas to usable habitat, but rarely would they duplicate the original habitat characteristics (Jorgenson and Joyce, 1994). As the most abundant habitat types, tussock tundra, dwarf shrub, and moist sedge-grass meadow probably are the habitats that would be most affected, but the proportion lost would be small relative to their abundance. Although presence of gravel structures will be long-term and habitat alteration severe, the area involved is relatively small (<60 acres; <110 acres if gravel must be mined locally). Displaced individuals may use undisturbed habitats with variable nesting results (Moiteret, Walker, and Martin, 1996; Post, 1990; Troy and Carpenter, 1990), i.e., (a) typical nest success in comparable habitat, (b) no attempt to nest (loss of that year's productivity), or (c) lower fecundity/breeding success/productivity, or survival/recruitment as a result of nesting in suboptimal habitat. The population effect would be complicated by substantial numbers of displaced individuals attempting to find comparable habitat to occupy, and variable success among those that do nest caused by behavioral factors such as territoriality and competition with individuals in the alternate area. Differences in food availability and predation also would affect breeding success. At present, we do not have adequate data for most species that would allow accurate determination of effects at various levels of reproductive success. Breeding success of a pair in undisturbed habitat could range from 0 100 percent in a given year. The small area likely to be made uninhabitable under this alternative (about 60 acres) is likely to contain relatively few breeding pairs even of abundant species (e.g., semipalmated sandpiper = 16 birds/km^2 at one site in the northeastern NPR-A, = 4 birds/60 acre tract—most species are present at much lower density). Even if these individuals were 100 percent successful raising a full complement of young, their loss would represent a negligible to minor effect for the population. Loss of a year's productivity for uncommon or rare species with specialized or limited habitat options and/or small populations would be more significant to the regional population. The probability of including the nest site of a rare species in a given 60 acre tract presumably is quite low.

Gravel mining outside the planning area is assumed to occur in the Nuiqsut area and be transported to site on ice roads during winter. This activity could cause minor local disturbance and temporary displacement of the three resident species along the road route and at the mine site. During the breeding season, nesting individuals would be displaced to undisturbed habitats with potential for lowered productivity as discussed above.

Habitat use by birds may be altered along roads and other structures by dust fallout, gravel spray, snow accumulations, thermokarst, impoundments, water withdrawal, and contaminants; habitat fragmentation from road networks also may affect use. Dust fallout effects would be most pronounced within 35 ft of the source (ARCO, 1996); this would approximate 34 acres at the expected facility (Fig. IV.A.1.b-1). The principal effects of dust fallout would include advanced snowmelt (up to 2 weeks early); increased depth of thaw; thermokarst; reduced plant photosynthesis; decreases in some common moss, lichen, and shrub species; and development of barren areas (Everett, 1980; Klinger, Walker, and Weber, 1983; Walker, Lederer, and Walker, 1985; Walker and Everett, 1987). Early melt provides waterfowl and ptarmigan prenesting access to exposed forage (Murphy and Anderson, 1993) but also exposes them to risk of vehicle strikes. Likewise, shorebirds may be attracted to areas adjoining light-traffic roads because of earlier availability of nesting habitat in combination with an acceptable level of disturbance (Troy, 1988; TERA, 1993).

Thermokarst from surface disturbance may result in enhanced growth and nutrient concentration in forage plants, which might be expected to attract birds, but the evidence appears insufficient to assess the net effect on populations (Truett and Kertell, 1992). Water temporarily impounded by roads and pads, in combination with early habitat availability caused by dust fallout and delayed availability due to persistent snowdrifts resulting from differing traffic levels, has been found to attract some shorebird species while others are found in lower densities than in undisturbed areas (Troy, 1986). For example, TERA (1993), in an extreme case, found habitat use by semipalmated sandpipers along a heavily traveled road at Prudhoe Bay reduced 40 percent from that in an undisturbed area. Most other species examined in this study showed declines of lesser magnitude; red-necked phalarope exhibited higher density. Water withdrawal from lakes could alter the local hydrologic regime resulting in less suitable habitat for some species but more favorable for others, e.g., dominant nesting species in such an area could change from red phalarope with preference for wetter habitat and access to open water, to pectoral sandpiper preferring drier habitat. The potential field layout (Fig. IV.A.1.b-1) does not appear to cause habitat fragmentation as occurred with road networks in the Prudhoe Bay area. In any case, TERA (1993) found little support for the hypothesis that fragmentation affects bird use of areas surrounded by facilities.

There is little doubt that bird use of habitats is altered when these habitats are near roads and pads, and that effects vary among species and phase of the summer season. However, potential facility size and design suggests that only a small amount of habitat will be altered by proposed oil and gas development resulting in no greater than minor effects on local bird populations.

(3) Effects of Spills: It is assumed that no crude oil would be released during exploration. No spills are expected to occur in offshore marine areas, so any spills contacting birds occupying marine habitats are likely to originate on land, as runoff from pads/roads, at an onshore well, or at pipeline river crossings. Approximately 65 to 80 percent of onshore crude-oil spills, averaging 4.0 bbl, occur on pads where they are contained before entering the surrounding area; thus, a substantial proportion of spills are not expected to adversely affect bird populations. Probability of exposure and species exposed to the 20 to 35 percent of spills that occur on or reach tundra habitats would depend on the season of occurrence and, if occurring in the open-water season, whether they enter nonaquatic or aquatic habitats. Spills reaching nonaquatic habitats generally remain in limited areas (<538 ft^2 = 50 m^2), and the small volume likely to be spilled suggests that only a few foraging or broodrearing shorebirds or passerines potentially would contact the oiled area; population effects under these circumstances are expected to be insignificant and are not likely to be detectable above the natural fluctuations of the population.

Birds exposed to spilled oil in aquatic habitats are not expected to survive moderate to heavy contact. Oil ingestion by adults during preening or feeding may reduce breeding success and causes various pathological conditions, including impaired endocrine and liver function and reduced nestling growth (Burger and Fry, 1993; Harvey, Phillips, and Sharp, 1982; Holmes, 1985; Holmes and Cavanaugh, 1990; Hughes, Kassera, and Thomas, 1990; Koth and Vank-Hentzelt, 1988; Peakall et al., 1980; Stubblefield et al., 1995). Oil contamination of eggs by adults significantly reduces hatching success (Albers, 1980; Butler, et al., 1988; Harfenist, Gilman, and Maus, 1990; King and Lefever, 1979; Stickel and Dieter, 1979). In addition, oil in tundra ponds can have long-term effects on invertebrate prey populations and emergent vegetation, thereby reducing food availability and escape cover for waterbirds in the area impacted by the spill (Barsdate et al., 1980; Hobbie, 1982). The occurrence of these effects may be increased by contamination of food, lakeshores, and marine shorelines.

At greatest risk would be loons and waterfowl occupying open waterbodies or streams, especially individuals with young or in molt. However, the small average spill volume suggests that only a small proportion of the surface of any but the smallest lakes (e.g., <1.2 mi^2 = 3 km^2) would be covered by oil, and most small lakes typically have <100 individuals; in these situations, contact is expected to be on the order of tens of individuals. A larger spill entering a larger lake (<7.7 mi^2 = 20 km^2) with a more substantial population could result in greater losses, on the order of hundreds of individuals. This would depend on the location of birds in relation to where the oil enters the lake and the direction and velocity of wind driving the slick; in either case, losses may not be detectable above the natural fluctuations of the population. Spills entering streams or rivers during the breeding season could contact waterfowl adults and/or young. Oil entering coastal lagoon habitats occupied by broodrearing or staging waterfowl (e.g., oldsquaw) potentially could contact substantial numbers of individuals, but the small estimated average spill size suggests that only minor contact and effect would occur.

Because spills of refined oil products (primarily fuels and lubricants) are likely to occur on pads or roads where they can be contained and removed, and the small estimated average spill volume (0.7 bbl), significant exposure of birds is not expected to occur.

If a 325-bbl crude-oil spill entered Teshekpuk Lake or the Colville River, small numbers of waterfowl and/or raptors could be exposed. Species observed on Teshekpuk Lake during breeding pair surveys at greater than the lowest density for the species include the Pacific and red-throated loons, tundra swan, greater white-fronted goose, oldsquaw, king eider, scaup, and scoters. At 30 days, the spill nominally would cover 61 acres but would disperse as patches so the effective size would become much larger, especially if winds were variable following the spill. If winds were more from a prevailing direction, the oil could pile up on a section of shoreline and expose few individuals. Thus, numbers of individuals oiled would depend primarily on wind conditions and numbers and location of birds following entry of the spill into the lake. If the spill entered the Colville River, a variety of loon, goose, or duck species could be present. Canada geese breed on bluffs along the river. Gyrfalcons, peregrine falcons, and rough-legged hawks could become secondarily oiled by preying on oiled waterfowl. If the spill moved into the delta area, additional waterfowl species that breed there or stop during migration would be at risk. A spill entering the river in spring could contaminate overflow areas or open water where spring migrants of several waterfowl species concentrate prior to occupying nesting areas. Information concerning numbers of waterfowl seasonally present on the river is lacking.

(4) Seawater Pipeline Spill in Planning Area: A pipeline spill of seawater used in waterflood enhancement of production would kill salt-intolerant tundra vegetation near the pipeline. The amount of tundra habitat affected is

expected to be no more than a few acres; this small area of degraded habitat is not likely to result in loss of productivity by displaced breeders that is detectable at the population level.

(5) Indirect Effects: During the period November to May, species that breed or molt in the northeastern NPR-A area migrate along well-known flyways and other major corridors to other areas in Alaska, the lower-48 states, Canada, Russia, or Mexico and south, where they are the focus of a wide range of user groups. These stakeholders—including nonconsumptive users, subsistence and recreational hunters, and wildlife managers—are concerned about the conservation and management of birds and the potential for adverse effects that Arctic Slope projects represent. Any effects that result in lowered productivity or survival of the various bird species could affect the access of stakeholder groups to this resource to some degree by decreasing bird population levels along migration corridors or in wintering areas. Because overall effects of management actions on birds in the northeastern NPR-A area are expected to be minor, and these birds in general disperse over large migration and wintering areas, effects on stakeholder groups also are expected to be minor. However, detailed information that could allow accurate analysis of this effect is not readily available or has not been compiled in a usable format.

Conclusions: Under Alternative B, most disturbance effects not associated with oil and gas activities are expected to be similar to those discussed for Alternative A, although lost productivity of nesting species and decreased survivorship of molting birds may not be detectable above the natural fluctuations of the population. Most raptors exposed to such activities at distances <1 mi exhibit minor behavioral changes and >1 mi experience no apparent effect or reduced productivity. Overall effect of aircraft operations supporting oil and gas activities, and most other activities causing disturbance, on productivity or recruitment of bird populations in the vicinity of drill sites is expected to be localized and minor, but likewise may not be detectable above the natural fluctuations of the population. Losses attributed to predators attracted to sites may be substantial but is difficult to quantify. Displacement of nesting birds from gravel structures and pits is expected to have primarily minor local effects on productivity because displaced individuals are likely to use adjacent undisturbed habitats.

As a result of their small average size, onshore oil spills reaching aquatic habitats are expected to cause losses of tens of individuals, but the effect of such losses may not be detectable above the natural fluctuations of the population. An oil spill at a well within 2 mi of the coast is expected to have similar effects as other onshore spills; it is unlikely to enter the marine environment.

Because overall effects of management actions on birds in the northeastern NPR-A area are expected to be minor, effects on stakeholder groups also are expected to be minor.

Multiple Sales: If multiple sales occur in the area available for leasing under Alternative B, intensive construction activity could last 15 to 30 years, tapering off as existing infrastructure is used for each succeeding development. Approximately four times the number of exploration wells may be drilled (1-4 versus 4-14), and the number of fields developed (0-1 versus 0-2) and production pads (0-2 versus 0-4) are expected to double, with multiple sales. Pipeline miles (0-75 mi) are expected to increase to 0 to 90 mi. Surface, air, and foot traffic is expected to increase somewhat near facilities with multiple sales, and to displace greater numbers of individuals and involve more species than with a single sale, though the increase is not expected to significantly affect populations. Effects from disturbance and habitat alteration or loss on birds is expected to increase in the southern half of the planning area with multiple sales under Alternative B.

The estimated number of onshore oil spills >1 bbl is expected to increase to 0-25 (average size 4 bbl) for multiple sales from 0-17 for the first sale. Small refined-oil spill are expected to increase to 0-232 for multiple sales from 0-162 for the first sale (average size of 29 gal) over the production life of the planning area (Tables IV.A.2-3a, IV A2-3b, IV A 2-6a and IV A 2-6b). These small, chronic spills are expected to have a similar effect on birds and their habitats as under Alternative B with the first sale but with increased numbers of species involved and increased loss of individuals; habitat contamination is expected to increase locally at the spill sites and along any streams contaminated by these spills. These spills are expected to result in the loss of small numbers of birds that is not likely to be detectable above the natural fluctuations of the population and survey methods/data available. Any habitat contamination that is not effectively cleaned up is expected to persist for several years but is not expected to affect populations significantly.

Conclusion—Multiple Sales: Displacement of birds from disturbance and habitat alteration is expected to double in the southern half of the planning area under Alternative B with multiple sales but still not significantly affect coastal plain populations. Increases in oil and refined oil spills are expected to result in the loss of small numbers of birds that is not likely to be detectable above the natural fluctuations of the population and survey methods/data available. Overall effect is expected to increase somewhat from that discussed for the first sale.

Effectiveness of Stipulations: Subject to several exemptions noted in Section II.7, the proposed stipulations are expected to have the following effects.

Disturbance of birds from ground transport and/or other activities including oil and gas activities (not allowed in the Goose Molting Habitat or Colville River Raptor, Passerine and Moose LUEA's under this alternative) would be mitigated, and essential habitat protected, by Stipulations 20b-d, g-m; 50a, c; minimizing and seasonally restricting traffic volume and vehicle use/speed, seismic activity, and taking other recommended environmental precautions in Goose Molting (no activities allowed 1 May-30 Sept) and Colville River LUEA's (loons, waterfowl, shorebirds, raptors, passerines affected); Stipulation 25 placing permanent facilities outside a 1,640-ft (500 m) buffer around all goose-molting lakes and 3,280 ft- (1,000 m) buffer around high-use lakes (loons, waterfowl, shorebirds); Stipulation 13c for not disposing of domestic wastewater into freshwater; Stipulation 17 for not removing water from lakes in the Goose Molting Habitat if it would adversely affect lakeshore goose-feeding habitats (loons, waterfowl, shorebirds); Stipulations 14, 34 offsetting ice road location annually, and seasonally restricting major construction in the Goose Molting LUEA (loons, waterfowl, shorebirds); Stipulations 39, 40, 41,43, 45, 48, 70, establishing facility setbacks along specified lakes and streams, facilities and mining sites located out of floodplains and 500 ft (152 m) from lake basins, maintaining natural drainage patterns during and after construction, prohibiting most surface structures in the Colville River Raptor, Passerine, and Moose LUEA, and minimizing impacts on key wetlands (loons, waterfowl, shorebirds, raptors, passerines); and Stipulation 59 for sites being rehabilitated when abandoned.

Aircraft disturbance of birds would be mitigated by Stipulations 54, 55, 56, 57, seasonal restriction of helicopter flights in the Goose Molting LUEA, maintenance of seasonal minimum air traffic volume in and flight altitudes over the Teshekpuk Lake Caribou and Goose Molting LUEA's, and within ½ mi of peregrine falcon nests, prohibiting use of aircraft to haze birds (loons, waterfowl, shorebirds, raptors, passerines).

Potentially adverse situations involving hazardous materials and wastewater would be mitigated by Stipulations 5, 8, immediate cleanup of fuel spills and other hazardous materials using procedures approved by USEPA, ADEC, and OSHA, and materials stored at all fueling and maintenance areas; and Stipulations 9, 11, 12, storing fuels in lined/diked areas at least 500 ft (152 m) from lakes and streams, not storing fuels on lake or river ice, and not refueling equipment within 500 ft of lakes or streams (loons, waterfowl, shorebirds, passerines).

Other potentially adverse situations would be mitigated by Stipulations 1, 75, taking precautions to avoid attracting wildlife (predators) to refuse, and prohibiting the feeding of birds (most birds); Stipulation 65, requiring all personnel to participate annually in an orientation program that aquaints them with biological resources and their sensitivity to disturbance and habitat degradation; and Stipulation 67, requiring all visitors to adhere to the applicable stipulations

These stipulations would minimize disturbance from most factors, prevent fuel or oil spilled on pads from reaching surrounding habitats, and help prevent pollution and degradation of critical wildlife habitats.

9. Mammals:

a. Terrestrial Mammals: Among the terrestrial-mammal populations that could be affected by ground-impacting-management actions under Alternative B are TLH and CAH caribou. Caribou of the WAH are not expected to be affected significantly, because their calving range is located far to the west of the planning area (Fig. III.B.9.a.-1). Some WAH caribou temporarily may be exposed to helicopter traffic and other human activities associated with resource inventories and seismic operations, but such exposure is not expected to have any effects on the population. Moose, muskoxen, grizzly bears, wolves, wolverines, and arctic foxes may be locally affected by planning-area activities. Small rodents (such as lemmings and voles) and their predators (such as short-tailed weasels) could be affected locally along seismic lines, pipelines, gravel pads, and other facilities. However, these losses are expected to be insignificant to populations on the Arctic Slope of Alaska.

(1) Activities Other than Oil and Gas Exploration and Development: Air traffic, humans on foot, and the presence of resource-inventory-survey camps are expected to increase somewhat under Alternative B as compared to Alternative A. Aircraft traffic associated with resource inventories and surveys is expected to pass overhead of caribou and other terrestrial mammals once during any flight to or from the camps and along aerial-survey routes. The disturbance reactions of caribou and other terrestrial mammals are expected to be brief, lasting for a few minutes to no more than 1 hour. Some terrestrial mammals may avoid inventory-survey camps and recreation camps during the 4 to 6 weeks of activities while bears and foxes may be attracted to the camps by food odors. These animals also may habituate to human activities.

(2) Oil and Gas Exploration and Development Activities: Under Alternative B, zero to one oil field is assumed to be discovered and developed. Primary effects

on terrestrial mammals would come from motor-vehicle traffic within the oil field. Some effects also would come from humans on foot near facilities and camps; from aircraft traffic; from seismic operations; from small, chronic, crude-oil and fuel spills contaminating tundra, stream, and coastal habitats; and from habitat alteration associated with gravel mining and with construction of within-field gravel roads, pads, and other production facilities. Trenching for and burial of pipelines at river crossings would have very local effects on tundra and riparian vegetation and would not significantly affect terrestrial mammal habitats.

(a) Effects of Disturbance: In the following discussion, the planning area is divided into thirds—northern (including Teshekpuk Lake and the Beaufort Sea coast), middle (the area generally west and southwest of Nuiqsut), and southern. Under Alternative B, the southern and portions of the middle planning area are available for leasing and development (Fig. II.C.1-2).

If a field is developed in the middle planning area, effects on TLH caribou are likely to be small. Production facilities would be located far to the south of the TLH calving range; therefore, little or no effect on caribou movements within the range is expected, and no TLH calving is expected to be displaced. Some TLH caribou migration movements and winter range may be adversely affected by air and surface traffic along pipelines and roads within the oil field.

If a field is developed in the southern planning area, development would not include calving habitats of any of the caribou herds in the Arctic. Some members of the CAH, WAH, and TLH would encounter the field along their fall migration route and within a portion of their winter range. Development in the southern planning area would not be expected to significantly affect caribou movements or their distribution or abundance.

A pipeline from the oil field would connect to the TAPS through facilities at the Alpine and Kuparuk River fields. The pipeline would be constructed during winter. So no permanent road would be associated with the pipeline, ice roads would be used. During construction, air traffic would include several flights per day, which temporarily could disturb some of the TLH, CAH, and WAH caribou and other terrestrial mammals within about 1.2 mi (2 km) of the pipeline. Disturbance and habitat effects on caribou and other terrestrial mammals are expected to be short term, interference with their movements would be temporary (probably a few minutes to less than a few days), and they eventually would cross the pipeline area. Also, disturbance reactions would diminish after construction, and flights would decrease to about 1 to 2 per day at most. If aircraft were to maintain altitudes of 2,000 ft (about 600 m) during the caribou calving and postcalving seasons and 1,000 ft (300 m) during other times of the year, disturbance of caribou could be avoided (Shideler et al., 1986). The abundance and overall distribution of terrestrial mammals are not expected to be affected by pipeline construction or operation.

Pipelines and roads within the oil field and the pipeline to the TAPS are not expected to affect moose and muskoxen habitat use and movements, although individual animals may be disturbed briefly by air and surface traffic. Some grizzly bears are expected to be attracted to oil field facilities, and some may be lost due to interactions with humans. Some wolverines may be displaced within a few miles of oil field facilities. In general, muskoxen responses to mobile seismic operations are expected to be a gradual and temporary avoidance of the local area, with reoccupation of the area after the exploration activities are complete. During development and production, avoidance may persist over the life of the oil field. Arctic fox abundance is expected to increase near the oil field because of increased food sources and shelter.

(b) Effects of Disturbance by Species:

1) Effects on Caribou:

Exploration: Exploration will occur primarily during winter and potential disturbance would come primarily from aircraft traffic and seismic operations. Caribou have been shown to exhibit panic or violent flight reactions to aircraft flying at elevations of ≤162 ft (≤60 m) and to exhibit strong escape responses (animals trotting or running from aircraft) to aircraft flying at 150 to 500 to 1,000 ft (300 m) (Calef, DeBock, and Lortie, 1976). However, these documented reactions were from aircraft that circled and repeatedly flew over caribou groups. Aircraft traffic associated with oil exploration is expected to pass overhead of caribou once during any flight to or from the exploration camps, and the disturbance reactions of caribou are expected to be brief, lasting for a few minutes to no more than 1 hour.

Development: Although much construction will occur primarily during winter, development will bring year-round facilities and activities to the caribou range. Caribou can be disturbed by ground vehicles, humans on foot, and low-flying aircraft associated with oil development (Calef, DeBock, and Lortie, 1976; Horejsi, 1981; Shideler, 1986; Tyler, 1991). The response of caribou to potential disturbance is highly variable—from no reaction to violent escape reactions— depending on their distance from human activity; speed of approaching disturbance source; frequency of disturbance; sex, age, and physiological condition of the animals; size of the caribou group; and season, terrain, and weather. Caribou cow and calf groups appear to be the most sensitive to traffic, especially in early

summer during and immediately after calving, while bulls appear to be least sensitive all year.

Tolerance to aircraft, ground-vehicle traffic, and other human activities has been reported in several studies of caribou and other hoofed-mammal populations in North America (Davis, Valkenburg, and Reynolds, 1980; Valkenburg and Davis, 1985; Johnson and Todd, 1977). The variability and unpredictability of the arctic environment dictate that caribou have the ability to adapt their behavior (such as change the time and route of migration) to some environmental changes. Consequently, repeated exposure to human activities over their summer range has led to some degree of tolerance by CAH caribou. Some groups of caribou that overwinter in the vicinity of Prudhoe Bay and near Camp Lonely on the NPR-A and that have been frequently exposed to disturbance apparently have become somewhat accustomed to human activities. Such habituation has been observed in the Prudhoe Bay area (Cronin et al., 1994). However, most caribou that will be calving the following spring overwinter to the south, in the foothills of the Brooks Range or beyond, are less tolerant of human activities to which they are seasonally or intermittently exposed, than animals that overwinter on the coast near oil field facilities.

Some displacement of the CAH from a portion of the calving range near the Prudhoe Bay and Milne Point facilities is well documented (Cameron, Whitten, and Smith, 1981, 1983; Cameron et al., 1992). This displacement of caribou cows and calves has occurred within about 1.86 to 2.48 mi (3 to 4 km) of oil facilities (Dau and Cameron, 1986; Nellemann and Cameron, 1996). The use of specific calving sites within the broad calving area varies from year to year, and the amount of displacement may have increased on the oil fields. In the Kuparuk-Milne Point area, the relative distribution of calving has shifted away from development facilities (Lawhead et al., 1997). Recent information on the body weight of CAH caribou calving in the oil fields compared to CAH caribou calving farther east (east of the Sagavanirktok River) suggests that displacement-disturbance of cow caribou on the oil fields may be affecting caribou productivity (Cameron, 1994). The avoidance of the Prudhoe Bay complex of roads and pipelines by cow caribou represents a functional loss of summer habitat (Cameron et al., 1995).

Recent studies (Roby, 1978; Cameron, Whitten, and Smith, 1981, 1983; Cameron et al., 1992; Pollard and Ballard, 1993) and literature reviews (Cronin et al.,1994, 1998) indicate some seasonal avoidance of habitats within 1.86 to 2.48 mi (3-4 km) of existing Prudhoe Bay area facilities by cows and calves during calving and early postcalving periods (May through June). Therefore, disturbance from vehicle traffic and human presence associated with present levels of oil development in the Prudhoe Bay area has affected the distribution of CAH caribou on the calving and summer range. However, there currently is no conclusive evidence that CAH caribou abundance has been affected—the CAH has increased greatly during early development of the North Slope oil fields. This increase in numbers is not to be inferred as caused by oil development. The CAH peaked at 23,000 in 1992 but declined to about 18,100 animals in 1994, with all of the decline occurring among caribou using the oil fields. However, differences in densities and movements between segments of the herd on the oil fields and east of the fields may have contributed to the decline (Cronin et al., 1997).

Cameron, Whitten, and Smith (1983) also reported that caribou cow/calf groups avoid the 124-mi-long (200-km) northern portion of the TAPS and Dalton Highway (Haul Road) corridor, particularly during the postcalving period. However, caribou cow/calf groups may be avoiding the TAPS corridor. because it runs primarily along the riparian habitat of the Sagavanirktok River valley. This habitat type is typically avoided by cows and calves during the postcalving season because of the possible presence of hidden predators, such as wolves (Carruthers, Jakimchuk, and Ferguson, 1984). Carruthers, Jakimchuk, and Ferguson (1984) reported no significant differences in cow/calf distribution between the TAPS corridor and other riparian habitats on the summer range of the CAH. Also, caribou cow/calf groups did not avoid a portion of the TAPS corridor that is 2.5 mi (4 km) away from riparian habitat and the Dalton Highway (Carruthers, Jakimchuk, and Ferguson, 1984). The latter investigators concluded that the differences in the distribution of cows with calves along the TAPS corridor, reported by Cameron, Whitten, and Smith (1983), reflect a seasonal preference to avoid riparian habitats, on which most of the corridor is located. However, Whitten and Cameron (1986) reported that Carruthers, Jakimchuk, and Ferguson (1984) incorrectly analyzed the data, and caribou did not avoid riparian habitats. Carruthers, Jakimchuk, and Ferguson (1984) did not investigate the question of whether cows with calves avoid the Dalton Highway during periods of high levels of truck traffic. The mere physical presence of the pipeline and associated facilities probably has no apparent effect on the behavior, movement, or distribution of caribou, except perhaps when heavy snowfall may prevent some animals from crossing under or over the pipeline. On the other hand, human activities associated with transportation routes—particularly road traffic—can affect the behavior and distribution of caribou. Frequent disturbance can have energetic effects on caribou. Pipeline-road corridors across the Arctic Slope (east-west) also could hamper the movements of the caribou herds (E. Brower, as cited in USDOI, MMS, Alaska OCS Region 1983). During the winter, caribou movements can be blocked or interrupted along the elevated (5 ft) pipelines, when snow drifts under

the pipeline (Issac Nukapigak, as cited in USDOI, BLM, 1997a). However, such an effect is expected to be temporary (the snow will melt) and local, with the caribou moving across the corridors at locations where the snow is shallow or has melted during the spring.

For caribou in the Prudhoe Bay and Kuparuk oil fields and pipeline-road corridors, the greatest human-caused influence on behavior and movement is vehicle traffic (particularly high traffic levels, such as 40-60 vehicles/hour, or traffic levels >15 vehicles/hour) in the pipeline-road corridors (Murphy and Curatolo, 1984; Lawhead and Flint, 1993). Caribou are hesitant to cross the Dalton Highway and other roads on the oil fields because of all the road traffic (Leonard Lampe, as cited in USDOI, BLM, 1997a). A decline in the frequency at which caribou cross pipeline corridors is attributed to high traffic levels on the adjacent road and the frequency of severe disturbance reactions exhibited by caribou during crossing (Curatolo, 1984). Caribou generally hesitate before crossing under an elevated pipeline (there is no problem with buried pipelines) and may be delayed in crossing a pipeline and road for several minutes or hours during periods of heavy road traffic; however, successful crossings do occur. Caribou have returned to areas of previous disturbance after construction was complete in other development areas (Hill, 1984; Northcott, 1984). In the planning area, roads will be built within the oil field but not along the pipeline to the TAPS, so disturbance of caribou would be limited.

Construction of existing pipelines and facilities on the North Slope has necessitated the use of large quantities (several million tons) of gravel. Roads and gravel pads for facilities occupy several square miles of tundra, and small areas of tundra vegetation were excavated at the gravel-quarry sites. However, these areas represent a very small percentage of the available tundra-grazing habitat. The construction of roads and gravel pads also provides the caribou with additional insect-relief habitat, particularly when little or no traffic is present. The loss of relatively small areas of tundra habitat to gravel pads, roads, and other alterations generally has not had significant effects on the CAH caribou. Caribou use oil field facilities such as roads, gravel pads, and pipeline for insect relief (Cronin et al., 1998). However, displacement of calving caribou because of disturbance has resulted in some loss of habitat within 4 km of some oil field roads.

Under Alternative B, one oil field is assumed to be discovered and developed in the southern half of the planning area, generally south and west of Nuiqsut. The TLH calving range lies north of the area available to leasing; therefore, Alternative B is expected to have little effect on caribou movements within the calving range, and no calving is expected to be displaced. Some TLH and CAH migration movements and the winter range of some caribou may be adversely affected by air and surface-vehicle traffic along pipelines and roads. However, caribou movements to coastal insect relief areas north of Teshekpuk Lake are not expected to be affected.

2) Effects on Moose: A number of studies show that the TAPS has no significant effect on moose movements and habitat use near the pipeline (Sopuck and Vernam, 1984, 1986; Eide, Miller, and Chihuly, 1986). In one study, 94 percent of the moose successfully crossed the pipeline corridor, and moose distribution was independent of distance from the pipeline (Sopuck and Vernam, 1986). However, moose preferred to cross pipelines elevated above 5 ft (Sopuck and Vernam, 1984). Under Alternative B, the pipeline (elevated ≥5 ft) connecting with the TAPS, and the pipelines and roads within the oil field itself, are not expected to affect moose habitat use and movements.

3) Effects on Grizzly Bears: Major sources of noise include seismic operations, construction of roads, installation of pipelines, gravel mining and dredging, and drilling operations. These activities may disturb grizzly bears occurring within a few miles of the noise sources. In the case of denning bears, industrial activities and human presence pose potentially serious disturbances. In one study, seismic activities within 1.15 mi (1.8 km) of a grizzly bear den caused changes in heart rate and movement of the female bear and cubs (Reynolds, Reynolds, and Follman, 1986). The investigators suggest that seismic-testing activities within about 600 ft of the den may cause abandonment of the den. Human scent and other noises also may disturb the bears. However, in a study of maternal denning of polar bears and their cubs (a comparable species), disturbances from capture, marking, and radio tracking did not affect litter sizes or the stature of cubs produced. This tolerance by bears and the fact that maternal investment in the denning effort increases through the winter indicate that spatial and temporal restrictions on development activities could prevent abandonment of the dens (Amstrup, 1993).

Initially, when grizzly bears first encounter humans on foot, their response is to flee; responses to ground-based human activities are stronger than responses to aircraft, especially when encounters occur in open areas such as the Arctic Slope (McLellan and Shackleton, 1989). The increase in human presence and encounters with grizzly bears associated with recreation and tourism usually is temporary in nature. However, the establishment of permanent settlements (oil fields, mines, etc.) usually leads to human-bear encounters on a regular basis and to conflict, particularly when bears learn to associate humans with food (Schallenberger, 1980; Harding and Nagy, 1980; Miller and Chihuly, 1987; McLellan, 1990). Grizzly bears

initially will avoid human settlements because of the noise and disturbance (Harding and Nagy, 1980), but if the area includes an important food source (such as a fish stream), some bears are likely to habituate to the noise and human presence, leading to an increase in encounters. People often will not accept the risk of bear attacks, and these encounters too often lead to the loss of bears (Archibald, Ellis, and Hamilton, 1987). However, individual bears, especially females with cubs, vary in the degree of habituation-tolerance to human presence, and some will continue to avoid areas when humans are present (Olson and Gilbert, 1994).

The attraction of grizzly bears to garbage and/or food odors at field camps and other facilities has lead to encounters in which the need to protect workers results in the loss of bears (Schallenberger, 1980). Once bears become conditioned to the availability of human sources of food, measures to reduce this availability by improved garbage handling are not always effective (McCarthy and Seavoy, 1994). The bears will make an extra effort to get to the food sources that they are conditioned to having.

In Alaska, nonsport (or nonsubsistence) mortality of grizzly bears has increased from 1970 to 1985 and is expected to increase further with development (logging, mining, etc.) and establishment of settlements in remote areas (Miller and Chihuly, 1987). The losses of brown and also black bears from incidental shootings by people in defense of life and or property generally has not been significant to the bear populations as a whole, but such losses contribute to a cumulative decline in bears and in their distribution near cities and villages in Alaska. As human populations in Alaska increase, the numbers of brown bears are expected to decrease particularly outside of national parks, refuges, and wilderness areas.

Oil exploration and development under Alternative B is expected to attract some grizzly bears to oil field facilities and may result in the loss of some bears due to interactions with humans.

4) Effects on Wolves: Potential effects on wolves include disturbance from air and surface traffic and human presence and increased hunting pressure through improved access that may be associated with oil development. If caribou abundance were affected by oil development, wolf abundance could be adversely affected in return.

5) Effects on Wolverines: Potential effects on wolverines could include disturbance from air and surface-vehicle traffic, increased human presence, and habitat alteration. Because wolverines are considered a shy and secretive species, they may be sensitive to oil exploration and development activities and abandon habitat areas near oil development. Winter seismic activities in the Pik Dunes area south of Teshekpuk Lake caused the displacement of a wolverine from its den (Harry Brower, Jr., as cited in USDOI, BLM, 1997a). If caribou abundance were adversely affected by oil development, wolverines could be affected in return. Decline in distribution and abundance of wolverines in Canada was attributed to increased harvest and decline in caribou populations (Van Zyll de Jong, 1975). Alteration of riparian habitats through gravel excavation could adversely affect wolverines, especially during the winter, when theses habitats provide cover and important hunting areas for wolverine. Because the wolverine is an important subsistence species, any decline in their abundance within the NPR-A proposed lease area would adversely affect subsistence. Some wolverines may be displaced near (within a few miles) oil field facilities under Alternative B.

6) Effects on Muskoxen:

Exploration: Studies on the effects of oil and gas exploration on muskoxen in Alaska and Canada have focused on disturbances associated with winter seismic operations. Some muskoxen reacted to seismic activities at distances up to 2.48 mi (4 km) from the operations; however, reactions by muskoxen were highly variable among individuals, with some individuals not reacting at very close distances (0.12 mi [0.2 km]) (Reynolds and LaPlant, 1985). Responses varied from no response to becoming alert, forming defense formations, or running away (Winters and Shideler, 1990). The movements of muskoxen away from the seismic operations did not exceed 3.1 mi (5 km) and had no apparent effect on muskoxen distribution (Reynolds and LaPlant, 1986). Helicopter support traffic seemed to have an cumulative effect on muskoxen responses to seismic activities (Jingfors and Lassen, 1984). Muskoxen reacted to helicopters flown at 325 and 1,300 ft (100 and 400 m) with durations of responses lasting from 2 to 12 minutes (Miller and Gunn, 1984). Muskoxen cows and calves appear to be more sensitive (responsive) to helicopter traffic than other age/sex classes, and muskoxen in general are more sensitive to overflights by helicopter than by fixed-wing aircraft (Miller and Gunn, 1979; Reynolds, 1986). Disturbances during the calving season may result in abandonment of the calf, if it occurs within the first or second day of life (Lent, 1970). Muskoxen appear to habituate to helicopter flights above about 500 ft (180 m), at least on a short-term basis (Miller and Gunn, 1980). Groups of muskoxen appear to be less responsive to fixed-wing aircraft overflights during the summer, rut, and fall than during winter and calving periods (Reynolds, 1986).

In general, muskoxen responses to seismic activities in the planning area are expected to be a gradual and temporary avoidance of the local area, with reoccupation of the area

after the exploration activities are complete (Urquhart, 1973; Jingfors and Lassen, 1984).

Development: Potential effects of oil-development activities include direct habitat loss from gravel mining in river floodplains and at oil field facilities, and indirect habitat loss through reduced access caused by physical or behavioral barriers created by roads, pipelines, and other facilities (Clough et al., 1987, as cited by Winters and Shideler, 1990; Garner and Reynolds, 1986). Muskoxen may be more exposed to oil exploration and development than caribou, because they tend to remain year-round in the same habitat area (Jingfors, 1982); therefore, muskoxen may be more likely to habituate because of this year-round exposure. Muskoxen have been exposed to the TAPS and the Dalton Highway with the expansion of their range west from the ANWR and the Kavik River.

7) Effects on the Arctic Fox: Oil and gas exploration and development activities can affect the arctic fox by increasing the availability of food and shelter. Seismic camps and oil field facilities provide additional food sources for foxes at dumpster sites near the galley and dining halls and at dump sites (Eberhardt et al., 1982; Rodrigues, Pollard, and Skoog, 1994). Crawlspaces under housing, culverts, and pipes provide foxes with shelter for resting and, in some cases, artificial dens (Eberhardt et al., 1982; Burgess and Banyas, 1993). At least localized seismic and oil development activities do not appear to have any dramatic, deleterious effect on the fox population (Eberhardt et al., 1982). A study of den sites and fox productivity in the area of Prudhoe Bay indicates that adult fox densities and pup production are higher in the oil fields than in surrounding undeveloped areas (Burgess et al., 1993). An increase in the fox population associated with oil development may adversely affect some fox-prey species (such as ground-nesting birds) in the development area and over a region larger than the oil field itself (Burgess et al., 1993).

8) Effects on Other Small Mammals: Small rodents (such as lemmings and voles) and their predators (such as short-tailed weasels) are expected to be affected locally (direct mortality and loss of habitat of individuals or small groups of lemmings and voles) along seismic lines, pipelines, gravel pads, and other facilities. However, these losses are expected to be insignificant to populations on the Arctic Slope of Alaska.

(c) Effects of Spills: Assuming the occurrence of small crude-oil and fuel spills (averaging 4 bbl and 29 gal, respectively), TLH and CAH caribou and moose, muskoxen, grizzly bears, and other terrestrial mammals could be directly exposed to and contaminated by the spill at river crossings, contaminated ponds or lakes, along the beaches, and in shallow waters during periods of insect-pest escape. Grazing animals could be exposed through ingestion of or contact with oiled vegetation. However, even in a severe situation, a comparatively small number of animals are likely to be directly exposed to the oil spills and die as a result of toxic-hydrocarbon inhalation and absorption, and/or loss of thermoinsulation. These losses probably would be small for any of these terrestrial mammal populations and are expected to be replaced within less than one generation (about 1 year). For the most part, the effect of pipeline spills would be very local and would contaminate tundra in the immediate vicinity of the pipeline; these spills would not be expected to significantly contaminate or alter terrestrial mammal ranges within the pipeline corridors.

1) Spill Effects on Caribou, Moose, and Muskoxen: Caribou and other terrestrial mammals may become oiled or may ingest contaminated vegetation. Caribou, moose, and muskoxen that become oiled are not likely to suffer from a loss of thermoinsulation during the summer, although toxic hydrocarbons could be absorbed through the skin or inhaled. However, the oiling of young calves could significantly reduce thermoinsulation, leading to their death. Oiled caribou, moose, and muskoxen hair would be shed during the summer before the winter fur is grown. If caribou were oiled in the winter after shedding their summer coat, oiling is not expected to affect adult caribou thermoinsulation, because the outer guard hairs of caribou are hollow. No documented caribou deaths have been associated with the numerous spills associated with the TAPS.

Toxicity studies of crude-oil ingestion in cattle (Rowe, Dollahite, and Camp, 1973) indicate that anorexia (significant weight loss) and aspiration pneumonia leading to death are possible adverse effects. Caribou, moose, and muskoxen that become oiled by contact with a spill in contaminated lakes, ponds, rivers, or coastal waters could die from toxic-hydrocarbon inhalation and absorption through the skin.

Under Alternative B, an estimate of 0 to 17 (>1 bbl) crude-oil spills (averaging 4 bbl in size) and 0 to 162 small refined oil-spills (averaging 29 gal in size) are assumed to occur onshore over the production life of the planning area (Tables IV.A.2-2 and 2-6). These chronic crude-oil and fuel spills from onshore activities and possible marine transportation probably would result in the loss of small numbers of terrestrial mammals.

If a pipeline spill occurred, some tundra vegetation within the pipeline corridor would become contaminated. However, caribou (also moose and muskoxen) probably would not ingest oiled vegetation, because they tend to be selective grazers and are particular about the plants they consume (Kuropat and Bryant, 1980). It also is likely that

control and cleanup operations (ground traffic, air traffic, and personnel) at the spill site would frighten caribou, moose, and muskoxen away from the spill and prevent the possibility of these animals grazing on the oiled vegetation. Thus, onshore oil spills associated with Alternative B are not expected to significantly affect caribou, moose, and muskoxen through ingestion of oiled vegetation.

Oil spills on wet tundra kill the moss layers and aboveground parts of vascular plants and sometimes kill all macroflora at the site (McKendrick and Mitchell, 1978). Damage to oil-sensitive mosses may persist for several years, if the site is not rehabilitated (e.g., by applying phosphorus fertilizers) (McKendrick and Mitchell, 1978). For the most part, onshore oil spills would be very local (1-2 acres) in their effects and would not be expected to significantly contaminate or alter caribou, moose, and muskoxen range. However, some local contamination of tundra vegetation is expected to occur near production wells and processing facilities. Spills that occur within or near streams and lakes may affect foraging habitat along these streams.

A potential oil spill from marine transportation or a spill from Alternative B reaching the marine environment probably would result in the loss of small numbers of terrestrial mammals. These losses are not likely to affect the distribution and abundance of terrestrial mammals on the NPR-A.

2) Spill Effects on Grizzly Bears: Grizzly bears depend on coastal streams, beaches, mudflats, and river mouths during the summer and fall for catching fish and finding carrion. If an oil spill contaminates beaches and tidal flats along the Beaufort Sea coast, some grizzly bears are likely to ingest contaminated food, such as oiled birds, seals, or other carrion. Such ingestion could result in the loss of at least a few to several bears. An oiling experiment on captive polar bears indicated that if a bear's fur becomes oiled and the bear ingests a considerable amount of oil while grooming, kidney failure and other complications could lead to the bear's death (Oritsland et al., 1981). Brown bears on the Shelikof Strait coast of Katmai National Park (an area contacted by the *Exxon Valdez* oil spill) were observed with oil on their fur and were consuming oiled carcasses (Lewis and Sellers, 1991). A study of the exposure of Katmai National Park (Katmai Bay area) brown bears to the *Exxon Valdez* oil spill through analysis of fecal samples indicated that some bears had consumed oil or were exposed to oil; one young bear that died had high concentrations of aromatic hydrocarbons in its bile and might have died from oil ingestion (Lewis and Sellers, 1991). Anecdotal accounts of polar bears deliberately ingesting hydraulic and motor oil and foreign objects from human garbage sites suggest that both bear species are vulnerable to ingesting oil directly, especially from oiled carrion and other contaminated food sources (Derocher and Stirling, 1991). Skin damage and temporary loss of hair can result from oiling of bears, with adverse effects on thermal insulation (Derocher and Stirling, 1991). The small spills assumed to occur under Alternative B could result in the loss of small numbers of grizzly bears through ingestion of contaminated prey or carrion. However, such losses are not expected to be significant to the population on the Arctic Slope.

Summary: Alternative B is expected to increase the level of noise and disturbance and habitat alteration effects on terrestrial mammals in the southern half of the planning area over the level of effect under Alternative A. The primary sources of disturbance to caribou, muskoxen, moose, and other terrestrial mammals associated with oil exploration are activities associated with seismic operations. The primary source of disturbance associated with oil development is road traffic within the oil field; other sources of disturbance are expected to include air traffic (helicopter and fixed-wing) to and from the oil field and humans on foot.

Gravel Extraction Outside of the Planning Area: Gravel mining associated with oil and gas exploration and development under Alternative B is assumed to occur in the Nuiqsut area and be transported to the NPR-A during winter over ice roads. This activity would have local disturbance effects on terrestrial mammals along the ice roads and at the excavation-mine sites and on the specific lease area. Caribou, muskoxen, moose, and other terrestrial mammals that overwinter near these activities could be temporarily displaced near (within no more than about 1 mi) operations over the winter season. Gravel extraction (outside of the planning area), transportation (into the planning area), and deposition of gravel in the lease areas would result in local disturbance-displacement (within no more than 1 mi of the operations) of small numbers of individual mammals but would not affect the distribution and abundance of caribou, muskoxen, moose, or other terrestrial mammals.

Impact of an Oil Spill on Teshekpuk Lake and the Colville River: Assuming a 325-bbl crude-oil spill reached or occurred within Teshekpuk Lake or reached the Colville River, some THL caribou and moose, muskoxen, and other terrestrial mammals would be exposed to part of this spill. The number of animals lost to this spill is not likely to exceed more than a few hundred caribou and smaller numbers of muskoxen, moose, and other terrestrial mammals. These losses of terrestrial mammals are likely to be replaced within 1 year and would not affect populations in the Arctic Slope.

Seawater Pipeline Spill in the Planning Area: If seawater were used for waterflood enhancement of oil production under Alternative B, a saltwater spill could occur within the NPR-A. This spill would have adverse effects on salt-intolerant vegetation near the pipeline but the amount tundra habitat affected would be small, no more than a few acres. This potential saltwater spill is not likely to affect forage availability of caribou, muskoxen, moose, or other terrestrial mammals in the planning area.

Conclusion—First Sale: For activities other than oil and gas, air traffic, humans on foot, and the presence of resource-inventory-survey camps are expected to increase under Alternative B as compared to Alternative A, but these activities are not expected to affect terrestrial mammal populations. For oil and gas activities, the level of effects from noise, disturbance, and habitat alteration is expected to increase in the southern half of the planning area. Increased habitat alteration would include the development of one oil field and a pipeline to the TAPS. Caribou of the CAH and TLH are expected to be disturbed and their movements delayed along the pipeline during periods of aircraft overflights (e.g., to inspect the pipeline), but these disturbances are not expected to affect migrations and overall distribution. Near oil field facilities, surface, air, and foot traffic is expected increase under Alternative B and to displace some caribou, moose, muskoxen, grizzly bears, wolves, and wolverines but not significantly affect Arctic Slope populations. The number of small, chronic crude-oil and fuel spills and a potential spill contacting Teshekpuk Lake or reaching the Colville River are expected result in the loss of small numbers of terrestrial mammals, with recovery expected within about 1 year. Trenching and burial of pipelines at river crossings would have very local effects on tundra and riparian vegetation and would not significantly affect terrestrial mammal habitats.

Multiple Sales: If several lease sales occur under Alternative B, considerably more exploration activity is expected to occur in the southern half of the planning area, with the number of exploration wells drilled increasing to 4-14 for multiple sales from the 1-4 wells for the first sale. The amount of development also is expected to increase. The number of oil fields would increase to 0-2 for multiple sales from the 0-1 fields from the first sale, the number of production pads would increase to 0-4 for multiple sales from the 0-2 pads for the first sale, and pipeline miles would increase to 0-90 mi for multiple sales from the 0-75 mi for the first sale. The level of effects on caribou and other terrestrial mammals, including noise, disturbance, and habitat alteration, is expected to increase in the southern half of the planning area with multiple sales under Alternative B. Caribou of the CAH and TLH are expected to be disturbed and their movements delayed along the pipeline during periods of aircraft overflights (e.g., to inspect the pipeline), but these disturbances are not expected to affect migrations and overall distribution. Near oil field facilities, surface, air, and foot traffic is expected to increase somewhat with multiple sales and to displace some caribou, moose, muskoxen, grizzly bears, wolves, and wolverines but not significantly affect Arctic Slope populations.

Under Alternative B, the number of small crude-oil spills (>1 bbl) is expected to increase to 0-25 spills (average size of 4 bbl) for multiple sales from an estimated 0-17 spills for the first sale. Small fuel-oil spills would increase to 0-232 spills for multiple sales from 0-162 spills (average size of 29 gal) for the first sale. The small crude- and fuel-oil spills are estimated to occur onshore over the production life of the planning area (Tables IV.A.2-3a, IV A2-3b, IV A 2-6a and IV A 2-6b). These small, chronic spills are expected to have about the same effect on terrestrial mammals and their habitats as under Alternative B with the first sale, but with loss of individual mammals to the spills and habitat contamination increasing locally at the spill sites and along any streams contaminated by these spills. These spills are expected to result in the loss of small numbers of terrestrial mammals, with recovery expected within 1 year. Any habitat contamination that is not effectively cleaned up is expected to persist for several years but is not expected to affect terrestrial mammal populations.

Conclusion—Multiple Sales: The level of effects due to noise, disturbance, and habitat alteration is expected to increase in the southern half of the planning area under Alternative B with multiple sales. Near oil field facilities, surface, air, and foot traffic are expected increase and to displace some caribou, moose, muskoxen, grizzly bears, wolves, and wolverines, but not significantly affect Arctic Slope populations. The number of small, chronic crude-oil and fuel spills is expected to increase and result in the loss of small numbers of terrestrial mammals, with recovery expected within about 1 year.

Effectiveness of Stipulations: Stipulations described in Section II.C.7 regarding solid- and liquid-waste disposal, fuel handling, and spill cleanup are expected to reduce the potential effects of spills and human refuse on grizzly bears and other terrestrial mammals. Stipulations on overland moves and seismic work are expected to minimize alteration of terrestrial mammal habitats in the planning area. The stipulation on aircraft to maintain a 1,000-ft AGL (except for takeoffs and landings) over caribou winter ranges from October through May 15, and a 2,000-ft AGL over the Teshekpuk Lake Caribou Habitat LUEA from May 16 through July 31, is expected to minimize disturbance of caribou. Stipulations on oil and gas exploration and development including facility design and construction of pipelines, roads, drill pads, airstrips, and

other facilities are expected to minimize interference with caribou movements and minimize the amount of terrestrial mammal habitat altered by gravel pads and other surface disturbances. The designation of the Colville River as a wild river under the Wild and Scenic River System could reduce potential noise and disturbance of TLH, CAH, and WAH caribou movements across the river from motorized boats and other human activities through restrictions in motorized travel and development activities (such as roads) within ½ mi on the west side of the river within the southern boundary of the NPR-A to the Umiat Meridian.

b. Marine Mammals: Six species of nonendangered marine mammals—ringed, spotted, and bearded seals, walruses, polar bears, and belukha whales—commonly occur year-round or seasonally in coastal habitats adjacent to the planning area. Under Alternative B, some individual members of these species may be exposed to effects from oil and gas activities in the Colville River Delta-inner Harrison Bay area and to effects from other activities. For the purpose of this analysis, generation is defined as the average time interval between the birth of the female parent and the birth of their offspring. The generation time for ringed seals is about 4 to 8 years and about 7 years for polar bears (Kelly, 1988; USDOI, FWS, 1995).

(1) Activities Other than Oil and Gas Exploration and Development: Activities other than oil and gas exploration and development along the coast that may affect marine mammals include aerial surveys (including surveys of wildlife); ground activities such as resource inventories, paleontological excavations, research and recreation camps; and overland moves. Effects under Alternative B would be similar to those for Alternative A—local and short term, with no significant adverse effects to the populations as a whole.

(2) Oil and Gas Exploration and Development Activities: Oil and gas exploration and development activities along the coast that may affect marine mammals are noise and disturbance from air and surface traffic, geophysical seismic activities. Small onshore crude- and fuel-oil spills associated with Alternative B are not expected to reach the marine environment and affect marine mammals. However, a small number of seals and no more than a few polar bears might be adversely affected or killed by a 325 bbl crude oil spill contacting the Colville River and some of the oil reaching marine waters, but these losses would not be significant to marine mammal populations

(a) Effects of Noise and Disturbance: Noise associated with oil and gas activities is a primary source of disturbance of seals, polar bears, and belukha whales. For a discussion of the nature of airborne and underwater noise effects on pinnipeds, polar bears, and belukha whales, see the Sale 124 Final EIS (USDOI, MMS, 1990). A discussion of noise and disturbance effects specific to the planning area follows.

The primary source of noise and disturbance would come from air traffic along the coast of the planning area, specifically from helicopters associated with the assumed oil exploration and production activities. Aircraft traffic (several helicopter round trips/day during exploration and development) centered out of Deadhorse-Prudhoe Bay, traveling to and from NPR-A exploration and production facilities, is assumed to be a potential source of disturbance to ringed or spotted seals hauled out on the ice or beaches, respectively, along the coast and polar bears using coastal habitats.

During the summer, some of the air traffic to and from exploration and production facilities could disturb ringed, bearded, and spotted seals hauled out on the ice along the coast, causing them to charge in panic into the water. Because of frequent low visibility caused by fog, aircraft may not always be able to avoid disturbing hauled-out seals. The number of seals affected would depend on the number of disturbance incidents. Aircraft disturbance of hauled-out seals in the planning area could result in injury or death to young ringed and bearded seal pups. Although air-traffic disturbance would be very brief, the effect on individual seal pups could be severe. Aircraft disturbance of small groups of spotted and ringed seals hauled out along the coast is not likely to result in the death or injury of any seals, although increases in physiological stress caused by the disturbance might reduce the longevity of some seals, if disturbances were frequent.

If exploratory drilling occurs during the winter (December to mid-April) near the coast, polar bears could be attracted to the oil field camps by food odors and curiosity. Some polar bears could be unavoidably killed to protect oil workers. Under the Marine Mammal Protection Act, the oil companies would be required to have a permit to take or harass polar bears. Consultation between the companies and the FWS on this matter is expected to result in the use of nonlethal means of protection in most cases. In any event, the number of bears lost as a result of such encounters is expected to be very low.

(b) Effects of Seismic Activities: Effects will be similar to those under Alternative A, i.e., short-term effects on a small number of polar bears that den along the coast of the planning area could occur.

Impact of an Oil Spill Contacting the Colville River: Assuming a 325-bbl crude-oil spill reached the Colville River during the open-water season, some of the oil would end up in marine waters in Harrison Bay. An estimated 50

percent of the oil would be in the sediment plume flowing out of the river and settle out on the seabottom near the river delta. A spill of this small size would be dispersed quickly and is not expected to affect many seals and polar bears that may be in the spill area. A small number of spotted seals that haul out along the river delta may come in contact with the oil directly or might consume fish exposed to the oil. A few polar bears might come in contact with the oil and be adversely affected. Other marine mammals, such as ringed and bearded seals and beluga whales are not likely to come in contact with this small spill. The number of seals and polar bears adversely affected or killed by this spill likely would be small (<100 seals and no more than a few bears) and would not be significant to marine mammal populations.

Conclusion—First Sale: For marine mammals, the effects of activities other than oil and gas under Alternative B are expected to be similar to those under Alternative A—local and short term, with no significant adverse effects to the populations as a whole. The effects of oil and gas activities for Alternative B are expected to increase somewhat over those of Alternative A. However, most oil and gas activities under Alternative B are expected to occur inshore and far to the south of the coast. Only a small increase in potential noise and disturbance effects is expected along the coast, primarily in the Colville River Delta-inner Harrison Bay area, and these effects are expected to be local and short term (generally <1 year). A small number of seals and no more than a few polar bears might be adversely affected or killed by a 325-bbl crude-oil spill contacting the Colville River and some of the oil reaching marine waters, but these losses wouldn't be significant to marine mammal populations.

Multiple Sales: If several lease sales occur under Alternative B, considerably more exploration activity is expected to occur in the southern half of the planning area, with the number of exploration wells drilled increasing to 4-14 for multiple sales from the 1-4 wells for the first sale. The amount of development also is expected to increase. The number of oil fields would increase to 0-2 for multiple sales from the 0-1 fields for the first sale, the number of production pads would increase to 0-4 for multiple sales from the 0-2 pads for the first sale, and pipeline miles would increase to 0-90 mi for multiple sales from the 0-75 for the first sale. However, most oil and gas activities under Alternative B are expected to occur inshore and far to the south of the coast. Only a small increase in potential noise and disturbance effects on marine mammals is expected along the coast, primarily in the Colville River Delta-inner Harrison Bay area, and these effects are expected to be local and short term (generally <1 year).

Conclusion—Multiple Sales: Multiple sales under Alternative B are expected to have similar effects to those under Alternative B with one sale, i.e., local and short term, with no significant adverse effects to marine mammal populations as a whole.

Effectiveness of Stipulations: The effectiveness of stipulations is expected to be the same as under Alternative A.

10. Endangered and Threatened Species:

a. Activities Other Than Oil and Gas Exploration and Development: Ground-impacting-management actions within the planning area that may affect bowhead whales and spectacled and Steller's eiders under Alternative B include aerial surveys (including that of wildlife) and ground activities, such as hazardous- and solid-material removal and remediation, which occur during the summer/early fall. Overland moves and seismic surveys, which occur during the winter on ice roads or frozen tundra, are discussed but are unlikely to have an effect on these species. A description of these activities and potential effects on these species are discussed in Alternative A and summarized here. The potential effects from these activities are expected to be the same as described for Alternative A. A detailed discussion of all management actions is found in Section II.

Bowhead whales are not likely to be affected by any activities associated with the IAP. Some eiders may be affected by activities associated with aircraft traffic and hazardous- and solid-material removal and remediation. These activities may continue for as long as 3 to 4 weeks. Summertime aircraft flights over these sensitive areas may affect nesting females and their broods. Under Alternative B, point-to-point flights increase from occasionally to regular but not daily, aerial wildlife surveys increase from 14 days to 21 days during June and July, and other aerial surveys increase from occasionally to several 1- to 2-week periods (Table II.D.3). Eiders breeding, nesting, or rearing young in coastal habitats north, west, and east of Teshekpuk Lake (Spectacled Eider LUEA) may be overflown by aircraft (both helicopters and fixed-wing) on a regular basis during the summer months and may experience temporary, nonlethal effects probably lasting less than an hour. Because of the relatively low density of eiders in the area, substantial disturbance is not expected to occur and is likely to be limited to within a few kilometers of the activities. Such short-term and localized disturbances are not expected to cause significant population effects. However, disturbance of some individuals over the life of the project is expected to be unavoidable. Disturbance, depending on its nature and duration, could be considered a "take" under the ESA.

b. Oil and Gas Exploration and Development Activities: Under Alternative B, oil and gas leasing

would occur in the planning area, although the northern portion of the planning area extending well south of Teshekpuk Lake is unavailable for oil and gas leasing. No leasing would occur in the Spectacled Eider LUEA. In addition, leasing would not occur in any of the higher density spectacled eider nesting areas outside of the Spectacled Eider LUEA. This analysis is based on a development scenario presented in Section IV.A.1.b. Please refer to these sections for a discussion of resource-recovery rates and quantities, timing of infrastructure development, platform emplacement, wells drilled, and resource production timeframes and other information relevant to the development of the resources of the IAP. The scenarios for oil and gas exploration and development activities range from exploration only for the low end of the resource range under Alternative B to development/ production with oil resources in the 250- to 1,100-MMbbl range with from 1 to 5 fields under Alternative E, which is considered a reasonable range of resource development and activity level for the planning area. The BLM also proposes to conduct multiple oil and gas lease sales within the planning area over a number of years, which is likely to result in a larger resource range. Multiple sales are discussed later in this section.

Three types of crude-oil spills are associated with exploration, development, and production of oil fields in the planning area, including accidental crude-oil spills from platforms, pipelines, and flowlines; blowouts of crude oil; and TAPS spills. Approximately 65 to 80 percent of all crude-oil spills are expected to occur on the drilling pad and would have little or no effect on the environment. Approximately 20 to 35 percent may occur on or reach the surrounding environment (Sec. IV.A.2). Those spills that reach the surrounding environment generally cover a small area ($\leq$500 ft^2). ARCO Alaska Inc. reports the largest tundra area impacted from a spill is approximately 1.5 acres. Accidental spills on the drilling pads and from pipelines are expected to be small. From 1989 to 1996, 56 percent of all crude spills on the Alaskan North Slope were <5 gal, and 99 percent were <25 bbl. For the purposes of analysis, this EIS assumes an average spill size of 4.0 bbl (see Table IV.A.2-2a). The potential for a blowout during drilling operations is considered negligible. Additional information pertaining to oil spills in the planning area can be found in Section IV.A.2.

It is assumed that crude oil would not be released during exploration. Activities that would occur during development and production are similar to those that would occur during exploration, with the addition of activity associated with oil transport. A spill of crude oil during development or production could affect individual species, as discussed below. In addition, cleanup activities associated with any oil spill may result in disturbance.

Under Alternative B, oil resources for the initial sale are expected to be in the 65- to 350-MMbbl range with from 0 to 1 fields, which is considered a reasonable range of resource-development and activity level for the portion of the planning area open to leasing (Table IV.A.1.b-5). Information on the number of exploration, delineation, and production wells anticipated to be drilled and pipeline miles can be found in Table IV.A.1.b-5. Resources at the low end of the resource range (65 MMbbl) are not economically viable as stand-alone fields. Differences in effects on the species as a result of noise and disturbance over this range of scenarios are expected to be minor. Differences in effects on the species as a result of an oil spill during the development/production scenario (65-350-MMbbl-resource range) also are expected to be minor.

For Alternative B, the number of oil spills estimated to occur over the assumed production life of the IAP is from 0 to 53 for <1 bbl and from 0 to 17 for >1 bbl (Table IV.A.2-3a). For the purposes of analysis, this EIS assumes an average spill size of 4.0 bbl and that the estimated number of crude oil spills over the assumed production life of the planning area would range from 0 to 70 spills (Table IV.A 2-2a). Information pertaining to oil spills can be found in Section IV.A.2.

(1) Effects on the Bowhead Whale: Bowhead whales may be present in the area offshore of the planning area primarily from August through October during their fall migration back to the Bering Sea. Bowhead whales are not likely to be affected by activities associated with the IAP other than oil and gas exploration and development. The following discussion describes how bowhead whales may be affected by oil and gas activities.

(a) Effects of Discharges: All drilling muds and cuttings will be hauled to approved disposal sites or disposed of in existing wells, so there will be no surface discharge of drilling wastes.. There should be no effects on bowhead whales as a result of discharges.

(b) Effects of Noise and Disturbance: Concern has been expressed that human-caused noise may affect bowheads by raising background-noise levels, which could interfere with detection of sounds from other bowheads or from important natural sources, or by causing disturbance reactions. Noise-producing activities, including aircraft traffic and marine-vessel traffic, are the activities most likely to affect bowhead whales. Seismic surveys, drilling, construction activities, and oil-spill-cleanup activities also are discussed but are not likely to affect bowhead whales. A detailed description of these activities and their potential effects on bowhead whales in the MMS Beaufort Sea OCS Planning Area can be found in Section IV.B.a.1 of the Beaufort Sea Sale 144 Final EIS (USDOI, MMS, 1996a). Activities associated with the

proposed oil and gas lease sale in the planning area under this alternative and their potential effects on bowhead whales follows.

1) Effects from Seismic Activities: No marine seismic surveys will occur as a result of this IAP. It is likely that seismic surveys in the planning area will be conducted entirely during the winter months (early December to mid-April) using all-terrain ground vehicles and supported by light aircraft. There should be no effects on bowhead whales as a result of seismic surveys.

2) Effects from Aircraft Activities: Aircraft likely will be used to support oil and gas exploration activities in the planning area. Seismic surveys and drilling operations probably would be conducted during the winter months, so aircraft support of these activities also would occur primarily during the winter. Any aircraft flights over the marine environment during the open-water season as a result of oil and gas operations in the planning area are likely to be minimal, should any occur. Bowheads are not affected much by any aircraft overflights at altitudes above 328 yards (Richardson and Malme, 1993). In addition, any such flights likely would be very near shore, well away from the normal migration corridor. It is unlikely there will be any effects on bowhead whales as a result of aircraft flights.

3) Effects from Vessel Activities: There may be some transportation of equipment and supplies through the marine environment during the open-water season. Due to logistics problems associated with moving materials over the long distances from existing infrastructure, barges may be used to transport heavy equipment and supplies. Staging areas may be established along the coastline of the planning area, and materials would be transported and stockpiled during the summer months (mid-July to early October) for operations at inland sites during the winter months.

Bowheads react to the approach of vessels at greater distances than they react to most other industrial activities. Most bowheads begin to swim rapidly away when vessels approach rapidly and directly. Avoidance usually begins when a rapidly approaching vessel is 0.62 to 2.5 mi away. A few whales may react at distances from 3 to 8 mi, and a few whales may not react until the vessel is <0.62 mi away. Received noise levels as low as 84 dB re 1 μPa or 6 dB above ambient noise may elicit strong avoidance of an approaching vessel at a distance of 2.5 mi (Richardson and Malme, 1993, as cited in USDOI, MMS, 1996a). Bowhead whales may encounter a few vessels associated with oil and gas activities in the planning area during their fall migration through the Alaskan Beaufort Sea, although most of the vessel activity would be in shallow, nearshore waters, probably shoreward of the main fall whale-migration route. Vessel traffic generally would be limited to routes between staging areas near existing infrastructure (such as West Dock or Oliktok Point) and staging areas in the planning area, such as Camp Lonely or Umiat.

In general, bowheads may exhibit avoidance behavior if approached by vessels at a distance of 0.62 to 2.5 mi. Fleeing from a vessel generally stopped within minutes after the vessel passed, but scattering may persist for a longer period. In some instances, bowheads returned to their original locations. Any effects on bowhead whales as a result of barge or other vessel traffic are likely to be minimal.

4) Effects from Drilling Activities: Exploration-drilling activities will be conducted only onshore and only during the winter months; bowhead whales would not be affected by the activity. If a commercial discovery is made, drilling of production wells likely will proceed during the summer months. Table IV.A.1.b-5 provides information regarding the number of wells likely to be drilled and the timeframe for drilling, development, and production for the estimated range of resources (65-350 MMbbl) in the planning area. Because no leasing will occur in the northern portion of the planning area under this alternative, no drilling operations will be conducted in that area. There should be no effects on bowhead whales as a result of drilling operations.

5) Effects from Construction Activities: Onshore pipeline construction or other construction activities would occur during the winter. No pipeline construction or other construction activities are expected in the marine environment. There should be no effects on bowhead whales as a result of construction activities.

6) Effects from Spill Cleanup: No spills are expected to occur in the marine environment. In the event of an oil spill in the planning area, it is likely that the spill will be contained onshore. It is unlikely that any oil spilled onshore will be released into the marine environment. If oil is spilled, personnel, equipment, and aircraft will be present conducting onshore-cleanup operations. No oil-spill-cleanup activities would occur adjacent to the coast during the bowhead whale migration, because no leasing will occur in the northern portion of the planning area under this alternative. There should be no effects on bowhead whales as a result of oil-spill-cleanup activities.

(c) Effects of Spills: The effects of an oil spill on bowhead whales are uncertain. Several researchers (Geraci and St. Aubin, 1982; St. Aubin, Stinson, and Geraci, 1984, as cited in USDOI, MMS, 1996a) concluded

that exposure to spilled oil is unlikely to have serious direct effects on baleen whales.

Under this alternative, there would be no leasing in the northern portion of the planning area. No spills are expected to occur in the marine environment, and small onshore spills are unlikely to reach the marine environment. If any spilled oil did reach the marine environment, it is likely to be a very small amount and is very unlikely to have any effect on bowhead whales. There is no discussion of potential effects on bowhead whales as a result of oil spills in the planning area because no leasing will occur in the northern portion of the planning area, the likelihood of an oil spill reaching the marine environment is small, the likelihood of exposure of bowhead whales to spilled oil is small, and any exposure to spilled oil that may occur is unlikely to have serious direct effects on bowheads.

Summary: Bowhead whales are not expected to be affected by discharges, seismic surveys, drilling operations, construction activities, oil-spill-cleanup activities, or oil spills as a result of this alternative. There is a limited potential for whales to be affected by aircraft flights, although few flights, if any, are anticipated over the marine environment. Bowheads are not affected much by any aircraft overflights at altitudes above 328 yards (Richardson and Malme, 1993). Vessel traffic, such as barges transporting equipment and supplies, has the greatest potential to affect whales. Some endangered whales may interact with marine vessel traffic, and some inadvertent conflicts or incidental "taking" situations may occur. These inadvertent conflicts with or incidental "taking" situations of some individual whales as a result of marine-vessel traffic would not constitute a threat of harm to the species. Bowheads may exhibit avoidance behavior if approached by vessels at a distance of 0.62 to 2.5 mi (Richardson and Malme, 1993). In general, bowheads do not seem to travel more than a few kilometers in response to a single disturbance incident; and behavioral changes are temporary, lasting only a few minutes in the case of vessels and aircraft. It also should be noted that individuals engaged in feeding, socializing, breeding, etc., may react to a stimulus at a higher threshold than resting or milling animals.

(2) Effects on the Spectacled and Steller's Eiders: Spectacled eiders are widely distributed throughout the coastal plain portion of the planning area and are essentially absent from the area from late October to May. Most nesting on the Arctic Slope occurs along this coastline, particularly west from the Sagavanirktok River. The highest densities of nesting spectacled eiders in the planning area occur in the Spectacled Eider Breeding Range LUEA to the north, west, and east of Teshekpuk Lake (Fig. II.B.3). Postbreeding male spectacled eiders leave the planning area by late June. Females are present in the breeding area from May to September. Females with young typically are found offshore later, when the ice usually is farther from the coast (Petersen, 1997, pers. comm., as cited in USDOI, MMS, 1997). Steller's eiders are relatively sparsely distributed throughout the central portion of the planning area with some also present in the northern portion of the planning area. Males depart the nesting areas in late June. Females with broods are present in the breeding area from early June to late August or early September. Deferral of the northern portion of the planning area from leasing will protect almost all known spectacled eider breeding and nesting areas in the planning area from noise and disturbance associated with oil and gas activities. It is not known for sure if Steller's eiders actually breed in the planning area.

The reaction of eiders to disturbance in the oil fields is not well understood. Anderson et al. (1992) reported a shift in distribution between 1989 and 1991 away from noisy facilities installed as part of the GHX-1 project. Anderson and Cooper (1994) reported that the mean distance from facilities to spectacled eider nests was greater than the mean distance of facilities to eider observations (mainly during the prenesting season), suggesting that eiders may be less tolerant of facilities during the nesting season. Telemetry studies in the Prudhoe Bay area provided information on responses to oil field facilities during the broodrearing period (TERA, 1995, 1996). In 1994, two of nine tracked broods crossed roads compared with three out of five in 1993. Some broods were located in areas away from facilities. In 1994, six out of nine broods spent at least some time within 200 m of facilities. Four broods frequented areas containing exceptionally high-noise facilities—two broods near the airport and two broods near gathering centers.

Spectacled and Steller's eiders may be adversely affected by activities other than oil and gas exploration and development in the planning area. These potential effects are summarized above and discussed in detail in Section IV.B.10 (Alternative A).

(a) Effects of Discharges: All drilling muds and cuttings will be hauled to approved disposal sites or disposed of in existing wells, so there will be no surface discharge of drilling wastes. No drilling muds and cuttings will be discharged into the marine environment. There should be no effects on spectacled and Steller's eiders as a result of discharges.

(b) Effects of Noise and Disturbance: Human-caused noise and activities and human presence may result in disturbance of spectacled eiders in the planning area. Noise-producing activities, including aircraft traffic and marine-vessel traffic, are the activities

most likely to affect spectacled eiders. Seismic surveys, drilling, construction activities including vehicle traffic, and oil-spill-cleanup activities also are discussed but are not likely to affect spectacled eiders. Noise-producing activities most likely to affect Steller's eiders include aircraft traffic and marine-vessel traffic; drilling; construction activities, including vehicle traffic; and oil-spill-cleanup activities. Activities associated with the oil and gas exploration and development in the planning area under this alternative and a discussion of their potential effects on spectacled and Steller's eiders follows.

1) Effects from Seismic Activities: No marine-seismic exploration will occur as a result of this IAP. It is likely that seismic surveys in the planning area will be conducted entirely during the winter months (early December to mid-April) using all-terrain ground vehicles and supported by light aircraft. Some 2-D seismic operations will occur each winter, and up to two 3-D operations will occur in alternate years. There should be no effects on spectacled or Steller's eiders as a result of seismic surveys.

2) Effects from Aircraft Activities: Aircraft likely will be used to support oil and gas exploration activities in the planning area. Mostly fixed-wing aircraft would be used for oil and gas exploration and development operations, with helicopters used only in emergencies. Seismic surveys and drilling operations probably will be conducted primarily during the winter months, so aircraft support of these activities also would occur during the winter. Any aircraft flights over the marine environment during the open-water season as a result of oil and gas operations in the planning area are likely to be minimal, if any occur. Because no leasing will occur in the northern portion of the planning area under this alternative, there should be no aircraft flights associated with oil- and gas-related operations. Also, it is unlikely that the primary Alaskan nesting area for Steller's eiders, located south and southeast of Barrow, would be overflown by aircraft associated with oil and gas activities, so significant disturbance of nesting or broodrearing Steller's eiders is not expected to occur.

In the event of a commercial discovery, drilling operations and other activities may continue through the summer months and would be supported by aircraft. Pipelines are likely to be constructed aboveground, and aircraft likely will be used to look for leaks in the pipeline. Balogh (1997) indicated that fixed-wing aircraft flown at an altitude of 150 ft often cause spectacled eiders to flush, although helicopters flown at similar altitudes around Prudhoe Bay do not cause them to flush. As stated previously, reactions of eiders to aircraft are not well understood. There are indications that some individuals are tolerant of aircraft activities in the vicinity of nests. Because most of the breeding, nesting, and rearing areas for spectacled eiders occur in the area closed to leasing, displacement of nesting eiders in the vicinity of pipeline corridors and near airstrips as a result of aircraft overflights is unlikely. Very few nest sites are expected to be affected because nest sites, if they occur in the area open for leasing, occur at very low density. Some displacement of nesting Steller's eiders in the vicinity of pipeline corridors and near airstrips in the central portion of the planning area could occur as a result of aircraft overflights. Relatively few nest sites are expected to be affected, because nest sites are scattered at relatively low density over much of the planning area.

Winter aircraft flights associated with oil and gas operations should have no effects on spectacled or Steller's eiders. It is likely there will be minimal effects on eiders as a result of any summer aircraft flights over the marine environment, should any occur. Spectacled or Steller's eiders staging or migrating in coastal or offshore waters during the relatively brief staging/migration periods (late June/early July, late August/September) are not expected to experience significant disruption of foraging because of the low probability that these areas would be overflown by support aircraft.

Summer aircraft flights over onshore areas of the planning area, especially north and east of Teshekpuk Lake, may affect nesting females and their broods. The lake areas to the north, west, and east of Teshekpuk Lake are very sensitive areas to waterfowl during the summer months. The highest densities of spectacled eiders in the planning area are found in this area; they may use some of these lakes and other habitat in the area for breeding, nesting, and rearing their young. Because there will be no leasing in this area under this alternative, there should be no effects on spectacled eiders as a result of aircraft flights related to oil and gas activities in the planning area. Steller's eiders may use some of the lakes in the northern and central portions of the planning area for breeding, nesting, and broodrearing. Summer aircraft flights over the central portion of the planning area may affect breeding activities as well as nesting females and their broods. Nest sites are scattered at relatively low density over much of the planning area, so substantial disturbance of nesting or broodrearing eiders is not expected to occur. Some eiders may experience temporary, nonlethal effects, probably lasting less than an hour.

3) Effects from Vessel Activities: There may be some transportation of equipment and supplies through the marine environment during the open-water season. Due to logistics problems associated with moving materials over the long distances from existing infrastructure, barges may be used to transport heavy equipment and supplies. Staging areas may be established

along the coastline and materials transported and stockpiled during the summer months (mid-July to early October) for operations at inland sites during the winter months. Spectacled and Steller's eiders staging or migrating in coastal or offshore waters during the relatively brief staging/migration periods (late June/early July, late August/ September) are not expected to experience significant disruption of foraging because of the low probability of disturbance by barging activities.

4) Effects from Drilling Activities: Exploration-drilling activities will be conducted only onshore and only during the winter months, so spectacled eiders would not be affected by the activity. Table IV.A.1.b-5 provides information regarding the number of wells likely to be drilled and the timeframe for drilling, development, and production for the estimated range of resources (65-350 MMbbl) in the planning area. Because no leasing will occur in the northern portion of the planning area under this alternative, no drilling operations will be conducted in that area. There should be no effects on spectacled eiders as a result of drilling operations.

There should be no effects on Steller's eiders as a result of exploratory drilling operations in the remainder of the planning area, because drilling would be conducted during the winter. If a commercial discovery is made, drilling of production wells likely will proceed during the summer months. Noise from drilling activities in the summer may affect some breeding and nesting Steller's eiders, although such effects are unlikely and the number of birds affected likely would be very limited. Disturbance is likely to be limited to within a few kilometers from the activities; but some eiders may experience temporary, nonlethal effects, although effects could continue all summer. During the development/production phase, crew-support camps likely would be established. Improper containment or disposal of refuse could attract potential bird predators such as arctic foxes, grizzly bears, ravens, and glaucous gulls. It is likely that an increase in predators, should it occur, would result in the loss of eggs, chicks, or even adult eiders.

5) Effects from Construction Activities: No pipeline-construction or other construction activities are expected to occur in the marine environment, so no effects on spectacled or Steller's eiders are expected in the marine environment. Onshore-pipeline-construction activities likely will occur in the winter and would not be likely to affect eiders. There should be no effects on spectacled or Steller's eiders as a result of onshore-pipeline-construction activities.

Vehicle traffic on road systems through the oil fields during the summer may affect spectacled and Steller's eiders. However, no leasing will occur in the northern portion of the planning area under this alternative, so spectacled eiders will not be affected by vehicle traffic. No summer road access to the oil fields in the remainder of the planning area is planned, so Steller's eiders should not be affected by vehicle traffic. Initial access will be by ice roads during the winter. If a discovery is made and development and production proceed, roads likely would be limited to the area between drill pads. Gravel for roads and pads is likely to come from gravel pits outside the planning area, possibly from the gravel mine across the Colville River from Nuiqsut. This is an existing gravel mine located in an area where the densities of spectacled and Steller's eiders are low. Little, if any, disturbance of these birds is expected to occur as a result of gravel mining operations at this location. Placement of fill for roads and pads could result in destruction of some breeding habitat or actual take of spectacled and Steller's eiders or their nests. While the amount of habitat lost may not be a significant proportion of the total amount of habitat available, the Fish and Wildlife Service (USDOI, FWS, 1998) anticipates some adverse effects to spectacled eiders. Spectacled eiders tend to be more concentrated within the planning areas than are Steller's eiders. In addition to vehicle traffic, there likely would be other activities occurring during the summer such as maintenance of roads and pads, construction of buildings, etc. Disturbance is likely to be limited to within a few kilometers from the activities. Because the density of Steller's eiders is very low in the southern half of the planning area, it is likely that the effects of vehicular traffic on Steller's eiders will be minimal, affecting at most a few nesting birds.

6) Effects from Spill Cleanup: No spills are expected to occur in the marine environment. In the event of an oil spill in the planning area, it is likely that the spill will be contained onshore. It is unlikely that any oil spilled onshore will be released into the marine environment. If oil is spilled onshore, personnel, equipment, and aircraft will be present to conduct cleanup operations. No oil-spill-cleanup activities would occur adjacent to the coast in the area of highest eider density, because no leasing will occur in the northern portion of the planning area under this alternative. There should be no effects on spectacled eiders as a result of oil-spill-cleanup activities. If oil-spill-cleanup activities occurred adjacent to Steller's eider breeding, nesting, or rearing areas, limited disturbance and possible displacement of eiders from their normal activities could occur. Due to the relatively small size of spills, the limited area affected by a spill, and the limited likelihood for a spill to occur near an eider-nesting area, it is likely that only a few eiders may be displaced from favored habitats or otherwise be affected by these activities.

(c) Effects of Spills: Exposure of spectacled and Steller's eiders to oil is expected to result in the general effects (i.e., individuals are not expected to survive

moderate to heavy contact) noted in Section IV.B.6.c of the Beaufort Sea Sale 144 Final EIS (USDOI, MMS, 1996a). If a discovery occurs and seawater is used for waterflooding during the production phase, it is possible that some seawater could be spilled on the tundra as a result of a pipeline leak. While mortality to eiders is unlikely, some habitat could be damaged or destroyed from the seawater.

Under this alternative, there would be no leasing in the northern portion of the planning area. No spills are expected to occur in the marine environment, nor is it likely that any oil spilled onshore will be released into the marine environment. Therefore, eiders occupying marine habitats during summer/fall periods for staging/migrating should not be at risk. Onshore spills of oil or seawater would not occur in the northern portion of the planning area in primary eider habitat. Any oil spills that occur in the remainder of the planning area are likely to be small and primarily confined to drilling pads, although some eiders may be adversely affected by spills that reach the surrounding tundra. The FWS anticipates that spectacled eiders or nests within 200 m of a spill are likely to be affected. Steller's eiders are less likely to be affected by spilled oil because few, if any, Steller's eiders would be contacted. Onshore spills generally are fairly small; consequently, the affected area would be fairly small and 65 to 80 percent of the spills are likely to occur on the drilling pad, where they would be unlikely to affect eiders. Those spills that occur on or reach the surrounding environment generally cover a small area ($\leq$500 ft^2). Although no oil and gas activities would occur in proximity to Teshekpuk Lake under this alternative, there may be some potential for an oil spill to contact Teshekpuk Lake. For the purpose of analysis, BLM assumes that a 325 bbl spill reaches the lake in early June. As a continuous spill, it would cover approximately 61 acres as a very thin film after 30 days. It likely would move around the lake as individual spillets with the prevailing wind direction. By the end of summer, all of the oil not cleaned up will be trapped along the lake's vegetated margins either on the water's surface or on the bottom. Some mortality of spectacled eiders may occur, if they are contacted by spilled oil. Spectacled eiders may be present in low densities on the lake during the breeding season, particularly the southwestern portion of the lake. There are little data regarding the presence or abundance of eiders on the lake during the remainder of the year. Seawater spills are not likely to cause mortality to eiders, although some habitat could be damaged or destroyed.

Summary: Under Alternative B, spectacled eiders are not expected to be affected by oil and gas activities such as discharges, seismic surveys, drilling, oil-spill-cleanup activities, construction activities, vehicle traffic, or oil spills. Steller's eiders are not expected to be affected by oil and gas activities such as discharges, seismic surveys, most construction activities, seawater spills or oil spills. Neither spectacled nor Steller's eiders staging or migrating in the marine environment along the Beaufort Sea coast are expected to experience adverse effects from noise or disturbance from marine-vessel traffic or aircraft traffic associated with activities under this alternative. Spectacled eiders breeding, nesting, or rearing young in coastal habitats occasionally may be overflown by support aircraft and may experience temporary, nonlethal effects, probably lasting less than an hour. Steller's eiders breeding, nesting, or rearing young in the central portion of the planning area may be overflown by support aircraft, disturbed by noise from drilling or vehicular traffic during development/ production activities in the summer, or affected by oil-spill-cleanup activities and may experience temporary, nonlethal effects, lasting probably less than an hour but possibly continuing all summer, in the case of summer drilling operations. Significant disturbance of nesting or broodrearing eiders is not expected to occur. These eiders may experience temporary, nonlethal effects as described under Alternative A. Some eiders may be displaced to habitat that may not be optimal for successful reproduction and survival. Adverse effects from such displacement likely would be minimal considering the relatively low density of eiders in the planning area and the likelihood that historic population levels using this habitat were much higher. Improper containment or disposal of refuse at support camps could attract potential bird predators. It is possible that an increase in predators could result in the loss of eggs, chicks, or even adult eiders.

Some eiders may be affected by activities other than oil and gas, such as hazardous- and solid-material removal and remediation and summertime aircraft flights over sensitive areas, which may affect nesting females and their broods. Eiders breeding, nesting, or rearing young in coastal habitats north, west, and east of Teshekpuk Lake may be overflown by aircraft (both helicopters and fixed-wing) on a regular basis during the summer months and may experience temporary, nonlethal effects as described in Alternative A. Substantial disturbance is not expected to occur and is likely to be limited to within a few kilometers of the activities. Such short-term and localized disturbances are not expected to cause significant population effects due to the relatively low density of eiders in the area. However, disturbance of some individuals over the life of the project is expected to be unavoidable. Disturbance, depending on its nature and duration, could be considered a "take" under the ESA.

Conclusion—First Sale: Overall, bowhead whales exposed to noise-producing activities such as marine vessel traffic and possibly aircraft overflights most likely would experience temporary, nonlethal effects. Bowheads may exhibit temporary avoidance behavior in response to vessel

and aircraft activities. In general, bowheads do not appear to travel more than a few kilometers in response to a single disturbance incident. Behavioral changes as a result of exposure to vessel or aircraft traffic likely will last only a few minutes after the disturbance has left the area or the whales have passed. Overall, spectacled and Steller's eiders are not expected to be exposed to most noise-producing activities from oil and gas operations. Any effects from exposure likely would be minimal. Spectacled and Steller's eiders breeding, nesting, or rearing young in coastal habitats may be overflown by support aircraft and may experience temporary, nonlethal effects, probably lasting less than an hour. In the central portion of the planning area, Steller's eiders occasionally may be overflown by support aircraft, disturbed by noise from drilling or vehicular traffic during development/production activities in the summer, or affected by oil-spill-cleanup activities and may experience temporary, nonlethal effects lasting probably less than an hour but possibly continuing all summer in the case of summer drilling operations. It is unlikely that the primary Alaskan nesting area, located south and southeast of Barrow, would be affected much by these activities; so significant disturbance of nesting or broodrearing eiders is not expected to occur. Improper containment or disposal of refuse at support camps could attract potential bird predators. It is possible that an increase in predators could result in the loss of eggs, chicks, or even adult eiders. Some eiders may be affected by activities associated with the management plan other than oil and gas activities, such as hazardous- and solid-material removal and remediation and summer aircraft flights over sensitive areas. Nesting females and their broods may experience temporary, nonlethal effects as a result of these activities. Such short-term and localized disturbances are not expected to cause significant population effects. However, disturbance of some individuals over the life of the project is expected to be unavoidable. Disturbance, depending on the nature and duration of the disturbance, could be considered a "take" under the ESA.

Multiple Sales: Under the multiple-sales approach, the resource estimate for Alternative B increases from a range of 65 to 350 MMbbl in zero to one oil fields (Table IV.A.1.b-4) to a range of 90 to 500 MMbbl in zero to two oil fields (Table IV.A.1.b-6). Resources at the low end of the resource range (90 MMbbl) are not economically viable as stand-alone fields. The number of exploration wells increases from a maximum of 4 to 14, delineation wells increase from a maximum of 6 to 12, and production wells increase from a maximum of 83 on 2 pads to 150 on 4 pads. Pipeline miles increase from 75 to 90 mi (Tables IV.A.1.b-5 and 7). Multiple sales would occur over a longer period of time and, depending on the frequency of sales and results from exploratory drilling operations, possibly increase the timeframe for oil and gas activities in the planning area by a couple of decades.

For Alternative B, it is estimated that the number of spills <1 bbl would increase from a range of 0 to 53 spills to a range of 0 to 75 spills, and the number of spills >1 bbl would increase from a range of 0 to 17 spills to a range of 0 to 25 spills over the assumed production life of the planning area (Tables IV.A.2-3a and IV.A.2-3b). The estimated number of crude-oil spills over the assumed production life of the planning area would increase from a range of 0 to 70 spills to a range of 0 to 100 spills (Tables IV.A 2-2a and IV.A.2-2b). Information pertaining to oil spills can be found in Section IV.A.2.

Conclusion—Multiple Sales: Effects of multiple sales are expected to be essentially as described above for the first sale. Bowhead whales exposed to noise-producing activities such as marine-vessel traffic and possibly aircraft overflights most likely would experience temporary, nonlethal effects. Spectacled and Steller's eiders are not expected to be exposed to most noise-producing activities from oil and gas operations, and any effects from exposure likely would be minimal. The assumptions that oil spills would be relatively small in size, that the majority of the spills would occur on pads, and that small areas would be affected where spills occur off the pads would remain the same as for the first sale. Therefore, the effects of multiple sales and increased potential for noise-producing activities and oil spills on endangered and threatened species at the resource ranges and activity levels described are expected to be essentially the same as described above for the single sale.

Effectiveness of Stipulations: No stipulations or other special mitigating measures are needed to protect bowhead whales. Section II.C.7 contains stipulations proposed by BLM to protect various waterfowl species from various activities in the planning area. Stipulations included under several categories, such as solid- and liquid-waste handling, hazardous-material disposal and cleanup, ice roads and water use, overland moves and seismic work, oil and gas exploratory drilling, facility design and construction, ground transportation, air traffic, oil field abandonment, orientation program, and other activities should provide adequate protection to eiders from most activities. The effectiveness of mitigating measures for noise and disturbance from aircraft traffic associated with activities other than oil and gas, such as aerial wildlife surveys and other aerial surveys, are the same as Alternative A. Aircraft traffic associated with activities other than oil and gas has the potential to affect breeding and nesting eiders, because several of the aircraft stipulations pertaining to flight-timing restrictions apply only to oil and gas activities. Therefore, the stipulations associated with flight-timing restrictions of aircraft

probably are not adequate to protect spectacled eiders and Steller's eiders from disturbance from aircraft associated with aerial wildlife surveys and other surveys conducted in the lake areas to the north, west, and east of Teshekpuk Lake. Steller's eiders in other portions of the planning area are less likely to be affected by aircraft flights, because fewer flights are likely to be conducted in those areas. Disturbance of some individuals over the life of the project is expected to be unavoidable.

c. Effects of an Oil Spill on Listed and Proposed Listed Species along the Transportation Route: This section includes an analysis of the effects of oil spills along transportation routes on species discussed in Section III.B.6. A number of listed and proposed species were discussed in previous consultations, as described in the consultation information presented in the lead paragraphs under Alternative A. This discussion concerns only additional species not included in previous consultations. These species include seventeen salmonids identified by NMFS; the Snake River sockeye salmon; Snake River spring, summer, and fall chinook salmon; southern Oregon/northern California coast coho salmon; central California coast coho salmon; Sacramento River winter-run chinook salmon; Umpqua River cutthroat trout; and ten steelhead ESU's. One steelhead ESU that is listed as a candidate species also is included. Also included are numerous species of animals and plants under the jurisdiction of the FWS—the Pacific pocket mouse, least Bell's vireo, San Francisco garter snake, tidewater goby, Sacramento splittail, callippe silverspot butterfly, Antioch Dunes evening primrose, Contra Costa wallflower, Monterey gilia, San Francisco lessingia, Contra Costa goldfields, Marin dwarf-flax, Suisun thistle, coastal dunes milk vetch, Hickmann's potentilla, showy Indian clover, Sonoma alopecurus, San Bruno Mountain manzanita, pallid manzanita, La Graciosa thistle, and yellow larkspur. Other species along transportation routes were discussed in previous EIS's, and potential effects are summarized in Section IV.B.10. This EIS analyzes potential effects on species from a tanker oil spill along the transportation route from Valdez to ports along the U.S. West Coast. The average tanker spill is approximately 30,000 bbl, although most are smaller. The average spill size was increased as a result of the *Exxon Valdez* Oil Spill. Based on Table IV.A.2-5a, the estimated mean number of spills under Alternative B ranges from 0 to 0.39, while the estimated mean number of spills under Alternative E ranges from 0.28 to 1.21. The most likely number of spills to occur resulting from NPR-A resources is zero spills under Alternatives B through D and one spill under Alternative E over the assumed production life of the NPR-A. There is a 24- to 70-percent chance that one or more spills ≥1,000 bbl will occur under Alternative E over the assumed life of the IAP.

Under the multiple-sales approach, the estimated mean number of spills under Alternative B increases to a range of 0 to 0.55, while the estimated mean number of spills under Alternative E increases to a range of 0.55 to 2.42 (Table IV.A.2-5b). The most likely number of spills to occur resulting from NPR-A resources is zero spills under Alternatives B and C, increasing to one spill under Alternative D and two spills under Alternative E over the assumed production life of the IAP. There is a 42- to 91-percent chance that one or more spills ≥1,000 bbl will occur under Alternative E over the assumed life of the IAP.

(1) Salmonids: Contact with sufficient concentrations of spilled oil may affect fish populations in several ways: (1) eggs and larvae may suffer increased mortality due to coating or direct toxic effects; (2) adults may fail to reach spawning grounds in critical, narrow, or shallow contaminated waterways; (3) fecundity or spawning behavior may change; (4) local food species of the adults, juveniles, fry, or larvae may be adversely affected or eliminated; and (5) sublethal effects may reduce fitness and affect the ability to endure environmental perturbations. However, concentrations of petroleum hydrocarbons (PHC's) are toxic to fishes only a short distance from, and for a short time after, a spill event (Malins, 1977). Available information indicates that concentrations of PHC's found beneath an oil slick are <0.1 ppm. This is well below toxic levels for fish eggs and larvae (sublethal effects on eggs, larvae, and adults at 0.01-1.0 ppm; lethal effects on eggs and larvae at 0.1 to 1.0 ppm, and on adults at 1 to 100 ppm) (Malins, 1977; Meyer, 1990).

There is some evidence that pelagic fishes (salmon) are able to detect and avoid hydrocarbons in the water (Weber, et al., 1981), although some salmon may not completely avoid oiled areas and, if exposed to sublethal amounts of spilled oil, may become temporarily disoriented; but they would eventually return to their home stream (Martin, 1992). Adult salmon appear to be relatively unaffected by oil spills and are able to return to natal streams and hatcheries even under very large oil-spill conditions, as evidenced by pink and red salmon returning to Prince William Sound and red salmon returning to Cook Inlet after the *Exxon Valdez* spill. Eggs of pelagic fish that spawn upstream in rivers and streams, such as the salmonids referenced above, would be unaffected by an oil spill. Potential effects on outmigrating smolts are less clear. Based on Malins (1977), some smolts may experience sublethal effects if a large oil spill occurred in the mouth of the river, bay, or estuary during the time that outmigrating smolts reached that area. This probably is an unlikely scenario.

It also has been suggested that the *Exxon Valdez* oil spill caused a reduction in food available to pink salmon

populations in Prince William Sound, and that this has caused reduced survival and subsequent failures in pink salmon runs. Studies examining growth, survival, and availability of prey for juvenile pink salmon have produced conflicting results. One study examined juvenile pink and chum salmon contaminated by ingesting *Exxon Valdez* crude in 1989 (Wertheimer et al., 1993). Oil was present in 1 percent and 3 percent of these salmon, respectively, that were collected at oiled sites in 1989; but there was no evidence of oil contamination in these same areas in 1990. Juvenile salmon were more abundant in unoiled areas, and this difference continued in 1990 after oil-exposure levels diminished. The observed difference was attributed to geographic differences in production and migration rather than oil exposure. The diet composition and feeding efficiency of these fish was unaffected by the oil spill. Juvenile pink salmon were smaller and slower growing in oiled areas in 1989 but not in 1990. There was no evidence of a reduction in available prey to pinks and chums in oiled areas in 1989 or 1990. The slower growth of pink salmon juveniles in 1989 was attributed to the metabolic cost of depurating the hydrocarbon burden. The slower growth may have caused an incremental reduction in survival to adulthood.

Overall, the potential for an oil spill to affect these species seems limited. Tanker routes usually pass well offshore of the coast, unless the tanker is approaching or entering a port. In the event that an oil spill occurred and coincided with the outmigration of smolt, some smolts could be exposed to spilled oil. If this occurred, an oil spill could cause slower growth for smolts, which could result in an incremental reduction in survival to adulthood but probably would not result in population-level effects.

(2) Tidewater Goby: No information is provided in 59 *FR* 5494 concerning the potential effects of an oil spill on tidewater gobies, in spite of the numerous oil tankers transporting oil along the coast of California. Coastal development projects that result in the loss of coastal saltmarsh habitat currently are considered the major factor adversely affecting the tidewater goby. This includes activities such as draining marsh habitat, dredging waterways, channelization, changes in salinity and temperature, discharge of agricultural and sewage effluents, etc. The potential for an oil spill to affect this species seems limited. Tanker routes usually pass well offshore of the coast unless the tanker is approaching or entering a port. The tidewater gobies are discontinuously distributed along the coast of California in tidal streams associated with coastal lagoons, and they are found at the upper end of those lagoons in low- salinity water. In the event of an oil spill occurring near one of these coastal lagoons, it may be possible to place booms across the openings of many of these lagoons and prevent oil from reaching the goby's habitat. If an oil spill did reach the upper portions of a lagoon, it could adversely affect these fish by causing further degradation of their habitat. Tidewater gobies could be adversely affected at the population level due to limited availability of suitable habitat, low population size, and their restricted ability to recolonize habitats from which they have been extirpated. In general, the potential for adverse effects on this species is considered low.

(3) Delta Smelt: No information is provided in 58 *FR* 12854 concerning the potential effects of an oil spill on the delta smelt, in spite of the numerous oil tankers transporting oil along the coast of California. A variety of factors affect the estuarine ecosystems that may have led to a decline of the delta smelt. The principal factor mentioned was large exports of freshwater for agricultural and urban use. The species also is threatened by other factors such as prolonged drought, introduced nonindigenous aquatic species, reduction in abundance of key food organisms, and agricultural and industrial chemicals. The potential for an oil spill to affect this species appears limited. Tanker routes usually pass well offshore of the coast, unless the tanker is approaching or entering a port. The Delta smelt occurs primarily in the Sacramento River channel in the Delta. It is rare in Suisun Bay and virtually absent from Suisun Marsh. The potential for an oil spill to reach the Sacramento River channel is likely to be very low. In the event of an oil spill occurring near this area, it may be possible to place booms across the channel, preventing oil from reaching this species' habitat. If an oil spill did reach these areas, it could adversely affect this fish by causing further degradation of its habitat. The Delta smelt could be adversely affected at the population level due to limited availability of suitable habitat and low population size. In general, the potential for adverse effects on this species is considered low.

(4) Sacramento Splittail: No information is provided in 59 *FR* 862 concerning the potential effects of an oil spill on the Sacramento splittail, in spite of the numerous oil tankers transporting oil along the coast of California. A variety of factors affect the estuarine ecosystems that have led to a decline of the Sacramento splittail. The principal factor mentioned was the altered hydraulics and reduced outflow of the delta caused by export of freshwater from the Sacramento and San Joaquin rivers. Threats to the species include reduced river outflow, loss of spawning and nursery habitat, urban and agricultural pollution, introduction of exotic species, etc. The potential for an oil spill to affect this species seems limited. Tanker routes usually pass well offshore of the coast, unless the tanker is approaching or entering a port. The Sacramento splittail occurs only in the Suisun Bay and the San Francisco Bay-Sacramento-San Joaquin river estuary. The potential for an oil spill to reach these areas is very low. In the event of an oil spill occurring near these

areas, it may be possible to place booms across the openings of many of these lagoons, preventing oil from reaching the Sacramento splittail's habitat. If an oil spill did reach these areas, it could adversely affect these fish by causing further degradation of their habitat. The Sacramento splittail could be adversely affected at the population level due to limited availability of suitable habitat and low population size. In general, the potential for adverse effects on this species is considered low.

(5) Suisun Thistle: Information is provided in 59 *FR* 862 concerning factors that may affect the Suisun thistle. A variety of factors affect the estuarine ecosystems that have led to a decline of the Suisun thistle. Habitat has been severely reduced due to hydraulic mining, diking, and filling involved in agricultural land conversion and urbanization, waste disposal, port and industrial development, railroad construction, dredging, salt production, sedimentation, etc. The potential for an oil spill to affect this species seems limited. Tanker routes usually pass well offshore of the coast, unless the tanker is approaching or entering a port. The Suisun thistle occurs only in salt or brackish tidal marshes within the San Francisco Bay area. The potential for an oil spill to reach these areas is very low. In the event of an oil spill occurring near these areas, it may be possible to place booms across the openings of many of these lagoons, preventing oil from reaching the Suisun thistle's habitat. The plant likely would be vulnerable only on a high tide. If an oil spill did reach these areas, it could adversely affect this species by smothering the plants and causing further degradation of their habitat. The Suisun thistle could be adversely affected at the population level due to limited availability of suitable habitat and low population size. In general, the potential for adverse effects on this species is considered low.

(6) Other Coastal Species: Many listed, proposed, and candidate species occupy coastal habitats that are not expected to be exposed to the same risk of impact as estuarine or offshore habitats. In particular, riverine habitat, coastal dunes, and adjacent inland habitats inhabited by the Pacific pocket mouse, least Bell's vireo, San Francisco garter snake, callippe silverspot butterfly, Antioch Dunes evening primrose, Contra Costa wallflower, Monterey gilia, San Francisco lessingia, Contra Costa goldfields, Marin dwarf-flax, coastal dunes milk vetch, Hickmann's potentilla, showy Indian clover, Sonoma alopecurus, San Bruno Mountain manzanita, pallid manzanita, La Graciosa thistle, and yellow larkspur are unlikely to be contacted by an oil spill from a tanker transporting oil from the NPR-A under typical weather and oceanographic conditions. None of the Federal Register notices or recovery plans published by the FWS refer to a potential for adverse effects from oil spills on these species. Many of these species occur in inland habitats, some at substantial elevations above sea level, and would not be contacted by oil spilled from a tanker. For those species living in the coastal dune habitat, significant contact of coastal dune habitat by a tanker spill is unlikely. It is likely that any contact of the coastal dune habitat by spilled oil would require a combination of the tanker spill occurring in the immediate area, very high tides, and strong onshore winds that would have to persist for an extended period of time prior to or immediately after the spill. If this scenario were to occur, it is possible that small numbers of some species may be affected by spilled oil.

11. Economy:

a. Activities Other Than Oil and Gas Exploration and Development: For Alternative B, recreation-field employment is generated by 30, 1-week duration float-trip parties per year (Table II.H.3.b), which is equal to one person working for 8 months each year.

b. Oil and Gas Exploration and Development Activities: Increased revenues and employment are the most significant economic effects that would be generated by Alternative B. Increased property-tax revenues and new employment would be created with the construction, operation, and servicing of facilities associated with oil and gas activities. These facilities are described in Table IV.A.1-1 and are summarized as follows. For exploration, 1 to 4 exploration and 0 to 6 delineation wells would be drilled between 2000 and 2006; for development, 0 to 83 production and service wells would be drilled, 0 to 2 production pads constructed, and 0 to 75 mi of onshore pipeline installed between 2006 and 2015. The number of workers needed to operate the infrastructure is determined by the scale of the infrastructure and not by the amount of oil produced. A wide range of production volume can be handled by a given level of infrastructure. Once the infrastructure is in place, the number of workers needed to operate it does not depend on the amount of product flowing through it. Effects include employment generated by seismic surveys during exploration. State property-tax revenues are in proportion to the value of onshore facilities. State royalty income and State severance tax are in proportion to production. Peak yearly production is estimated at 0 to 35 MMbbl. (For complete descriptions of resources and associated activity, see Sec. IV.A.1.b).

(1) North Slope Borough Revenues and Expenditures: Potential revenues will be determined by several different factors; therefore, the revenue projections should be considered with the understanding that many uncertainties exist. Exploration, development, and production are projected to generate increases in property taxes above the levels without Alternative B activities starting in 2000 and averaging about 0 to 2 percent each year through the production period, or about $0 to $3

million. This will decline over the period of oil and gas activity due to depreciation of the infrastructure. The two expenditure categories that affect employment—operations and the Capital Improvements Program (CIP)—are projected to decline without oil and gas activity. Of these two categories, it is assumed that only expenditures on operations would be affected by the effects of oil and gas activity on taxable property value. Those CIP expenditures that have generated many high-paying jobs for residents would not be changed by oil and gas activity. For revenues shared by the State, see subpart (4) below.

(2) North Slope Borough Employment: Under Alternative B, the gains in direct employment would include jobs in petroleum exploration, development, and production, and related activities (Table IV.C.11-1). For oil at a price of $18/barrel, exploration would occur only in the year 2000, and employment would be 99 direct jobs. At $18/barrel, any resources discovered would not be economically viable as stand-alone fields (Table IV.A.1.b-4). At $30/barrel, direct employment is anticipated to peak at 1,500 jobs during the development phase and decline to a level of 700 during production from 2015 to 2028. All of these jobs would be filled by commuters who would be present at the existing enclave-support facilities in and near the Prudhoe Bay complex approximately half of the days in any year. Most workers would commute to permanent residences in the following three regions of Alaska: Southcentral, Fairbanks and, to a much smaller extent, the North Slope. Some workers would commute from these enclaves to permanent residences outside Alaska, especially during the exploration phase.

Because of the development of facilities or the continued use of facilities that are taxable by the NSB, the NSB will have additional revenues that most likely will be used for ongoing operations. This in turn results in NSB-government jobs, which are a large proportion of the increases in NSB resident employment generated by this alternative.

At $18/barrel, there would be no change in NSB resident employment for any year. At $30/barrel, total resident employment is anticipated to increase by 44 jobs in the peak of development and level off to 24 in the production phase after 2014 (Table IV.C.11-1). Peak increases in resident employment are about 3-percent greater with Alternative B than without during the development phase and about 2-percent greater during production. The increase in employment opportunities partially may offset declines in other job opportunities and delay expected outmigration. Increases in resident population will correspond to increases in employment (Table IV.C.11-2).

The employment and population forecasts were calculated using the Manpower Model, created by MMS, and the Rural Alaska Model (RAM) for the NSB, created and updated by the Institute for Social and Economic Research (ISER) of the University of Alaska Anchorage (UAA) (Tables IV.C.11-1 and IV.C.11-2). Using the Development Scenario in Section IV.A.1.b and associated levels of activities, the numbers of wells, platforms, shore bases, and kilometers of pipeline are input to the Manpower Model. The Manpower Model predicts the number of direct oil-industry workers. These data are then input to the RAM. Among other variables, the RAM predicts the resident workers in the NSB (which in this case is indirect employment) and resident population. The terms "job" and "employee" are used in this section to mean one full-time-equivalent worker working for 1 year. A "resident worker" is defined as a resident of the NSB.

Jobs working directly for the oil industry in activities associated with Alternative B also will be available. However, the number of NSB-resident Natives working directly for oil companies in and near Prudhoe Bay historically has been low—approximately 60 out of more than 6,000 workers, or about 1 percent (UAA, ISER, 1993). While the proposed oil and gas activity is projected to generate a large number of direct oil-industry jobs in the region, the number of jobs filled by permanent NSB Native residents is not projected to be large. It is assumed NSB resident Natives will hold approximately 1 percent of the oil-industry jobs, based on historical experience.

No workers will be needed to clean up numerous small oil spills beyond those already employed in the workers' enclave.

(3) Effects of Subsistence Disruptions on the North Slope Borough Economy: Disruptions to the harvest of subsistence resources could affect the economic well-being of NSB residents primarily through the direct loss of subsistence resources. See Section IV.C.13 for effects on subsistence-harvest patterns.

(4) Local, State, and Federal Revenues: Local, State, and Federal revenues will increase as a result of Alternative B. Property-tax revenues to the State will be approximately 25 percent of the revenues to the NSB, or $0 to $0.75 million annually. For this ratio, please see *Alaska Statewide and Regional Economic and Demographic Systems: Effects of OCS Exploration and Development, 1990* (UAA, ISER, 1990). A Federal royalty rate of 16.67 percent is assumed to apply. According to law, the Federal Government must share 50 percent of this royalty with the State; and the State must share a portion of its royalty with the affected local government (see Sec. III.C.1.d). The affected local government is assumed to be the NSB. The annual royalty will be $4 to $37 million for the Federal Government and $4 to $37 million for the State and the NSB. The State can collect a severance tax, which is 12.5

Table IV.C.11-1
Summary of Employment Forecasts, Alternative B

	IAP Employment in Enclave			NSB Resident Employment		
	Without IAP Activity	With IAP Activity		Without IAP Activity	*Increase* with IAP Activity	
Year		$18/bbl	$30/bbl		$18/bbl	$30/bbl
1999	0	0	0	1,865	0	0
2000	0	99	99	1,825	0	2
2001	0	0	179	1,794	0	8
2002	0	0	179	1,767	0	12
2003	0	0	199	1,746	0	13
2004	0	0	139	1,730	0	13
2005	0	0	349	1,716	0	14
2006	0	0	1,421	1,701	0	44
2007	0	0	727	1,685	0	42
2008	0	0	729	1,662	0	18
2009	0	0	1,541	1,614	0	32
2010	0	0	933	1,565	0	19
2011	0	0	970	1,513	0	25
2012	0	0	899	1,470	0	27
2013	0	0	909	1,431	0	30
2014	0	0	853	1,393	0	30
2015	0	0	740	1,357	0	24
2016	0	0	700	1,350	0	24
2017	0	0	700	1,330	0	24
2018	0	0	700	1,310	0	24
2019	0	0	700	1,290	0	24
2020	0	0	700	1,290	0	24
2021	0	0	700	1,310	0	24
2022	0	0	700	1,330	0	24
2023	0	0	700	1,350	0	24
2024	0	0	700	1,370	0	24
2025	0	0	700	1,390	0	24
2026	0	0	700	1,410	0	24
2027	0	0	700	1,430	0	24
2028	0	0	700	1,450	0	24

Sources: Resident employment 1999–2015, Rural Alaska Model, North Slope Borough, 1996; IAP employment and resident employment 2016–2028, Manpower Model and MMS.

Table IV.C.11-2
Summary of NSB Population Forecasts, Alternative B

		Increase in Resident Population				Increase in Resident Population	
Year	Resident Population No IAP Activity	IAP Activity $18/bbl	IAP Activity $30/bbl	Year	Resident Population No IAP Activity	IAP Activity $18/bbl	IAP Activity $30/bbl
1999	6,067	0	0	2014	6,582	0	90
2000	6,134	0	6	2015	6,423	0	72
2001	6,213	0	24	2016	6,300	0	72
2002	6,301	0	36	2017	6,200	0	72
2003	6,391	0	29	2018	6,100	0	72
2004	6,488	0	29	2019	6,000	0	72
2005	6,684	0	42	2020	6,000	0	72
2006	6,695	0	132	2021	6,100	0	72
2007	6,820	0	126	2022	6,200	0	72
2008	6,918	0	54	2023	6,300	0	72
2009	7,011	0	96	2024	6,400	0	72
2010	7,050	0	57	2025	6,500	0	72
2011	7,004	0	75	2026	6,600	0	72
2012	6,891	0	81	2027	6,700	0	72
2013	6,743	0	90	2028	6,800	0	72

Sources: For years 1999–2015, Rural Alaska Model, North Slope Borough, 1996. For 2016–2028, MMS.

percent for the first 5 years and 15 percent for the following years. The average annual State severance tax is estimated to be $6 to $62 million.

(5) Southcentral Employment: Workers in the enclave centered at Prudhoe Bay probably would commute to permanent residences in Southcentral Alaska, Fairbanks, and outside the State. However, for the purpose of this analysis, it is assumed all of the enclave workers (Table IV.C.11-1) commute to Southcentral Alaska and have permanent residences there except during peak construction years. Every enclave worker generates approximately five additional jobs, and these are assumed to be located in Southcentral Alaska, mostly in the trade, finance, and service sectors. This is a result of spending by enclave workers, who have higher than average wages, which has a multiplier effect on the economy and generates additional employment.

At $18/barrel for oil, direct employment would occur in one year of exploration only, 2000, at 99 jobs. Because of the brief and limited number of jobs, it is assumed no indirect jobs or additional population would be created in Southcentral Alaska.

At $30/barrel for oil, the population in Southcentral Alaska generated directly and indirectly by enclave workers during production will be 10,500, or 2.4 percent of the Southcentral Alaska population of 434,000 anticipated without the IAP in 2015. In the 7-year period of the exploration and development phases, the population directly and indirectly associated with Alternative B would rise to the level sustained during production. Population associated with workers, that is, families of workers, is at a ratio of approximately 2.5 persons for each worker. The population for Southcentral without the IAP is assumed to be 370,000 in 1999 and increase at a rate of 1 percent per year, resulting in a population of 434,000 in 2015. In 1995, the population for Southcentral Alaska was 356,000, of which 258,000 were in Anchorage, 51,000 in the Matanuska-Susitna Borough, and 47,000 in the Kenai Peninsula Borough (State of Alaska, Department of Community and Regional Affairs [DCRA], 1996). In the two peak construction years, approximately half of the construction workers are assumed will commute from outside Alaska to the North Slope and spend little time in Anchorage. This assumption has a leveling effect on the increase in workers and population in Southcentral Alaska. Employment and population ratios in the above analysis are derived from UAA, ISER (1990).

Conclusion—First Sale: For activities other than oil and gas exploration and development, Alternative B would generate approximately 50 jobs for 4½ months associated with seismic surveys and recreation employment, equivalent to one person working 8 months per year. For oil and gas exploration and development activities, production under Alternative B is projected to generate increases above the levels of Alternative A as follows: NSB property taxes, 0 to 2 percent ($0-$3 million); direct oil-industry employment, 0 to 700 (5 times this in additional jobs) residing in Southcentral Alaska; NSB resident employment, 0 to 2 percent; annual revenues of $0 to $0.75 million property tax to the State; $4 to $37 million royalty to the Federal Government; $4 to $37 million royalty to the State and the NSB; and $6 to 62 million severance tax to the State.

Multiple Sales: The effect of multiple sales for Alternative B is projected to be approximately two times that of the First Sale for Alternative B.

Conclusion—Multiple Sales: The effect of multiple sales for Alternative B is projected to be approximately two times that of Alternative B.

Effectiveness of Stipulations: There are no mitigating measures that would change potential economic effects.

12. Cultural Resources:

a. Activities Other than Oil and Gas Exploration And Development: Cultural resources (the physical remains resulting from the activities of historic or prehistoric humans) are nonrenewable. Once they are adversely impacted and/or displaced from their natural context, the damage is irreparable.

Under Alternative B, the management-action impacts generally are the same as under Alternative A, except the intensity of the actions may increase because of potential oil and gas exploration activities in addition to seismic-data gathering.

b. Oil and Gas Exploration and Development Activities: Cultural resources are not ubiquitous in the planning area as are wildlife and habitat, and their locations are much less predictable. As a result, it is quite possible that no oil and gas exploration or development activities would impact a cultural resources site.

(1) Effects of Disturbance from Exploration: The types of environmental conditions and the cultural resources that may be impacted by exploration activities would be the same as those described under Alternative A for activities other than oil and gas exploration and development.

Drilling 10 exploration/delineation wells is anticipated under Alternative B. No more than two wells are expected to be drilled during a single winter season. Drilling the 10 wells probably would occur over the span of several winter

seasons using drill pads, camp pads, roads, and airstrips made of ice and snow. Because no permanent pads, roads, or airstrips would be constructed and, therefore, no significant disturbance of the ground surface would occur, buried cultural resources should not be measurably impacted. On the other hand, cultural resources on or incorporated in the ground's surface could be significantly impacted by ice- and snow-construction activities, while the integrity of aboveground cultural structures certainly would be compromised. The only significant surface/subsurface disturbance that would occur as a result of the actual drilling would be the drill hole itself.

(2) Effects of Exploration Spills: Sixty-five to 80 percent of all spills are confined to a pad. Spills not confined to a pad usually are confined to an area adjacent to the pad. Therefore, it is assumed that most spills would occur on an ice pad, ice road, or during winter conditions where cleanup is less invasive than in a summertime terrestrial spill. The actual spilling of hydrocarbons on a cultural resources site, in most cases, would have limited impact. However, spill cleanup may pose a serious threat to the integrity of a site, perhaps resulting in its destruction.

(3) Effects of Disturbance from Development: The construction of two production pads (connected by a road), one airstrip, and 75 mi of pipeline is anticipated under Alternative B. Surface disturbance resulting from this work would impact approximately 100 acres. Additional surface disturbance could occur, depending on the source of the material used to construct the pads, etc. Any cultural resources within the pad, road, and airstrip perimeters or located on the material borrow areas would be severely impacted or destroyed. It is anticipated that the pipeline would not have an associated all-weather road or pads and would be constructed during the winter months from an ice road and pads. Therefore, aside from the previously mentioned impacts associated with ice-pad construction, the only significant surface impact resulting from pipeline construction will be associated with the placement of VSM's and check valves. Any cultural resources at the location of VSM's or check valves will be severely impacted or destroyed. It is possible that a pump station would be necessary. A pump station would impact about 50 surface acres. The impacts associated with these types of activity easily could impact cultural resources, if any are present.

(4) Effects of Development Spills: Sixty-five to 80 percent of all spills are confined to a pad. Spills not confined to a pad usually are confined to an area adjacent to the pad or the pipeline. The actual spilling of hydrocarbons on a cultural resources site, in most cases, would have limited impact, especially if the spill occurs when the ground is snow-covered and frozen. However, spill cleanup may pose a serious threat to the integrity of the site, perhaps resulting in its destruction.

Conclusion—First Sale: Under Alternative B, impacts to cultural resources from management activities other than oil and gas exploration and development would be similar in nature to but of an increased magnitude from those of Alternative A. Impacts would include displacement and/or destruction of resources and will be minimal. Adopting the no-seismic option would reduce these impacts slightly, because aboveground structures would be at reduced risk. Under Alternative B, most of the potential impacts to cultural resources would result from oil and gas exploration and development.

Multiple Sales: Under Alternative B, potential impacts increased by a factor of two to four, depending on a suite of variables, including shared infrastructure. The scattered nature of cultural locales and the fact that the location of many remain unknown, make it somewhat difficult to assess the likelihood and severity of potential impacts.

Conclusion—Multiple Sales: Under Alternative B, potential impacts to cultural resources from management activities other than oil and gas exploration and development would be similar in nature to Alternative A, but the probability of impacts occurring might increase. Under Alternative B, the potential impacts to cultural resources from oil and gas exploration and development would increase dramatically compared to Alternative A, because only seismic activities are permitted under Alternative A.

Effectiveness of Stipulations: Along with the guidance (particularly in regard to inventory) in Sections 106 and 110 of the National Historic Preservation Act, Executive Order 11593, consultation with the SHPO, and the North Slope Borough Commission on Inupiat History, Language, and Culture, the current clearance process (see Cultural Resources, Sec. IV.B.12), and "standard" stipulation (#79) are adequate to protect cultural resources in the NPR-A through the leasing process. Any postleasing activity engaged in by the lessee would require an action-specific NEPA document tiered off this or other EIS's. The protection of cultural resources in the planning area would follow the established and proven procedures developed by the BLM during the NPR-A exploration of the late 1970's and early 1980's. This is done through a site-specific examination and/or assessment process initiated only after a specific locale of activity, e.g., proposed wellpad or airstrip construction, has been identified. As a result of this process the presence or absence of cultural resources can be determined, and potential impacts, if any, are identified and mitigated. Following site-specific identification of potential impacts, appropriate consultation

with the SHPO and, if necessary, the Advisory Council on Historic Preservation will occur.

13. Subsistence-Harvest Patterns: This section analyzes the impacts of ground-impacting-management actions and oil and gas leasing activity on the subsistence-harvest patterns of communities in or near the planning area. This analysis is organized by types of effects and discusses effects on subsistence-harvest patterns on each affected community as a result of disturbance and oil spills. Analytical descriptions of affected resources and species as well as indigenous Inupiat knowledge concerning effects are described in detail.

Under Alternative B, a maximum protection to surface resources would be emphasized by making the Teshekpuk Lake Watershed, Goose Molting Habitat, Spectacled Eider Breeding Range, Teshekpuk Lake Caribou Habitat, and Fish Habitat LUEA's unavailable to oil and gas leasing. Leasing would be deferred on lands subject to pending Kuukpik Corporation conveyances. The Colville River would be recommended to be included in the WSR System and managed as such. The BLM's option to regulate motorized use of and access to the river could disrupt subsistence hunters' use of the upper Colville, and local opinion in Barrow and Nuiqsut clearly opposes such a designation.

Raptor, passerine, and moose areas on the Colville River, the Pik Dunes, Ikpikpuk Paleontological Sites, and recreation and scenic areas would be made unavailable to oil and gas leasing and subject to restrictions for siting pipelines and industrial structures.

The planning area includes a portion of Barrow's primary terrestrial subsistence-harvest area, the western half of Nuiqsut's terrestrial subsistence-harvest area, and the eastern edge of Atqasuk's terrestrial subsistence-harvest area crosses over the western boundary of the planning area (the Ikpikpuk River) (Sec. III.C.3).

As noted in Sections III.C.2 and 3, onshore oil developments at Prudhoe Bay already have affected the subsistence-harvest system. Many of these effects are the indirect result of increased wage employment made available through projects and services funded by the NSB. Wage employment has led to an upgrading of hunting technology but, alternatively, has constricted the total time available for hunting. Additionally, Prudhoe Bay development has restricted access to traditional hunting areas in the vicinity. Currently, diminished household incomes, reduced by the loss of high earnings from NSB CIP activity in the early to mid-1980's, tend to encourage subsistence activity and to foster an increase in harvest levels and an expansion of subsistence-harvest areas for many subsistence resources (Pedersen, 1997). Another effect to subsistence harvest patterns has been the alteration of use areas due to Prudhoe Bay development. Pedersen (1998, pers. comm.) has indicated that Nuiqsut residents have altered their use patterns around Prudhoe Bay, and Nuiqsut residents confirm this. Another major change is increased access to Deadhorse, the haul road, and beyond provided by a winter ice road that has connected Nuiqsut and Prudhoe Bay for the last few years.

Access to subsistence resources, subsistence hunting, and the use of subsistence resources could be affected by reductions in subsistence resources and changes in subsistence-resource-distribution patterns. These changes could occur as a result of disturbance from seismic surveys, aircraft and vessel traffic, drilling activities, and construction activities that include pipeline construction; structure placement; and support-base, pump-station, and road construction. The following analysis examines the effects of these disturbance agents on the communities near the planning area, with specific information on the subsistence resources harvested by the Inupiat living in these communities. This analysis discusses impacts on the terrestrial resources harvested by the residents of Barrow, Atqasuk, and Nuiqsut.

The factors affecting the subsistence-harvest patterns of Barrow, Atqasuk, and Nuiqsut are summarized as follows:

- Heavy reliance on caribou in the annual average harvest for Barrow (22-58% of the total subsistence harvest), Atqasuk (57%), and Nuiqsut (30-37%) (see Table III.C.4-3; Stoker, 1983, as cited by Alaska Consultants, Inc, (ACI)/Braund, 1984; S.R. Braund 1989b; State of Alaska, Dept. of Fish and Game (ADF&G) 1995d; S.R. Braund and Assocs. and ISER, 1993b; Pedersen, 1995a, 1995b; S.R. Braund and Assocs., 1996; Brower and Opie, 1997; Opie, Brower, and Bates, 1997).
- Heavy reliance on bowhead whales in the annual average harvest for Barrow (21-38%) and Nuiqsut (4-38%) (see Table III.C.2-4; Stoker, 1983, as cited by ACI/Braund, 1984; S.R. Braund and Assocs. 1989b; ADF&G, 1995d; NSB Planning Dept., 1993; Kaleak, 1996; Brower and Opie, 1997). Percentages have continued to rise, because IWC quotas have almost doubled in recent years.
- Reliance on fish in the annual average harvest for Barrow (6-7%), Atqasuk (37%), and Nuiqsut (44-33%), (see Table III.C.2-4; S.R. Braund and Assocs. 1989b; ADF&G 1995d; Brower and Opie, 1997; Opie, Brower, and Bates, 1997).
- Hunting ranges overlap for many species harvested by Barrow, Atqasuk, and Nuiqsut.
- Hunting and fishing are cultural values that are central to the Inupiat way of life and culture.

- In 1990, the population of Barrow was 3,469; Atqasuk, 216; and Nuiqsut, 354. In 1997, the ADOL estimates were 4,276 for Barrow, 233 for Atqasuk, and 435 for Nuiqsut (ADF&G, 1995d; State of Alaska DCRA, 1997).

Effects Agents: The agents associated with management actions and oil and gas leasing in the planning area that could affect subsistence resources and subsistence-harvest patterns are impacts from disturbance and oil spills from activities other than oil and gas exploration and development and from oil and gas exploration and development activities.

Effects Definitions and Effects Levels: The assessment of effects levels derives from a set of effects-level definitions that have been developed over many years by MMS anthropologists and socioeconomic specialists and that have withstood many professional and legal reviews. These definitions follow a two-tiered approach in that they account for effects to subsistence resources as well as effects to subsistence harvests. Disturbance to subsistence is measured by duration of effect to resources and harvests and by changes in availability, in desirability, and in population levels of resources. The definitions used in this analysis consider periodic (short-term) effects to resources that have no consequent effects to harvests as the lowest level of effect (very low effect). The next level of effect has resources being affected for a period up to 1 year (1 harvest season), but none of these resources would become unavailable, undesirable, or experience population reductions and, therefore, would not alter subsistence harvests (low effect). The third gradation of effect has resources becoming unavailable, undesirable for use, or experiencing population reductions for a period up to 1 year (1 harvest season), with subsistence harvests being affected for that period (moderate effect). The next level of effect is similar to the previous definition, except resources would become unavailable, undesirable for use, or experience population reductions for a period from 1 to 2 years (2 harvest seasons) with subsistence harvests affected for a longer period (high effect). The highest level of effect defined again follows the structure of the previous two effects levels with resources becoming unavailable, undesirable for use, or experiencing population reductions for a period from 2 to 5 years (5 harvest seasons) with subsistence harvests affected for a much longer period (very high effect).

Disturbance: The noise-producing exploration and construction activities of seismic surveys, aircraft traffic, vessel traffic (supply vessels), and construction activities are those most likely to produce disturbance effects to subsistence species that include bowhead whales, belukha whales, caribou, fish, seals, walrus, and birds. A more detailed narrative of the effects from these activities on important subsistence species can be found in Section IV.B.10 of the Beaufort Sea Sale 144 Final EIS (USDOI, MMS, 1996a) and is summarized and incorporated here by reference.

Disturbance effects would be associated with aircraft and vessel noise, construction activities, and oil spills; specifically: (1) seismic surveys that occur prior to an oil and gas lease sale (if there is a decision to hold a lease sale); (2) aircraft support of exploration and development activities; (3) possible vessel supply and support of exploration and development activities; (4) drilling activities during the exploration and development and production phases; and (5) onshore construction, including pipeline, road, support-base, landfall, and pump-station construction. Noise and traffic disturbance would be a factor throughout the life of the IAP.

Disturbance from construction activities could cause some animals to avoid areas in which they normally are harvested or to become more wary and difficult to harvest. The latter could be a concern during the bowhead whale migration offshore, although possible supply-barge traffic to coastal staging areas likely would occur during the summer when whales are not present and tend to follow a nearshore route. Current Western scientific research indicates bowheads do not seem to travel more than a few kilometers out of their original swimming direction due to noise-disturbance events, and that these changes in swimming direction are temporary, lasting from a few minutes for aircraft and vessel noise to up to 1 hour in response to seismic activity. Traditional Inupiat observation and experience affirms that whales are affected by noise at greater distances and alter their swimming directions for longer periods. In some instances, as in the case of nesting birds, construction activities may decrease the biological productivity of an area. Restrictions may be placed on the use of firearms in areas surrounding new oil-related installations (such as roads, landfalls, and pipelines) to protect oil workers and valuable equipment from harm. Finally, structures such as pipelines may limit hunter access to certain active hunting sites.

a. Ground-Impacting-Management Actions:

(1) Activities Other than Oil and Gas Exploration and Development:

Ground-impacting-management actions within the planning area that may affect subsistence resources and harvest patterns under Alternative B include aircraft use for point-to- point transport, wildlife and other aerial surveys, ground activities such as seismic surveys, resource inventories for paleontological and cultural excavations, research and recreational camps, and overland moves as well as guided hunting and river float parties on the Colville River from the headwaters to below Umiat. Hazardous- and solid-

waste removal and remediation would continue to occur at abandoned drill sites. Only potential oil spills from fuel storage at construction sites and camps could occur, but the size of such spills is likely to be small (a few barrels) and areal contamination small. Cleanup activity is not likely to cause great disturbance to normal subsistence-harvest activities or the surrounding environment. As these are normal occurrences under the existing BLM management regime, little net change is expected in disturbance effects to subsistence resources and harvest patterns of the communities nearby the planning area. Even though use levels by researchers, recreationists, and seismic surveyors would increase under this alternative, effects from ground-impacting-management actions are expected to be the same as those under Alternative A. For a more in-depth discussion of activities other than oil and gas exploration and development, see impacts discussion for subsistence-harvest patterns under Alternative A.

(2) Oil and Gas Exploration and Development Activities: Oil exploration activities—seismic activity and exploration drilling—would occur in winter (early December to mid-April). Transportation of construction materials (and gravel for pads), personnel, and fuel would be done over winter ice roads from existing infrastructure at Prudhoe Bay and Kuparuk. Large equipment would be barged to coastal staging areas in the summer, stockpiled, and moved inland the following winter. Seismic surveys would continue on the NPR-A if a leasing program occurs and typically would involve 1 to 2 crews of 60 persons each collecting approximately 5 to 10 line miles of seismic data per day. A typical operation would employ Vibroseis trucks, supply vehicles, and a supply train pulling a camp on skids that would provide living facilities for the crew. Under Alternative B, 0 to 1 fields with a resource range of 65 to 350 MMbbl of oil is estimated. One to 4 exploration wells would be drilled. For development, 0 to 6 delineation and 0 to 83 production and service wells could be drilled, as well as 75 mi of pipeline constructed. At $18/barrel, Alternative B would not be an economically viable stand-alone field.

(a) Effects of Disturbance: During the exploration phase, facilities at Kuparuk and Prudhoe/ Deadhorse, and a new coastal site at Kogru River would be used for air-support staging, where personnel and air freight would be transferred to aircraft. Two fixed-wing aircraft trips per week per drill unit are assumed for exploration. The existing facilities at Kuparuk and Prudhoe Bay are adequate to handle the projected needs during exploration. Air traffic through Barrow might increase, but no significant staging of equipment or personnel would occur from the community. During the development phase, facilities at Kuparuk and Prudhoe/ Deadhorse also would be used for air-support staging, and air traffic would increase. Seismic and drilling activities would occur in the winter, as would transportation of construction equipment; in this way, disturbance to subsistence resources would be kept to a minimum.

(b) Effects of Spills and Spill Cleanup: The analysis for North Slope onshore spills indicates a record of chronic small spills, 65 to 80 percent of which occur on the drill pad. Twenty to 35 percent of these spills may occur on or reach areas off pad. Thirty-two percent of the crude-oil spills between 1989 and 1996 were ≤2 gal. Ninety-nine percent of the crude-oil spills were <25 bbl and, during the same period, no spills >1,000 bbl occurred. Of the spills that move off pad, generally coverage is <500 ft^2; spills that occur in winter contact snow, which is cleaned up before the tundra is contaminated.

Under Alternative B, one field with a resource range of 65 to 350 MMbbl of oil is estimated. Oil-spill-occurrence estimates over the assumed production life of the IAP range from 0 to 70 crude-oil spills, with a volume range from 0 to 280 bbl (average spill size equals 4 bbl). For spills >1 bbl, the range is from 0 to 17 spills. For TAPS spills resulting from NPR-A production, the number of spills ranges from 0 to five, with a volume ranging from 0 to 6 bbl. The oil-spill-occurrence estimate for TAPS tanker spills resulting from NPR-A resources is a 0 to 68-percent chance of 0 spills (with an average spill size of 30,000 gal) occurring. Zero to 162 refined-oil spills (diesel fuel, aviation fuel, engine lube, fuel oil, gasoline, grease, hydraulic oil, transformer oil, and transmission oil) with an estimated volume ranging from 0 to 112 bbl (average spill size equals 29 gal) are estimated. Historically, by volume, diesel fuels account for 75 percent of the refined-oil spills.

All NPR-A scenarios call for an onshore pipeline for oil delivery to TAPS, and there is the potential for a pipeline spill contaminating the Colville River. Adequate data are not available to estimate a chance of such an occurrence. Records indicate four pipeline leaks, with the largest discharge being 125 bbl. A spill entering the Colville River potentially could affect fish populations, disrupt subsistence-fishing activity, and curtail the subsistence hunt as resources well may be tainted or, even if available, the perception of tainting would affect substantially the subsistence harvest.

Other industrial activities associated with oil development that could have an effect on subsistence-harvest patterns would be the result of cleanup if an oil spill did occur. In the event of a large spill contacting and extensively oiling habitats, the presence of hundreds of humans, boats, and aircraft would increase the displacement of subsistence species and alter or reduce access to subsistence species by subsistence hunters. Because oil spills estimated from NPR-A activities would be small, chronic events and normally be contained on the drill pad, effects from the

spills themselves and potential disruption from cleanup activities would have little to no impact on subsistence resources and harvest patterns.

b. Effects on Subsistence Species:

(1) Terrestrial Mammals:

(a) Effects from Disturbance: Additional pipelines built as a result of oil and gas activities in the planning area could disrupt the Nuiqsut subsistence caribou hunt to the extent the constructed pipeline and roads displaced caribou from traditional subsistence-hunting areas. Pipelines can create physical barriers to subsistence access, making subsistence hunters' pursuit of caribou more difficult (Kruse et al., 1983). Also to be noted is the disturbance to caribou from scientific study noted by Noah Itta in 1993 public testimony, where he related having to kill a caribou that was suffering from rubbing the hair and skin off its legs trying to get free of a radio collar (USDOC, NOAA, NMFS, 1993). Effects from disturbance to the harvests experienced by Nuiqsut, Barrow, and Atqasuk are expected to be short term, as their caribou harvests depend primarily on the Teshekpuk Lake Herd that is expected to be protected by no leasing and by stipulations that would protect primary calving and migration areas.

(b) Effects of Spills: Contamination of ranges for caribou, moose, muskoxen and other terrestrial mammals from small, chronic crude-oil and fuel spills, a potential seawater pipeline spill, and spills in or reaching Teshekpuk Lake and the Colville River are expected to cause habitat losses of a few acres and small losses to mammal populations, with recovery expected within about 1 year (Sec. IV.C.9). The potential for an oil spill occurring, contacting, and seriously contaminating areas used by Barrow, Atqasuk, and Nuiqsut subsistence-caribou hunters is very low, considering the data that indicate primarily chronic, small spills that most often are contained on pad. If a spill occurred off the pad, the impact would be very local and would tend to contaminate tundra in the immediate vicinity of the spill source.

(2) Fish:

(a) Effects from Disturbance: Complaints about reduced fish size and overall harvest size persist in Nuiqsut although subsistence-fish resources still accounted for 33 percent in 1993 (Pedersen, 1996) and 25 percent in 1995 of the total subsistence harvest for the community (Brower and Opie, 1997) (Sec. IV.G.7). Overall effects on fish resources from seismic noise and construction disturbance are expected to be short term, and have little measurable impact on the subsistence fisheries of Barrow and Nuiqsut; Atqasuk's subsistence fishery does not quite reach the western edge of the planning area. Subsistence mitigation that includes setbacks from primary subsistence creeks and rivers would further protect subsistence fisheries.

(b) Effects from Spills: The potential for oil spills occurring and contacting subsistence-fishing areas used by Barrow, Atqasuk, and Nuiqsut subsistence fisherman is very low, considering the data that indicate primarily chronic, small spills that most often are contained on the pad. Oil spills may have lethal or sublethal impacts on fish in the immediate area of a spill, especially in important migration or overwintering areas. However, because of the small size of anticipated spills for this alternative and the fact that leasing would not be allowed in high-density fish habitat, oil spills are expected to cause lethal or sublethal impacts to <1 percent of the arctic fish resources in the planning area over the life of the field (Sec. IV.C.7).

Chronic crude-oil and fuel spills, a potential seawater pipeline spill, and spills in or reaching Teshekpuk Lake and the Colville River may adversely affect arctic fish in the immediate area but are not expected to have a measurable effect on arctic fish populations. The potential for an oil spill occurring, contacting, and seriously contaminating areas used by Barrow, Atqasuk, and Nuiqsut subsistence fisherman is very low, considering the data that indicate primarily chronic, small spills that most often are contained on pad.

(3) Birds:

(a) Effects from Disturbance: Overall disturbance effects to important subsistence species of feeding, molting, and nesting white-fronted geese, black brant, eiders, oldsquaw, and other species are expected to be localized and temporary. Recovery in these instances is expected to require no more than 1 season. Disturbance from more intense activity such as routine flights over goose-molting lakes and increased river traffic would require several breeding seasons for recovery (Sec. IV.G.8). Overall effects on subsistence waterfowl from seismic noise and construction disturbance are expected to be short term, and have little measurable impact on the subsistence waterfowl harvests of Barrow, Atqasuk, and Nuiqsut.

(b) Effects from Spills: The potential for an oil spill occurring and contacting areas used by Barrow, Atqasuk, and Nuiqsut subsistence-waterfowl hunters is very low, considering the data that indicate primarily chronic, small spills that most often are contained on the pad. If an oil spill, a potential seawater pipeline spill, and larger spill entering lakes such as Teshekpuk Lake with larger numbers of molting or broodrearing geese and other

species did occur it could result in losses in the hundreds, requiring several breeding seasons for recovery. Cleanup activity off the pad is expected to displace small numbers of nesting, broodrearing, and molting birds, with a few clutches or broods lost to predation while adults are absent, with recovery requiring 1 year season. Increases in oil and refined oil spills are expected to result in the loss of small numbers of birds that is not likely to be detectable above the natural fluctuations of the population and survey methods/data available. Impacts on the subsistence waterfowl harvests of Barrow, Atqasuk, and Nuiqsut would not make any waterfowl resource unavailable, undesirable for use, or experience overall population reductions.

(4) Bowhead Whales:

(a) Effects from Disturbance: Bowhead whales are not expected to be impacted from seismic surveys, drilling operations, construction activities, or oil spills because all of these activities would occur onshore. Temporary, nonlethal effects to bowheads from aircraft overflights and marine vessel traffic disturbance could occur, but little aircraft activity is expected over water. Also, the northern portion of the planning area would not be leased under Alternative B, thereby eliminating barge-supply traffic to coastal staging areas. Negligible effects from disturbance would be expected by Barrow and Nuiqsut on their subsistence hunt of bowhead whales (Sec. IV.C.10).

(b) Effects from Spills: Oil spills are not likely to pose direct threats to bowhead whales, but, in the unlikely event that a spill occurred in the marine environment, whales could experience skin contact, baleen fouling, respiratory distress caused by inhalation of hydrocarbon vapors, localized reduction in food resources, consumption of some contaminated prey items, and perhaps a temporary displacement from some feeding areas. It is even more unlikely that this spill would contact whales in their normal migration path. Therefore, effects from oil spills, in terms of the subsistence harvest, are not expected to make bowhead whales unavailable, undesirable for use, or experience overall population reductions.

(5) Other Marine Mammals:

(a) Effects from Disturbance: Under Alternative B, local and short-term effects for marine mammals from activities other than oil and gas are expected to be similar to those under Alternative A, with no significant adverse effects to the populations as a whole. The effects of oil and gas activities on marine mammals are expected to increase somewhat over those of Alternative A. However, most oil and gas activities under Alternative B would occur inshore and to the south of the coast. Consequently, only a small increase in noise and disturbance effects is expected along the coast, primarily in the Colville River Delta-inner Harrison Bay area. These effects are expected to be local and short term (generally <1 year) (Sec. IV.C.9).

(b) Effects from Spills: A small number of seals and no more than a few polar bears might be adversely affected or killed by a 325-bbl crude-oil spill contacting the Colville River, but these losses would not be significant to marine mammal populations. Small onshore spills are unlikely to reach the marine environment and affect seals and polar bears. In terms of the subsistence harvest, effects from oil spills are not expected to make seals or polar bears unavailable, undesirable for use, or experience overall population reductions.

c. Effects on Communities: Effects on Barrow, Atqasuk, and Nuiqsut from oil-industry-development disturbance are discussed in detail in Section IV.B.10 of the Beaufort Sea Sale 170 Final EIS (USDOI, MMS, 1998). See previous discussions in this section of effects on the primary subsistence species: caribou (and other terrestrial mammals), fish, birds, bowhead whales, and other marine mammals. Effects assessments from these sections are summarized below; also included is a synthesis of traditional knowledge (where available) that addresses the specific disturbance agents.

(1) Barrow—Effects from Disturbance and Spills: Overall, short-term, localized, and nonlethal impacts from disturbance and oil spills to the Teshekpuk Lake Caribou Herd, other terrestrial mammals, fish, birds, bowhead whales, and other marine mammals harvested by Barrow subsistence hunters would have little effect on Barrow's subsistence harvest. Under Alternative B, it is expected that subsistence-hunter concerns about access to resources and resource contamination would be minimal. Impacts would be further minimized by not leasing in important caribou, waterfowl, and fishing areas under this alternative, and from the protection afforded by other management actions (see Effectiveness of Stipulations below).

Barrow resident Charles Brower stated in 1986 that subsistence access could be adversely affected if a pipeline were built; additional hunting restrictions would occur, requiring a permit (USDOI, MMS, Alaska OCS Region, 1986). And the fact remains that pipelines built in the past have created access problems. Taqulik Hepa, NSB, Dept. of Wildlife Management subsistence research specialist, has made it clear that an NPR-A IAP/EIS must identify stipulations to protect subsistence-hunting sites, traditional fish camps, and access routes from development impacts (USDOI, BLM, 1997a) (Effectiveness of Stipulations below).

Under this alternative, BLM would determine that the Federal portion of the Colville River to be eligible as a "wild" river in the WSR System. If Congress eventually added the river to the system, BLM would develop a management plan to identify its management practices for the river. One issue that would be addressed in the plan would be whether motorized travel would be allowed on the river. A decision not to allow motorized travel could reduce the use of the river for subsistence.

Oil-industry impacts were described by Barrow elder Jonah Leavitt testifying in court in a class-action suit filed against the U.S. Government in 1980 to gain allotments and protect traditional hunting and fishing areas from industry development within NPR-A: "My grandfather, William J.L. Inuguak, moved on to the land in the fall of 1844. At first he lived in someone else's sod house; then he built his own house. My grandfather lived there because the fishing was so good. Other people would stop at that place and fish when they were on their way to trap foxes up inland. The lake nearby had very good fishing up until 1961. Then a vehicle broke down the side bank of the lake and the water drained out. Now we cannot fish in the lake. Baxter Adams, a resident of Barrow, saw the tracks, and he told me that they were made by an LVT (Land Vehicle Transport) vehicle" (The Arctic Coastal Zone Management Newsletter, Nov. 1980).

Noah Itta described past impacts from older seismic techniques, where fish disappeared for three years due to seismic disturbance. "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" (USDOI, BLM, 1997a). More recent seismic activity still has considerable effects to wildlife, even when conducted in winter. Harry Brower, Jr., whaling captain and subsistence analyst for the NSB Department of Wildlife Management, had this to say of his recent observations traveling NPR-A:

> 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 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 Piks 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. And there was no caribou in the area. Well you know, I'd seen that. I made these trips up to my cabin. It's up on the Ikpikpuk River and I've observed the displacement of the wildlife over the winter. I've been going back and forth since December to just last week and I've seen the different areas where they've been over the winter, and I just wanted to bring that out, of my personal observations.... (USDOI, BLM, 1997a).

At the Barrow NPR-A Scoping Meeting, Johnny Aiken spoke about oil-development impacts on a variety of species:

> We go to Taqulik lake where we go fishing. Every now and then we in that particular lake we hardly get any fish. It's a surprising time. Two years ago we hardly got any grayling from that spot, that's our main grayling fish getter and we hardly got any a couple of years ago; that was surprising. And then in our river Kuparuk, Kuparuk too . . . we hardly get any more fish there...and I want to say too that I grew up hunting ugrooks and...I don't hardly see those ugrooks out there no more. And those eiders, the colored ones, me and my papa used to hunt them. We don't see those no more, hardly ever see them.... (USDOI, BLM, 1997a).

Both the establishment of a Subsistence Advisory Panel under this Alternative (and under Alternatives C-E) and the adoption of effective stipulations designed specifically to protect subsistence resources and subsistence practices, will serve to address local concerns about scientific survey impacts to caribou, pipelines as barriers to caribou migration, reduced fish size, fewer fish (grayling) in lakes, pollution impacts from past NPR-A exploration, winter seismic effects to caribou and furbearers, and reduced populations of ugrooks and eiders. The panel was conceived specifically to address local subsistence issues, to assist in monitoring the effects of oil and gas activity on subsistence practices, and to help design solutions to ongoing subsistence conflicts with development.

(2) Atqasuk—Effects from Disturbance and Spills: Overall, short-term, localized, and nonlethal impacts from disturbance and oil spills to the Teshekpuk Lake Caribou Herd, other terrestrial mammals, fish, birds, bowhead whales, and other marine mammals harvested by Atqasuk subsistence hunters would have little effect on Atqasuk's's subsistence harvest. Under Alternative B, it is expected that subsistence-hunter concerns about access to resources and resource contamination would be minimal.

Impacts would be further minimized by not leasing in important caribou, waterfowl, and fishing areas under this alternative, and from the protection afforded by other management actions (see Effectiveness of Stipulations below).

Luke Kagak, president of Atqasuk Search and Rescue, expressed concern for areas critical to calving caribou and nesting waterfowl, suggesting that special management zones be established for these populations. He believes oil development has affected animal migrations and duck populations near Prudhoe Bay. He contends that development should not occur any closer than 15 to 20 mi to these habitats. Kagak adds that the oil industry should be responsible for funding studies that survey these population effects that have already occurred to wildlife near Prudhoe Bay. It is up to industry to prove developments not Native subsistence hunters: "The question is, industry, oil and gas developers in particular, have made life rather difficult for us. We have had to go so far as to make accommodations and pay for scientists...to document what we've known so that we can continue a way of life that we've had for centuries or forever. Why not have industry themselves try to find out...what happened to those species whose populations we have seen decline over the years because of impacts that they have done?" (USDOI, BLM, 1997a; Adams, 1997:1, 2). Arnold Brower, Sr., interviewed in the early 1980's, remembers returning from World War II and noticing the extensive environmental damage left by the Navy. He believed that damage done by the Navy near Imagruaq Lake damaged the tundra to such an extent that a drainage ditch was created that lowered the lake's water level and ruined fishing there. After the War, Navy exploration continued and Thomas Brower, Sr., remembers having to negotiate with the Navy so their planes wouldn't buzz his reindeer herd (Arundale and Schneider, 1987).

After World War II, seismic exploration was a problem to the reindeer in other ways, and Brower remembers the seismic wire catching in the hooves of the reindeer and making them lame (Arundale and Schneider, 1987). Fifty years later, seismic activity still is a problem. Karen Burnell, NSB Planning Director, indicated at the March 1997 Atqasuk NPR-A Scoping Meeting that inspection of seismic crews is necessary to keep their activities in line with permitting guidelines: "We have found a couple of instances where spills had occurred, small spills, but we didn't think they were adequately cleaned up, so we required the company to go back an do a better job. Or there's been debris left behind; we've made them go back and pick it up and since we've started doing that they know that we're going to be following them around; they've changed drastically in the last couple of weeks" (USDOI, BLM, 1997a).

Access issues are viewed as critical in view of the areas near Prudhoe now off limits to subsistence. Arnold Brower, Jr., NSB NPR-A Coordinator, said that similar firearm restrictions at oil-development sites would create problematic detours for subsistence hunters. Atqasuk subsistence hunter Dave Summond added: "I have an allotment out there at Ikpikpuk. I have land there and it won't be right if I'm not able to take my guns with me for purposes of hunting" (USDOI, BLM, 1997a).

Past drilling activity in the NPR-A has left its mark. Notes Thomas Brower, Jr.: "I have gone how many times to Inigok where there was some drilling that took place, and I have seen bones from birds that have been killed...after they drill a hole, the stuff they leave behind, the fluids. I don't want to see that kind of thing happening where we see our wildlife and waterfowl, dying from contaminants being left after having conducted drilling activity. I don't want to see that kind of thing" (USDOI, BLM, 1997a).

Considering the overall impact of NPR-A oil development near Atqasuk, Luke Kagak explained: "We need to be thinking of our future and what we leave for our children as we go through this process" (USDOI, BLM, 1997a). Atqasuk elder Ella Sakeagak, interviewed in the early 1980's, summed up the local attitude (that is still current today) about oil development in the vicinity of the village: "We lived at Suqlak [just west of Teshekpuk Lake]; our little house is up there. It's standing. There's lots of fish, all kinds of animals, and I desperately wish that the people working for oil would not disturb that hunting area" (Arundale and Schneider, 1987).

Both the establishment of a Subsistence Advisory Panel under this Alternative (and under Alternatives C-E) and the adoption of effective stipulations designed specifically to protect subsistence resources and subsistence practices will serve to address Atqasuk's concerns about establishing special game-management zones, impacts to animal migrations, reduced duck populations (especially eiders), the need for industry to monitor development effects to subsistence resources and practices, past environmental damage and contamination from exploration, anticipated contamination from drilling, fuel spills and litter left by seismic crews, firearm restrictions around development sites, and general disturbance to animal populations.

(3) Nuiqsut—Effects from Disturbance and Spills: Overall, short-term, localized, and nonlethal impacts from disturbance and oil spills to the Teshekpuk Lake Caribou Herd, other terrestrial mammals, fish, birds, bowhead whales, and other marine mammals harvested by Nuiqsut subsistence hunters would have little effect on Nuiqsut's subsistence harvest. Under Alternative B, it is expected that subsistence-hunter concerns about access to resources and resource contamination would be minimal.

Impacts would be further minimized by not leasing in important caribou, waterfowl, and fishing areas under this alternative, and from the protection afforded by other management actions (see Effectiveness of Stipulations below).

Pipelines can create physical barriers to subsistence access, making subsistence hunters' pursuit of caribou more difficult (Kruse et al., 1983). Fourteen years later, this same concern was still being expressed by Nuiqsut officials Leonard Lampe and Thomas Napageak, who recounted how designed caribou crossings of pipelines did not seem to work (USDOI, BLM, 1997a).

Elder Bessie Ericklook from Nuiqsut maintained that since the oil fields have been established [at Prudhoe Bay], the fox have been dirty and discolored in [the] area of Oliktok [Point] (USDOI, MMS, 1979a). Leonard Lampe, former Nuiqsut Vice Mayor, recently expressed further air-pollution problems and habitat concerns, asserting that Nuiqsut has been experiencing such effects for some time: "A lot of air pollution, asthma, bronchitis—a lot with young children. We see smog pollution that goes from Prudhoe Bay out to the ocean and sometimes to Barrow when the wind is blowing that way. Tundra damage around the village" (Lavrakas, 1996:1, 5). At NPR-A scoping meetings in the village, Lampe reaffirmed his concern for air-quality degradation; Rosemary Ahtuangaruak noted that: "The atmosphere has eroded and the fear of ozone depletion is upon us. What will be done to combat this?" (USDOI, BLM, 1997a). A Nuiqsut hunter commented in a subsistence survey done in the community by the NSB Wildlife Management Department in 1995 that white fox couldn't be trapped at Prudhoe Bay anymore because of yellow skin (Brower and Opie, 1997). In this same survey, another hunter observed that gas from Deadhorse was poisoning the animals; he was very concerned about gasses from Prudhoe (Brower and Opie, 1997).

Noting problems with seismic activity, Lampe continued, "I swear they seismiced the entire North Slope. It's dangerous with snowmachines to run into deep seismic trails. There's wire cables all over the place" (Lavrakas, 1996:1, 5). At the Nuiqsut village scoping meeting for NPR-A, Lampe again related village conflicts with seismic activity, explaining that seismic work in the vicinity of the village threatened traditional sites and might have somehow have affected the caribou food chain as well. He suggested that increased traffic on the Dalton Highway might be interfering with migrations by spooking the animals. "Caribou have always been our primary source of subsistence...this has got to be evaluated very carefully " (USDOI, BLM, 1997a; Adams, 1997:5, 9). At an NPR-A symposium held in Anchorage in April 1997 after the village scoping meeting, Thomas Napageak, elder, Nuiqsut Native Village President, and AEWC Chairman, noted recent problems with seismic activity: "Down by the village two years ago, seismic exploration was moving rapidly right over two graveyards. Of course, the markers were driftwood and had fallen off. But the graveyards were still visible. However, you can't see everything from a Rolligon or exploration vehicle when the snow is drifting. The graveyards were being run over. When I die I would like to rest peacefully under the ground without any seismic activity running over me" (USDOI, BLM and MMS, 1997). Ruth Nukapigak recounted that seismic activity has repeatedly trespassed onto her allotment on the Itkillik River and that she has been trying unsuccessfully to get compensation since 1974 (USDOI, BLM, 1997a). Oil-exploration crews have been a constant problem to villagers. A cultural plan (*Nuiqsut Paisanitch: A Cultural Plan*) drafted by the village in 1979 noted these objections to field crews by a Nuiqsut resident: "Those oil exploration crews wreck our camps. They tore up our ice cellars at Oliktok and left meat and fish around to rot. They must not know we use those camps" (City of Nuiqsut, 1995).

Nuiqsut fish harvesters have noted that the number of arctic cisco have been down, coinciding with the [operation of] the Endicott water-treatment plant (Dames and Moore, 1996b). A Nuiqsut subsistence fisherman wondered in a subsistence survey done in the community by the NSB Wildlife Management Department in 1995 why whitefish were so small that year when they used to be big last year (Brower and Opie, 1997). At the April 1997 NPR-A scoping meeting in Nuiqsut, Rosemary Ahtuangaruak elaborated on development impacts to fish and the associated impact to village life: "The oil companies made causeways for the benefit of oil development. It took the fish away. The people suffered immensely without this natural resource. The community could not meet the needs for survival and the atmosphere was black. We had an increase in all the bad things: domestic violence, suicide, family demise" (USDOI, BLM, 1997a).

In 1979, Nannie Woods, the late Nuiqsut elder, talked about fish and caribou being abundant at the Sagavanirktok River, but now the river isn't as abundant since the development at Prudhoe Bay. She explained that the tributaries off the river don't have as many fish either, and that there are fewer caribou than there used to be in the summer (USDOI, MMS, 1979a).

Concerns about access restrictions have been voiced by local residents. Sarah Kunaknana, talking about local subsistence hunters, observed that others have stated that they don't hunt near Prudhoe Bay anymore because of oil development (S. Kunaknana, in Shapiro, Metzner, and Toovak, 1979). Nuiqsut's present Vice Mayor Mark Ahmakak, when asked in 1982 if people had been turned

back from hunting and fishing areas, answered: "Oh, yes. I have experienced that myself in going out towards Nuiktuk [?] over toward DEW Line station. We have been told by oil company officials that we can't hunt near development area" (Kruse et al., 1983). Access problems were expressed by Nelson Ahvakana from Nuiqsut. He was concerned that areas that are supposed to be left open for subsistence hunting effectively will be closed because of increased security associated with the new drill sites, and that access to subsistence resources will be restricted (USDOI, MMS, Alaska OCS Region, 1990a). This concern takes on even more substance as the Northstar Project and development at the Alpine field become realities. During the 1996 Northstar Project Nuiqsut community meeting, two Nuiqsut men described being denied access to fishing and hunting areas around Prudhoe operations, even though they have traditional rights to be there. They do not want to be restricted or denied access by new projects (Dames and Moore, 1996c). In recent NPR-A scoping meetings in the village, Thomas Napageak elaborated on the issue of lost access noting that oil development at Prudhoe Bay and Kuparuk had already cut off Nuiqsut residents from nearly one-third of their traditional subsistence harvest areas. At the same meeting, Leonard Lampe, Jr., recounted how he has not been able to hunt or fish in the Kuparuk/Prudhoe Bay area once visited by village elders and that he fears the same loss of critical subsistence access to important lands in the NPR-A to future generations (USDOI, BLM, 1997a).

A major issue with the recent initiative in the NPR-A is the velocity of the environmental assessment process and the way it has taxed the resources of the Native community. Nuiqsut residents believe it precludes a thorough compilation of the vast cultural knowledge the Inupiat have gained over millennia. Leonard Lampe, Jr., Kuukpik Village Corporation officer, commented that 11,000 years of cultural and traditional knowledge could not be compiled and communicated in 8 days (USDOI, BLM, 1997a; Adams, 1997:5, 9). At the same meeting, Rosemary Ahtuangaruak vocalized this problem more simply when she said: "What we have to say will be documented but not integrated. We are being pushed and pulled in all directions at the same time with all the various agencies affecting our ability to thoroughly evaluate and document all issues." Taqulik Hepa, NSB, Dept. of Wildlife Management subsistence research specialist, did not believe the schedule set by BLM would allow for sufficient time for the proper analysis of recent wildlife and subsistence harvest data (USDOI, BLM, 1997a).

Oil spills also are an identified threat. Thomas Napageak stated in his testimony at the Nuiqsut NPR-A scoping meeting that: "The oil industry still does not have adequate technology for oil spill clean up in the Arctic, particularly in rivers, lakes, and the Beaufort Sea. Adequate spill response must be part of any development" (USDOI, BLM, 1997a).

Thomas Napageak expresses the larger issue of oil development and its potential effect on the subsistence lifeway: "...improvements in our physical comforts and services should not blind us to the threats that oil development on the wrong terms poses to our very identity and culture. Our land and our subsistence practices are our history, our identity, and our future. If we lose the land or can no longer maintain our subsistence culture, we lose ourselves and the future of our children." Rosemary Ahtuangaruak further elaborated Inupiat cultural conflicts with oil development when she asserted: "We need to live as our ancestors have shown us. We have this passion to our families for their survival...NPR-A has been set aside and should be left alone. It has given the sustenance for countless animals that migrate throughout the world. They come back to us every year unless development prevents it" (USDOI, BLM, 1997a).

Both the establishment of a Subsistence Advisory Panel under this Alternative (and under Alternatives C-E) and the adoption of effective stipulations designed specifically to protect subsistence resources and subsistence practices will serve to address Nuiqsut's concerns about (a) pipelines as barriers to caribou migration, (b) ineffective caribou crossings in existing pipelines, (c) air pollution from Prudhoe Bay, (d) discoloration in white foxes, (e) tundra damage near the village, (f) air-quality degradation from Prudhoe Bay development, (g) gasses from Prudhoe Bay poisoning wildlife, (h) the dangers of seismic trails to hunters on snowmachines, (i) seismic impacts on the caribou food chain, (j) damage to traditional sites and allotments from seismic activity, (k) difficulty receiving any compensation for seismic damage to traditional sites, (l) road-traffic interference with caribou migrations, (m) fewer arctic cisco and smaller whitefish, (n) causeway impacts to fish, (o) reduced fish and caribou abundance in the Sagavanirktok River and its tributaries, (p) fewer caribou in summer, (q) access restrictions on subsistence hunters and loss of harvest areas from general development and specifically from increased security around encroaching drill sites, (r) inadequate technology for cleaning up spills in lakes and rivers, (s) the fast-track schedule for the NPR-A IAP/EIS will prevent proper analysis of wildlife and subsistence data, (t) what we (Nuiqsut residents) say will not be integrated, and (u) overall development threats to Inupiat cultural identity.

(4) Other Communities—Effects from Disturbance and Spills: Other communities within or adjacent to the NPR-A are the Chukchi Sea villages of Point Lay and Wainwright to the west and the inland community of Anaktuvuk Pass to the south and east. Subsistence-harvest areas for these communities are not

within or adjacent to the planning area, although recent research indicates that movement by the Teshekpuk Lake Caribou Herd does bring the herd into the traditional subsistence-harvest areas of the communities of Wainwright and Point Lay. Historically, Anaktuvuk Pass caribou hunters have ranged to the southerly boundary of the planning area, and movement by the Teshekpuk Lake Caribou Herd would bring it into the harvest area of Anaktuvuk Pass subsistence hunters as well, although they primarily hunt the Western Arctic Caribou Herd (and to a lesser extent the Central Arctic Herd). Short-term and localized impacts from disturbance and oil spills to the Teshekpuk Lake and Central Arctic herds would have no apparent effect on the subsistence-caribou harvest of these three communities.

Impacts to subsistence users farther from the planning area, including those in the Yukon-Kuskokwim Delta, would not be significant. The populations of waterfowl used by subsistence users south of the Brooks Range are not expected to be significantly impacted, because key waterfowl habitat would not be leased.

Summary: Short-term and localized impacts from disturbance and oil spills to the Teshekpuk Lake Caribou Herd, other terrestrial mammals, fish, birds, bowhead whales, and other marine mammals harvested by Barrow, Atqasuk, and Nuiqsut subsistence hunters would have little effect on subsistence harvests in these communities. Under Alternative B, it is expected that subsistence-hunter concerns about access to resources and resource contamination would be minimal. Impacts would be further minimized by not leasing in important caribou, waterfowl, and fishing areas under this alternative and from the protection afforded by other management actions (Effectiveness of Stipulations below).

Conclusion—First Sale: Overall effects associated with Alternative B subsistence-harvest patterns in the communities of Barrow, Atqasuk, and Nuiqsut, and other nearby communities from oil and gas activities in the planning area as a result of impacts from disturbance and oil spills are expected to periodically impact subsistence resources, but no resource would become unavailable, undesirable for use, or experience overall population reductions.

Multiple Sales: Under the multiple-sales approach, the resource estimate for Alternative B increases from a range of 65 to 350 MMbbl and zero to one oil fields to a range of 90 to 500 MMbbl in zero to two oil fields. The number of exploration wells increases from a maximum of 4 to 14, delineation wells increase from a maximum of 6 to 12, and production wells increase from 83 to 150. Pipeline miles increase to 90 mi. Multiple sales would occur over a longer period of time and, depending on the frequency of sales, the timeframe for oil and gas activities in the planning area would extend to at least two decades.

For Alternative B, it is estimated that the number of spills <1 bbl would increase from a range of 0 to 53 spills to a range of 0 to 75 spills, and the number of spills >1 bbl would increase from a range of 0 to 17 spills to a range of 0 to 25 spills over the assumed production life of the planning area. The estimated number of crude-oil spills over the assumed production life of the planning area would increase from a range of 0 to 70 spills to a range of 0 to 100 spills (Sec.IV.A.2).

If several lease sales occur under Alternative B, considerably more exploration activity is expected to occur in the southern half of the planning area, and the levels of effects due to noise, disturbance, and habitat alteration are expected to increase. Surface, air, and foot traffic near oil field facilities is expected to increase and to displace some caribou, moose, muskoxen, grizzly bears, wolves, and wolverines but not significantly affect Arctic Slope populations. The number of small, chronic crude-oil and fuel spills is expected to increase and result in the loss of small numbers of terrestrial mammals, with recovery expected within about 1 year. Seismic surveys and pipelines associated with multiple sales are expected to have the same overall effect on arctic fish populations as the first sale. Gravel pads are expected to have about twice the effect as the first sale. Fuel and oil spills are likely to have a greater effect on arctic fish populations than the first sale. Insufficient recovery time between sales and/or greater levels of activity would be likely to result in greater effects than estimated herein for multiple sales. Displacement of birds from disturbance and habitat alteration is expected to double in the southern half of the planning area under Alternative B with multiple sales, but still not significantly affect coastal plain populations. Increases in oil and refined oil spills are expected to result in the loss of small numbers of birds that is not likely to be detectable above the natural fluctuations of the population and survey methods/data available. Overall effects are expected to increase somewhat from those discussed for the first sale. Effects of multiple sales on bowhead whales are expected to be essentially the same as described for the first sale. Bowhead whales exposed to noise-producing activities such as marine vessel traffic and possibly aircraft overflights most likely would experience temporary, nonlethal effects. Small onshore spills are unlikely to reach the marine environment. If spilled oil did reach the marine environment, it likely would be a very small amount, and any exposure to spilled oil likely would not pose serious direct effects to bowhead whales. For marine mammals, multiple sales under Alternative B are expected to have similar effects to those under Alternative B with one sale, i.e., local and short term, with no significant adverse effects to marine mammal populations as a whole.

Conclusion—Multiple Sales: Effects from multiple sales to terrestrial mammals are expected to increase, but no significant impacts to populations are anticipated. Disturbance from air, surface, and foot traffic could displace some caribou and other terrestrial mammals. Small numbers of terrestrial mammals would be lost due to the increase of small, chronic crude-oil and fuel spills, but populations are expected to recover within 1 year. Arctic fish populations would experience effects similar to the first sale as high-density fish areas are deferred, but increases are expected if sale intervals are not spaced sufficiently to provide population recovery. Increased disturbance and displacement effects and increased oil-spills risks are expected for birds, but timing of the sales again is critical to recovery. With extended intervals between sales, impacted bird populations are expected to recover from noise and disturbance effects in 1 year. Bowhead whales are expected to experience short-term, nonlethal effects. Effects to marine mammals would be short term and local with no adverse effects to populations.

Given that resource estimates and development scenarios project an increase in resources and increases in the number of drill pads and pipeline miles, logic would assume increased effects to potentially affected resources, except for the fact that these effects would be spread over 2 decades. The biological analyses expect slight increases in effects with little overall effects to resource populations. Effects associated with multiple sales on subsistence-harvest patterns in the communities of Barrow, Atqasuk, and (especially) Nuiqsut as a result of impacts from disturbance and oil spills are expected to make no subsistence resource unavailable, undesirable for use, or experience overall population reductions.

Effectiveness of Stipulations: Stipulations that specifically would protect subsistence resources are discussed in Sections IV.C.7, Fish Resources, IV.C.8, Birds, IV.C.9, Mammals, and IV.C.10, Endangered and Threatened Species. Important proposed subsistence stipulations that would specifically protect subsistence practices include a BLM proposal to establish a Subsistence Advisory Panel to monitor subsistence issues and concerns arising from oil and gas activity on the NPR-A. Additionally, important proposed subsistence stipulations would require lessees:

1. To monitor exploration, development, and production effects on subsistence.
2. To not unreasonably restrict subsistence access by establishing procedures for use and firearm discharge near oil facilities.
3. To notify BLM if conflicts arise between the lessee and subsistence hunters and that BLM resolve the issue.
4. To consult with local communities about siting, timing, methods of operation, and possible mitigation to assure that exploration, development, and production activities are compatible with subsistence practices to encourage conflict resolution. Local communities, the NSB, and the Subsistence Advisory Panel all will concurrently review any exploration, development and production plans, and any interested party may request that BLM resolve disputes that cannot be otherwise settled.
5. To provide an employee-orientation program that addresses environmental, social, and cultural concerns relating to the NPR-A.
6. To conduct an inventory of known traditional land use sites to develop a plan to avoid these sites and to mitigate any possible damage to them.

14. Sociocultural Systems: This discussion is concerned with those communities that could be impacted by ground-impacting-management actions and oil and gas leasing in the planning area—Barrow, Atqasuk, and Nuiqsut. Under Alternative B, a maximum protection to surface resources would be emphasized by making unavailable to oil and gas leasing 2.61 million acres (2.04 million would remain available). The Teshekpuk Lake Watershed, Goose Molting Habitat, Spectacled Eider Breeding Range, Teshekpuk Lake Caribou Habitat, and Fish Habitat LUEA's would be unavailable to oil and gas leasing. Leasing would be deferred on lands subject to pending Kuukpik Corporation conveyances. The Colville River would be recommended to be included in the WSR System and managed as such. The BLM's option to regulate motorized use of and access to the river could disrupt subsistence-hunters' use of the upper Colville and local opinion in Barrow and Nuiqsut clearly opposes such a designation.

Raptor, passerine, and moose areas on the Colville River, the Pik Dunes, Ikpikpuk Paleontological Sites, and recreation and scenic areas also would be made unavailable to oil and gas leasing and subject to restrictions for siting pipelines and industrial structures.

The primary aspects of the sociocultural systems covered in this analysis are (1) social organization, (2) cultural values, and (2) social health, as described in Section III.C.3. For the purpose of effects assessment, it is assumed that effects on social organization and cultural values could be brought about at the community level, predominantly by industrial activities, increased population, increased employment, and effects on subsistence-harvest patterns associated with a proposed oil and gas lease sale. Potential effects are evaluated relative to the tendency of introduced social forces to support or disrupt existing systems of organization and relative to how rapidly they occur and their duration (Langdon, 1996).

North Slope Inupiat continue to express concern about the differences in how they and the dominant culture relate to

the land and waters. Rex Okakok from Barrow expressed the problem when he said "Our land and sea are still considered and thought by outsiders to be the source of wealth, a military arena, a scientific laboratory, or a source of wilderness to be preserved, rather than as a homeland of our Inupiat" (USDOI, MMS, 1987c). Considering such use of Inupiat territory, Robert Edwardson from Barrow said that he would like to see revenues paid to the Inupiat for mineral rights (USDOI, MMS, Alaska OCS Region, 1995a; see Sec. IV.C. 13., Subsistence).

a. Parameters of this Analysis: An analysis of the social organization of a society involves examining how people are divided into social groups and networks. Activities such as the sharing of subsistence foods are profoundly important to the maintenance of family ties, kinship networks, and a sense of community well-being. In rural Alaskan Native communities, task groups associated with subsistence harvests are important in defining social roles and kinship relations: the individuals one cooperates with help define kin ties, and the distribution of specific tasks reflects and reinforces the roles of husbands, wives, grandparents, children, friends, and others (Sec. III.C.3). Social groups generally are based on kinship and marriage systems, as well as on nonbiological alliance groups formed by such characteristics as age, sex, ethnicity, community, and trade. Kinship relations and nonbiological alliances serve to extend and ensure cooperation within the society.

An analysis of cultural values looks at those values shared by most members of a social group. Generally, these values are shared conceptions concerning what is desirable. They are ideals that members of a social group accept explicitly or implicitly. Forces powerful enough to change the basic values of an entire society would include a seriously disturbing change in the physical conditions of life: a fundamental cultural change imposed or induced by external forces, such as when an incoming group induces acculturation of the residing group, or when a series of fundamental technological inventions change existing physical and social conditions. Such changes in cultural values can occur slowly and imperceptibly or suddenly and dramatically (Lantis, 1959). For the system of sharing to operate properly, some households must be able to produce, rather consistently, a surplus of subsistence goods, and it is obviously more difficult for a household to produce a surplus than to simply satisfy its own needs. For this reason, sharing, and the supply of subsistence foods in the sharing network, could be more sensitive to harvest disruptions than the actual harvest and consumption of these foods by active producers.

Social organization could be affected by an influx of new population that causes growth in the community and/or change in the organization of social groups and networks. Disruption of subsistence-harvest task groups would damage the social bonds that hold the community together. Disruption of the subsistence cycle also could change the way these groups are organized. A serious disruption of subsistence-harvest patterns could alter these cultural values and could trigger an array of negative emotions: fear, anger, and frustration, as well as a sense of loss and helplessness. Because of the psychological importance of subsistence in these sharing networks, perceived threats to subsistence activities are a major cause for anxieties about oil development.

An Alaska Department of Fish and Game social-effects survey administered by the Division of Subsistence in 1994 in Nuiqsut included questions on effects from Outer Continental Shelf development. The majority of Nuiqsut residents believed that development would negatively impact fish, marine mammal, and bird resources. Most were not in favor of further oil development because of its perceived adverse impact on subsistence and the belief that small and large oil spills could not be effectively contained or cleaned up. The overall study on 21 Alaskan communities concluded that impacts persist from the *Exxon Valdez* Oil Spill on subsistence use and the social and cultural system that subsistence activities support (Fall and Utermohle, 1995).

A study conducted by Picou et al. (1992) on the disruption to the community of Cordova by the *Exxon Valdez* Oil Spill demonstrated empirically that 18 months following the spill, residents of Cordova had experienced long-term negative social impacts that took the form of disruption to work roles and increased personal stress. Additionally, they observed that "...work disruption was correlated with intrusive stress...and fishermen experienced more work disruption than...other occupations. It may be possible that other natural resource community activities such as participation in subsistence harvests...may identify subpopulations more vulnerable to long-term negative social impacts" (Picou et al., 1992).

In the Social Indicators Study of Alaskan Coastal Villages, Volume VI. Analysis of the *Exxon Valdez* Spill Area, 1988-1992, the summary of findings section affirmed that immediately after the spill and continuing into early 1990, Natives decreased their harvests of wild resources and relied on preserved foods harvested before the spill. By the winter of 1991, Native harvesting activities had begun to resume to normal, but the proportions of wild foods in their diets remained below 1989 proportions. The study also demonstrated in its analysis that non-Natives and Natives "define the environment and resources within the environment very differently. Commodity valuation takes precedence" for non-Natives and "instrumental use and cultural and spiritual valuation take precedence" for Natives (Human Relations Area Files, Inc., 1994). The

ADF&G and Picou et al. surveys and the Social Indicators Study demonstrate the impacts to social and cultural institutions and indicate the underlying fears that linger from such a catastrophic environmental event, even in communities not directly impacted by such an event.

Effects Agents: The agents associated with management actions and oil and gas leasing in the planning area that could affect the sociocultural institutions and systems in communities in the sale area (described in Sec. III.C.3) are disturbance and oil spills (and cleanup) from activities other than oil and gas exploration, and oil and gas exploration and development activities that would include changes in population and employment, and effects on subsistence-harvest patterns.

b. Ground-Impacting-Management Actions:

(1) Activities Other than Oil and Gas Exploration and Development: Even though use levels by researchers, recreationists, and seismic surveyors would increase under this alternative, because these are normal activities under the existing BLM management regime, little net change in effects is expected from disturbance from ground-impacting-management actions to subsistence resources and the communities nearby the planning area. For a more in-depth discussion of activities other than oil and gas exploration and development, see impacts discussion for sociocultural systems under Alternative A.

(2) Oil and Gas Exploration and Development Activities: Exploration activities—seismic activity and exploration drilling—would occur in winter (early December to mid-April). Transportation of construction materials (and gravel for pads), personnel, and fuel would be done over winter ice roads from existing infrastructure at Prudhoe Bay and Kuparuk. Under Alternative B, one field with a resource range of 65 to 350 MMbbl of oil is estimated. Four exploration wells would be drilled. For development, 6 delineation and 83 production and service wells would be drilled, as well as 75 mi of pipeline constructed.

(a) Effects of Disturbance: During the exploration phase, facilities at Kuparuk and Prudhoe/ Deadhorse, and a new coastal site at Kogru River would be used for air-support staging where personnel and air freight would be transferred to aircraft. Two fixed-wing aircraft trips per week per drill unit are assumed for exploration. The existing facilities at Kuparuk and Prudhoe Bay are adequate to handle the projected needs during exploration. With the use and upgrading of existing infrastructure for the staging of air support, contact with non-Native construction personnel in the villages of Atqasuk and Nuiqsut would not be expected to occur except under exceptional circumstances. Air traffic through Barrow might increase, but no significant staging of equipment or personnel would occur from the community. During the development phase, facilities at Kuparuk and Prudhoe/ Deadhorse also would be used for air-support staging, and air traffic would increase.

(b) Spills and Spill Cleanup: See Section IV.C.13, Subsistence for a discussion of North Slope onshore spills.

All planning-area scenarios call for an onshore pipeline for oil delivery to TAPS, and there is the potential for a pipeline spill contaminating the Colville River. A spill entering the Colville River potentially could affect fish populations, disrupt subsistence-fishing activity, and curtail the subsistence hunt as resources well may be tainted or, even if available, the perception of tainting would substantially affect the subsistence harvest (Sec. IV.C.13, Subsistence).

Other industrial activities associated with oil development that could have an effect on sociocultural systems would be the result of cleanup if an oil spill did occur. In the event of a large spill contacting and extensively oiling habitats, the presence of hundreds of humans, boats, and aircraft would increase the displacement of subsistence species and alter or reduce access to subsistence species by subsistence hunters (Sec. IV.B.1, Water Quality). Because oil spills estimated from NPR-A activities would be small, chronic events and normally be contained on the drill pad, effects from the spills themselves and potential disruption from cleanup activities are not likely to cause great disturbance to sociocultural systems or the surrounding environment, and impacts would be negligible.

Nuiqsut residents reiterated at a recent town meeting for the Northstar Project that they believe it is a matter of *when* a spill will occur, not *if* it will occur. They want assurance against disaster and impact funds set aside for them in the event of such a disaster (Dames and Moore, 1996b). Earlier village comments expressed the same attitude. In 1979, Gordon Rankin from Kaktovik suggested that a compensation fund be set aside for villages in case there is a devastating oil spill (USDOI, MMS, 1979b; see Sec. IV.C. 13, Subsistence).

c. Population and Employment: Under Alternative B, oil and gas leasing in the planning area is projected to affect the population of the NSB through two types of effects on regional employment: (1) more petroleum-industry-related jobs as a consequence of NPR-A exploration and development and production activities and (2) more NSB-funded jobs as a result of higher NSB operating revenues and expenditures (see Sec. IV.B.11). Employment projections as a consequence of planning-area activities are provided in Section IV.C.11. With this

alternative, total petroleum-related employment would range from a low of 93 jobs (exploration only) in the year 2000 to 1,500 jobs (with development) in 2006. Resident employment as a result of NPR-A activities would peak at 44 jobs in the year 2006. Most workers are expected to permanently reside outside of the North Slope. The NPR-A oil and gas activities are projected to increase resident employment 3 percent during the development phase and 2 percent during the production phase above the declining existing-condition projections between 2000 and 2016 (Tables IV.D.11-1 and IV.D.11-2).

The NPR-A development under Alternative B is projected to increase the NSB population above the existing-condition level if oil prices are high enough to allow for maximum development (1,100 MMbbl). The Native proportion of the population is not expected to change much—approximately 70 to 77 percent Native. There may be some degree of sale-induced employment, but these changes, particularly as they translate into Native employment, historically have been and are expected to continue to be only 1 percent of total oil-industry jobs in the region. Even though Native employment in oil-related jobs on the North Slope is low, Native leaders continue to push for programs and processes with industry that would encourage more Native hire.

d. Subsistence-Harvest Patterns: Subsistence is important to the Inupiat sociocultural system through sharing subsistence foods, creating community task groups and crew structures, and through the strengthening of social bonds (see Sec. III.C.3 for a detailed description). Effects could be expected on subsistence-harvest patterns in the planning area as a result of disturbance to Barrow, Atqasuk, and Nuiqsut's subsistence harvests due to seismic disturbance, aircraft noise, supply vessel traffic, offshore exploration, onshore-construction, gravel extraction, pipeline trenching, and oil spills (see discussion for Alternative B, Sec. IV.C.13).

e. Effects on Barrow, Atqasuk, and Nuiqsut: The relatively homogenous nature of the communities of Atqasuk and Nuiqsut—both are predominantly Inupiat—whose sociocultural systems may be affected by oil and gas activities in the planning area indicates that changes in the communities would be similar. Barrow, which is larger, has a larger percentage of non-Natives and already has experienced more change than the other two smaller Native communities. This section analyzes effects of industrial activities, population and employment changes, and subsistence-harvest-pattern impacts on North Slope social organization, cultural values, and other issues. This discussion focuses on the North Slope as a whole, with a discussion of each community where necessary.

(1) Social Organization: The social organization of communities that might be affected by oil and gas activities in the planning area includes typical features of Inupiat culture: kinship networks that organize much of a community's subsistence-harvest, consumption, and sharing activities; informally derived systems of respect and authority; strong extended families (although not always living in the same household); stratification between families focused on success in the subsistence harvest; and access to subsistence technology (Sec. III.C.2). These non-Western elements of social organization could be altered to become less oriented toward the family, and changes would be exhibited in a breakdown of kinship networks as a result of social conditions induced by oil and gas activities in the planning area. Increased air traffic and winter ice-road traffic during exploration is unlikely to have a large effect on these communities, except possibly increases in noise disturbance to the community of Nuiqsut. Recent increases in non-Native workers in the community from the development of the Alpine Field resembles the situation present in North Slope communities during the peak of the Capital Improvements Program construction in the 1980's. Other industrial activities (pipeline construction) would occur nearest to the community of Nuiqsut but not within the actual community itself. Changes in population and employment would not be greater than those already experienced in the past by these communities. Social institutions in all three communities would experience little direct disturbance from the staging of personnel and air freight expected for oil and gas activities in the planning area for exploration, development, and production; negligible effects would be expected to sociocultural systems, and no displacement of existing institutions would occur. The scenario for oil and gas activities in the planning area stresses that staging will occur primarily from existing or enhanced facilities at the Prudhoe Bay/Deadhorse and Kuparuk, a situation that significantly would reduce disruption to nearby Native communities.

No disruptions are expected to the three communities' social institutions as a result of increases in temporary or permanent population growth, but the construction of winter ice roads near and a new hotel within Nuiqsut could cause some disruptions to Nuiqsut social organization because of an increase of social interaction between residents and oil-industry workers. Traffic restrictions near exploration infrastructure along the Nuiqsut/Prudhoe Bay ice road already has created some friction in Nuiqsut, where considerable dependence has developed within the village on this arterial for winter access to Prudhoe Bay and south to Fairbanks. Locally, Nuiqsut residents have articulated these conflicts, as seismic and drilling activity has increased dramatically for offshore projects such as the Northstar and Liberty developments, seismic and drilling

activities from the onshore Alpine field, and potential NPR-A development.

Other instances of increased interaction would occur if many local residents were employed in oil-industry jobs but, historically, the number of local Native hires is quite small. Some of the interactions of oil workers with the local Inupiat population are likely to be unpleasant and could lead to a growth in racial tension. Nuiqsut already has been exposed to oil workers due to its proximity to Prudhoe Bay, village travel to Prudhoe on the winter ice road that is maintained between the two communities, and increased seismic activity in the vicinity of the village, and a recent influx of personnel working on development of the Alpine field. It appears that the number of oil workers associating with local residents has increased. Social interaction of oil-industry workers with Nuiqsut residents could be long term, but there is not expected to be a tendency toward displacement of their social institutions. Changes in population and employment are unlikely to cause some disruption to sociocultural systems but would not displace existing institutions.

Subsistence is a cyclical activity, and harvests vary from year to year, sometimes substantially. Numerous species are hunted to compensate for a reduced harvest of a particular resource in any one year, but there is no satisfactory replacement for bowhead whales or caribou. Multiyear disruptions to even one resource, particularly one as important as the caribou or the bowhead whale, could disrupt sharing networks and subsistence-task groups. Other tensions perceived as a threat to subsistence resources could be caused by NPR-A oil and gas activities, especially if oil-industry activities are visibly evident, and North Slope residents in the Northeast planning area do not perceive development as a benefit to the Inupiat people.

Speaking at a 1983 hearing for an MMS sand and gravel lease sale, Nuiqsut resident Mark Ahmakak stated: "I think that if you are going to go ahead with this sale that you should utilize Natives in...the areas affected by this lease sale; then utilize some of these Natives as monitors on some of your projects" (USDOC, NOAA, NMFS, 1993). The general consensus is the desire for some benefit or employment opportunity to the community from nearby oil activities. Nuiqsut resident Joseph Ericklook expressed the community desire to see employment opportunities for local people result from development (USDOI, MMS, 1990d). Arnold Brower, Jr. noted that he would like to see residual rights to old abandoned wells in the NPR-A pass to the local communities because the local communities could benefit from local oil and gas resource development even when they were not economic for industry to develop (USDOI, BLM, 1997a; Sec. IV.C. 13., Subsistence).

(2) Cultural Values: Cultural values and orientations (as described in Sec. III.C.2) can be affected by changes in the population, social organization and demographic conditions, economy, and alterations of the subsistence cycle. Of these, the only changes that could be expected to occur would be in Nuiqsut's social organization (see discussion above) and the subsistence cycle in Barrow, Atqasuk and Nuiqsut (see Sec. IV.C.14 and discussion above).

A trend toward displacement of the community social institutions could lead to a short-term decreased emphasis on the importance of the family, cooperation, sharing, and subsistence as a livelihood. Increasing oil-development activity could increase access to urban communities and cause more interaction with oil-industry workers, resulting in the introduction of new values and ideas as well as increased racial tensions and an increased availability of drugs and alcohol. Tensions would be created and could result in increased incidents of socially maladaptive behavior and family stress, potentially straining traditional Inupiat institutions' abilities to maintain social stability and cultural continuity. Cultural values and orientations can change slowly or suddenly (Lantis, 1959).

Long-term change depends on the relative weakening of traditional stabilizing institutions through prolonged stress and disruptive effects that could be exacerbated by activities accompanying the IAP. These changes already are occurring to some degree on the North Slope as a result of onshore oil and gas development, more dependence on a wage economy, higher levels of education, improved technology, improved housing and community facilities, improved infrastructures, increased presence of non-Natives, increased travel outside of the North Slope, and the introduction of television and the Internet. To mitigate this onslaught, NSB institutions, such as the school district that promotes teaching Inupiat language and culture, the AEWC that negotiates with industry to protect Inupiat subsistence whaling interests, the Borough's Department of Wildlife Management, and other regional and village Native corporations and organizations, all work vigorously and quite successfully at preventing any weakening of traditional cultural institutions and practices.

Subsistence is considered the core value and central feature of Inupiat cultural values (see Sec. III.C.2). While a year-long disruption to only one subsistence resource likely would not cause long-term, chronic disruption or displacement of the sociocultural system, multiyear disruptions throughout the 35-year life of the project could begin affecting cultural values, with the potential for long-term sociocultural change and the displacement of existing institutions. When a group's identity is formed around being able to hunt, particularly caribou and bowhead whales, and this hunt is not possible or not

successful due to oil-industry activity, a considerable amount of social stress, tension, and anxiety are likely to occur (see the *Exxon Valdez* Oil Spill discussion above).

Short-term and localized impacts from disturbance and oil spills to the Teshekpuk Lake Caribou Herd, other terrestrial mammals, fish, birds, bowhead whales, and other marine mammals harvested by Barrow, Atqasuk, and Nuiqsut subsistence hunters would have little effect on subsistence harvests in these communities. Under Alternative B, it is expected that subsistence-hunter concerns about access to resources and resource contamination would be minimal.

Overall effects associated with Alternative B on subsistence-harvest patterns in the communities of Barrow, Atqasuk, and Nuiqsut, and other nearby communities from oil and gas activities in the planning area as a result of impacts from disturbance and oil spills are expected to periodically impact subsistence resources with no apparent effect on subsistence harvests. Short-term disruptions of subsistence-harvest activities would cause periodic disruption to institutions and sociocultural systems but likely would not displace existing institutions.

Native testimony at hearings for North Slope development actions has presented ways to mitigate such impacts. At MMS hearings in 1982, Mark Ahmakak from Nuiqsut stated that there should be economic benefits to Nuiqsut, such as cheaper diesel (USDOI, MMS, 1982b). Barrow resident Charles Okakok said that subsistence users should be compensated by the oil industry in case of an oil spill (USDOI, MMS, 1995c). This sentiment has been repeated often by Native resident of the North Slope. There are concerns about protecting traditional sites from development. Nannie Woods expressed her opposition to leasing in the Colville River Delta because of her concern for her husband's burial site that might be disturbed by development (USDOI, MMS, 1982b). Recently, a Nuiqsut elder had her "home place" at Prudhoe Bay desecrated by an oil company. Her house was looted and built over. She emphasized that graves of family members are in the area, and that she has been denied access there (Dames and Moore, 1996e). Susie Akootchook, Village Coordinator for Kaktovik, commented during MMS scoping meetings for Sale 170 in Nov. 1996, that traditional fishing and hunting sites need protection, and that a contingency plan needs to be developed to protect them (USDOI, MMS, 1996c). The need for impact assistance often is articulated at hearings held in local communities (USDOI, BLM and MMS, 1997).

(3) Social Health: Effects on sociocultural systems often are evidenced in rising rates of mental illness, substance abuse, and violence. This has proven true for Alaskan Natives who have been faced since the 1950's with increasing acculturative pressures. The rates of these occurrences far exceed those of other American populations such as Alaskan non-Natives, American Natives, and other American minority groups. For the period 1980 through 1989, the rate for Alaskan Native deaths from suicides and homicides was 77.9 per 100,000 compared to the rate of 25.8 per 100,000 for non-Natives; half of the Alaskan Native suicides are committed by 15- to 24-year olds. The alcohol mortality rate for Alaskan Natives is three- and- one-half times higher than the rate for non-Natives (4.1/10,000 for Natives; 1.2/10,000 for non-Natives). The reports of harm from physical abuse, neglect, and sexual abuse translate into a rate of 94 alleged victims per 1,000 Native children as compared to 55 per 1,000 children in non-Native communities. Although the Native population of Alaska represents 16 percent of the total Alaskan population, a 1991 study reported that for persons under the age of 18 arrested in Alaska, of those arrested for rape, 50 percent were Native; for aggravated assault, 30.7 percent were Native; for burglary, 37.1 percent were Native; for arson, 37.5 percent were Native; and for alcohol-related offenses, 39.8 percent were Native (Alaska Natives Commission, 1994; Middaugh et al., 1991; Kraus and Buffler, 1979). Also, rates of mental illness are higher ". . .in larger rural Native towns than in the more traditional Native villages" (Foulks and Katz, 1973; Kraus and Buffler, 1979). While such behaviors are individual acts, the rates at which they occur vary among different groups and through time. These changing rates are recognized as the results of a complex interaction of interpersonal, social, and cultural factors (Kraus and Buffler, 1979; see also Kiev, 1964; Murphy, 1965; Inkeles, 1973). Traditional Native communities help buffer the individual by providing a sense of continuity and control.

Increases in social problems—rising rates of alcoholism, drug and alcohol abuse, domestic violence, wife and child abuse, rape, homicide, and suicide—also are issues of direct concern in this analysis of sociocultural systems (see Sec. III.C.3). Local Prince William Sound residents participating in the cleanup of the *Exxon Valdez* Oil Spill in Prince William Sound in 1989 tended to: (1) not participate in subsistence activities, (2) have a surplus of cash to spend on material goods as well as drugs and alcohol, and (3) not seek or continue employment in other jobs in the community (because oil-spill-cleanup wages typically were higher than those earned in the community). Studies indicate that the sudden, dramatic increase in income as a result of working on the oil-spill cleanup, as well as being unable or unwilling to pursue subsistence harvests because of the spill, caused considerable social dislocation—particularly seen in increases in depression, violence, and substance abuse (Fall and Utermohle, 1995; Cohen, 1993; Picou and Gill, 1993; Picou et al., 1992; Fall, 1992; Impact Assessment, Inc., 1990e).

Although the oil industry strictly forbids the consumption of alcohol and drugs by camp workers, such events frequently occur in Prudhoe Bay and Kuparuk. In Prudhoe Bay, it is often the service industries that have not complied with enforcing the ban on alcohol. The increased availability of drugs and alcohol in local communities as a result of increased traffic through their airports, visitors in town, and oil-industry workers associating with local residents could be disruptive to the social well-being of these communities. These problems already have occurred in Nuiqsut, which is within 35 mi of Kuparuk and 65 mi of Prudhoe Bay. Although not accessible by road year-round, Nuiqsut is connected to the Prudhoe Bay/Kuparuk industrial complex by a winter road and by air. An increase in social problems (consumption of alcohol and drugs, sexual abuse, domestic violence) in Nuiqsut at a rate slightly higher than in other North Slope communities has been observed possibly because of Nuiqsut's road accessibility (Armstrong, 1985).

Although there may be additional reasons for differences in social problems in local communities, it is clear that accessibility to cities and larger communities enables residents easier access to drugs and alcohol, thereby affecting the social health of the community—a situation that could intensify in Nuiqsut as a result of NPR-A oil and gas activity. Any effects on social health would have ramifications in the social organization, but NSB Native communities have, in fact, proven quite resilient to such effects by local voter insistence on these communities being "dry," and by the NSB's continued support of Inupiat cultural values and its strong commitment to health, social service, and other assistance programs.

Several salient points in the evaluation of possible sociocultural effects from oil-related developments due to oil and gas activities in the planning area should be made:

1. Change itself, even though induced primarily by forces outside the communities, does not necessarily cause the levels of psychic stress that lead to pathology but technological disasters, as opposed to natural disasters, have been shown to produce more long-term stresses on affected communities (Picou et al., 1992; Inkeles, 1973).
2. Related to the first point is the fact that not all sociocultural change (directly or indirectly related to oil development) may be negative. Higher levels of employment, better health programs, and improved public services must be viewed as possible positive sociocultural effects from oil development on the North Slope. Additionally, income from oil-industry revenue and employment could improve living conditions, although major dependence on a nonrenewable-resource-based economy could cause long-term social disruption at the time of resource depletion.
3. What drives the disruption of sociological change ". . .is the manner in which changes occur" (Murphy, 1965).
4. The conditions that make sociocultural change stressful must be viewed as ongoing. If the stressful conditions alter, the society can make successful adjustments to the changes that have occurred; and the rates of violence, suicide, and substance abuse will drop.

Nuiqsut is the most likely community in the region to experience additional sale-related effects in social health and well-being above those effects already experienced as a result of NSB CIP employment and the indirect effects from current oil development. These effects on social health could have direct consequences on the sociocultural system but would not have a tendency toward displacement of existing institutions above the displacement that already has occurred with the current level of development. Effects on the institutions and sociocultural systems in Barrow and Atqasuk would be periodic but not displace existing institutions.

Impacts from approaching oil and gas development now practically encircling the community of Nuiqsut are addressed by local residents more and more. In a 1996 public meeting for the Northstar project, a Nuiqsut elder stated that she wanted potential human-health issues that could result from the project looked into beforehand. She specifically expressed concern about cancers, health problems related to air pollution, and shortened lifespans (Dames and Moore, 1996e; see Sec. IV.C. 13., Subsistence).

Summary: Impacts on the sociocultural systems of communities in and near the planning area could occur as a result of disturbance from industrial activities (seismic activity, aircraft noise, supply-vessel traffic, offshore exploration, construction, and oil spills); changes in population and employment; and effects on subsistence-harvest patterns. These effect agents could affect the social organization, cultural values, and social health of the communities.

Social institutions in all three communities would experience little direct disturbance from the staging of personnel and air freight expected for oil and gas activities in the planning-area from exploration, development, and production; negligible effects would be expected to sociocultural systems, and no displacement of existing institutions would occur.

Social interaction of oil-industry workers with Nuiqsut residents could be long term, but there would not be a tendency toward displacement of their social institutions. Changes in population and employment are unlikely to

cause disruption to sociocultural systems but would not displace existing institutions. Oil-spill employment is not likely to disrupt subsistence-harvest activities for an entire season (1 year) or create disruption to institutions and sociocultural systems, and would not displace existing institutions.

Under Alternative B, disturbance disruptions on Nuiqsut's subsistence resources are not likely to render important subsistence resources unavailable, undesirable for use, or available in reduced numbers or their pursuit more difficult for an entire season. The same would be true in Barrow and Atqasuk as a result of disturbance effects on subsistence resources. There would be no disruption to institutions and sociocultural systems expected.

Any effects on social health would have ramifications in the social organization, but NSB Native communities have, in fact, proven quite resilient to such effects with the NSB's continued support of Inupiat cultural values and its strong commitment to health, social service, and other assistance programs. Health and social-services programs have attempted to meet the needs of alcohol and drug-related problems with treatment programs and shelters for wives and families of abusive spouses and with greater emphasis on recreational programs and services, yet a lack of adequate financing for individual NSB city governments has hampered the development of these programs, and declining revenues from the State of Alaska have seriously impaired the overall function of NSB city governments. Partnering together, Tribal governments, city governments and the NSB government may be able to provide programs, services, and benefits to residents. For several years, all communities in the NSB have banned the sale of alcohol although alcohol possession is not banned in Barrow and many communities are continually under pressure to bring the issue up for a local referendum vote (North Slope Borough, 1998).

Nuiqsut is the most likely community in the region to experience additional sale-related effects in social health and well-being above those effects already experienced as a result of NSB CIP employment and the indirect effects from current oil development. These effects on social health could have direct consequences on the sociocultural system but would not have a tendency toward displacement of existing institutions above the displacement that has already occurred with the current level of development. Effects on the institutions and sociocultural systems in Barrow and Atqasuk would be periodic and with no tendency toward displacing existing institutions. There is a likelihood for disproportionately adverse effects on Alaskan Natives as a result of the proposed action. Effects are expected to be focused on the Inupiat communities of Barrow, Atqasuk, and Nuiqsut within the North Slope Borough. The sociocultural and subsistence activities of these Native communities could be affected by routine development.

Conclusion—First Sale: Effects from management actions and oil and gas activities in the planning area under Alternative B are unlikely to disrupt sociocultural systems. Periodic, short-term disturbance effects would be expected on the sociocultural systems of Barrow, Atqasuk, and Nuiqsut but these disturbances are not expected to disrupt or displace institutions and sociocultural systems; community activities; and traditional practices for harvesting, sharing, and processing subsistence resources.

Multiple Sales: Under the multiple-sales approach, the resource estimate for Alternative B increases from a range of 65 to 350 MMbbl and zero to one s to a range of 90 to 500 MMbbl in zero to two s. The number of exploration wells increases from a maximum of 4 to 14, delineation wells increase from a maximum of 6 to 12, and production wells increase from 83 to 150. Pipeline miles increase to 90 mi. Multiple sales would occur over a longer period of time and, depending on the frequency of sales, the timeframe for oil and gas activities in the planning area would extend to at least two decades.

For Alternative B, it is estimated that the number of spills <1 bbl would increase from a range of 0 to 53 spills to a range of 0 to 75 spills, and the number of spills >1 bbl would increase from a range of 0 to 17 spills to a range of 0 to 25 spills over the assumed production life of the planning area. The estimated number of crude oil spills over the assumed production life of the planning area would increase from a range of 0 to 70 spills to a range of 0 to 100 spills (Sec. IV.A.2).

If several lease sales occur under Alternative B, considerably more exploration activity is expected to occur in the southern half of the planning area, and the levels of effects due to noise, disturbance, and habitat alteration are expected to increase. Given that resource estimates and development scenarios project an increase in resources and an increase in the number of drill pads and pipeline miles, logic would assume an increase in the effects to potentially affected subsistence resources, except for the fact that these effects would be spread over 2 decades. The critical factor would be the timing between sales—a longer interval would allow more recovery to subsistence resources from aircraft, vehicular, and construction disturbance and subsistence practices from increased access conflicts; less of an interval might not allow for sufficient recovery. In any case, the expected cumulative effect would be an increased development "footprint" and consequent increased habitat loss to resources and use are loss to hunters. The biological analyses expect slight increases in effects with little overall effects to subsistence resource populations. Effects associated with multiple sales on

subsistence-harvest patterns would make no subsistence resource unavailable, undesirable for use, or experience overall population reductions. Impacts would be further minimized by not leasing in important caribou, waterfowl, and fishing areas under this alternative, and from proposed stipulations, particularly the work of the Subsistence Advisory Panel designed to address local subsistence and cultural issues throughout the life of the plan.

Conclusion—Multiple Sales: Effects from management actions and oil and gas activities in the planning area for multiple sales under Alternative B could disrupt sociocultural systems for periods up to 1 year, but impacts would not be expected to displace institutions and sociocultural systems, community activities, or traditional practices for harvesting, sharing, and processing subsistence resources.

Effectiveness of Stipulations: Stipulations that specifically would protect subsistence resources are discussed in Sections IV.C.7, Fish Resources, IV.C.8, Birds, IV.C.9, Mammals, and IV.C.10, Endangered and Threatened Species. Important proposed subsistence stipulations that would specifically protect subsistence practices and sociocultural systems include a BLM proposal to establish a Subsistence Advisory Panel to monitor subsistence issues and concerns arising from and oil and gas activity on the NPR-A. Additionally, important proposed Subsistence Stipulations would require lessees:

1. To monitor exploration, development, and production effects on subsistence.
2. To not unreasonably restrict subsistence access by establishing procedures for use and firearm discharge near oil facilities.
3. To notify BLM if conflicts arise between the lessee and subsistence hunters and that BLM resolve the issue.
4. To consult with local communities about siting, timing, methods of operation, and possible mitigation to assure that exploration, development, and production activities are compatible with subsistence practices. Local communities, the NSB, and the Subsistence Advisory Panel all will concurrently review any exploration, development and production plans, and any interested party may request that BLM resolve disputes that cannot be settled between the parties.
5. To provide an employee-orientation program that addresses environmental, social, and cultural concerns relating to the NPR-A.
6. To conduct an inventory of known traditional land use sites in order to develop a plan to avoid these sites and to mitigate any possible damage to them.

15. Coastal Zone Management: Under Alternative B, approximately 2.4 million acres would be available to leasing. The area excluded from possible leasing includes nearly the entire Beaufort Sea coast, areas around Teshekpuk Lake, and other fish-bearing lakes in the planning area. Surface resource protections exclude 2.2 million acres from oil and gas leasing. These excluded areas include the Teshekpuk Lake Watershed, Goose Molting Habitat, Spectacled Eider Nesting Concentrations, Teshekpuk Lake Caribou Habitat, Fish Habitat, Colville River Raptor, Passerine, and Moose Area, Umiat Recreation Site, Scenic Areas, Pik Dunes, Ikpikpuk Paleontological Sites, and Potential Colville Wild and Scenic River LUEA's. Although the LUEA's would be unavailable to leasing, aboveground pipelines would be permitted to cross all but the potential Colville Wild and Scenic River LUEA. These areas would be subject to restrictions for siting pipelines and industrial structures and seismic and exploratory drilling setbacks.

Federal lands within the NPR-A are excluded from the coastal zone; however, all uses and activities on Federal lands either occurring within the coastal zone or that may reasonably be expected to affect the coastal area and its resources must be consistent to the maximum extent practicable with enforceable standards of the ACMP, including state standards in 6 AAC 80 and enforceable policies of local district programs. The primary goal of the NSB's CMP is to protect the subsistence lifestyle of the Borough's largely Inupiat population, while also encouraging and managing economic development. The enforceable policies of the NSB CMP have been incorporated within the Comprehensive Plan.

Major land uses on the North Slope are divided between traditional subsistence uses and hydrocarbon-development operations. Subsistence uses of the coastal resources in the NPR-A have been and will continue to be of the highest priority of the NSB Inupiat, given cultural and historic patterns of existence within NPR-A lands. Standards for development prohibit severe harm to subsistence resources or activities or disturbance of cultural and historic sites. Requirements address reasonable use of vehicles, vessels, and aircraft; engineering criteria for structures; drilling plans; oil-spill-control and -cleanup plans; pipelines; causeways, residential development associated with resource development; air and water quality; and solid-waste disposal.

a. Activities Other than Oil and Gas Exploration and Development: Ground-impacting management actions associated with Alternative B include aerial surveys (including that of wildlife) and ground activities, such as hazardous- and solid-material removal and remediation, which occur during the summer/early fall, and overland moves, which occur during the winter on frozen tundra. These activities generally would be the same as Alternative A, except that the number and frequency of

camps and moves would increase, depending on potential oil and gas exploration activity.

b. Oil and Gas Exploration and Development Activities: Alternative B involves several ground-impacting-management actions associated with oil and gas development. These include seismic surveys, exploration drilling, and the construction of gravel drill pads, roads, airstrips, pipelines; and possible oil spills (drill pad, pipeline, and supply vessel). Oil exploration activities would occur in winter (early December-mid-April). Transportation of construction materials, personnel, and fuel would be done over winter ice roads from existing infrastructure at Prudhoe Bay and Kuparuk. Large equipment would be barged to coastal staging areas in the summer, stockpiled, and moved inland the following winter. Under this alternative, one is assumed to be discovered and developed.

As previously indicated, the NPR-A is excluded Federal land and, while Federal lands are defined as being outside of the coastal zone, Federal activities and federally permitted activities must be reviewed for consistency with coastal management programs. Therefore, onshore activities within NPR-A and some offshore activities identified under Alternative B should be assessed against the ACMP, which includes the NSB CMP (Sec. III.C.5(b).

While the NPR-A is technically outside the coastal zone, it is within the North Slope Borough. The NSB Comprehensive Plan is applied to all developments occurring on private, Federal, and State lands. While local land use plans are not controlling on Federal lands, as with Coastal Zone Management (CZM), the BLM conducts its management to be consistent with those plans to the maximum extent practical. Activities could include portions of road/pipeline corridors, including the offshore portions (such as inlets and bays) within the NSB boundary. Development activities that occur adjacent to the Colville and Ikpikpuk rivers that could affect coastal resources or uses, including activities described in Exploration Plans and Development and Production Plans, could be subject to the Statewide standards and NSB district policies of the ACMP. All policies of the ACMP are examined herein for potential conflicts with effects from oil and gas exploration or development activities identified in Sections IV.C.1-14 and 16. While some policies may not directly apply to actions under Alternative B, they may apply to Alternatives C through E. Where applicable, to minimize redundancies, only those standards where potential conflicts with activities identified in Alternatives C through E may occur are examined in Sections IV.D.15 through IV.F.15.

Effects of Exploration and Development on the Alaska Coastal Management Program: Section 307(c)(3)(B) of the Federal Coastal Zone Management Act (CZMA) requires applicants to certify that each activity that is described in detail in an exploration or development and production plan that affects any land use or water use in the coastal zone complies with, and will be implemented consistent with, the State's coastal program. The State would concur with or object to an applicant's certification. The State reviews exploration and development and production plans to determine if activities that could affect the coastal zone are consistent with the ACMP.

In the following discussion, ACMP uses and activities standards would relate to Alternatives B through E and to potential effects identified for each alternative in other resource sections of this EIS (Secs. IV.B.1-14 and 16 through IV.E.1-14 and 16). Policies of the NSB CMP are assessed in conjunction with the most closely associated Statewide standard. The NSB CMP policies have been incorporated into the NSB Comprehensive Plan.

This analysis is not a consistency determination pursuant to the Coastal Zone Management Act of 1972, as amended, nor should it be used as a local planning document. It is highly unlikely that the activities or events that are hypothesized will occur as assumed in this EIS. It is unknown at this time which of the alternatives, or any combination thereof, may be selected in BLM's record of decision.

(1) Coastal Development (6 AAC 80.040): Water dependency is a prime criterion for development along the shoreline (6 AAC 80.040 [a]). The intent of this policy is to ensure that onshore developments and activities that can be placed inland do not displace activities that depend on shoreline locations including marine, lakes, and river waterfronts. Only activities in T. 13 N., R. 1 E., U.M. might require a shoreline location, because the rest of the Beaufort Sea coast within the planning area is excluded from leasing under Alternative B. Protective measures would forbid leasing and most types of surface use for oil and gas activities in all the LUEA's except the Kuukpik Corporation Entitlement LUEA, thereby protecting all the habitat identified as important for molting geese, calving caribou, caribou seeking insect relief, spectacled eiders, fish, paleontological resources, and various wildlife and recreation resources associated with the Colville River. Although large equipment could be barged outside the NPR-A to coastal staging areas in the summer and stockpiled until winter, no development activity would conflict with this policy.

(2) Geophysical Hazard Areas (6 AAC 80.050): This Statewide standard requires coastal districts and State agencies to identify areas in which geophysical hazards are known and in which there is a substantial probability that geophysical hazards may occur. Development in these

areas is prohibited until siting, design, and construction measures for minimizing property damage and protecting against the loss of life have been provided.

Permafrost, faults and earthquakes, hydrates and shallow gases, and factors affecting the geotechnical characteristics of the planning area must be considered. Onshore development would be sited in areas of permafrost. Development in these areas must "maintain the natural permafrost insulation quality of existing soils and vegetation" (NSB CMP 2.4.6[c] and NSBMC 19.70.050.L.3). The BLM's current management practices and stipulations (Section II.C.7.b) will reduce conflicts and Alternative B will be consistent with this standard.

(3) Recreation (6 AAC 80.060: This Statewide standard requires coastal districts to designate areas for recreational use if (1) the area receives significant use by persons engaging in recreational pursuits or is a major tourist destination; or (2) the area has potential for high quality recreational use because of physical, biological or cultural features. High priority is given to maintaining or increasing public access to coastal waters. The NSB has identified many areas within NPR-A as high recreational use areas. The BLM's current management practices and stipulations developed through the permitting process and attached to land use authorizations for temporary facilities, overland moves, seismic operations, and exploratory oil and gas activities to protect visual/recreation values will reduce conflicts, and Alternative B will be consistent with this standard.

(4) Energy Facilities (6 AAC 80.070): The ACMP requires that decisions on the siting and approval of energy-related facilities be based, to the extent feasible and prudent, on 16 criteria within the energy facilities standard. Stipulations (Section II.C.7.b) will reduce conflicts and Alternative B will be consistent with this standard.

Other criteria within this standard require that facilities be consolidated and sited in areas of least biological productivity, diversity, and vulnerability (6 AAC 80.070 [3]). The NSB CMP also requires that "transportation facilities and utilities must be consolidated to the maximum extent possible" (NSB CMP 2.4.5.2[f] and NSBMC 19.70.050. K.6).

Construction associated with energy-related facilities under Alternative B also must comply with siting standards that apply to all types of development. These more general standards are discussed later under Habitats and Air, Land, and Water Quality.

(5) Transportation and Utilities (6 AAC 80.080): This Statewide standard requires that routes for transportation and utilities be compatible with district programs and sited inland from shorelines and beaches. No conflict with these policies is anticipated under Alternative B.

The NSB CMP contains several additional policies related to transportation that may be relevant to this analysis. All but one of the policies are "best-effort policies" and subject to some flexibility if (1) there is a significant public need for the proposed use and activity, (2) all feasible and prudent alternatives have been rigorously explored and objectively evaluated, and (3) all feasible and prudent steps have been taken to avoid the adverse effects the policy was intended to prevent. "Transportation development, including pipelines, which significantly obstructs wildlife migration" is subject to the three conditions listed above (NSB CMP 2.4.5.1[g] and NSBMC 19.70.050.J.7). Section IV.C.9 indicates that interference with caribou movements would be temporary and brief; caribou migrations and overall distribution are not expected to be affected. Stipulations related to overland moves and seismic work (19, 20) and facility design and construction (24, 25, 27, 28.b, 34-38) will reduce conflicts and Alternative B will be consistent with this standard.

As noted in the previous standard for energy facilities, transportation facilities are expected to be consolidated to the maximum extent practicable. Therefore, there should be no conflict with either NSB CMP 2.4.5.1(i) (NSBMC 19.70.050.J.9), which discourages duplicative transportation corridors from resource-extraction sites, or NSB CMP 2.4.5.2(f) (NSBMC 19.70.050.K.6), which requires that transportation facilities and utilities be consolidated to the maximum extent practicable.

The NSB CMP 2.4.6(b) (NSBMC 19.70.050.L.2), under the category of "Minimization of Negative Impacts," requires that alterations to shorelines, water courses, wetlands, and tidal marshes and significant disturbance to important habitat associated with transportation and utilities be minimized. In the discussion of habitats Sections IV.C.6-9, it is recognized that alterations to wetland habitat and ponds and lakes will occur and birds could be disturbed during construction. This policy also requires that periods critical for fish migration be avoided. These requirements identify constraints for the siting, design, construction, and maintenance of transportation and utility facilities. Also, stipulations identified in Section II.C.7.b. provide protections to resources and habitats. Therefore, BLM's current management practices and stipulations will reduce conflicts and Alternative B will be consistent with this standard.

(6) Mining and Mineral Processing (6 AAC 80.110): Extraction of sand and gravel is a major concern on the North Slope. Gravel resources are needed for construction of pads, roadbeds, berms or causeways, and

docks to protect the tundra. The ACMP Statewide standards require that mining and mineral processing be compatible with the other standards, adjacent uses, and activities; state and national needs; and district programs (6 AAC 80.110 [a]). Sand and gravel may be extracted from coastal waters, intertidal areas, barrier islands, and spits when no feasible and prudent noncoastal alternative is available to meet the public need (6 AAC 80.110 [b]). Substantial alteration of shoreline dynamics is prohibited (NSB CMP 2.4.5.1[j] and NSBMC 19.70.050.J.10). Constraints may be placed on extraction activities to lessen environmental degradation of coastal lands and waters, if gravel is not obtained from inland sites, and to ensure floodplain integrity (NSB CMP 2.4.5.2[a] and [d] and NSBMC 19.70.050.K.1 and 4). Given the extraction required to support oil and gas development anticipated under Alternative B in conjunction with mitigation measures (Stipulations 34 and 40) will reduce conflicts, and Alternative B will be consistent with this standard and the NSB policies.

(7) Subsistence (6 AAC 80.120): The Statewide standard for subsistence guarantees opportunities for subsistence use of coastal areas and resources. Subsistence uses of coastal resources and maintenance of the subsistence way of life are primary concerns of the residents of the NSB. Under Alternative B, the entire Beaufort Sea coast within the NPR-A planning area is excluded from leasing, significantly reducing potential disturbance to bowhead whales and other marine mammals. However, access to subsistence resources, subsistence hunting and resource use could be affected by reductions in subsistence resources and changes in subsistence-resource-distribution patterns. These changes could occur as a result of disturbance from seismic surveys, aircraft and vessel traffic, drilling activities, and construction activities that include pipeline construction; structure placement; and support-base, pump-station, and road construction. Short-term and localized impacts from disturbance and oil spills to the Teshekpuk Lake Caribou Herd, other terrestrial mammals, fish, birds, bowhead whales, and other marine mammals would have no apparent effect on subsistence harvests for Barrow, Atqasuk and Nuiqsut hunters. Subsistence-hunter concerns about access to resources and resource contamination would be minimal. Impacts would be further minimized by not leasing in important caribou, waterfowl, and fishing areas under Alternative B, and from protections afforded by stipulations identified in Section II.C.7.b to protect marine and terrestrial mammals, waterfowl, and fishing resources. Surface, air, and foot traffic near the s is expected to increase under Alternative B and to displace some caribou, moose, muskoxen, grizzly bears, wolves, and wolverines but not significantly affect Arctic Slope populations. This conclusion is based partially on the established policy that roads and pipelines are constructed to provide for unimpeded wildlife crossings. Based on the analysis of disturbance effects of activities on caribou described in Section IV.C.9 and subsistence described in Section IV.C.13, potential conflict with the subsistence policies under Alternative B would be reduced by subsistence Stipulations 61 through 63 and 65 and would be consistent with this standard.

Policy 2.4.3(d) (NSBMC 19.70.050.D) requires that development not preclude reasonable subsistence-user access to a subsistence resource. Onshore pipelines and construction activities could cause disruptions to subsistence caribou harvests from access and movement conflicts, but effects are expected to be short term. Where access is reduced or restricted, development can occur only if no feasible or prudent alternative is available, and then it is subject to the conditions of best-effort policies. Conflict with these standards and policies will also be minimized under Alternative B by the exclusion of the Teshekpuk Lake Caribou Habitat LUEA from leasing and stipulation 66.

Several important NSB CMP policies relate to adverse effects on subsistence resources. The NSB CMP policy 2.4.3(a) (NSBMC 19.70.050.A) relates to "extensive adverse impacts to a subsistence resource" that "are likely and cannot be avoided or mitigated." In such an instance, "development shall not deplete subsistence resources below the subsistence needs of local residents of the Borough." Policy 2.4.5.1(a) (NSBMC 19.70.050.J.1) addresses "development that will likely result in significantly decreased productivity of subsistence resources or their ecosystems." Temporary reductions in subsistence resources and changes in subsistence resource-distribution patterns could occur as a result of disturbance from seismic surveys, aircraft and vessel traffic, drilling activities, and construction activities including offshore dredging, pipeline construction, structure placement and onshore pipelines, and support-base, pump-station, and road construction.

All NPR-A development scenarios for Alternatives B through E call for an onshore pipeline for oil delivery to TAPS, and potential for a pipeline spill contaminating the Colville River. A spill entering the Colville potentially could affect fish populations, disrupt subsistence-fishing activity, and curtail the subsistence hunt as resources well may be tainted or, even if available, the perception of tainting could substantially affect the subsistence harvest (Sec. IV.C.13). However, given that the number and size of oil spills estimated in Alternative B would be small, and that chronic spills can normally be contained on the drill pad, it is anticipated that the effects from spills and potential disruption from cleanup activities would have little to no impact on subsistence resources and harvest patterns.

Conflict with these policies is possible during the exploration, development, and production phases, but is more likely during development and production increases in the unlikely event of an oil spill and associated oil-spill-cleanup activities. The referenced stipulations will reduce conflicts and Alternative B will be consistent with this standard.

(8) Habitats (6 AAC 80.130): The Statewide standard for habitats contains an overall standard policy plus policies specific to eight habitat areas: offshore areas; estuaries; wetlands and tideflats; rocky islands and seacliffs; barrier islands and lagoons; exposed high-energy coasts; rivers, streams, and lakes; and important upland habitat (6 AAC 80.130 [a], [b], and [c]). Activities and uses that do not conform to the standards may be permitted if there is significant public need and no feasible prudent alternatives to meet that need, and all feasible and prudent measures are incorporated to maximize conformance (6 AAC 80.030 [d]). The NSB CMP contains a district policy that reiterates the applicability of the Statewide standard (NSB CMP 2.4.5.2[g] and NSBMC 19.70.050.K.7), plus several others that augment the overall policy or can be related to activities within a specific habitat. Under Alternative B, areas excluded from leasing include the Teshekpuk Lake Watershed, Goose Molting Habitat, Spectacled Eider Nesting Concentrations, Teshekpuk Lake Caribou Habitat, Fish Habitat, Colville River Raptor, Passerine, and Moose Area, Umiat Recreation Site, Scenic Areas, Pik Dunes, Paleontological Sites, and Potential Colville Wild and Scenic River LUEA's. Also, special stipulations have been developed to provide protection for birds, terrestrial mammals, and fish (Sec. II.C.7.b; Stipulations 14-18, 20, 24, 25, 27, 28, 34-45, 54-66). Therefore, conflicts for exploration under Alternative B are not anticipated, and will be consistent with this standard.

The ACMP Statewide standard for habitats in the coastal zone requires that habitats "be managed so as to maintain or enhance the biological, physical, and chemical characteristics of the habitat which contribute to its capacity to support living resources" (6 AAC 80.130 [b]). This overall policy is supported by an NSB CMP policy requiring that development "be located, designed, and maintained in a manner that prevents significant adverse impacts on fish and wildlife and their habitat, including water circulation and drainage patterns and coastal processes" (NSB CMP 2.4.5.2[b] and NSBMC 19.70.050.K.2). In addition, "vehicles, vessels, and aircraft that are likely to cause significant disturbance must avoid areas where species that are sensitive to noise or movement are concentrated at times when such species are concentrated" (NSB CMP 2.4.4 [a] and NSBMC 19.70.050.I.1). Some disturbances associated with exploration and development would be mitigated by stipulations placed on permits. The analyses in Sections IV.B.6 through 14 indicate that resources would not be subject to significant disturbance from these activities. Although there are no conflicts with the reasonably foreseeable activities under this proposal at this point, some activities that may appear as specific proposals are brought forward at the time of development.

Activities may affect several of the habitats identified in the Statewide standard, including lagoons, wetlands, rivers, lakes, and streams. Much of the uplands in the NSB are considered wetlands. Therefore, onshore-development activities would need to be designed and constructed to avoid (1) adverse effects to the natural drainage patterns, (2) destruction of important habitat, and (3) the discharge of toxic substances (6 AAC 80.130 [c][3]). Water impoundments created by a pipeline/road corridor would have both positive and negative effects. In localized areas near the pipeline-road complex (Sec. IV.B.8), impoundments would benefit some waterfowl by creating additional habitat but displace other nesting shorebirds.

Caribou of the CAH and TLH are expected to be disturbed and their movements delayed along the pipeline during periods of air overflights (i.e. pipeline inspections), but disturbances are not expected to affect migrations and overall distribution (Sec. IV.C.9). Surface, air, and foot traffic near the s is expected to increase under Alternative B and to displace some caribou, moose, muskoxen, grizzly bears, wolves, and wolverines but not significantly affect Arctic Slope populations. This conclusion is based partially on the established policy that roads and pipelines are constructed to provide for unimpeded wildlife crossings. The NSB CMP policy 2.4.6(e) (NSBMC 19.70.050.L.5) emphasizes this practice and provides a set of guidelines and an intent statement specifically to implement the policy. There is no inherent conflict between the crossing requirements and the assumed activities. If a spill occurred as a result of activities under Alternative B, it is expected to result in the loss of no more than small numbers of terrestrial mammals, with recovery expected within about a year (Sec. IV.B.9).

Rivers, lakes, and streams are managed to protect natural vegetation, water quality, important fish or wildlife habitat, and natural water flow (6 AAC 80.130 [c][7]). Pipeline and road construction, including gravel extraction, could affect these waterways and would need to be conducted in a manner that ensures the protection of riverine habitat and fish resources. Gravel extraction also is regulated under policies that are described in the section on mining. Stipulations related to ice roads and water use (14-18); overland moves and seismic work (19 and 20); facility design and construction (24, 25, 27, and 34-45) will reduce conflicts and Alternative B will be consistent with this standard.

(9) Air, Land, and Water Quality (6 AAC 80.140): The air, land, and water quality standard of the ACMP incorporates by reference all the statutes pertaining to, and regulations and procedures of, the ADEC. The NSB reiterates this standard in its district policies and emphasizes the need to comply with specific water and air quality regulations in several additional policies.

Water quality can be affected by oil spills, deliberate discharges and emissions, and gravel operations. As a precaution against accidental spills, the NSB CMP requires the use of impermeable lining and diking for fuel-storage units with a capacity >660 gal (NSB CMP 2.4.4[k] and NSBMC 19.70.050.I.11). In addition, development within 1,500 ft of a coast, lake, or river shoreline "that has the potential of adversely impacting water quality (e.g., landfills, or hazardous-materials storage areas, dumps, etc.)" must comply with the conditions of the best-effort policies (NSB CMP 2.4.5.1[e] and NSBMC 19.70.050.J.4). These conditions are: (1) there must be a significant public need, (2) the developer has rigorously explored and objectively evaluated all feasible and prudent alternatives and cannot comply with the policy, and (3) all feasible and prudent steps have been taken to avoid the adverse effects the policy was intended to prevent. There may be some short-term conflict with water quality due to potential oil spills between this policy and activities assumed under Alternative B. However, the stipulations imposed for the lease sale will reduce conflicts and Alternative B will be consistent with this standard.

Some discharges and emissions would occur during exploration and development, and the NSB CMP policy 2.4.4(c) (NSBMC 19.70.050.I.3) requires that "development resulting in water or airborne emissions...comply with all state and federal regulations." This is consistent with the Statewide standard.

Discharges of muds, cuttings, and drilling fluids are regulated closely. Formation waters produced from the wells along with the oil is regulated by the USEPA Underground Injection Control program. The Alaska Oil and Gas Conservation Commission has primacy for this program for Class II wells in the State of Alaska. Produced waters and drilling wastes fall within the Class II category. Some wastes are disposed through the annulus of producing wells. This activity is exempt from the Underground Injection Control program, however, the AOGCC also regulates this practice for the State of Alaska. Surface disposal of drilling wastes would require a solid waste permit from ADEC.

Because discharges are carefully regulated, no conflict is anticipated with the Statewide standard or NSB CMP policy 2.4.4(d) (NSBMC 19.70.050.I.4), which requires that "industrial and commercial development...be served by solid waste disposal facilities which meet state and federal regulations." Any onshore development under Alternative B must meet the Statewide standard and the district policy related to solid-waste disposal. Assuming the regulations are implemented properly, including Stipulations 1 through 13 related to solid- and liquid-waste handling and hazardous-material disposal and cleanup, there is no inherent conflict between the proposed activities and the ACMP water-quality provisions, and Alternative B will be consistent with this standard.

Air quality also must conform with Federal and State standards (6 AAC 80.140, NSB CMP 2.4.3[i] and 2.4.4[c], and NSBMC 19.70.050.H and I.3). The analysis of air-quality effects under Alternative B in Section IV.C.5 indicates that conformance is anticipated, and no conflict between air quality and coastal policies should occur.

(10) Statewide Historic, Prehistoric, and Archaeological Resources (6 AAC 80.150): The ACMP Statewide standard requires that coastal districts and appropriate State agencies identify areas of the coast that are important to the study, understanding, or illustration of national, State, or local history or prehistory.

The NSB developed additional policies to ensure protection of its heritage. The NSB CMP 2.4.3(e) (NSBMC 19.70.050.E) requires that development that is "likely to disturb cultural or historic sites listed on the National Register of Historic Places; sites eligible for inclusion in the National Register; or sites identified as important to the study, understanding, or illustration of national, state, or local history or prehistory shall (1) be required to avoid the sites; or (2) be required to consult with appropriate local, state and federal agencies and survey and excavate the site prior to disturbance." The NSB CMP 2.4.3(g) (NSBMC 19.70.050.G) goes on to require that "development shall not cause surface disturbance of newly discovered historic or cultural sites prior to archaeological investigation." These NSB CMP policies establish clearly what is required. Although the NPR-A technically is excluded from the coastal area, given the number of existing sites, it is likely that new cultural and paleontological sites may be discovered under Alternative B. However, we do not anticipate conflicts with these policies, since mitigation measures (Stipulation 66 [Sec. II.C.7.b]), which requires an inventory of traditional use sites prior to conducting any activities, and Stipulation 79, which requires all operations be suspended in the immediate area of a cultural or paleontological resource, once found, and notifying the AO of such finding) will reduce conflicts and Alternative B will be consistent with this standard.

Traditional activities at cultural or historic sites also are protected under the NSB CMP 2.4.3(f) (NSBMC

19.70.050.F) and 2.4.5.2(h) (NSBMC 19.70.050.K.8). As noted in the discussion of policies related to subsistence, the latter is a best-effort policy that requires protection for transportation to subsistence-use areas as well as cultural-use sites. There is no inherent reason to assume conflict with these policies.

Summary: Alternative B is expected to increase the level of noise and disturbance and habitat alteration effects on terrestrial mammals in parts of the planning area over the level of effects under Alternative A. However, conflicts with coastal management policies and standards of the ACMP and NSB CMP are not anticipated under Alternative B. Short-term and localized impacts from disturbance and oil spills to the Teshekpuk Lake Caribou Herd, other terrestrial mammals, fish, birds, bowhead whales, and other marine mammals harvested by Barrow, Atqasuk, and Nuiqsut subsistence hunters would have no apparent effect on subsistence harvests in these communities (Sec. IV.C.13). Under Alternative B, it is expected that subsistence-hunter concerns about access to resources and resource contamination would be minimal. Impacts would be further minimized by not leasing in important caribou, waterfowl, and fishing areas under this alternative and from the protection afforded by other management actions, including protective stipulations placed on activities.

Potential conflict between Alternative B proposed activities and Statewide standards and NSB district policies may arise, but are not expected, in conjunction with the NSB CMP 2.4.5.2(h) (NSBMC 19.70.050.K.8) that relates to both subsistence and cultural resource areas. This policy requires that development be located, designed, and maintained so as not to interfere with the use of a site that is important for significant cultural uses or essential for transportation to subsistence-use areas. Also, conflict with district policies may arise in the potential for adverse effects to subsistence resources. NSB CMP policy 2.4.3(a) (NSBMC 19.70.050.A) relates to "extensive adverse impacts to a subsistence resource" that "are likely and cannot be avoided or mitigated." In such an instance, "development shall not deplete subsistence resources below the subsistence needs of local residents of the Borough." Policy 2.4.5.1(a) (NSBMC 19.70.050.J.1) relates to "development that will likely result in significantly decreased productivity of subsistence resources or their ecosystems." Potential conflicts with these standards will be minimized. The BLM's current management practices and stipulations (Sec. II.C.7.b) developed for this alternative will reduce conflicts and Alternative B will be consistent with this standard.

Conclusion—First Sale: For Alternative B, conflicts could occur with specific Statewide standards and NSB CMP policies related to potential user conflicts between development activities and access to subsistence resources. Conflicts are possible with the NSB CMP policy related to adverse effects on subsistence resources resulting from periodic disturbance and oil spills, but no resource would become unavailable, undesirable for use, or experience overall population reductions. These effects would occur in the unlikely event of spilled oil contacting subsistence resources and habitats and the activities associated with oil-spill cleanup. No conflicts are anticipated during exploration, since no oil spills are assumed to occur during exploration.

Multiple Sales: Under a multiple-sales approach, under Alternative B, resource estimates increase to 90 to 500 MMbbl and up to two s, exploration wells to 14, delineation wells to 12, and production wells to 150. Pipeline miles increase to 90 mi. Multiple sales would occur over a longer period of time and, depending upon the frequency of sales, the time frame for oil and gas activities in the planning area would extend to at least 20 years. The estimated number of crude oil spills over the assumed production life of the planning area would increase from a range of 0 to 70 spills to a range of 0 to 100.

If several sales occur under Alternative B, considerably more exploration activity is expected to occur in the southern half of the planning area, and the levels of effects due to noise, disturbance, and habitat alteration is expected to increase. Surface, air, and foot traffic near facilities is expected to increase and to displace some caribou, moose, muskoxen, grizzly bears, wolves, and wolverines but not significantly affect Arctic Slope populations. The number of small, chronic crude-oil and fuel spills is expected to increase and result in the loss of small numbers of terrestrial mammals, with recovery expected within about 1 year (Sec. IV.C.9). For arctic fish populations, each additional lease sale is expected to have similar effects on arctic fish as described for one sale under Alternative B. However, if there are increased levels of activity associated with future lease sales, and/or insufficient recovery time between sales, greater adverse effects than described for a single sale under Alternative B are likely to occur. An increase in effects to bird populations from increased noise disturbance could be expected with multiple sales. Surface, air, and foot traffic are expected to increase somewhat near facilities with multiple sales, and to displace greater numbers of individuals and involve more species than with a single sale, though the increase is not expected to significantly affect populations. Effects from disturbance and habitat alteration or loss on birds is expected to increase in the southern half of the planning area with multiple sales under Alternative B. Effects from small, chronic oil spills are expected to have a similar effect on birds and their habitats as under Alternative B with the first sale but with increased numbers of species involved and increased loss of individuals; habitat

contamination is expected to increase locally at the spill sites and along any streams contaminated by these spills. These spills are expected to result in the loss of small numbers of birds that is not likely to be detectable above the natural fluctuations of the population and survey methods/data available. (Sec. IV.C.8)

Effects of multiple sales on bowhead whales are expected to be essentially the same as described for the first sale. Bowhead whales exposed to noise-producing activities such as marine-vessel traffic and possibly aircraft overflights most likely would experience temporary, nonlethal effects. Small onshore spills are unlikely to reach the marine environment. If spilled oil did reach the marine environment, it is assumed to be a very small amount, and any exposure to spilled oil would not pose serious direct effects to bowhead whales. For marine mammals, multiple sales under Alternative B are expected to have similar effects to those described earlier for one sale, i.e., local and short term, with no significant adverse effects to marine mammal populations as a whole.

Conclusion—Multiple Sales: Displacement of birds from disturbance and habitat alternation is expected with multiple sales, but should not significantly affect coastal plain bird populations. Effects from multiple sales to terrestrial mammals are expected to increase, but no significant impacts to populations are anticipated. Small numbers of terrestrial mammals would be lost due to the increase of small, chronic crude-oil and fuel spills, but populations are expected to recover within 1 year (Sec. IV.C.9). Arctic fish populations would experience effects from seismic surveys and pipelines similar to those discussed for the first sale (i.e., no measurable effect on arctic fish populations). However, fuel and oil spills are likely to have a greater effect on fish populations than the first sale. Insufficient recovery time between sales and/or greater levels of activity would be likely to result in greater effects than estimated for multiple sale. Increased disturbance and displacement effects and increased oil-spills risks are expected to increase for birds in the southern half of the planning area under Alternative B with multiple sales, but not significantly affect coastal plain populations. Bowhead whales exposed to noise-producing activities such as marine-vessel traffic and possibly aircraft overflights most likely would experience temporary, nonlethal effects. Effects of multiple sales and increased potential for noise-producing activities and oil spills to marine mammals would be short term and local with no adverse effects to populations. Multiple sales may cause potential conflicts with the subsistence, habitat, air- and water-quality, and transportation standards of the ACMP; however, each oil and gas lease operating plan will be reviewed for consistency on a case-by-case basis.

Effectiveness of Stipulations: Stipulations described in Section II.C.7.b, including ice roads and water use (14-18), overland moves and seismic work (19 and 20), and facility design and construction measures (24), solid- and liquid-waste handling and disposal, fuel handling and spill cleanup, general environmental stipulations, and aircraft restrictions are expected to minimize effects to terrestrial mammals, birds, and fish. These stipulations would minimize disturbance from most factors and prevent fuel or oil spilled on pads from reaching surrounding habitats and would protect subsistence resources. No stipulations or other special mitigating measures are needed to protect bowhead whales, since development activities would be focused southward, away from the coast. Section II.C.7.b. contains stipulations proposed by BLM to protect various waterfowl species from various activities in the planning area. Stipulations included under several categories, such as solid- and liquid-waste handling, hazardous-material disposal and cleanup, ice roads and water use, overland moves and seismic work, oil and gas exploratory drilling, facility design and construction, ground transportation, air traffic, abandonment, orientation program, and other activities should provide adequate protection to eiders from most activities.

The effectiveness of stipulations for noise and disturbance from aircraft traffic associated with activities other than oil and gas, such as aerial wildlife surveys and other aerial surveys, are the same as Alternative A. Aircraft traffic associated with activities other than oil and gas has the potential to affect breeding and nesting eiders, because several of the aircraft stipulations pertaining to flight-timing restrictions apply only to oil and gas activities. Therefore, the stipulations associated with flight-timing restrictions of aircraft probably are not adequate to protect spectacled eiders and Steller's eiders from disturbance from aircraft associated with aerial wildlife surveys and other surveys conducted in the lake areas to the north, west, and east of Teshekpuk Lake (Sec. IV.C.10). Steller's eiders in other portions of the planning area are less likely to be affected by aircraft flights, because fewer flights are likely to be conducted in those areas. Disturbance of some individuals over the life of the project is expected to be unavoidable.

In addition to specific resource protection stipulations developed to protect fish, birds, mammals, and endangered and threatened species, subsistence Stipulations 61 through 63, orientation program Stipulation 63, and traditional land use site Stipulation 66 have been identified to protect subsistence practices under Alternative B. Proposed subsistence Stipulation 64 would specifically protect subsistence practices by requiring an Subsistence Advisory Panel be established to monitor subsistence issues and concerns arising from and oil and gas activity on the NPR-A. Other measures require monitoring of exploration,

development, and production effects on subsistence; prohibit unreasonable restrictions on subsistence access by establishing procedures for use and firearm discharge near oil facilities; and require consultation with local communities about siting, timing, methods of operation, and possible mitigation so that oil and gas activities are compatible with subsistence practices and to encourage conflict resolution agreements.

16. Recreation and Visual Resources:

a. Activities Other than Oil and Gas Exploration and Development: The kinds of activities other than oil and gas exploration and development expected under Alternative B are the same as under Alternative A. However, certain of these activities would increase as a result of and in support of oil and gas development. For example, field activities associated with archeological site clearances, such as camps, excavations, and aircraft activity all likely would increase. The resulting impacts would be minimal and short term in nature as described under Alternative A, but the total area impacted could increase to 2,000 acres (from 1,500 in Alternative A).

The longer lasting visual impacts of green trails under Alternative B are expected to remain about the same as those under Alternative A, even though the amount of supplies and material transported by winter overland moves may increase This is because these moves generally follow the same route; therefore, neither the length nor number of green trails in some phase of recovery is expected to noticeably increase.

b. Oil and Gas Exploration and Development Activities:

(1) Exploration: Under this alternative, seismic-survey work would continue but would increase from one operation (under Alternative A) to two to three and would include 3-D as well as 2-D operations. Assuming two crews working per season, ongoing seismic operations are expected to affect no more than approximately 1,000 acres at a time, or about 500 acres more than under Alternative A. Green trails (see Alternative A) resulting from these operations could increase severalfold from Alternative A with hundreds of miles of intermittent green trail being visible during any one summer season.

A total of 10 exploration/delineation wells are anticipated under this alternative. However, due to the limited number of drill rigs available, no more than one well is anticipated to be drilled at any one time. Drilling would occur over several winter seasons using ice pads, roads, and airstrips. Temporary on site location of structures (e.g., drill rigs); noise from generators, vehicles, aircraft etc.; human presence; and associated activity all would have adverse, short-term impacts on scenic quality, solitude, naturalness, or primitive/unconfined recreation during the winter season. These impacts are expected to be greatest within a 2-mi radius of the drill site, which is an area of approximately 8,000 acres per well site. Accordingly, under this alternative, there would be a temporary loss of scenic quality, solitude, naturalness, or primitive/unconfined recreation over an area of approximately 8,000 acres.

In addition to the short-term impacts that result from ongoing exploratory drilling operations, summer-season visual concern exists as a result of the greening of vegetation under vacated ice pads, airstrips, and roads. This direct impact to the area's naturalness is a result of the same conditions that create green trails—the greater availability of moisture and nutrients as ice or compacted snow melts. This greening of the vegetation does not necessarily develop wherever ice pads are constructed or snow is compacted but when it does, it can be very detectable from the air for 2 to 5 years or longer. Assuming approximately 50 acres of ice pads, airstrips, and roads per drill site , as many as 500 acres (10 vacated sites x 50 acres/site) will be in various states of recovery from this greening effect.

Exploration wells also will leave behind a marker pipe expected to be no larger than a square foot on the surface and 6 ft tall. This is essentially a permanent impact, but almost unnoticeable from several hundred feet.

(2) Development: A total of as many as two production pads and 75 mi of pipeline are anticipated under this alternative. Although with the cessation of construction activities and closure of material sites, the intensity of impacts likely would be reduced from the development phase to the production phase, remaining structures, human presence, and associated activity and noise all would have adverse impacts on scenic quality, solitude, naturalness, or primitive/unconfined recreation during the life of the field. Because production could occur for 30 years, impacts would be long term. These long-term, adverse impacts are expected to be greatest within 2 mi of the pad site (or an area of about 8,000 acres). Additionally, pipelines and associated facilities would impact recreation values. Pipelines are expected to be elevated only about 5 ft and, except during construction and repair, there would be no associated on-the-ground activity. Therefore, long-term impacts to recreation values from pipelines are expected to be minimal beyond about ½ mi. This equates to about 640 acres per mile of pipeline. Under this alternative, a single pump station also is expected along the route of a pipeline. Adverse impacts to recreation values would be similar to those resulting from a production pad and its facilities, or about 8,000 acres

impacted per pump station. Accordingly under this alternative, there would be a long-term loss of scenic quality, solitude, naturalness, or primitive/unconfined recreation over an area of approximately 72,000 acres (i.e., [8,000 acres/pad x 2 pads] + [8,000 acres/pump station x 1 pump station] + [640 acres/mi x 75 mi of pipeline]). Short-term, routine/daily inspection flights also will impact solitude and naturalness along the length of all pipelines as long as they are in use.

Effects of Spills: Most spills (65-80%) will be confined to a pad. Spills not confined to a pad usually are confined to the area immediately around the pad or pipeline. Therefore, impacts on scenic quality, solitude, naturalness, or primitive/unconfined recreation resulting from spills likely would be confined to the same area described above under (2) Development.

A large spill that reaches a river and moves rapidly downstream would have disastrous short-term (and possibly long-term) impacts on recreation values.

Impacts to Wild and Scenic River Values: Under this alternative, resources on Federal lands and waters on and along the Colville River will receive the full protection of a "wild river" as afforded by the WSRA (Appendix G). Therefore, no impacts to outstandingly remarkable river values are anticipated on BLM-managed lands/waters. However, the majority of lands and resources along that portion of the Colville proposed for WSR designation are not under BLM management or protection.

Conclusion—First Sale: As compared to Alternative A, there would be an increase of approximately 500 acres to 2,000 acres in adverse, short-term impacts to recreation values from activities other than oil and gas exploration and development. Short-term impacts from ongoing oil and gas exploration activities would impact approximately 9,000 acres. The greening of vegetation resulting from ice pads, roads, airstrips, and compacted snow would impact about 500 acres. Seismic operations would result in several hundred miles of green trails, possibly double those of Alternative A.

Oil and gas development would result in the long-term loss of scenic quality, solitude, naturalness, or primitive/unconfined recreation over an area of approximately 72,000 acres (or 1.6% of the planning area) for the life of production fields and pipelines.

Multiple Sales: The types of impacts resulting from additional lease sales would be the same as described above for the first sale. Short-term impacts such as green trails and pads, disturbance from noise, aircraft, and other ongoing activities would not accumulate. Impacts from long-term or permanent facilities such as roads, pipelines, gravel pads, and pits would accumulate to the extent such facilities are necessary to support additional exploration and production. It is anticipated that such facilities will increase about 40 percent over those of the first sale and would affect a total of approximately 90,000 acres.

Conclusion—Multiple Sales: Long-term impacts would increase about 40 percent over those of the first sale, ultimately affecting about 90,000 acres or 1.9 percent of the planning area.

Effectiveness of Stipulations: The Colville River upstream from about Ocean Point would be designated Visual Management Class I under this alternative. As such, very limited management activity is allowed. Any contrast created within the characteristic landscape must not attract attention. These management standards will prevent any impacts to visual/recreation values in this scenic and important recreation area.

Also of importance is that short-term impacts to recreation values from exploratory oil and gas activities, as well as overland moves, are significantly mitigated by being restricted to winter months. Few recreationists visit the area in winter months.

D. ALTERNATIVE C: Alternative C would include BLM's management actions described for Alternative A and a proposal for making about 3.31 million acres of the Northeast NPR-A Planning Area available to oil and gas leasing. This alternative focuses protection on certain high-value resources by making important waterfowl and caribou habitat unavailable to oil and gas leasing; the status of the LUEA's for oil and gas leasing under Alternative C is shown in Table IV.D-1. Seismic activities would be permitted throughout the planning area. Applicable stipulations identified in Section II.C.7.b will be applied to this alternative. In addition, the alternative includes (1) recommending the Colville River be included as a "scenic" river in the Wild and Scenic River System, (2) proposing a Bird Conservation Area that would incorporate part of the Colville River valley, (3) urging the creation of a Special Area designated by the Secretary of the Interior along the Ikpikpuk River to protect paleontological resources, and (4) recommending the addition of the Pik Dunes LUEA to the Teshekpuk Lake Special Area.

The types of activities that might impact the resources include those noted for Alternative A and those additional activities associated with oil and gas exploration and development as noted for Alternative B. The level of activities other than oil and gas would be similar to or slightly greater for Alternative C than for Alternative A (Table IV.A.1.a-1). The economically recoverable oil resources for the first sale are estimated to range from 75 to 410 MMbbl; Table IV.A.1.b-4. The oil resources estimated for Alternative C are greater than those estimated for Alternative B (Table IV.A.1.b-4) and, thus, the levels of activities associated with Alternative C also are estimated to be greater than they are for Alternative B. These activities include drilling 4 to 15 exploration and delineation wells, constructing one to two production pads, drilling 23 to 122 production and service wells, and constructing 10 to 90 mi of pipeline (Table IV.A.1.b.5). If the area available for oil and gas leasing under Alternative C results in multiple sales, 110 to 580 MMbbl of oil are estimated to be recovered (Table IV.A.1.b-6). The types of activities associated with multiple sales would be similar to those that might occur as the result of the first sale. The level of activities for multiple sales is shown in Table IV.A.1.b-7.

1. Soils: The types of activities that may affect soils under Alternative C include those analyzed under

Table IV.D-1
Land Use Emphasis Areas Status for Oil and Gas Leasing Under Alternative C[1]

Land Use Emphasis Area	Fig. No. II.B.	Oil and Gas Leasing Status
Teshekpuk Lake Watershed	1	The northern part of the LUEA including Teshekpuk Lake would be unavailable for leasing. The southern part of the watershed would be available for leasing
Goose Molting Habitat	2	Unavailable
Spectacled Eider Nesting Concentrations	3	Unavailable
Teshekpuk Lake Caribou Habitat	4	Unavailable
Fish Habitat	5	Fish habitat in and along Teshekpuk Lake, the northern part of the Ikpikpuk River, and Miguakiak River would be unavailable for leasing. Fish habitat in the central part of the planning area, along the southern part of the Ikpikpuk River adjacent to the planning area, the Colville River, and Fish and Judy creeks would be available for leasing
Colville River Raptor, Passerine, and Moose Area	6	Available
Umiat Recreation Site	8	Available
Scenic Areas	9	Available
Pik Dunes	10	Available
Ikpikpuk Paleontological Sites	11	The northern part of the Ikpikpuk River would be unavailable for leasing. The southern part of the Ikpikpuk River adjacent to the planning area would be available for leasing.
Kuukpik Corporation Entitlement	13	Available
Potential Colville Wild and Scenic River	14	Available

[1] Section II.

Alternatives A and B.

a. Activities Other than Oil and Gas Exploration and Development: The effects of management actions described under Alternative C are similar to Alternative A, except there may be an increase in excavations (see Vegetation, Sec. IV.D.6).

b. Oil and Gas Exploration and Development Activities: Under Alternative C, the impacts from exploratory drilling and development activities would be the same as under Alternative B, except there would be an increase in the estimated level of activities. These activities could result in an estimated permanent loss of soils (based on loss of vegetation as noted in Sec. IV.D.6). Impacts to soils from spills and spill cleanup also are similar in area to those with impacts to vegetation.

Conclusion—First Sale: Estimated areas of impacts and losses of soils from all activities are similar to those areas discussed under vegetation.

Multiple Sales: Additional lease sales under Alternative C would result in additional exploration and development activities. The area of impacted soils is closely related to that of the disturbed vegetation (see Vegetation, Sec. IV.D.6, for acreage details).

Conclusion—Multiple Sales: Areas of impacts and losses of soils from all activities in multiple sales would be similar to those areas discussed under Vegetation (Sec. IV.D.6).

Effectiveness of Stipulations: There are no stipulations beyond those identified in Section II.C.7 that could reduce the impacts to soils.

2. Paleontological Resources:

a. Activities Other than Oil and Gas Exploration and Development: Paleontological resources (plant and animal fossils) are nonrenewable. Once they are adversely impacted and/or displaced from their natural context, the damage is irreparable.

Under Alternative C, the management-action impacts generally are the same as under Alternative A, except the intensity of the actions would increase due to potential oil and gas exploration.

b. Oil and Gas Exploration and Development Activities: Paleontological resources are not ubiquitous in the planning area as are wildlife and habitat, and their occurrence is much less predictable. As a result, it is quite possible that oil and gas exploration or development activities would nave no impact on paleontological resources.

(1) Effects of Disturbance from Exploration: The types of oil and gas exploration activities that would occur under Alternative C would be the same as those that would occur under Alternative B. However, the level or intensity of these exploration activities would increase under Alternative C. The number of exploration/ delineation wells drilled would increase from 10 to 15, and as many as 3 might be drilled during a single winter season. This would increase the probability of potential impact by 50 percent over Alternative B.

(2) Effects of Exploration Spills: These effects would be the same as those under Alternative B, except the probability of impacts would be increased by 50 percent.

(3) Effects of Disturbance from Development: The types of oil and gas development activities that would occur under Alternative C would be the same as those that would occur under Alternative B. However, the level or intensity of these development activities would increase under Alternative C. While the number of production pads and pump stations is expected to remain the same as in Alternative B, crude-oil-pipeline miles would increase by 15 for a total of 90 mi under Alternative C. This would slightly increase the probability of potential impact over Alternative B.

(4) Effects of Development Spills: These effects would be the same as those under Alternative B, although the probability of spills would be slightly increased.

Conclusion—First Sale: Under Alternative C, the probability of impacts to paleontological resources from management activities other than oil and gas exploration and development would be similar in nature but may be somewhat increased in magnitude over Alternative B. Under Alternative C, most of the impacts to paleontological resources would result from oil and gas exploration and development. When compared with Alternative B, the potential for impact to paleontological resources may range from similar to Alternative A to somewhat greater under Alternative C.

Multiple Sales: The potential impacts to paleontological resources under Alternative C could increase by as much as 20 percent compared to Alternative B.

Conclusion—Multiple Sales: Under Alternative C, potential impacts to paleontological resources from management activities other than oil and gas exploration and development would be similar in nature to Alternative B, but the probability of impacts occurring would increase. Under Alternative C, the potential impacts to

paleontological resources from oil and gas exploration and development would increase by roughly 20 percent compared to Alternative B.

Effectiveness of Stipulations: The effectiveness of stipulations would be the same as under Alternative B.

3. Water Resources:

a. Activities Other than Oil and Gas Exploration and Development: Ground-impacting-management actions within the planning area that may affect water resources under Alternative C would be similar to those in Alternative A, except that the number and frequency of camps and moves would increase slightly. The increase would depend on management actions in land, water, and resource monitoring as related to leasing activities. Because Alternative C provides less protection of surface resources than Alternative B, some of the areas adjacent to streams and lakes (Fish Creek drainage and deepwater lakes) identified as critical aquatic habitat would be available to leasing. Therefore, some of the additional camps and moves likely would be near these critical aquatic habitat areas.

b. Oil and Gas Exploration and Development Activities:

(1) Disturbance: Exploration and development activities within the planning area that may affect water resources under Alternative C would be similar to those in Alternative B, except that the number and frequency of these activities would increase slightly (Table IV.A.1.b-1). The increase would depend on the number of leases issued, the number of proposals for exploratory activity, and the locations of this activity. As noted previously (Sec. IV.D.3.a), some of the areas adjacent to streams and lakes identified as critical aquatic habitat would be available to leasing. Therefore, some of the additional exploration and development likely would be near these critical aquatic habitat areas. Annual water usage for oil and gas activities under Alternative C would vary depending upon the areas leased and number of exploration and developmental wells drilled. Tables III.A.2.a-4 and IV.C.3 estimate water availability and requirements for exploration and development. Stipulations limit drawdown to 15 percent of the under-ice water depth (Sec. II.C.7.b, Stipulation 20) in lakes with resident fish populations. The likelihood of exploration and development activities occurring in an area that contains more water resources and critical aquatic habitat areas than Alternative B increases the risk of melting permafrost, disrupting drainage patterns, increasing erosion and sedimentation, and removing water from riverine pools and lakes.

(2) Spills and Spill Cleanup: Under alternative C, the potential number and extent of oil spills and cleanup would increase from those under Alternative B (Sec. IV.A.2). Alternative C, because it includes more of the critical lake and river habitat than Alternative B, will have greater adverse effects on water resources as compared to Alternative B.

Conclusion—First Sale: The impacts of activities other than oil and gas exploration and development under Alternative C are expected to be similar to those under Alternative A (and similar to those under Alternative B). The potential long-term impacts (melting of permafrost and disrupting drainage patters) and short-term impacts (increasing erosion and sedimentation and removing water from riverine pools and lakes) of oil and gas exploration and development on the water resources in the planning area is expected to be greater for Alternative C than for Alternative B.

Multiple Sales: While the effects of oil and gas exploration and development from multiple lease sales may be up to several times greater than a single sale, impacts would not necessarily go up proportionally. Indirect impacts, such as thermokarst and erosion and sedimentation due to channel alteration or gravel removal may not occur until many years after the original development. Shared use of infrastructure such as airfields, roads, camps, and pipelines could significantly reduce the size of the impacted areas and adverse effects to the water resources. Where infrastructure is not shared, both long and short-term impacts, as noted above, as well as recovery times could increase.

Conclusion—Multiple Sales: Adverse impacts from multiple lease sales may be up to several times greater than a single sale, while indirect impacts may take years to develop. Shared infrastructure could reduce the adverse effects to water resources of multiple lease sales, because combined facilities require less water for construction, maintenance, and camp use than separate, independent facilities. Where infrastructure is not shared, both long and short-term impacts, and recovery times could increase.

Effectiveness of Stipulations: The stipulations that are effective in minimizing potential effects of the ground-impacting-management actions on the water resources in the planning area for Alternative C are the same as for Alternative B.

4. Water Quality:

a. Activities Other Than Oil and Gas Exploration and Development: As discussed under Alternative A, ground-impacting management actions other

than seismic operations and other oil and gas activities would not impact water quality.

b. Oil and Gas Exploration and Development Activities:

(1) Exploration: Exploration activities within the planning area that may affect water quality under Alternative C are 2-D and 3-D seismic activity beyond that described under Alternative A, ice-road construction, and ice-pad construction, as found for Alternative B. Under Alternative C, total acres with high damage to vegetation caused by seismic trails would be about 6 times that for Alternative A (see Sec. IV.D.6) and result in parallel 6-times-greater water degradation. Total miles of seismic trails and resulting water degradation would be about 6 times that for Alternative A. Water quality would be degraded over perhaps 1 to 2 acres.

For Alternative C, annual ice-pad and -road construction (45-370-acre footprint each year), drilling, and domestic (crew) needs for water could require winter pumping of unfrozen water from 17 to 130 acres of nearby lakes. Most of this water use would be for ice roads. Pad construction, drilling, and crew needs together would require water pumped from a 2- to 4-acre source. The areas affected would shift each year as the ice roads are realigned and shifted to avoid continued compaction of vegetation. Upslope impoundment of snowmelt waters by ice roads could occur briefly but would have no effect on water quality.

(2) Development: Development activities within the planning area that may affect water quality under Alternative C are ice-road and ice-pad construction and spills, as found for Alternative B.

Because of the continued need for ice roads, annual water use during development would be similar to that for exploration, with needed water for construction of 40 to 360 acres of ice-road withdrawn from 15- to 130-acres' worth of intermediate-depth lakes. During the seasonal construction phase, annual water demand would be on the order of 37 acre-feet for each field, requiring water sources equivalent to an additional 12 acres of lake for each field. After major construction is finished, annual water demand would decrease to about 15 acre-feet/year for each field, requiring about 5 to 10 acres of lake for water supply for all field(s). The areas affected would shift each year as the ice roads are realigned and shifted to avoid continued compaction of vegetation. Upslope impoundment of snowmelt waters by ice roads could occur briefly but would have no effect on water quality.

The primary water-quality effect from construction and placement of gravel structures is related to upslope impoundment and thermokarst erosion. Gravel construction of pads, within-field roads, and field air strip would cover about a 100-acre footprint per field, or a 100- to 200-acre total under Alternative C. In flat, thaw-lake plains on the North Slope, gravel construction can be anticipated to result in upslope water impoundment and thermokarst erosion equivalent to twice the area directly covered by gravel, or 200 to 400 acres. Unlike the situation for ice structures, the same locations would be affected by gravel structures each year over the life of the field(s). These locations, however, would not be within the area deferred under Alternative C.

Spills are another impacting agent on water quality. A number of small crude spills averaging 4 bbl and smaller fuel spills averaging 0.7 bbl are projected to occur under Alternative C. Only about 8 percent of crude spills can be reasonably expected to reach tundra waters. For Alternative C, this calculation results in an estimate of 1 to 7 spills, each averaging 4 bbl, reaching tundra waters. Over the life of the fields, spills could affect the water quality of one to seven ponds or small lakes, making their waters toxic to sensitive species for about 7 years. These spill locations, however, would not be within the area deferred under Alternative C.

For the purpose of analysis, the effects of a 325-bbl spill reaching the Colville River in summer also are analyzed. The high rate of waterflow would preclude any effects on dissolved oxygen concentrations. Direct toxicity in the water column would be minimal and limited to the first few reservoir pools downcurrent of where the spill entered the river. Some toxicity might persist in these initial reservoir pools for a few days to weeks, until toxic compounds were washed out of the oil trapped in the sediment or the oiled sediment was buried under cleaner sediment.

A similar spill reaching Teshekpuk Lake also would result in a minimal effect on water quality. Dissolved oxygen levels would not be affected. Direct toxicity would be minimal because of the much greater dilution volume in Teshekpuk Lake than in the small ponds and lakes discussed earlier and because of the relatively unrestricted movement of slick and underlying water. The spreading of the spill over about 60 acres (0.03% of the lake surface) could be considered an effect on water quality. This effect would exist for less than a summer, until the slick was either cleaned up or the oil stranded on the shoreline.

At the level of activity estimated in Alternative C, it is unlikely but possible for a spill to enter the marine environment. A most likely number of zero spills ≥1,000 bbl along the TAPS tanker route is projected for this alternative.

Major crude oil spills generally result in peak dissolved hydrocarbon concentrations that are only locally and marginally at toxic levels—parts per million or more. A spill ≥1,000 bbl could temporarily, about a month, contaminate water over a few hundreds of square miles above the chronic criterion of 0.015 ppm. Concentrations above the 1.5-ppm-acute criterion may occur over a few tens of square miles during the first several days of such a spill.

However, such a spill is unlikely under this alternative and marine water quality is not anticipated to be affected by spillage of NPR-A crude.

Conclusion—First Sale: Effects under Alternative C are similar to those in Alternative B for oil and gas activities, and similar to those for Alternative A for activities other than oil and gas. Water quality over a few hundred acres could be affected by construction or placement of ice or gravel roads, and other structures. Oil spills could result in waters of up to seven ponds or small lakes remaining toxic to sensitive species for about 7 years. Water quality could be degraded over a few weeks along a short stretch of the Colville from a 325-bbl spill. The spreading of a similar-sized spill over about 60 acres of Teshekpuk Lake (0.03% of the lake surface) for a few weeks could be considered an effect on water quality.

Multiple Sales: During peak exploration, annual ice-pad and -road construction (45-370-acre footprint each year), drilling, and domestic (crew) needs for water could require winter pumping of unfrozen water from 19 to 170 acres of nearby lakes. Most of this water use would be for ice roads. Pad construction, drilling, and crew needs together would require water use equivalent to 4 to 6 acres of lake.

Because of the continued need for ice roads, annual water use during development for ice-road construction would be similar to that for exploration, requiring extraction of water from 19 to 179 acres of intermediate-depth lakes. During the seasonal construction phase, annual water demand would be on the order of 37 acre-feet for each field, requiring water from an additional 12 acres of lake for each field. After major construction is finished, annual water demand would decrease to about 15 acre-feet/year for each field, requiring up to 15 acres of lake for water supply for all fields. Temporary up-slope impoundment of snowmelt waters by ice roads could cover another 40 acres.

The primary water-quality effect from construction and placement of gravel structures is related to upslope impoundment and thermokarst erosion. Gravel construction of pads, within-field roads, and field airstrip would cover about a 100-acre footprint per field, or a 100- to 300-acre total. In flat thaw-lake plains on the North Slope, gravel construction can be anticipated to result in upslope water impoundment and thermokarst erosion equivalent to twice the area directly covered by gravel, or up to 600 acres. Unlike the situation for ice structures, the same locations would be affected by gravel structures each year over the life of the fields.

Over the life of development resulting from multiple sales, spills could degrade water quality of up to nine ponds or small lakes, with resultant toxicity persisting and eliminating sensitive species in their waters for about 7 years. Water quality could be degraded over a few weeks along a short stretch of the Colville from a 325-bbl spill. The spreading of a similar-sized spill over about 60 acres of Teshekpuk Lake (0.03% of the lake surface) for a few weeks could be considered an effect on water quality.

Conclusion—Multiple Sales: Longer-term (decade-or-more) effects of multiple sales would be slightly greater than for a single sale. Oil spills could result in waters of up to nine ponds or small lakes remaining toxic to sensitive species for about 7 years. Water quality could be degraded over a few weeks along a short stretch of the Colville from a 325-bbl spill. The spreading of a similar-sized spill over about 60 acres of Teshekpuk Lake (0.03% of the lake surface) for a few weeks could be considered an effect on water quality.

Effectiveness of Stipulations: Effectiveness of stipulations is similar to that under Alternative B.

5. Air Quality:

a. Activities Other than Oil and Gas Exploration and Development:

The ground-impacting-management activities that would affect air quality under Alternative C would be the same as those under Alternative A. The impacts of these activities would be the same as those under Alternative A.

b. Oil and Gas Exploration and Development Activities:

(1) Effects of Exploration: Exploration activities within the planning area that may affect air quality under Alternative C are drilling and pad construction, the same as for Alternative B. For Alternative C, the number of exploratory wells drilled per year would be the same as for Alternative B.

(2) Effects of Development: Development activities within the planning area that may affect air quality under Alternative C are drilling, facility and pipeline construction, and production, the same as Alternative B. Total number of wells drilled for Alternative C would be approximately one-quarter more that alternative B. Total emissions from these activities

would be limited through permits obtained from the State of Alaska to less than the Clean Air Act standards.

Conclusion—First Sale: The impacts of oil and gas activities under Alternate C would be similar to those under Alternative B. Annually, air quality would be affected by drilling and construction activities at levels less than the PSD criteria. Effects of activities other than oil and gas are negligible, as in Alternative A.

Multiple Sales: The effects on air quality from multiple sales should result in air emissions that remain below the maximum allowable PSD Class II increments. The concentrations of criteria pollutants in the ambient air would remain well within the air-quality standards. Consequently, a minimal effect on air quality with respect to standards is expected.

Conclusion—Multiple Sales: Activities associated with multiple sales would result in sequential effects which would remain small and localized. Concentrations would remain within the PSD Class II limits and effects would remain low.

Effectiveness of Stipulations: Current laws and regulations are assumed to be in place for the analysis of the IAP, and effects levels reflect this assumption.

6. Vegetation: Ground-impacting-management actions within the planning area that may affect vegetation under Alternative C include those analyzed under Alternative A and those resulting from oil exploration and development analyzed under Alternative B. The impacts of management actions described under Alternative A would be similar under Alternative C, except that the total areal extent of archaeological/paleontological excavations may increase to 4 acres per year and seismic survey activity would increase (see below).

a. Exploration: Impacts of exploratory drilling under Alternative C would be of the same type as under Alternative B, but there might be 4 to 15 wells drilled rather than 1 to 10. This scenario could result in the death of vegetation on the perimeters of oversummer ice pads of 0.1 to 0.3 acres of vegetation spread among 2 to 8 different sites. Construction of well collars would cause the destruction of vegetation on 0.02 to 0.09 acres.

The type of impacts of seismic exploration would remain the same as under Alternative B. It is assumed that the number of 2-D surveys would remain the same at one per winter, but that this frequency would continue for 15 years rather than 10 before decreasing to alternate winters. Because the tundra can recover from about 90 percent of these impacts in 9 years, it is expected that this change would result in little increase in area affected at any one point in time. It also is assumed that the number of 3-D surveys would increase from 0 to 2 over 5 years to 1 to 3 over 10 years. This would result in 46,000 to 138,000 acres impacted by 3-D surveys.

b. Development: The impacts of development would be of the same type under Alternatives B and C. It is assumed the number of pump stations would remain 0 to 1, but the number of s developed might increase to 1-2 from 0-1, with a proportional increase in the extent of area impacted. The gravel pads of these oil fields would bury 100 to 200 acres of vegetation. Dust effects would cover 36 to 72 acres and the effects of a changing moisture regime might affect 200 to 400 acres. Material sites would cause the destruction of 40 to 80 acres, with moisture-regime changes around them affecting another 20 to 40 acres. Pipeline miles would increase, causing impacts to vegetation to increase to 0.5 to 3.0 acres (or more, if any portion of a pipeline would be buried). The occurrence of oil spills would increase, affecting 0.5 to 3.0 acres, and the probability of a seawater pipeline spill would also increase.

Conclusion—First Sale: Impacts to vegetation from activities other than oil exploration and development under Alternative C would be the same as those under Alternative A, except that the effects of archaeological excavation might increase from 1 to 4 acres. The impacts of oil exploration and development would be of the same types as for Alternative B but greater in areal extent. The maximum acreage affected by 3-D seismic surveys would increase from 0 to 92,000 acres to 46,000 to 138,000 acres. The combined effect of development activities would cause the destruction of vegetation on 140 to 320 acres rather than 0 to 180 acres and the alteration in plant species composition of another 220 to 500 acres instead of 0 to 280 acres, for a total of effects over 360 to 820 acres rather than 0 to 460 acres. Finally, the occurrence of oil spills would increase, affecting 0.5 to 3.0 acres instead of 0.5 to 2.6 acres, but the probability of a blowout would remain low.

Multiple Sales: Additional lease sales under Alternative C would result in additional exploration activities and a total of 1 to 3 s being developed. More acreage would be impacted by seismic surveys, but it would be over a longer period of time. Recovery from at least 90 percent of the impacts from the earliest surveys is expected to be complete before additional seismic operations would commence as a result of multiple sales. The total number of exploratory wells is assumed to increase to 6-18 from 2-6, and delineation wells to 2-15 from 2-9, for a total of 8 to 33 wells drilled from ice pads. Vegetation destruction from well collars would increase to affect 0.05 to 0.2 acres, and vegetation death around ice-pad perimeters would increase to 0.2 to 0.8 acres. Tundra would recover from the latter in 1 to a few years.

With the assumption of 1 to 3 s developed, the vegetation that might be destroyed by burial under gravel fill would increase to 100 to 300 acres. The area of vegetation around gravel pads that would undergo change from dust or moisture regime impacts would be 200 to 600 acres. The impacts of developing material sites would increase correspondingly to the number of s. This would mean the destruction of vegetation on 40 to 120 acres and effects of moisture-regime changes on 20 to 60 acres. It is assumed that the number of pump stations would remain at 0 to 1, resulting in the burial of 0 to 40 acres and dust- or moisture-regime changes on an additional 0 to 60 acres. The number of pipeline miles would increase somewhat under multiple sales, with a total of 15 to 120 mi, resulting in the destruction or alteration of a total of 0.5 to 3.6 acres (or more, if any portion of a pipeline would be buried). The incidence of oil spills also would increase, affecting 0.8 to 4.2 acres of vegetation.

Conclusion—Multiple Sales: The impacts of oil exploration would include more vegetation disturbance from seismic work than under a single-sale scenario, but the extended period of time over which it would occur, coupled with the recovery time for disturbed areas, would result in a small increase in the amount of disturbance that would be evident at any one time. Exploration activities also would result in 0.05 to 0.2 acres of permanent vegetation destruction around well collars and alteration of 0.2 to 0.8 acres around ice pads. The activities of development that would impact vegetation include construction of gravel pads, roads, and airstrips for each ; potential construction of one pump station within the planning area; excavation of material sites; and construction of pipelines. The combined effect of these activities would cause the destruction of vegetation on 140 to 460 acres and the alteration in plant species composition of another 220 to 720 acres, for a total of effects over 360 to 1,180 acres. The duration of these impacts would be permanent, assuming that the gravel pads would remain after oil production ends, and recovery thus would be moot. Oil spills would affect 0.8 to 4.2 acres of vegetation within the planning area. Recovery from spills would take a few years to two decades. The probability of a blowout would remain low.

Effectiveness of Stipulations: Effectiveness of stipulations would remain the same as under Alternative B: there are no stipulations beyond existing management practices that could reduce the above impacts to vegetation.

7. Fish:

a. Activities Other Than Oil and Gas Exploration and Development: Actions associated with Alternative C that may affect fish include the establishment of large work camps at pre-existing airstrips; small scientific excavations for paleontological, geologic, and soils-related information; the sport harvest of fish by workers; and those associated with fuel spills at fuel-storage sites. The establishment of work camps, scientific excavations, and the sport harvest of fish are not expected to have a measurable adverse effect on arctic fish populations. Fuel spills at fuel-storage sites may adversely affect arctic fish populations.

b. Oil and Gas Exploration and Development Activities: Alternative C also involves several management actions associated with oil and gas development. These include seismic surveys; the construction of gravel drill pads, roads, airstrips, and pipelines; and oil spills (drill pad, pipeline, and supply barge). The individual effects of these actions and the chemical agents associated with them have been discussed in previous Beaufort Sea EIS's (e.g., USDOI, MMS, 1996a), which are incorporated here by reference. The remainder of this analysis focuses on differences in the amount of exposure arctic fish are likely to have to each of these actions in Alternative C as compared to Alternative B. More of the planning area is exposed to oil and gas development in Alternative C (72%) than in Alternative B (53%). This additional area supports a greater number and diversity of fish than the fish-bearing waters of Alternative B. These differences increase the probable number of oil- and gas-related activities, the probability of their affecting arctic fish populations (roughly 2-3 times higher), and the probable overall effect of Alternative C on fish over that of Alternative B.

(1) Effects of Disturbance:

(a) Effects from Seismic Surveys: Arctic fish are likely to be adversely affected by seismic surveys located above overwintering areas. Likely effects would include avoidance behavior and short-term added stress but also could result in the death of some of the more sensitive lifestages (e.g., juveniles). However, the effect on most overwintering fish is expected to consist of only short-term, sublethal effects. While Alternative C is likely to involve more seismic surveys than Alternative A and thereby would increase the probability of seismic activity occurring above overwintering habitat, such events are likely to be infrequent. Hence, seismic surveys associated with Alternative C are expected to have the same overall effect on fish as discussed for Alternative A (i.e., no measurable effect on arctic fish populations). While Alternative C is likely to involve more fuel spills than Alternative A, the amount of fuel entering fish habitat is not expected to increase significantly. Hence, fuel spills associated with Alternative C are expected to have the same overall effect on fish as discussed for Alternative A (i.e., no measurable effect on arctic fish populations).

(b) Effects from Construction:
Construction-related activities that may affect arctic fish include the construction of drill pads, roads, airstrips, pipelines; and possibly gravel extraction. The individual effects of these activities for Alternative C are expected to be the same as discussed for Alternative B and are summarized below. However, the likelihood of the above construction-related activities occurring and affecting fish habitat is roughly two to three times greater in Alternative C than in Alternative B. Depending on the specific level and location of implementation, this could result in a corresponding increase in the overall effect of these activities in Alternative C over that of Alternative B.

Construction during exploration would involve freshwater withdrawals for the construction of ice drill pads, roads, and airstrips. Ice roads or airstrips constructed through overwintering areas <10 ft deep would freeze to the bottom and form a barrier to water circulation, resulting in reduced levels of dissolved oxygen. This could have lethal effects on the fish affected by the barrier. The construction of ice roads and airstrips in nonoverwintering areas is expected to have no measurable effect on arctic fish. Freshwater withdrawals may adversely affect fish, if the water is taken from areas where they are overwintering. Under-ice withdrawals from areas having water and dissolved-oxygen levels barely to moderately sufficient to support to overwintering fish would be likely to kill many of the fish overwintering there. The recovery of affected fish populations would be expected in 5 to 10 years. However, withdrawals from freshwater sources that do not support resident fish populations, or from areas having sufficient under-ice reserves of water and dissolved oxygen, are not likely to adversely affect overwintering fish.

Construction during production would involve the construction of gravel drill pads, roads, and airstrips. The effects of gravel construction and gravel extraction activities in high density spawning and overwintering habitat, or in access corridors used by migratory fish, are expected to be spawning failure and mortality for many of the fish affected (an estimated 10-year recovery). No measurable effects on arctic fish populations are expected in low-density areas. The same applies to gravel extraction activities that might occur outside of the planning area. The effects of pipeline trenching through overwintering or spawning habitat are likely to be spawning failure and/or mortality of many fish, and a 5 to 10-year recovery period. Trenching that avoids these habitats is not expected to adversely affect fish. The difference in the estimated number of pipeline miles (up to 75 mi for Alternative B and up to 90 mi for Alternative C) is not expected to make a measurable difference in effects on arctic fish in Alternative C. Alternative C may also involve the construction of a coastal docking facility to offload supply barges into the planning area. The effect of a docking facility on arctic fish would depend on its location, size, and design characteristics. The construction of a large docking facility in offshore waters, requiring a long access road, could adversely affect the movement of some coastal marine and migratory fish. However, the construction of a facility that provides for the movement of these fish is not likely to adversely affect them. Because supply barges are shallow draft vessels, the docking facility for Alternative C is expected to be constructed in shallow nearshore waters. Additionally, the size of the facility for Alternative C is expected to be relatively small (up to several hundred feet), and to provide for the movement of coastal fish. Hence, the construction of a coastal docking facility associated with Alternative C is not expected to have a measurable effect on arctic fish.

(2) Effects of Spills: The individual effects of oil on fish for Alternative C are the same as discussed for Alternatives A and B. As discussed therein, lethal effects on fish due to a petroleum-related spill are seldom observed outside the laboratory environment. Sublethal effects are more likely and include changes in growth, feeding, fecundity, and survival rates and temporary displacement. Other possibilities include interference with movements to feeding, overwintering, or spawning areas; localized reduction in food resources; and consumption of contaminated prey. The specific effect of oil on fish generally depends on the concentration of petroleum present, the time of exposure, and the stage of fish development involved (eggs, larva, and juveniles are most sensitive). The oil-spill assessment estimates that the amount of oil spilled during the life of the field would be 328 bbl for Alternative C and 280 bbl for Alternative B. However, neither this difference nor the fact that oil- and gas-related activities are estimated to be two to three times more likely to affect fish in Alternative C are expected to alter the overall effect of oil spills on arctic fish. Hence, oil spills associated with Alternative C are expected to have the same overall effect on arctic fish as discussed for Alternative B (no measurable effects on arctic fish populations in the planning area over the production life of the field). The effects of a seawater pipeline spill on arctic fish populations are expected to be similar to that of Alternative B (no measurable effects on arctic fish populations in the planning area over the production life of the field).

Conclusion—First Sale: The effect of fuel spills on arctic fish populations in Alternative C are expected to be similar to Alternative A. The individual effects of seismic surveys, construction related activities, and oil and seawater spills are expected to be similar to that of Alternative B. However, the likelihood of their occurrence is estimated to be roughly two to three times higher for Alternative C than for Alternative B. Depending on the actual level and location of implementation, this could result in a

corresponding increase in the overall effect of these activities on arctic fish populations in Alternative C over that of Alternative B.

Multiple Sales: The actions most likely to affect arctic fish for the first lease sale have been discussed herein and include seismic surveys, construction related activities, fuel spills, and oil spills. While additional northeastern NPR-A lease sales would involve more seismic surveys than the first sale, and thereby would increase the probability of seismic activity occurring above overwintering habitat, such events are likely to be infrequent. Seismic surveys associated with multiple sales in Alternative C are expected to have the same overall effect on fish as discussed for the first sale (i.e., no measurable effect on arctic fish populations). For additional northeastern NPR-A lease sales that may occur in the future, the number of production pads and pipeline miles have been estimated (Table IV.A.1.b-7). That table estimates that there would be about twice the number of gravel pads as the first sale (Table IV.A.1.b-6). On the basis of this estimate, gravel pads for multiple sales are likely to have about twice the effect on arctic fish as the first sale. Because there is little difference in the estimated number of pipeline miles for multiple sales (up to 105) and the first sale (up to 90), they are expected to have a similar effect as discussed for the first sale. It is estimated that up to 460 bbl of crude oil would be spilled for multiple sales, or about 1.4 times that of the first sale (estimated at up to 328 bbl). On the basis of this estimate, crude oil spills for multiple sales are expected to have a slightly greater effect on arctic fish than the first sale. However, if there were not enough time between sales to allow for full recovery, or if the level of activity of the selected alternatives were significantly greater than that of the first sale, the effect of each additional sale on arctic fish populations is likely to be greater than estimated herein for multiple sales.

Conclusion—Multiple Sales: Seismic surveys and pipelines associated with multiple sales are expected to have the same overall effect on arctic fish as the first sale. Gravel pads are expected to have about twice the effect as the first sale. Fuel and oil spills are likely to have a greater effect on arctic fish populations than the first sale. Insufficient recovery time between sales and/or greater levels of activity would be likely to result in greater effects than estimated herein for multiple sales.

Effectiveness of Stipulations: The stipulations having the most beneficial effect on arctic fish are the same as discussed for Alternative B.

8. Birds: This section discusses potentially adverse effects of ground-impacting-management actions on nonendangered birds within the planning area under Alternative C. Such actions potentially may result in disturbance factors, habitat alteration or loss, and fuel or oil spills. Effects on birds exposed to such factors would be similar to those discussed under Alternative B.

a. Activities Other than Oil and Gas Exploration and Development: Management actions other than oil and gas exploration and development under Alternative C, and their potential effects, differ from Alternative A approximately as discussed under Alternative B, differing from B primarily in that the Colville River would be recommended for inclusion as a "scenic" river in the WSR System rather than a "wild" river in Alternative B. These differ as follows: (1) mineral leases are allowed in the river corridor; (2) new roads/trails/bridges could be constructed in the river corridor and be more conspicuous, and prohibitions on motorized travel may be less likely; and (3) major public facilities are allowed within the river corridor. These specifications could enhance raptor and passerine habitat protection and potentially decrease the level of noise and visual disturbance of nesting birds in comparison to Alternative A but is expected to allow greater levels of habitat degradation and disturbance than Alternative B. Without stipulations to assure avoidance of important habitat areas, raptor nesting success and passerine populations in developed areas of the river corridor could decline under this classification in comparison to Alternative B.

b. Oil and Gas Exploration and Development Activities: Oil and gas leasing would be allowed on most (approximately 72%) of the planning area (Fig. II.C.1-3; Table IV.A-1), except in the Goose Molting Habitat and Teshekpuk Lake Caribou Habitat LUEA's. Exploration and development activity under Alternative C will be slightly greater than under Alternative B, with 3 to 5 additional exploratory and delineation wells drilled (4-15 versus 1-10), 1 additional production pad, and 10-15 additional miles of pipeline (Tables IV.A.1.b-5-7). Additional drilling would prolong the period during which disturbance and habitat unavailability would occur over one to two winter seasons. Gravel mining outside the planning area is assumed to occur in the Nuiqsut area and be transported to site on ice roads during winter. This activity could cause minor local disturbance and temporary displacement of the three resident species along the road route and at the mine site. During the breeding season, nesting individuals would be displaced to undisturbed habitats with potential for lowered productivity. An additional production pad would displace any nesting birds from 60 to 110 acres for the duration of production, and additional pipeline would result in a negligible increase in disturbance during monitoring flights. The additional acreage leased could result in potential exposure of additional areas of concentration for some waterbird or raptor species.

If a 325-bbl crude-oil spill entered Teshekpuk Lake, small numbers of waterfowl and/or raptors could be exposed. Numbers of individuals oiled would depend primarily upon wind conditions, and numbers and location of birds following entry of the spill into the lake. If the spill entered the Colville River, a variety of waterfowl could be present. Canada geese breed on bluffs along the river. Gyrfalcons, peregrine falcons, and rough-legged hawks could become secondarily oiled by preying on oiled birds. If the spill moved into the delta area additional waterfowl species that breed there or stop during migration would be at risk. A spill entering the river in spring could contaminate overflow areas or open water, where spring migrants of several waterfowl species concentrate prior to occupying nesting areas. None of these differences are expected to result in significantly greater effects on bird populations than those discussed for Alternative B.

Slightly more coastal area would be available for oil and gas leasing under this alternative than for Alternative B. An oil spill at a well within 2 mi of the coast is expected to have similar effects as other onshore spills discussed above. Effects are likely to be more severe if the oil enters aquatic habitats. Because of the oil-absorptive capacity of tundra habitats and the distance from the coast, it is not likely that the spill would enter the marine environment.

It is assumed for Alternative C that a crude-oil spill from an offshore site would occur. The spill could contact loons and flocks of brant, oldsquaw, and/or eiders staging in protected coastal habitats (e.g., Harrison Bay) or waters farther offshore. Effects on individual birds would be the same as described for Alternative B. Lethal effects are expected to result from moderate to heavy oiling of any birds contacted. Light to moderate exposure could reduce future reproductive success as a result of pathological effects caused by oil ingested by adults during preening or feeding that interfere with the reproductive process. Some broodrearing, molting, or staging brant, Canada geese, and snow geese could contact oil in coastal habitats. Mortality of molting oldsquaw from a spill entering protected areas could be substantial, but the population effect would be difficult to determine because numbers are stable in some areas, declining in others (Conant, 1997). Large flocks of staging eiders could contact oil in areas farther offshore. The king eider population has declined 50 percent in 20 years, so substantial mortality could be significant. Common eiders, nesting on barrier islands and along the coastal, could be contacted by a marine spill. Also, several thousand shorebirds could encounter oil in shoreline habitats (e.g., Colville River Delta), and the rapid turnover of migrants during the migration period suggests many more could be exposed. A spill that enters open water off river deltas in spring, or nearshore areas in fall, could contact migrant loons and eiders.

A pipeline spill of seawater used in waterflood enhancement of production would kill salt-intolerant tundra vegetation near the pipeline. The amount of tundra habitat affected is expected to be no more than a few acres; this small area of degraded habitat is not likely to result in loss of productivity by displaced breeders that is detectable at the population level.

Conclusions: Effects of actions other than oil and gas activity under Alternative C are expected to be essentially the same as for Alternative B, except in the Colville River corridor, where increased activity would result in greater effects. Effects of oil and gas activity are not expected to be significantly different than discussed for Alternative B.

As a result of their small average size, onshore oil spills reaching aquatic habitats are expected to cause losses of tens of individuals, but the effect of such losses may not be detectable above the natural fluctuations of the population. A crude-oil spill from an offshore site in the marine environment during August or September could contact loons and flocks of brant, oldsquaw, and/or eiders staging in protected coastal habitats or waters farther offshore. Some broodrearing, molting, or staging brant, Canada geese, snow geese, oldsquaw, king eiders, and common eiders could be contacted in coastal habitats. Mortality of molting oldsquaw could be substantial, but the effect would be difficult to determine because of an uncertain population status. Because of an apparently declining population, substantial king eider mortality could be significant. Also, several thousand shorebirds could encounter oil in shoreline habitats. A spill that enters open water off river deltas in spring, or nearshore areas in fall, could contact migrant loons and eiders.

Multiple Sales: If multiple sales occur in the area available for leasing under Alternative C, intensive construction activity could last 15 to 30 years, tapering off as existing infrastructure is used for each succeeding development. Approximately twice the number of exploration and delineation wells may be drilled (8-33 versus 4-15), and the number of fields developed (1-3 versus 1-2) and production pads (1-5 versus 1-2) are expected to double with multiple sales (Tables IV.A.1.b-4-7). Pipeline miles (10-90 mi) are expected to increase to 10 to 105 mi. Surface, air, and foot traffic is expected to increase somewhat in some areas, if facilities associated with multiple sales are grouped in high-resource-interest areas; if these coincide with high-bird-concentration areas, greater numbers of individuals are expected to be displaced and more species involved than with a single sale. Such increases may cause some changes in planning area population levels. Effects from disturbance and habitat alteration or loss on birds is expected to increase in the southern three-quarters of the planning area with multiple sales under Alternative C.

The estimated number of onshore oil spills >1 bbl is expected to increase to 5-28 for multiple sales from 4-21 for the first sale (Tables IV.A.2-3a-3b); this slight increase in spills is expected to cause a slightly greater loss of individuals and number of species involved. An increase in small, refined-oil spills to 51-269 spills for multiple sales from 35-190 spills for the first sale (average size of 29 gal) is expected over the production life of the planning area (Tables IV.A.2-6a-6b). Although these small, chronic spills generally are contained and cleaned up on pads and roads, a slight increase in their occurrence is expected to have a similar slight effect on birds and their habitats as the first sale under Alternative C. Habitat contamination is expected to increase locally at the spill sites and along any streams contaminated by these spills. Any habitat contamination that is not effectively cleaned up is expected to persist for several years but is not expected to affect populations significantly. These spills are expected to result in the loss of only small numbers of birds. Recovery of cumulative lost productivity and recruitment is expected within 1 year.

Conclusion—Multiple Sales: Displacement of birds from disturbance and habitat alteration is expected to increase over the southern three-quarters of the planning area under Alternative C with multiple sales, but not significantly affect planning area populations. Increases in oil and refined oil spills are expected to result in the loss of small numbers of birds that is not likely to be detectable above the natural fluctuations of the population and survey methods/data available. Overall effect is expected to increase somewhat from that discussed for the first sale.

Effectiveness of Stipulations: Effectiveness of stipulations under Alternative C is expected to be essentially the same as described under Alternatives A and B.

9. Mammals:

a. Terrestrial Mammals: Among the terrestrial-mammal populations that could be affected under Alternative C are TLH and CAH caribou. Moose, muskoxen, grizzly bears, wolves, wolverines, and arctic foxes may be locally affected by planning-area activities.

(1) Activities Other than Oil and Gas Exploration and Development: The level of activities such as resource inventories, aerial surveys, and research camps is expected to increase somewhat under Alternative C compared to Alternative A, but the level of effect is expected to be about the same.

(2) Oil and Gas Exploration and Development Activities: Under Alternative C, one to two oil fields are assumed to be discovered and developed. Primary effects on terrestrial mammals would come from motor-vehicle traffic within the oil field(s). Other effects could come from foot traffic near facilities and camps; from aircraft traffic; from seismic operations; from small, chronic crude-oil and fuel spills contaminating tundra, stream, and coastal habitats; and from habitat alteration associated with gravel mining and construction. (See Alternative B, Sec. IV.C.9.a, for a discussion of general effects of disturbance and spills.) The planning area is divided into thirds—northern (including Teshekpuk Lake and the Beaufort coast), middle (the area generally west and southwest of Nuiqsut), and southern. Under Alternative C, the middle and southern areas would be available for leasing and development (Fig. II.C.1-3).

(a) Effects of Disturbance: If a field is developed in the middle planning area west and southwest of Nuiqsut, production pads, pipelines, within-field roads, and other facilities (housing, airfield, processing plant) would be located far to the south of the TLH calving area. Little or no effect on caribou movements within the calving range is expected, and no TLH calving is expected to be displaced. Some TLH migration movements may be adversely affected by air and surface traffic along pipelines and roads within the oil field(s).

If a field is developed in the southern planning area, some members of the CAH, WAH, and TLH would encounter the field during their fall migration route and within a portion of their winter range. However, neither the pipeline to TAP nor facilities within the oil field would be expected to significantly affect the movement of caribou or alter their distribution or abundance.

A pipeline from the oil field(s) would connect to the TAPS through facilities at the Alpine and Kuparuk River fields. The pipeline would be constructed during winter using ice roads, so that no permanent road would be associated with the pipeline. During construction, air traffic would include several flights per day, which temporarily could disturb some of the caribou of the TLH and CAH and other terrestrial mammals within about 1.2 mi (2 km) of the pipeline. Disturbance effects on caribou and other terrestrial mammals are expected to be short term, interference with mammal movements would be temporary (probably a few minutes to less than a few days), and the mammals eventually would cross the pipeline area. Additionally, disturbance reactions would diminish after construction, and flights would decrease to about one or two per day at most. The abundance and overall distribution of terrestrial mammals are not expected to be affected by pipeline construction or operation. Trenching for and burial of pipelines at river crossings would have very local, effects on tundra and riparian vegetation and wouldn't significantly affect terrestrial mammal habitats.

Gravel extraction (outside of the planning area), hauling of the gravel on ice roads (into the planning area), and deposition of gravel in the lease areas would result in local disturbance-displacement (within no more than 1 mi of the operations) of small numbers of individual mammals but would not affect the distribution and abundance of caribou, muskoxen, moose, or other terrestrial mammals.

Under Alternative C, some terrestrial mammals could be affected by possible oil exploration offshore from an ice island and subsequent oil development on the coast of the NPR-A in Harrison Bay in a small area south of Atigaru Point (Figure II.C.1-3). Effects of these activities would be local and are not likely to affect terrestrial mammal populations.

(b) Effects of Spills: For general information on the effects of oil spills on terrestrial mammals, please see the discussion under Alternative B (Sec. IV.C.9.a). Chronic crude-oil and fuel spills from onshore activities including a potential oil spill contacting Teshekpuk Lake or the Colville River and possible marine transportation spill probably would result in the loss of small numbers of terrestrial mammals. Under Alternative C, approximately 4 to 21 small (>1 bbl) crude-oil spills (averaging 4 bbl) and 35 to 190 small refined-oil spills (averaging 29 gal) are assumed to occur onshore over the production life of the planning area (Tables IV.A.2-2 and 2-6). These small, chronic spills are expected to have about the same effect on terrestrial mammals and their habitats as under Alternative B.

If seawater were used for waterflood enhancement of oil production under Alternative C, a saltwater spill could occur within the NPR-A. This spill would have adverse effects on salt- intolerant vegetation near the pipeline but the amount tundra habitat affected would be small, no more than a few acres. This potential saltwater spill is not likely to affect forage availability of caribou, muskoxen, moose, or other terrestrial mammals in the planning area.

Conclusion—First Sale: For activities other than oil and gas, the effects of Alternative C are expected to be similar to those of Alternative A. For oil and gas activities, effects of Alternative C are expected to be somewhat greater than those of Alternative B. Increased habitat alteration would include the development of one or two oil fields and a pipeline to the TAPS. Some CAH and TLH caribou are expected to be disturbed and their movements delayed along the pipeline during periods of air traffic, but these disturbances are not expected to affect caribou migrations and overall distribution. Near the oil fields, surface, air, and foot traffic is expected to increase and to displace some terrestrial mammals but not significantly affect Arctic Slope populations. The number of small, chronic crude-oil and fuel spills, including a potential oil spill contacting Teshekpuk Lake or the Colville River, are expected to result in the loss of small numbers of terrestrial mammals, with recovery expected within 1 year. Trenching for and burial of pipelines at river crossings would have very local effects on tundra and riparian vegetation and would not significantly affect terrestrial mammal habitats. Under Alternative C, some terrestrial mammals could be affected by possible oil exploration offshore from an ice island and subsequent oil development on the coast of the NPR-A in Harrison Bay in a small area south of Atigaru Point (Figure II.C.1-3). Effects of these activities would be local and are not likely to affect terrestrial mammal populations.

Multiple Sales: If several lease sales occur under Alternative C, considerably more exploration activity is expected to occur in the southern half of the planning area, with the number of exploration wells drilled increasing to 6-18 for multiple sales from the 2-6 wells for the first sale. The amount of development also is expected to increase. The number of oil fields would increase to 1-3 for multiple sales from the 1-2 fields for the first sale, the number of production pads would increase to 1-5 for multiple sales from the 1-2 pads for the first sale, and pipeline miles would increase to 10-105 mi for multiple sales from the 10-90 mi for the first sale. The level of effects on caribou and other terrestrial mammals, including noise, disturbance, and habitat alteration, is expected to increase somewhat, primarily in the southern half of the planning area. Surface, air, and foot traffic near the oil fields is expected to increase and to displace some terrestrial mammals but not significantly affect Arctic Slope populations.

Under Alternative C, the number of small crude-oil spills (>1 bbl) is expected to increase to 5-228 spills (average size of 4 bbl) for multiple sales from an estimated 4 to 21 for the first sale, Small fuel-oil spills would increase to 51-269 spills for multiple sales from a total of 35-190 (average size of 29 gal) for the first sale. The small crude- and fuel-oil spills are estimated to occur onshore over the production life of the planning area (Tables IV.A.2-3a, 3b, 6a, and 6b). These small, chronic spills are expected to have about the same effect on terrestrial mammals and their habitats as those under Alternative B with one sale, but with a loss of individual mammals to the spills and habitat contamination increasing locally at the spill sites and along any streams contaminated by these spills. These spills are expected to result in the loss of small numbers of terrestrial mammals, with recovery expected within 1 year. Any habitat contamination that is not effectively cleaned up is expected to persist for several years but is not expected to affect terrestrial mammal populations.

Conclusion—Multiple Sales: Effects of oil and gas activities under multiple sales are expected to be somewhat greater than those of Alternative C under the first sale. Surface, air, and foot traffic near the oil fields is expected

to increase and to displace some terrestrial mammals but not significantly affect Arctic Slope populations. The number of small, chronic crude-oil and fuel spills is expected to increase somewhat and result in the loss of small numbers of terrestrial mammals, with recovery expected within 1 year.

Effectiveness of Stipulations: Effectiveness of stipulations under Alternative C are expected to be essentially the same as described under Alternative A. No long-term oil and gas surface occupancy would be allowed within the Pik Dunes LUEA, an area available to leasing under Alternative C and used in summer by some TLH caribou for insect relief. This stipulation could reduce potential disturbance of some TLH, caribou.

b. Marine Mammals:

(1) Activities Other than Oil and Gas Exploration and Development: Effects under Alternative C would be similar to those for Alternative A—local and short term, with no significant adverse effects to the populations as a whole.

(2) Oil and Gas Exploration and Development Activities: Effects under Alternative C are expected to be essentially the same as those for Alternative B. Some potential noise and disturbance effects could occur along the coast, primarily in the Colville River Delta-inner Harrison Bay area, and these effects are expected to be local and short term (generally <1 year). Small onshore crude- and fuel-oil spills associated with Alternative C are not expected to reach the marine environment and affect marine mammals. However, a small number of seals and no more than a few polar bears might be adversely affected or killed by a 325-bbl crude-oil spill contacting the Colville River and some of the oil reaching marine waters, but these losses would not be significant to marine mammal populations.

Under Alternative C, seals and polar bears could be affected by possible oil exploration offshore from an ice island and subsequent oil development on the coast of the NPR-A in Harrison Bay in a small area south of Atigaru Point (Figure II.C.1-3). Effects of these activities would be local and are not likely to affect marine mammal populations.

Conclusion—First Sale: For marine mammals under Alternative C, the effects of activities other than oil and gas are expected to be similar to those for Alternative A; the effects of oil and gas activities are expected to increase slightly over the effects for Alternative B.

Multiple Sales: If several lease sales occur under Alternative C, considerably more exploration activity is expected to occur in the southern half of the planning area, with the number of exploration wells drilled increasing to 6-18 for multiple sales from the 2-6 for the first sale. The amount of development also is expected to increase. the number of oil fields would increase to 1-3 for multiple sales from the 1-2 fields for the first sale, the number of production pads would increase to 1-5 for multiple sales from the 1-2 pads for the first sale, and pipeline miles would increase to 10-105 mi for multiple sales from the 10-90 mi for the first sale. However, most oil and gas activities under Alternative C are expected to occur inshore and far to the south of the coast. Only a small increase in potential noise and disturbance effects on marine mammals is expected along the coast, primarily in the Colville River delta-inner Harrison Bay area, and these effects are expected to be local and short term (generally <1 year) and are not likely to affect marine mammal populations.

Conclusion—Multiple Sales: The effect of oil and gas activities under Alternative C with multiple sales is expected to increase slightly over those effects for Alternative B with multiple sales.

Effectiveness of Stipulations: Effectiveness of stipulations is expected to be the same as under Alternative A.

10. Endangered and Threatened Species:

a. Activities Other Than Oil and Gas Exploration and Development: Activities other than oil and gas associated with the management plan still would occur under this alternative. Ground-impacting management actions within the planning area that may affect bowhead whales and spectacled and Steller's eiders under Alternative C include aerial surveys (including that of wildlife) and ground activities such as hazardous- and solid-material removal and remediation, which occur during the summer/early fall. A description of these activities and potential effects on these species is discussed in Section IV.B.10 (Alternative A) and summarized here. The potential effects from these activities are expected to be essentially the same as described in Alternative A. A detailed discussion of all management actions is found in Section II.

Bowhead whales are not likely to be affected by any activities associated with the management plan. Some eiders may be affected by activities associated with aircraft traffic and hazardous- and solid-material removal and remediation. Under this alternative there will be an increase in the number of aircraft flights for point-to-point flights, aerial wildlife surveys, and other aerial surveys. Under Alternative C, point-to-point flights increase from occasional to regular but not daily. Aerial wildlife surveys in late June and early July increase from 14 days to 21 days and other aerial surveys increase from occasional flights to

several 1- to 2-week periods (Table II.D.3). Summertime aircraft flights over sensitive areas for eiders may affect nesting females and their broods. Eiders breeding, nesting, or rearing young in coastal habitats north, west, and east of Teshekpuk Lake (spectacled eider LUEA, Fig. II.B.3) may be overflown by aircraft (both helicopters and fixed-wing) on a regular basis during the summer months and may experience temporary, nonlethal effects lasting probably less than an hour. Due to the relatively low density of eiders in the area, substantial disturbance is not expected to occur and is likely to be limited to within a few kilometers of the activities. Such short-term and localized disturbances are not expected to cause significant population effects. However, disturbance of some individuals over the life of the project is expected to be unavoidable. Disturbance, depending on its nature and duration, could be considered a "take" under the ESA.

b. Oil and Gas Exploration and Development Activities: Under Alternative C, oil and gas leasing would occur in the planning area, although the northern portion of the planning area extending just to the south of Teshekpuk Lake would be unavailable to oil and gas leasing. No leasing would occur in the spectacled eider LUEA. In addition, leasing would not occur in most of the higher density eider-nesting areas outside of the spectacled eider LUEA. This analysis is based on a development scenario presented in Section IV.A.1.b of this EIS. Please refer to these sections for a discussion of resource-recovery rates and quantities, timing of infrastructure development, platform emplacement, wells drilled, and resource production timeframes and other information relevant to the development of the resources of the IAP. The BLM proposes to conduct multiple oil and gas lease sales within the planning area. Multiple sales are discussed later in this section. Under Alternative C, oil resources for the initial sale are expected to be in the 75- to 410-MMbbl range with from one to two fields, which is considered a reasonable range of resource development and activity level for the portion of the planning area open to leasing (Table IV.A.1.b.5). Information on the number of exploration, delineation, and production wells anticipated to be drilled and pipeline miles can be found in Table IV.A.1.b-5. Resources at the low end of the resource range (75-MMbbl) are not economically viable as stand-alone fields. Differences in effects on the species as a result of noise and disturbance over this range of scenarios are expected to be minor. Differences in effects on the species as a result of an oil spill during the development/production scenario (75-410-MMbbl-resource range) also are expected to be minor.

For Alternative C, the number of oil spills estimated to occur over the assumed production life of the IAP is from 11 to 61 spills <1 bbl and from 4 to 21 spills >1 bbl (Table IV.A.2-3a). For the purposes of analysis, this EIS assumes an average spill size of 4.0 bbl and that the estimated number of crude-oil spills over the assumed production life of the planning area would range from 15 to 82 spills (Table IV.A 2-2a). Information pertaining to oil spills can be found in Section IV.A.2.

(1) Effects on the Bowhead Whale: The potential effects on bowhead whales from discharges, noise and disturbance, and oil spills associated with oil and gas activities or other activities associated with the management plan are expected to be essentially the same under this alternative as under Alternative B.

(2) Effects on the Spectacled and Steller's Eiders: The potential effects on spectacled and Steller's eiders from discharges, noise and disturbance, seawater spills, and oil spills associated with oil and gas activities are expected to be essentially the same under this alternative as under Alternative B.

Conclusion—First Sale: The potential effects on bowhead whales from discharges, noise and disturbance, and oil spills are expected to be essentially the same under this alternative as under Alternative B. The potential effects on spectacled and Steller's eiders from discharges, noise and disturbance, seawater spills, and oil spills associated with oil and gas activities are expected to be essentially the same under this alternative as under Alternative B. However, there may be an increase in potential effects on eiders from activities other than oil and gas activities associated with the management plan due to an increase in summertime aircraft flights over sensitive areas that may affect nesting females and their broods. Under this alternative, there will be an increase in the number of aircraft flights for aerial wildlife surveys and other aerial surveys. Aerial wildlife surveys in late June and early July increase from 14 days to 21 days. Spectacled and Steller's eiders breeding, nesting, or rearing young in the coastal areas may be overflown by support aircraft and may experience temporary, nonlethal effects lasting probably less than an hour. In the central portion of the planning area, Steller's eiders occasionally may be overflown by support aircraft and may experience temporary, nonlethal effects lasting probably less than an hour. It is unlikely that the primary Alaskan nesting area, located south and southeast of Barrow, would be affected much by these activities; so significant disturbance of nesting or broodrearing eiders is not expected to occur. Such short-term and localized disturbances are not expected to cause significant population effects. However, disturbance of some individuals over the life of the project is expected to be unavoidable. Disturbance, depending on its nature and duration, could be considered a "take" under the ESA.

Multiple Sales: Under the multiple-sales approach, the resource estimate for Alternative C increases from a range

of 75 to 410 MMbbl in one to two oil fields (Table A2-5) to a range of 110 to 580 MMbbl in one to three oil fields (Table IV.A.1.b-6). Resources at the low end of the resource range (110 MMbbl) are not economically viable as stand-alone fields. The number of exploration wells increase from a maximum of 6 to 18, delineation wells increase from a maximum of 9 to 15, and production wells increase from a maximum of 122 on 2 pads to 174 on 5 pads. Pipeline miles increase from 90 to 105 mi (Tables IV.A.1.b-5 and 7). Multiple sales would occur over a longer period of time and, depending on frequency of sales and results from exploratory drilling operations, possibly increase the timeframe for oil and gas activities in the planning area by a couple of decades.

For Alternative C, it is estimated that the number of spills <1 bbl would increase from a range of 11 to 61 spills to a range of 17 to 87 spills, and the number of spills >1 bbl would increase from a range of 4 to 21 spills to a range of 5 to 28 spills over the assumed production life of the planning area (Tables IV.A.2-3a and 3b). The estimated number of crude oil spills over the assumed production life of the planning area would increase from a range of 15 to 82 spills to a range of 22 to 115 spills (Tables IV.A 2-2a and 2b). Information pertaining to oil spills can be found in Section IV.A.2.

Conclusion—Multiple Sales: The effects of multiple sales and increased potential for noise-producing activities and oil spills on endangered and threatened species at the resource ranges and activity levels described are expected to be essentially the same as described above for the first sale.

Effectiveness of Stipulations: The effectiveness of stipulations for noise and disturbance from oil and gas activities is the same as for Alternative B, and from activities other than oil and gas, such as aerial wildlife surveys and other aerial surveys, the same as for Alternative A.

11. Economy:

a. Activities Other Than Oil and Gas Exploration and Development: Alternative C would generate recreation-field employment by 30, 1-week long float-trip parties per year (Table II.H.3.b), which is equal to one person working for 8 months each year.

b. Oil and Gas Exploration and Development Activities: Increased revenues and employment are the most significant economic effects that would be generated by Alternative C. Increased property-tax revenues and new employment would be created with the construction, operation, and servicing of facilities associated with oil and gas activities. These facilities are described in Table IV.A.1-1 and are summarized as follows. For exploration, 2 to 6 exploration and 2 to 9 delineation wells would be drilled between 2000 and 2008; for development 23 to 122 production and service wells would be drilled, 1 to 2 production pads constructed, and 10 to 90 mi of onshore pipeline installed between 2006 and 2017. The number of workers needed to operate the infrastructure is determined by the scale of the infrastructure and not by the amount of oil produced. A wide range of production volume can be handled by a given level of infrastructure. Once the infrastructure is in place, the number of workers needed to operate it does not depend on the amount of product flowing through it. Effects include employment generated by seismic surveys during exploration. State property-tax revenues are in proportion to the value of onshore facilities. State royalty income and State severance tax are in proportion to production. Peak yearly production is estimated at 8 to 41 MMbbl. (For complete descriptions of resources and associated activity, see Sec. IV.A.1.b)

(1) North Slope Borough Revenues and Expenditures: Exploration, development, and production are projected to generate increases in property taxes above the levels without Alternative C activities starting in 2000 and averaging about 1 to 2 percent each year through the production period, or about $2 to $4 million. For revenues shared by the State see subpart (4) below.

(2) North Slope Borough Employment: The gains from Alternative C in direct employment would include jobs in petroleum exploration, development, and production and jobs in related activities (Table IV.D.11-1). Direct employment is anticipated to peak in the range of 1,100 to 1,500 jobs during the development phase, and decline to a level in the range of 500 to 800 during production from 2018 to 2028.

Total NSB resident employment is anticipated to increase in the range of 36 to 44 jobs in the peak of development and level off to 17 to 27 during production after 2017 (Table IV.D.11-1). The peak increase in resident employment is about 2 to 3 percent greater with Alternative C than without during development, and about 1 to 2 percent greater during production. The increase in employment opportunities may partially offset declines in other job opportunities and delay expected outmigration. Increases in resident population will correspond to increases in employment (Table IV.D.11-2).

No workers will be needed to clean up numerous small oil spills beyond those already employed in the workers' enclave.

(3) Effects of Subsistence Disruptions on the NSB Economy: Disruptions to the harvest of subsistence resources could affect the economic well-being of NSB

Table IV.D.11-1
Summary of Employment Forecasts, Alternative C

	IAP Employment in Enclave			NSB Resident Employment		
	Without IAP Activity	With IAP Activity		Without IAP Activity	*Increase* with IAP Activity	
Year		$18/bbl	$30/bbl		$18/bbl	$30/bbl
1999	0	0	0	1,865	0	0
2000	0	99	99	1,825	2	2
2001	0	179	259	1,794	8	9
2002	0	99	259	1,767	10	17
2003	0	39	359	1,746	8	20
2004	0	59	139	1,730	9	21
2005	0	269	349	1,716	9	16
2006	0	1,185	1,332	1,701	36	43
2007	0	638	844	1,685	39	44
2008	0	625	760	1,662	15	18
2009	0	607	1,578	1,614	13	32
2010	0	476	933	1,565	9	19
2011	0	476	889	1,513	12	23
2012	0	486	978	1,470	14	29
2013	0	486	956	1,431	15	30
2014	0	486	911	1,393	16	31
2015	0	506	911	1,357	17	31
2016	0	506	911	1,350	17	31
2017	0	506	911	1,330	17	31
2018	0	506	800	1,310	17	27
2019	0	500	800	1,290	17	27
2020	0	506	800	1,290	17	27
2021	0	506	800	1,310	17	27
2022	0	506	800	1,330	17	27
2023	0	506	800	1,350	17	27
2024	0	506	800	1,370	17	27
2025	0	506	800	1,390	17	27
2026	0	506	800	1,410	17	27
2027	0	506	800	1,430	17	27
2028	0	506	800	1,450	17	27

Sources: Resident employment 1999–2015, Rural Alaska Model, North Slope Borough, 1996; IAP employment and resident employment 2016–2028, Manpower Model and MMS.

Table IV.D.11-2
Summary of NSB Population Forecasts, Alternative C

		Increase in Resident Population				Increase in Resident Population	
Year	Resident Population No IAP Activity	IAP Activity $18/bbl	IAP Activity $30/bbl	Year	Resident Population No IAP Activity	IAP Activity $18/bbl	IAP Activity $30/bbl
1999	6,067	0	0	2014	6,582	48	93
2000	6,134	6	6	2015	6,423	51	93
2001	6,213	24	27	2016	6,300	51	93
2002	6,301	30	51	2017	6,200	51	93
2003	6,391	24	60	2018	6,100	51	81
2004	6,488	27	63	2019	6,000	51	81
2005	6,684	27	48	2020	6,000	51	81
2006	6,695	109	129	2021	6,100	51	81
2007	6,820	117	132	2022	6,200	51	81
2008	6,918	45	54	2023	6,300	51	81
2009	7,011	39	96	2024	6,400	51	81
2010	7,050	27	57	2025	6,500	51	81
2011	7,004	36	66	2026	6,600	51	81
2012	6,891	42	87	2027	6,700	51	81
2013	6,743	45	90	2028	6,800	51	81

Sources: For years 1999–2015, Rural Alaska Model, North Slope Borough, 1996. For 2016–2028, MMS.

residents primarily through the direct loss of subsistence resources. See Section IV.D.13 for effects on subsistence-harvest patterns.

(4) Local, State and Federal Revenues: Local, State, and Federal revenues will increase as a result of Alternative C. Property-tax revenues to the State will be approximately 25 percent of the revenues to the NSB, or $0.5 to $1 million annually. The annual royalty will be $4 to $43 million for the Federal Government and $4 to $43 million for the State and NSB. The average annual State severance tax is estimated to be $7 to $73 million.

(5) Southcentral Employment: Workers in the enclave centered at Prudhoe Bay probably would commute to permanent residences in Southcentral Alaska, Fairbanks, and outside the State. However, for the purpose of this analysis, it is assumed all of the enclave workers (Table IV.D.11-1) commute to Southcentral and have permanent residences there except during peak construction years.

Population in Southcentral generated directly and indirectly by enclave workers during production will be in the range of 7,500 to 12,000, or 2 to 3.2 percent of the Southcentral population. In the 7-year period of the exploration and development phases, the population directly and indirectly associated with Alternative C would rise to the level sustained during production.

Conclusion-First Sale: For activity other than oil and gas, Alternative C would generate approximately 50 jobs for 4½ months associated with seismic surveys and recreation-field employment, which is equal to one person working 8 months per year. Activities other than oil and gas would have no effect; production in Alternative C is projected to generate increases above the levels of Alternative B as follows: NSB property taxes, 1 percent ($1-$2 million); direct oil-industry employment, 200 to 500 during production (5x this in additional jobs) residing in Southcentral Alaska; NSB resident employment, 1 percent; and annual revenues of $0.25 to $0.5 million property tax to the State, $0 to $6 million royalty to the Federal Government, $0 to $6 million royalty to the State and NSB, and $1 to $11 million severance tax to the State.

Multiple Sales: The effect of multiple sale for Alternative C is project to be approximately two times that of the first sale for Alternative C.

Conclusion—Multiple Sales: The effect of multiple sale for Alternative C is project to be approximately two times that of the first sale for Alternative C.

Effectiveness of Stipulations: Mitigating measures would not change potential economic effects.

12. Cultural Resources:

a. Activities Other than Oil and Gas Exploration and Development: Cultural resources (the physical remains resulting from the activities of historic or prehistoric humans) are nonrenewable. Once they are adversely impacted and/or displaced from their natural context, the damage is irreparable.

Under Alternative C, the management-action impacts generally would be the same as under Alternative A, except the intensity of the actions would increase due to potential oil and gas exploration.

b. Oil and Gas Exploration and Development Activities:

(1) Effects of Disturbance from Exploration: The types of oil and gas exploration activities that would occur under Alternative C would be the same as those that would occur under Alternative B. However, the level or intensity of these exploration activities would increase under Alternative C. The number of exploration/ delineation wells drilled would increase from 10 to 15, and as many as 3 might be drilled during a single winter season. This would increase the area of potential impact by 50 percent over Alternative B.

(2) Effects of Exploration Spills: These effects would be the same as those under Alternative B, except the possibility of impacts would be increased by 50 percent.

(3) Effects of Disturbance from Development: The types of oil and gas development activities that would occur under Alternative C are the same as those that would occur under Alternative B. However, the level or intensity of these development activities would increase under Alternative C. While the number of production pads and pump stations is expected to remain the same as in Alternative B, crude-oil pipeline miles would increase by 15, for a total of 90 mi under Alternative C. This would increase slightly the area of potential impact over Alternative B.

(4) Effects of Development Spills: These effects would be the same as those under Alternative B, although the possibility of spills would be slightly increased.

Conclusion—First Sale: Under Alternative C, impacts to cultural resources from management activities other than oil and gas exploration and development would be similar in nature but may be somewhat increased in magnitude over Alternative A. Under Alternative C, most of the impacts to cultural resources would result from oil and gas exploration and development, although there is a possibility that no such activities would impact cultural resources

sites. When compared with Alternative B, the potential for impact to cultural resources is somewhat greater under Alternative C.

Multiple Sales: The potential impacts to cultural resources under Alternative C could increase by as much as 20 percent compared to Alternative B.

Conclusion—Multiple Sales: Under Alternative C, potential impacts to cultural resources from management activities other than oil and gas exploration and development would be similar in nature to Alternative B, but the probability of impacts occurring would increase. Under alternative C, the potential impacts to cultural resources form oil and gas exploration and development would increase by roughly 20 percent compared to Alternative B.

Effectiveness of Stipulations: These effectiveness of stipulations would be the same as under Alternative B.

13. Subsistence-Harvest Patterns: This section analyzes the impacts of ground-management actions and oil and gas leasing on the subsistence-harvest patterns of communities in or near the planning area. This analysis is organized by types of effects and discusses effects on subsistence-harvest patterns on each affected community as a result of disturbance and oil spills. Analytical descriptions of affected resources and species, a more in-depth discussion of the parameters for subsistence-harvest patterns impact analysis as well as indigenous Inupiat knowledge concerning effects are described in more detail in the discussion for Alternative B and the Preferred Alternative (Secs. IV.C.13 and IV.G.13).

Under Alternative C, maximum protection to certain high-value resources would be emphasized. The Teshekpuk Lake Watershed, Goose Molting Habitat, Spectacled Eider Breeding Range, and Teshekpuk Lake Caribou Habitat LUEA's would be made unavailable to oil and gas leasing. The Fish Habitat LUEA would be available to oil and gas leasing, with the exception of Teshekpuk Lake. The Colville River would be recommended as a "scenic" river in the WSR System and managed as such. Also, Kuukpik Corporation entitlement lands would be made available to oil and gas leasing.

Portions of the Colville River would be made available to oil and gas leasing. Raptor, passerine, and moose areas on the Colville River, the Pik Dunes, Ikpikpuk Paleontological Sites, and recreation and scenic areas also would be made available to oil and gas leasing but subject to restrictions for siting pipelines and industrial structures.

a. Ground-Impacting-Management Actions:

(1) Activities other than Oil and Gas Exploration and Development: Even though use levels by researchers, recreationists, and seismic surveyors would increase under this alternative, effects from ground-impacting-management actions are expected to be the same as those under Alternative A. For a more in-depth discussion of activities other than oil and gas exploration and development, see impacts discussion for subsistence-harvest patterns under Alternative A.

(2) Oil and Gas Exploration and Development Activities: Oil exploration activities—seismic activity and exploration drilling—would occur in winter (early December to mid-April). Transportation of construction materials (and gravel for pads), personnel, and fuel would be done over winter ice roads from existing infrastructure at Prudhoe Bay and Kuparuk. Under Alternative C, one to two fields with a resource range of 75 to 410 MMbbl are estimated. For exploration, two to six wells would be drilled. For development, 2 to 9 delineation and from 23 to 122 production and service wells would be drilled, as well as from 10 to 90 mi of pipeline constructed. At $18/barrel, Alternative C as a stand alone field would not be commercially viable; nevertheless, such a field would be developed if it were close to existing infrastructure.

(a) Effects of Disturbance: Sources for disturbance from exploration and development would be essentially the same as those discussed for Alternative B, except for possible barge-resupply traffic. (Sec. IV.C.13, Subsistence).

(b) Effects of Spills: Under Alternative C, one to two fields with a resource range of 75 to 410 MMbbl are estimated. Oil-spill-occurrence estimates over the assumed production life of the planning area range from 15 to 82 crude-oil spills, with a volume range from 60 to 328 bbl (average spill size equals 4 bbl). For spills >1 bbl, the range is from 4 to 21 spills. For TAPS spills resulting from NPR-A production, the number of spills ranges from 1 to 6, with a volume ranging from 1 to 7 bbl. Oil-spill-occurrence estimate for TAPS tanker spills resulting from NPR-A resources is a 64- to 92-percent chance of 0 spills (with an average spill size of 30,000 gal) occurring. Thirty-five to 190 refined-oil spills (diesel fuel, aviation fuel, engine lube, fuel oil, gasoline, grease, hydraulic oil, transformer oil, and transmission oil) with an estimated volume ranging from 24 to 131 bbl (average spill size equals 29 gal) are estimated. Historically, by volume, diesel fuels account for 75 percent of the refined oil spills. All NPR-A scenarios call for an onshore pipeline for oil delivery to TAPS, and there is the potential for a pipeline spill contaminating the Colville River. Adequate data are not available to estimate a chance of such an occurrence.

Records indicate four pipeline leaks, with the largest discharge being 125 bbl. A spill entering the Colville River potentially could affect fish populations, disrupt subsistence-fishing activity, and curtail the subsistence hunt as resources well may be tainted or, even if available, the perception of tainting would substantially affect the subsistence harvest (Sec. IV.C.13, Subsistence).

b. Effects on Subsistence Species:

(1) Terrestrial Mammals:

(a) Effects from Disturbance: For oil and gas activities, effects of Alternative C on terrestrial mammals are expected to be somewhat greater than those of Alternative B. Increased habitat alteration would include the development of one or two s and a pipeline to the TAPS. Some CAH and TLH caribou are expected to be disturbed and their movements delayed along the pipeline during periods of air traffic, but these disturbances are not expected to affect caribou migrations and overall distribution. Surface, air, and foot traffic near the s is expected to increase and to displace some terrestrial mammals but not significantly affect Arctic Slope populations (Secs. IV.C.9 and IV.D.9).

(b) Effects of Spills: The potential for an oil spill occurring and contacting areas used by Barrow, Atqasuk, and Nuiqsut subsistence-caribou hunters is very low, considering the data that indicate primarily chronic, small spills that most often are contained on pad. If a spill occurred off the pad, the impact of oil spills would be very local and would tend to contaminate tundra in the immediate vicinity of the spill source. The number of small, chronic crude-oil and fuel spills is expected to increase somewhat over Alternative B and result in the loss of small numbers of terrestrial mammals, with recovery expected within 1 year (Secs. IV.C.9 and IV.D.9).

(2) Fish:

(a) Effects of Disturbance: The individual effects of actions related to oil and gas development on arctic fish resources are the same for Alternative C as for Alternative B. However, the likelihood of their occurrence is estimated to be roughly two to three times higher for Alternative C than for Alternative B. Depending on the actual level and location of implementation, this could result in a corresponding increase in the overall effect of drill pad, road, airstrip, and pipeline construction on arctic fish populations in Alternative C over that of Alternative B (Secs. IV.C.7 and IV.E.7). Effects on fish resources from seismic and construction disturbance are expected to increase under this alternative with chronic, local, short-term impacts on the subsistence fisheries of Barrow and Nuiqsut; Atqasuk's subsistence fishery does not quite reach the western edge of the planning area.

(b) Effects of Spills: Oil spills associated with Alternative C are expected to have the same overall effect on arctic fish populations as those discussed for Alternative A (Secs. IV.C.7 and IV.D.7).

(3) Birds:

(a) Effects of Disturbance: Effects of seismic surveys, exploratory drilling, construction in winter, and development well drilling year-round, as well as spill cleanup activities, are expected to be similar to Alternative B, i.e., localized and range from brief to several months in duration, requiring no more than 1 year for recovery. More intense activity such as routine overflights of lakes and increased boat or foot traffic along rivers is expected to require >1 year for recovery (Secs. IV.C.8 and IV.D.8).

(b) Effects of Spills: Effects of oil and gas activity are not expected to result in significantly greater effects on bird populations than those discussed for Alternative B. The potential for an oil spill occurring and contacting areas used by Barrow, Atqasuk, and Nuiqsut subsistence-waterfowl hunters is very low considering the data that indicate primarily chronic, small spills that most often are contained on pad, but oil or fuel spills entering lakes with large staging waterfowl populations are expected to require >1 year for recovery. (Secs. IV.C.8 and IV.D.8).

(4) Bowhead Whales:

(a) Effects of Disturbance: The potential effects on bowhead whales from discharges, noise and disturbance, and oil spills are expected to be the same under this alternative as under Alternative B (Secs. IV.C.10 and IV.D.10).

(b) Effects of Spills: Under Alternative C, there would be no leasing in the northern portion of the planning area, thereby eliminating the potential for a fuel-oil spill from a supply barge transporting equipment to coastal staging areas. Small onshore spills are unlikely to reach the marine environment. Oil-spill effects on bowhead whales under Alternative C would be the same as Alternative B (Secs. IV.C.10 and IV.D.10).

(5) Other Marine Mammals:

(a) Effects of Disturbance: For marine mammals under Alternative C, the effects of oil and gas activities essentially are expected to be the same as for Alternative B (Secs. IV.C.9 and IV.D.9).

(b) Effects of Spills: For marine mammals under Alternative C, the effects of oil and gas activities essentially are expected to be the same as for Alternative B (Secs. IV.C.9 and IV.D.9).

c. Effects on Communities: Effects on Barrow, Atqasuk, and Nuiqsut from oil-industry-development disturbance are discussed in detail in Section IV.B.10 of the Beaufort Sea Sale 170 Final EIS (USDOI, MMS, 1998). See previous discussions in this section of effects on the primary subsistence species: caribou (and other terrestrial mammals), fish, birds, bowhead whales, and other marine mammals. Effects assessments from these sections are summarized below; for a synthesis of traditional knowledge (where available), see effects discussion for Subsistence under Alternatives B and the Preferred Alternative (Sec. IV.C.13 and IV.G.13).

(1) Barrow, Atqasuk, and Nuiqsut—Effects from Disturbance and Spills: Under Alternative C, effects similar to those for Alternative B with slight effects increases are expected, i.e., short-term and localized impacts from disturbance and oil spills to caribou and other terrestrial mammals, fish, birds, bowhead whales, and other marine mammals. Increases in disturbance and oil spills are expected, but overall populations would not be impacted. Effects to resources harvested by subsistence hunters from these three communities would have little effect on overall subsistence harvests. Under Alternative C, it is expected that subsistence-hunter concerns about access to resources and resource contamination would be minimal, with the same expected effects as for Alternative B, although fish resources would not be subject to as much protection under this alternative. Impacts would be further minimized by not leasing in important caribou and waterfowl areas under this alternative and from protection afforded by other management actions (see Effectiveness of Stipulations below).

(2) Other Communities—Effects from Disturbance and Spills: Other communities within or adjacent to the NPR-A are the Chukchi Sea villages of Point Lay and Wainwright to the west and the inland community of Anaktuvuk Pass to the south and east. Subsistence-harvest areas for these communities are not within or adjacent to the planning area, although recent research indicates that movement by the Teshekpuk Lake Caribou Herd does bring the herd into the traditional subsistence-harvest areas of the communities of Wainwright and Point Lay. Historically, Anaktuvuk Pass caribou hunters have ranged to the southerly boundary of the planning area, and movement by the Teshekpuk Lake caribou herd would bring it into the harvest area of Anaktuvuk Pass subsistence hunters as well, although they primarily hunt the Western Arctic Herd (and, to a lesser extent, the Central Arctic Herd). Short-term and localized impacts from disturbance and oil spills to the Teshekpuk Lake and Central Arctic herds would have little effect on the subsistence-caribou harvests for these three communities, the same level of effects as for Alternative B.

Impacts to subsistence users farther from the planning area, including those in the Yukon-Kuskokwim Delta, would not be significant. The populations of waterfowl used by subsistence users south of the Brooks Range are not expected to be significantly impacted, because key waterfowl habitat would not be leased.

Conclusion—First Sale: Overall effects associated with Alternative C subsistence-harvest patterns in the communities of Barrow, Atqasuk, and Nuiqsut, and other nearby communities from oil and gas activities in the planning area as a result of impacts from disturbance and oil spills are expected to increase somewhat over Alternative B. Periodic impacts to subsistence resources are expected but no resource would become unavailable, undesirable for use, or experience overall population reductions, essentially the same level of effect as Alternative B.

Multiple Sales: Under the multiple-sales approach, the resource estimate for Alternative C increases from a range of 75 to 410 MMbbl in one to two s to a range of 110 to 580 MMbbl in one to three s. Resources at the low end of the resource range (110 MMbbl) are not economically viable as stand-alone fields; nevertheless, such a field would be developed if it were close to existing infrastructure. The number of exploration wells increase from 6 to 18, delineation wells increase from 9 to 15, and production wells increase from 122 on 2 drill pads to 174 on 5 drill pads. Pipeline miles increase from 90 to 105 mi. Multiple sales would occur over a longer period of time and, depending on frequency of sales, the timeframe for oil and gas activities in the planning area would extend to at least two decades.

For Alternative C, it is estimated that the number of spills <1 bbl would increase from a range of 11 to 61 spills to a range of 17 to 87 spills, and the number of spills >1 bbl would increase from a range of 4 to 21 spills to a range of 5 to 28 spills over the assumed production life of the planning area. The estimated number of crude-oil spills over the assumed production life of the planning area would increase from a range of 15 to 82 spills to a range of 22 to 115 spills.

Effects of oil and gas activities under multiple sales are expected to be somewhat greater than those of Alternative C with the first sale. Surface, air, and foot traffic near the s is expected to increase and to displace some terrestrial mammals but not significantly affect Arctic Slope populations. The number of small, chronic crude-oil and

fuel spills is expected to increase somewhat and result in the loss of small numbers of terrestrial mammals, with recovery expected within 1 year. For arctic fish populations, each additional sale is expected to have similar effects on arctic fish as those described for Alternative C. However, if there are increased levels of activity associated with future lease sales and/or insufficient recovery time between sales, greater adverse effects than those described for Alternative C are likely to occur. An increase in effects to bird populations from increased noise disturbance could be expected with multiple sales, with corresponding increases in disturbance and local displacement, but recovery in these instances is still expected to require no more than 1 year. Oil spills entering larger lakes with larger numbers of molting or broodrearing geese and other species may result in losses in the hundreds, requiring several breeding seasons for recovery. The effects of multiple sales and increased potential for noise-producing activities and oil spills on bowhead whales at the resource ranges and activity levels described are expected to be the same as described above for the first sale. The effects of oil and gas activities on marine mammals under Alternative C with multiple sales essentially are expected to be the same as for Alternative B with multiple sales.

Conclusion—Multiple Sales: Effects from multiple sales to terrestrial mammals are expected to increase but no significant impacts to populations are anticipated. Small numbers of terrestrial mammals would be lost because of the increase of small chronic crude oil and fuel spills, but populations are expected to recover within 1 year. Arctic fish populations would experience effects similar to Alternative B as high-density fish areas are unavailable to leasing, but increases are expected if sale intervals are not spaced sufficiently to provide population recovery. Increased disturbance and displacement effects and increased oil-spill risks are expected for birds, but timing of the sales again is critical to recovery. With extended intervals between sales, impacted bird populations are expected to recover from noise and disturbance effects in 1 year. Bowhead whales, as in Alternative B, are expected to experience short-term, nonlethal effects. Effects to marine mammals would be short term and local with no adverse effects to populations.

Given that resource estimates and development scenarios project an increase in resources and increases in the number of drill pads and pipeline miles, logic would assume increased effects to potentially affected resources, except for the fact that these effects would be spread over two decades. The biological analyses expect slight increases in effects with little overall effect to resource populations. Effects associated with multiple sales on subsistence-harvest patterns in the communities of Barrow, Atqasuk, and (especially) Nuiqsut as a result of impacts from disturbance and oil spills are expected to make no subsistence resource unavailable, undesirable for use, or experience overall population reductions.

Effectiveness of Stipulations: Stipulations that specifically would protect subsistence resources are discussed in Sections IV.D.7, Fish Resources, IV.D.8, Birds, IV.D.9, Mammals, and IV.D.10, Endangered and Threatened Species. The effectiveness of stipulations for protecting subsistence practices is the same as for Alternative B, most important of which being a BLM proposal to establish a Subsistence Advisory Panel to monitor subsistence issues and concerns arising from oil and gas activity on NPR-A.

14. Sociocultural Systems: This discussion is concerned with those communities that could be impacted by ground management actions and oil and gas leasing in the planning area—Barrow, Atqasuk, and Nuiqsut. Under Alternative C, maximum protection to certain high-value resources would be emphasized by making unavailable to oil and gas leasing important waterfowl and caribou habitat (3.39 million acres would be available and 1.26 million acres would be unavailable to oil and gas leasing). The Teshekpuk Lake Watershed, Goose Molting Habitat, Spectacled Eider Breeding Range, and Teshekpuk Lake Caribou Habitat LUEA's would be made unavailable to oil and gas leasing. The Fish Habitat LUEA would be available to oil and gas leasing, with the exception of Teshekpuk Lake. The Colville River would be recommended as a "scenic" river in the Wild and Scenic Rivers System and managed as such. Also, Kuukpik Corporation entitlement lands would be made available to oil and gas leasing.

Portions of the Colville River would be made available to oil and gas leasing. Raptor, passerine, and moose areas on the Colville River, the Pik Dunes, Ikpikpuk Paleontological Sites, and recreation and scenic areas also would be made available to oil and gas leasing but subject to restrictions for siting pipelines and industrial structures.

The primary aspects of the sociocultural systems covered in this analysis are (1) social organization and (2) cultural values, as described in Section III.C.3. For the purpose of effects assessment, it is assumed that effects on social organization and cultural values could be brought about at the community level, predominantly by industrial activities, increased population, increased employment, and effects on subsistence-harvest patterns associated with the sale. For a more in-depth discussion of the parameters for sociocultural effects analysis, see the discussion for Alternative B (Sec. IV.C.13).

a. Ground-Impacting Management Actions:

(1) Activities Other than Oil and Gas Exploration and Development: Even though use levels by researchers, recreationists, and seismic surveyors would increase under this alternative, effects from ground-impacting-management actions are expected to be the same as those under Alternative A. For a more in-depth discussion of non oil and gas exploration and development activities, see impacts discussion for subsistence-harvest patterns under Alternative A.

(2) Oil and Gas Exploration and Development Activities: Oil exploration activities—seismic activity and exploration drilling—would occur in winter (early December-mid-April). Transportation of construction materials (and gravel for pads), personnel, and fuel would be done over winter ice roads from existing infrastructure at Prudhoe Bay and Kuparuk. Large equipment would be barged to coastal staging areas in the summer, stockpiled, and moved inland the following winter. Under Alternative C, one to two fields with a resource range of 75 to 410 MMbbl are estimated. Two to 6 exploration wells would be drilled. For development, 2 to 9 delineation and from 23 to 122 production and service wells would be drilled, as well as from 10 to 90 mi of pipeline constructed. At $18 per barrel, Alternative C would not be commercially viable.

(a) Disturbance from Exploration and Development: Sources for disturbance from exploration and development essentially would be the same as those discussed for Alternative B (Sec. IV.C.13, Sociocultural Systems).

(b) Spills and Spill Cleanup: See Section IV.C.13, Subsistence for a discussion of Alternative C oil spills.

b. Population and Employment: Under Alternative C, oil and gas leasing in the planning area is projected to affect the population of the North Slope Borough through two types of effects on regional employment: (1) more petroleum industry-related jobs as a consequence of NPR-A exploration and development and production activities and (2) more NSB-funded jobs as a result of higher NSB operating revenues and expenditures (Sec. IV.B.11.). Employment projections as a consequence of NPR-A activities are provided in Section IV.C.11. Throughout the development and production phase, total petroleum-related employment would peak in 2006 at 1,185 to 1,332 jobs. Resident employment as a result of NPR-A activities would peak at 36 to 44 in the year 2006. Most workers are expected to permanently reside outside of the North Slope. The NPR-A oil and gas activities are projected to increase resident employment 2 to 3 percent during the development phase and 1 to 2 percent during the production phase above the declining existing-condition projections (Tables IV.D.11-1 and IV.D.11-2). The NPR-A development under Alternative C is projected to increase the NSB population at above the existing-condition level.

c. Subsistence-Harvest Patterns: Effects could be expected on subsistence-harvest patterns in the planning area as a result of disturbance to Barrow, Atqasuk, and Nuiqsut's subsistence harvests due to seismic disturbance, aircraft noise, supply vessel traffic, offshore exploration, onshore-construction, gravel extraction, pipeline trenching, and oil spills (see discussion for Alternative B, Sec. IV.C.14).

d. Effects on Barrow, Atqasuk, and Nuiqsut:: This section analyzes effects of industrial activities, population and employment changes, and subsistence-harvest-pattern impacts on North Slope social organization, cultural values, and other issues. This discussion focuses on the North Slope as a whole and with a discussion for each community.

(1) Social Organization: The social organization of communities that might be affected by oil and gas activities in the planning area includes typical features of Inupiat culture: kinship networks that organize much of a community's subsistence-harvest, consumption, and sharing activities; informally derived systems of respect and authority; strong extended families (although not always living in the same household); stratification between families focused on success in the subsistence harvest; and access to subsistence technology (Sec. III.C.2). However, activities generated by oil and gas activities in the planning area are not likely to bring about effects to these features in the communities in question (see discussion for Alternative B, in Sec. IV.C.13).

(2) Cultural Values: Cultural values and orientations (as described in Sec. III.C.2) can be affected by changes in the population, social organization and demographic conditions, economy, and alterations of the subsistence cycle. Of these, the only changes that could be expected to occur would be in Nuiqsut's social organization and the subsistence cycle in Barrow, Atqasuk and Nuiqsut (see discussion for Alternative B, Secs. IV.C.13 and IV.C.14; Sec. IV.D.14).

Short-term and localized impacts from disturbance and oil spills to the Teshekpuk Lake Caribou Herd and Central Arctic Caribou Herd, other terrestrial mammals, fish, birds, bowhead whales, and other marine mammals harvested by Barrow, Atqasuk, and Nuiqsut subsistence hunters would have little effect on subsistence harvests. Under Alternative C, it is expected that subsistence hunter concerns about access to resources and resource contamination would be minimal. No leasing in important

caribou and waterfowl areas under this alternative and protection afforded by other management actions (see Effectiveness of Stipulations below) would further minimize impacts.

Overall effects associated with Alternative C subsistence-harvest patterns in the communities of Barrow, Atqasuk, and Nuiqsut, and other nearby communities from oil and gas activities in the planning area as a result of impacts from disturbance and oil spills are expected to increase from those under Alternative B, but subsistence resources would be only periodically impacted with no apparent effect on subsistence harvests. Short-term disruptions of subsistence-harvest activities could cause periodic disruption to institutions and sociocultural systems but likely would not displace existing institutions.

(3) Social Health: Effects on sociocultural systems often are evidenced in rising rates of mental illness, substance abuse, and violence. This has proven true for Alaskan Natives who have been faced since the 1950's with increasing acculturative pressures. The rates of these occurrences far exceed those of other American populations such as Alaskan non-Natives, American Natives, and other American minority groups (see discussion for Alternative B, Sec. IV.C.13). Although there may be additional reasons for differences in social problems in local communities, it is clear that the proximity to industrial enclaves enables residents easier access to drugs and alcohol, thereby affecting the social health of the community—a situation that could intensify in Nuiqsut as a result of NPR-A oil and gas activity. Any effects on social health would have ramifications in the social organization, but NSB Native communities have, in fact, proven quite resilient to such effects by local voter insistence on these communities being "dry," and by the NSB's continued support of Inupiat cultural values and its strong commitment to health, social service, and other assistance programs.

Nuiqsut is the most likely community in the region to experience additional sale-related effects in social health and well-being. These effects on social health could have direct consequences on the sociocultural system but would not have a tendency toward displacement of existing institutions above the displacement that already has occurred with the current level of development. Effects on the institutions and sociocultural systems in Barrow and Atqasuk would be periodic but not displace existing institutions.

Conclusion—First Sale: Effects from management actions and oil and gas activities in the planning area under Alternative C are unlikely to disrupt sociocultural systems. Periodic, short-term disturbance effects would be expected on the sociocultural systems of Barrow, Atqasuk, and Nuiqsut but these disturbances are not expected to disrupt or displace institutions and sociocultural systems; community activities; and traditional practices for harvesting, sharing, and processing subsistence resources.

Multiple Sales: If several lease sales occur under Alternative C, considerably more exploration activity is expected to occur in the planning area, and the levels of effects due to noise, disturbance, and habitat alteration are expected to increase. Given that resource estimates and development scenarios project an increase in resources and a large increase in the number of drill pads and pipeline miles, logic would assume a large increase in the effects to potentially affected subsistence resources, except for the fact that these effects would be spread over 2 decades. The critical factor would be the timing between sales—a longer interval would allow more recovery for subsistence resources from aircraft, vehicular, and construction disturbance and for subsistence practices from increased access conflicts; less of an interval might not allow for sufficient recovery. In any case, the expected cumulative effect would be an increased development "footprint" and consequent increased habitat loss to resources and use loss to hunters. The biological analyses expect slight increases in effects with little overall effects to subsistence resource populations. Effects associated with multiple sales on subsistence-harvest patterns would make no subsistence resource unavailable, undesirable for use, or experience overall population reductions. Impacts would be further minimized by not leasing in important caribou, waterfowl, and fishing areas under this alternative, and from proposed stipulations, particularly the work of the Subsistence Advisory Panel designed to address local subsistence and cultural issues throughout the life of the plan.

Conclusion—Multiple Sales: Effects from management actions and oil and gas activities in the planning area for multiple sales under Alternative C could disrupt sociocultural systems for periods up to 1 year, but impacts would not be expected to displace institutions and sociocultural systems, community activities, or traditional practices for harvesting, sharing, and processing subsistence resources, the same level of effect anticipated for multiple sales under Alternative B.

Effectiveness of Stipulations: Stipulations that specifically would protect subsistence resources are discussed in Sections IV.D.7, Fish Resources, IV.D.8, Birds, IV.D.9, Mammals, and IV.D.10, Endangered and Threatened Species. The effectiveness of stipulations for protecting subsistence practices and sociocultural systems is the same as for Alternative B, most important of which being a BLM proposal to establish a Subsistence Advisory Panel to monitor subsistence issues and concerns arising from and oil and gas activity on NPR-A.

15. Coastal Zone Management: Under Alternative C, approximately 3.3 million acres would be available for leasing, including coastal areas near the Colville River Delta and in southern Harrison Bay. Surface resource protections for important, high-value waterfowl and caribou habitat exclude about 1.3 million acres from possible oil and gas leasing. These excluded areas include the Goose Molting Habitat, Spectacled Eider Nesting Concentrations, and Teshekpuk Lake Caribou Habitat LUEA's. Portions of some other LUEA's would be unavailable for leasing, because they overlap these LUEA's. Areas that would be made available to oil and gas leasing are subject to restrictions for siting pipelines and industrial structures. The Colville River in the planning area would be recommended and managed as a "scenic" river in the WSR System.

Federal lands within the NPR-A are excluded from the coastal zone; however, all uses and activities on Federal lands either occurring within the coastal zone or that may reasonably be expected to affect the coastal area and its resources must be consistent to the maximum extent practicable with enforceable standards of the ACMP, including State standards in 6 AAC 80 and enforceable policies of the NSB CMP. The primary goal of the NSB's LMR's and zoning ordinances is to protect the subsistence lifestyle of the Borough's largely Inupiat population while also encouraging and managing economic development.

a. Activities Other than Oil and Gas Exploration and Development: The level of activities other than oil and gas would be similar to or somewhat greater for Alternative C than for Alternative A (Table IV.A.1.a-1). Ground-impacting-management actions described under Alternative C would be the same as for Alternative A, except that under Alternative C, the level of activities would increase due to potential oil and gas exploration. The number and frequency of camps and overland moves would increase but are unknown at this time.

b. Oil and Gas Exploration and Development Activities: Under Alternative C, oil-exploration activities, including seismic activity and exploration drilling, would occur in winter (early December-mid-April). Transportation of construction materials (and gravel for pads), personnel, and fuel would be done over winter ice roads from existing infrastructure at Prudhoe Bay and Kuparuk. Under this alternative, one to two fields with a resource range of 75 to 410 MMbbl are estimated. For exploration, two to six wells would be drilled. For development, 2 to 9 delineation and from 23 to 122 production and service wells would be drilled and from 10 to 90 mi of pipeline constructed. At $18 per barrel, Alternative C as a stand-alone field would not be commercially viable; nevertheless, such a field would be developed if it were close to existing infrastructure.

Effects of Exploration and Development on the Alaska CMP: For oil and gas activities, effects of disturbance from Alternative C to terrestrial mammals are expected to be slightly greater than under Alternative B. For Alternative C, the effects of potential conflicts with the State's and Borough's coastal management programs are expected to be about the same as for Alternative B, because no leasing in important caribou and waterfowl areas would occur under Alternative C. Increased habitat alteration would include the development of one or two s and a pipeline to the TAPS. Some CAH and TLH caribou are expected to be disturbed and their movements delayed along the pipeline during periods of air traffic, but such disturbances are not expected to affect caribou migrations and overall distribution. Some terrestrial mammals may be displaced, but there would not be a significant effect to Arctic Slope populations (Secs. IV.C.9 and IV.D.9). Effects to the community of Nuiqsut are similar to Alternative B, but access is greater, because the area around Nuiqsut is more immediately available to leasing. Should development occur near Nuiqsut, effects are expected to be short term with localized impacts from disturbance and oil spills to terrestrial mammals (other than caribou), birds, bowhead whales, and other marine mammals. Corresponding increases in effects to fish and caribou would occur as a result of human disturbance and oil spills but would not impact overall populations, migration, and distribution patterns of caribou. Effects to resources harvested by Barrow subsistence hunters would have no apparent effect on their overall harvest. Under Alternative C, it is expected that subsistence-hunter concerns about access to resources and resource contamination would be minimal, the same effects as for Alternative B, although fish resources would not be subject to as much protection under this alternative. Impacts would be further minimized by not leasing in important caribou and waterfowl areas under this alternative and from protection afforded by other management actions, including special stipulations (see Section II.C.7.b. and Effectiveness of Stipulations).

Potential conflict between Alternative C proposed activities and Statewide standards and NSB district policies may arise but are not expected, in conjunction with the NSB CMP 2.4.5.2(h) (NSBMC 19.70.050.K.8) that relates to both subsistence and cultural resource areas. This policy requires that development be located, designed, and maintained so as not to interfere with the use of a site that is important for significant cultural uses or essential for transportation to subsistence-use areas. Also, conflict with district policies may arise in the potential for adverse effects to subsistence resources. NSB CMP policy 2.4.3(a) (NSBMC 19.70.050.A) relates to "extensive adverse impacts to a subsistence resource" that "are likely and

cannot be avoided or mitigated." In such an instance, "development shall not deplete subsistence resources below the subsistence needs of local residents of the Borough." Policy 2.4.5.1(a) (NSBMC 19.70.050.J.1) relates to "development that will likely result in significantly decreased productivity of subsistence resources or their ecosystems." Potential conflicts with these standards will be minimized by stipulations developed for this lease sale. Potential conflicts with the State's subsistence standards (6 AAC 80.120) are not anticipated, given BLM's current management practices and stipulations imposed for this lease sale.

Conclusion—First Sale: For Alternative C, the effects of potential conflicts with the State's and Borough's coastal management programs are expected to be about the same as for Alternative B, because no leasing in important caribou and waterfowl areas would occur under Alterative C. Problems could occur with specific Statewide standards and NSB CMP policies related to user conflicts between development activities and access to subsistence resources. Conflicts are possible with the NSB CMP policy related to adverse effects on subsistence resources. These effects could occur as a result of spilled oil contacting subsistence resources and habitats and as a result of the activities associated with oil-spill cleanup. No conflicts are anticipated during exploration.

Multiple Sales: If multiple sales occur in the area for leasing under Alternative C, intensive construction activity could last 15 to 30 years. Increases in wells drilled and number of fields developed and producing may double with multiple sales. Potential conflicts with State and Borough policies are essentially the same as Alternative B.

Conclusion—Multiple Sales: Displacement of birds from disturbance and habitat alternation is expected with multiple sales, but should not significantly affect coastal plain bird populations. Effects from multiple sales to terrestrial mammals are expected to increase, but no significant impacts to populations are anticipated. Small numbers of terrestrial mammals would be lost due to the increase of small, chronic crude-oil and fuel spills, but populations are expected to recover within 1 year (Sec. IV.C.9). Arctic fish populations would experience effects from seismic surveys and pipelines similar to those discussed for the first sale (i.e., no measurable effect on arctic fish populations). However, fuel and oil spills are likely to have a greater effect on fish populations than the first sale. Insufficient recovery time between sales and/or greater levels of activity would be likely to result in greater effects than estimated for multiple sale. Increased disturbance and displacement effects and increased oil-spills risks are expected to increase for birds in the southern half of the planning area under Alternative B with multiple sales, but not significantly affect coastal plain populations. Bowhead whales exposed to noise-producing activities such as marine-vessel traffic and possibly aircraft overflights most likely would experience temporary, nonlethal effects. Effects of multiple sales and increased potential for noise-producing activities and oil spills to marine mammals would be short term and local with no adverse effects to populations. Multiple sales may cause potential conflicts with the subsistence, habitat, air- and water-quality, and transportation standards of the ACMP; however, each oil and gas lease operating plan will be reviewed for consistency on a case-by-case basis.

Effectiveness of Stipulations: The effectiveness of stipulations for protecting subsistence practices under Alternative C is the same as Alternative B, particularly with establishment of a Subsistence Advisory Panel to monitor subsistence issues and concerns. Stipulations to protect terrestrial mammals would be in place, the same as under alternative B. Other protections are provided, since no long-term oil and gas surface occupancy would be allowed within the Pik Dunes LUEA. This area is open to leasing under Alternative C and used in the summer by some TLH caribou for insect relief. Stipulations would be in place to protect arctic fish, and are the same as discussed under Alternative B. Stipulations would be in place to protect disturbance of birds from ground transport and other activities, including oil and gas, and essential habitat protections. For example, Stipulations 20b through m will minimize and seasonally restrict vehicle use and seismic activity and provide precautions in Goose Molting and Colville River LUEA's for geese, raptor, and passerine, as well as seasonal restrictions on drilling and major construction (see Sec. IV.C.8 for a detailed description of additional stipulations developed to provide protections to birds and waterfowl). Management actions in Alternative C also provide protections to high-value resources.

16. Recreation and Visual Resources:

a. Activities Other than Oil and Gas Exploration and Development:

Disturbance: Activities other than oil and gas exploration and development under Alternative C are the same as under Alternative A. However, certain of these activities would increase as a result of or in support of oil and gas development. For example, field activities associated with archaeological site clearances such as camps, excavations, and aircraft activity all likely would increase. Impacts would be minimal and short term in nature, as described under Alternative A, but the total area impacted could increase to 2,000 acres (from 1,500 acres under Alterative A). This is the same as under Alternative B.

Although the amount of supplies and material transported by winter overland moves may increase under this

alternative, these moves generally follow the same route. Therefore, neither the length nor number of green trails is expected to noticeably increase from Alternative A.

b. Oil and Gas Exploration and Development Activities:

(1) Exploration: The types of oil and gas exploration activities that would occur under Alternative C are similar to those under Alternative B. However, the level of some of these exploration activities would increase compared to Alternative B—additional seismic-survey operations are expected, the number of exploration/delineation wells drilled at any one time would increase from 1 to 2, and the total number of these wells would increase from 10 to 15. Consequently, short-term impacts from ongoing seismic activity could increase from 500 acres affected under Alternative A and 1,000 acres under Alternative B to 1,500 acres affected under Alternative C. The area that could be impacted during drilling operations would increase from approximately 8,000 acres to 16,000 acres (winter only). Accumulating summer-season visual impacts from the greening of ice pads, roads, and airstrips would increase from about 500 acres to 750 acres. Several hundred miles of lineal green trails also would be visible from the air as a result of seismic operations; the numbers of miles visible would increase from Alternative B in direct relationship to increased seismic operations.

(2) Development: The types of oil and gas development activities that would occur under Alternative C are similar to those under Alternative B. While the number of production pads and pump stations is anticipated to be the same, the number of miles of pipeline is expected to increase from 75 mi (under Alternative B) to 90 mi under Alternative C. Consequently under this alternative, there would be a long-term loss of scenic quality, solitude, naturalness, or primitive/unconfined recreation over an area of approximately 82,000 acres (i.e., [8,000 acres/pad x 2 pads] + [8,000 acres/pump station x 1 pump station] + [640 acres/mi x 90 mi of pipeline]). This is about 10,000 acres more than under Alternative B.

Effects of Spills: The effects of spills would be the same as analyzed for Alternative B.

Effects to Wild and Scenic River Values: Under this alternative, resources on Federal lands and waters on and along the Colville River will receive the protection of a "scenic river" as afforded by the WSRA (Appendix G). As such, certain development not allowed in the designated river corridor under Alternative B would be allowed under this alternative. However, management priorities for a scenic river still require that outstandingly remarkable river values be protected. Therefore, while developments such as pipelines and roads would be allowed to cross or access the river, these developments would be designed to minimize or avoid impacts to outstandingly remarkable river values. For example, a pipeline could cross the river, but it might be buried rather than aboveground to protect scenic values. Roads could access the river, but through design and perhaps location restrictions, the impacts to identified outstandingly remarkable values would be minimized. Under this alternative, the potential impacts to outstandingly remarkable values on Federal lands and waters is greater than under Alternative B, but nevertheless minimal. State and private lands and resources on and along the designated portion of the Colville River would not be under BLM management or protection.

Conclusion—First Sale: As compared to Alternative A, there would be an increase of approximately 500 acres to 2,000 acres in adverse, short-term impacts to recreation values from activities other than oil and gas exploration and development. As compared to Alternative B, short-term impacts from ongoing oil and gas exploration activities would increase from approximately 9,000 acres impacted to approximately 17,500 acres. The greening of vegetation resulting from ice pads, roads, airstrips, and compacted snow would increase to about 750 acres, a 250-acre increase from Alternative B. Seismic operations would result in several hundred miles of green trails with likely increases over Alternative B directly corresponding to increases is seismic operations.

Oil and gas development would result in the long-term loss of scenic quality, solitude, naturalness, or primitive/unconfined recreation over an area of approximately 82,000 acres (or 1.8% of the planning area) for the life of production fields and pipelines. This is 10,000 acres more than under Alternative B.

Multiple Sales: The types of impacts resulting from additional sales will be the same as described above for the first sale. Short-term impacts such as green trails and disturbance resulting from noise, aircraft, and other ongoing activities would not accumulate. Impacts from permanent facilities such as roads, pipelines, gravel pads, and pits are long term and will accumulate to the extent such facilities are necessary to support additional exploration and production. It is anticipated that such facilities will increase about 45 percent over that needed for the first sale and affect a total of approximately 107,000 acres.

Conclusion—Multiple Sales: Long-term impacts will accumulate and increase about 45 percent above those of the first sale, ultimately affecting approximately 170,000 acres or about 2.3 percent of the planning area.

Effectiveness of Stipulations: The upper Colville River upstream from about Umiat would be designated Visual

Management Class II under this alternative. As such, no permanent visible structures would be allowed in this important recreation and scenic Class A area. The Colville River from abut Umiat to Ocean Point, a scenic Class B area and also an important recreation area, would be managed as a Visual Management Class III area. Under Class III guidelines, construction may be visible but should not dominate the landscape. Mitigation required to meet the standards established by these management classes should prevent any significant long-term impacts to visual/recreation values in these two highly scenic and important recreation areas.

Under this alternative, the Kuukpik LUEA would be managed as a Visual Management Class IV area rather than Class III area, as under Alternative B. Under Class IV guidelines, construction may dominate the landscape in terms of scale. This would result in less aggressive efforts to mitigate visual impacts. An aboveground pipeline through this area may exceed Class III standards.

The remaining planning area is designated Visual Management Class IV, the same as under Alternative B.

As under other alternatives, impacts to recreation values from exploratory oil and gas activities and from overland moves are significantly reduced by restricting these activities to winter months. Few recreationists visit the area during winter months.

E. ALTERNATIVE D: Alternative D would include BLM's management actions described for Alternative A and a proposal making approximately 4.14 million acres of the Northeast NPR-A Planning Area available to oil and gas leasing. This alternative focuses protection on certain high-value resources by making important waterfowl habitat unavailable to oil and gas leasing; the status of the LUEA's for oil and gas leasing under Alternative D is shown in Table IV.E-1. Seismic activities would be permitted throughout the planning area. Applicable stipulations identified in Section II.C.7.b will be applied to this alternative. In addition, the alternative includes (1) recommending the Colville River be included as a "recreational" river in the WSR System, (2) establishing a Bird Conservation Area that would incorporate part of the Colville River valley, (3) creating a Special Area designated by the Secretary of the Interior along the Ikpikpuk River to protect paleontological resources, and (4) adding the Pik Dunes LUEA to the Teshekpuk Lake Special Area.

The types of activities that might impact resources include those noted for Alternative A and those additional activities associated with oil and gas exploration and development as noted for Alternative B. The level of activities other than oil and gas would be similar to or slightly greater for Alternative D than for Alternative A (Table IV.A.1.a-1). The economically recoverable oil resources for the first oil and gas lease sale are estimated to range from 185 to 825 MMbbl (Table IV.A.1.b-4). The oil resources estimated for Alternative D are greater than those estimated for Alternative B (Table (IV.A.1.b-4), and thus the levels of activities associated with Alternative D also are estimated to be greater than they are for Alternative B. These activities include drilling 9 to 28 exploration and delineation wells, constructing one to six production pads, drilling 55 to 248 production and service wells, and constructing 80 to 105 mi of pipeline (Table IV.A.1.b-5). If the area available for oil and gas leasing under Alternative D results in multiple sales, 370 to 1,650 MMbbl of oil are estimated to be recovered (Table IV.A.1.b-6). The types of activities associated with multiple sales would be similar to those that might occur as the result of the first sale. The level of activities for multiple sales is shown in Table IV.A.1.b-7.

1. Soils: The types of activities that may affect soils under Alternative D include those analyzed under Alternatives A and B.

a. Activities Other than Oil and Gas Exploration and Development: The effects of

Table IV.E-1
Land Use Emphasis Areas Status for Oil and Gas Leasing Under Alternative D[1]

Land Use Emphasis Area	Fig. No. II.B.	Oil and Gas Leasing Status
Teshekpuk Lake Watershed	1	The northern part of the LUEA north of Teshekpuk Lake would be unavailable for leasing. The remainder of the watershed would be available for leasing
Goose Molting Habitat	2	Unavailable
Spectacled Eider Nesting Concentrations	3	Spectacled eider nesting concentrations north of Teshekpuk Lake would be unavailable for leasing. Spectacled eider nesting concentrations east of the Ikpikpuk River would be available for leasing.
Teshekpuk Lake Caribou Habitat	4	The northern part of the LUEA north of Teshekpuk Lake would be unavailable for leasing. The remainder of the Teshekpuk Lake Caribou Habitat would be available for leasing
Fish Habitat	5	Available
Colville River Raptor, Passerine, and Moose Area	6	Available
Umiat Recreation Site	8	Available
Scenic Areas	9	Available
Pik Dunes	10	Available
Ikpikpuk Paleontological Sites	11	Available
Kuukpik Corporation Entitlement	13	Available
Potential Colville Wild and Scenic River	14	Available

[1] Section II.

management actions described under Alternative D are similar to those under Alternative A, except there may be an increase in excavations (Sec. IV.E.6).

b. Oil and Gas Exploration and Development Activities: Under Alternative D, the impacts from exploration drilling and development activities would be the same as under Alternative B, except there would be an increase in the estimated level of activities. These activities could result in an estimated permanent loss of about 142 to 564 acres of soils (based on loss of vegetation, as noted in Sec. IV.E.6). Impacts to soils from spills and spill cleanup are similar in area as those with impacts to Vegetation (Sec. IV.E.6).

Conclusion—First Sale: Estimated areas of impacts and losses of soils from all activities are similar to those areas discussed under Vegetation (Sec. IV.E.6).

Multiple Sales: Additional lease sales under Alternative D would result in additional exploration and development activities. The area of impacted soils is closely related to that of the disturbed vegetation (see Vegetation, Sec. IV.E.6, for acreage details).

Conclusion—Multiple Sales: Areas of impacts and losses of soils from all activities in multiple sales are similar to those areas discussed under Vvegetation (Sec. IV.E.6).

Effectiveness of Stipulations: There are no stipulations beyond those identified in Section II.C.7 that could reduce the impacts to soils.

2. Paleontological Resources:

a. Activities Other than Oil and Gas Exploration and Development: Paleontological resources (plant and animal fossils) are nonrenewable. Once they are adversely impacted and/or displaced from their natural context, the damage is irreparable.

Under Alternative D, the management-action impacts generally are the same as under Alternative A, except the intensity of the actions would increase due to potential oil and gas exploration.

b. Oil and Gas Exploration and Development Activities: Paleontological resources are not ubiquitous in the planning area as are wildlife and habitat, and their occurrence is much less predictable. As a result, it is quite possible that no oil and gas exploration or development activities would have an impact on paleontological resources. However, as the area open to exploration and development increases, as it does dramatically in Alternative D, the possibility of no impacts to paleontological resources decreases markedly.

(1) Effects of Disturbance from Disturbance: The types of oil and gas exploration activities that would occur under Alternative D would be the same as those that would occur under Alternative B. However, the level or intensity of these exploration activities would increase dramatically under Alternative D. The number of exploration/delineation wells drilled would increase from 10 in Alternative B to 28, and as many as 6 wells might be drilled in a single winter season. This would increase the probability of potential impact nearly 200 percent over Alternative B.

(2) Effects of Exploration Spills: These effects would be the same as those under Alternative B, except the probability of impacts would be increased by almost 200 percent.

(3) Effects of Disturbance from Development: The types of oil and gas development activities that would occur under Alternative D would be the same as those that would occur under Alternative B. However, the level or intensity of these activities would increase under Alternative D. The number of production pads would increase from two in Alternative B to six in Alternative D, and pipeline miles would increase by 30 for a total of 105 mi under Alternative D. The potential for pump stations also increases in Alternative D. However, as mentioned previously, the variability in causal factors is great enough to make quantification difficult. These factors would increase significantly the potential for impacts over Alternative B.

(4) Effects of Development Spills: These effects would be the same as those under Alternative B, although the possibility of spills is greatly increased.

Conclusion—First Sale: Under Alternative D, impacts to paleontological resources from management activities other than oil and gas exploration and development would be similar in nature but may be significantly increased in magnitude over Alternative B. Under Alternative D, most of the impacts to paleontological resources would result from oil and gas exploration and development. When compared with Alternative B, the potential for impact to paleontological resources would be significantly greater under Alternative D.

Multiple Sales: The potential impacts to paleontological resources under Alternative D could increase by as much as 30 percent compared to Alternative B.

Conclusion—Multiple Sales: Under Alternative D, potential impacts to paleontological resources from management activities other than oil and gas exploration and development would be similar in nature to Alternative B, but the probability of impacts occurring would increase.

Under Alternative D, the potential impacts to paleontological resources from oil and gas exploration and development would increase by at least 300 percent compared to Alternative B.

Effectiveness of Stipulations: The effectiveness of stipulations would be the same as under Alternative B.

3. Water Resources:

a. Activities Other than Oil and Gas Exploration and Development: Ground-impacting-management actions within the planning area that may affect water resources under Alternative D would be similar to those under Alternative A, except that the number and frequency of camps and moves would increase slightly. The increase would depend on management actions in land, water, and resource monitoring as related to leasing activities. Because Alternative D emphasizes less protection of surface resources than Alternatives B and C, some of the areas adjacent to streams and lakes (Fish Creek drainage, much of Teshekpuk Lake, and adjacent deepwater lakes) identified as critical aquatic habitat would be available to leasing. Therefore, some of the additional camps and moves likely would be near these critical aquatic habitat areas.

b. Oil and Gas Exploration and Development Activities:

(1) Disturbance: Exploration and development activities within the planning area that may affect water resources under Alternative D would be similar to those in Alternative B, except that the number and frequency of these activities would increase (Table IV.A.1.b-1). The increase would depend on the number of leases sold, the number of proposals for exploratory activity, and the locations of this activity. As noted previously (Sec. IV.B.3.a), some of the areas adjacent to streams and lakes identified as critical aquatic habitat would be available to leasing. Therefore, some of the additional exploration and development likely would be near these critical aquatic habitat areas. Annual water usage for oil and gas activities under Alternative D would vary depending upon the areas leased and number of exploration and developmental wells drilled. Tables III.A.2.a-4 and IV.C.3 estimate water availability and requirements for exploration and development. Stipulations limit drawdown to 15 percent of the under-ice water depth (Sec. II.C.7.b, Stipulation 20) in lakes with resident fish populations. The likelihood of exploration and development activities occurring in an area that contains more water resources and critical aquatic habitat areas than Alternative B increases the risk of melting permafrost, disrupting drainage patterns, increasing erosion and sedimentation, and removing water from riverine pools and lakes.

(2) Spills and Spill Cleanup: Under Alternative D, the potential number and extent of oil spills and cleanup would increase from those under Alternatives B and C (Sec. IV.A.2). Alternative D, because it includes more of the critical lake and river habitat than Alternatives B and C, would have greater adverse effects on water resources as compared to Alternatives B and C.

Conclusion—First Sale: The impacts of activities other than oil and gas exploration and development under Alternative D are expected to be similar to those under Alternative B and C. The potential long-term impacts (melting of permafrost, and disrupting drainage patterns) and short-term impacts (increasing erosion and sedimentation and removing water from riverine pools and lakes) of oil and gas exploration and development on the water resources in the planning is expected to be greater for Alternative D than for Alternatives B and C.

Multiple Sales: While the effects of oil and gas exploration and development from multiple sales may be up to several times greater than a single sale, impacts would not necessarily go up proportionally. Indirect impacts, such as thermokarst and erosion and sedimentation due to channel alteration or gravel removal may not occur until many years after the original development. Shared use of infrastructure such as airfields, roads, camps, and pipelines could significantly reduce the size of the impacted areas and adverse effects to the water resources. Where infrastructure is not shared, both long and short-term impacts, as noted above, and recovery times could increase.

Conclusion—Multiple Sales: Adverse impacts from multiple lease sales may be up to several times greater than a single sale, while indirect impacts may take years to develop. Shared infrastructure could reduce the adverse effects to water resources of multiple lease sales, because combined facilities require less water for construction, maintenance, and camp use than separate, independent facilities. Where infrastructure is not shared, both long and short-term impacts, and recovery times could increase.

Effectiveness of Stipulations: The stipulations that are effective in minimizing potential effects of the ground-impacting-management actions on the water resources in the planning area for Alternative D are the same as for Alternative B.

4. Water Quality:

a. Activities Other Than Oil and Gas Exploration and Development: As discussed under Alternative A, ground-impacting-management actions other than seismic operations and other oil and gas activities would not impact water quality.

b. Oil and Gas Exploration and Development Activities:

(1) Exploration: Exploration activities within the planning area that may affect water quality under Alternative D are 2-D and 3-D seismic activity beyond that described under Alternative A, ice-road construction, and pad construction, as found for Alternative B. Under Alternative D, total acres with high damage to vegetation caused by seismic trails would be an order of magnitude greater than for Alternative A (see Sec. IV.E.6) and would result in a parallel tenfold areal increase in potential water degradation. Water quality still would be degraded over <5 acres. For Alternative D, annual ice-pad and -road construction (330-440-acre footprint each year), drilling, and domestic (crew) needs for water could require winter pumping of unfrozen water from 120 to 170 acres of nearby lakes. Most of this water use would be for ice roads. Pad construction, drilling, and crew needs together would require water use equivalent to 4 to 8 acres of lake. The areas affected would shift each year, as the ice roads are realigned and shifted to avoid continued compaction of vegetation. Upslope impoundment of snowmelt waters by ice roads could occur briefly but would have no effect on water quality.

(2) Development: Development activities within the planning area that may affect water quality under Alternative D are ice-road and ice-pad construction and spills, as found for Alternative B.

Because of the continued need for ice roads, annual water use during development would be similar to that for exploration, requiring water from 120 to 160 acres worth of intermediate-depth lakes to construct 320 to 420 acres of ice road. During the seasonal construction phase, annual water demand would be on the order of 37 acre-feet for each field, requiring water from an additional 12 acres of lake for each field. After major construction is finished, annual water demand would decrease to about 15 acre-feet per year for each field, requiring about 5 to 20 acres total of lake for water supply. The areas affected would shift each year, as the ice roads are realigned and shifted to avoid continued compaction of vegetation. Upslope impoundment of snowmelt waters by ice roads could occur briefly but would have no effect on water quality.

The primary water-quality effect from construction and placement of gravel structures is related to upslope impoundment and thermokarst erosion. Gravel construction of pads, within-field roads, and field airstrip would cover about a 100-acre footprint per field, or a total of 100 to 400 acres under Alternative D. In flat thaw-lake plains on the North Slope, gravel construction can be anticipated to result in upslope water impoundment and thermokarst erosion equivalent to twice the area directly covered by gravel, or 200 to 800 acres. Unlike the situation for ice structures, the same locations would be affected by gravel structures each year over the life of the field(s). These locations, however, would not be within the area deferred under Alternative D.

Spills are another impacting agent on water quality. A number of small crude spills averaging 4 bbl and smaller fuel spills averaging 0.7 bbl are projected to occur under Alternative D. Only about 8 percent of crude spills can be reasonably expected to reach tundra waters. For Alternative D, this calculation results in an estimate of 3 to 13 spills, each averaging 4 bbl, reaching tundra waters. Over the life of the fields, spills could affect the water quality of 3 to 13 ponds or small lakes, making their waters toxic to sensitive species for about 7 years. These spill locations, however, would not be within the area deferred under Alternative D.

For the purpose of analysis, the effects of 325-bbl spill reaching the Colville River in summer are also analyzed. The high rate of water flow would preclude any effects on dissolved oxygen concentrations. Direct toxicity in the water column would be minimal and limited to the first few reservoir pools downcurrent of where the spill entered the river. Some toxicity might persist in these initial reservoir pools for a few days to weeks until toxic compounds were washed out of the oil trapped in the sediment or the oiled sediment was buried under cleaner sediment.

A similar spill reaching Teshekpuk Lake also would result in minimal effect on water quality. Dissolved oxygen levels would not be affected. Direct toxicity would be minimal because of the much greater dilution volume in Teshekpuk Lake than in the small ponds and lakes discussed earlier and because of the relatively unrestricted movement of slick and underlying water. The spreading of the spill over about 60 acres (0.03% of the lake surface) could be considered an effect on water quality. This effect would exist for less than a summer, until the slick was either cleaned up or the oil stranded on the shoreline.

At the level of activity estimated in Alternative D, it is unlikely but possible for a spill to enter the marine environment. A most likely number of zero spills ≥1,000 bbl along the TAPS tanker route is projected.

Major crude oil spills generally result in peak dissolved-hydrocarbon concentrations that are only locally and marginally at toxic levels—parts per million or more. A spill ≥1,000 bbl could temporarily, about a month, contaminate water over a few hundreds of square miles above the chronic criterion of 0.015 ppm. Concentrations above the 1.5-ppm-acute criterion may occur over a few tens of square miles during the first several days of such a spill.

However, such a spill is unlikely under this alternative and marine water quality is not anticipated to be affected by spillage of NPR-A crude.

Conclusion—First Sale: Effects under Alternative D are higher than in Alternative B for oil and gas activities. Effects for activities other than oil and gas are similar to those for Alternative A. Water quality up to 2,000 acres could be affected by construction or placement of ice or gravel roads and other structures. Oil spills could result in waters of up to 13 ponds or small lakes remaining toxic to sensitive species for about 7 years. Water quality could be degraded over a few weeks along a short stretch of the Colville from a 325-bbl spill. The spreading of a similar-sized spill over about 60 acres of Teshekpuk Lake (0.03% of the lake surface) for a few weeks could be considered an effect on water quality.

Multiple Sales: Effects from seismic trails would be similar to that for a single sale. During exploration, annual ice-pad and -road construction (390-620-acre footprint each year), drilling, and domestic (crew) needs for water could require winter pumping of unfrozen water from 150 to 230 acres of nearby lakes. Most of this water use would be for ice roads. Pad construction, drilling, and crew needs together would require water use equivalent to 4 to 8 acres of lake. Because of the continued need for ice roads, annual water use during development for ice-road construction would be similar to that for exploration, requiring extraction of water from 150 to 230 acres of intermediate-depth lakes. During the seasonal construction phase, annual water demand would be on the order of 37 acre-feet for each field, requiring water from an additional 12 acres of lake for each field. After major construction is finished, annual water demand would decrease to about 15 acre-feet/year for each field, requiring up to 10 to 30 acres of lake for water supply for all fields.

The primary water-quality effect from construction and placement of gravel structures is related to upslope impoundment and thermokarst erosion. Gravel construction of pads, within-field roads, and field air strip would cover about a 100-acre footprint per field, or a 200- to 600-acre total. In flat thaw-lake plains on the North Slope, gravel construction can be anticipated to result in upslope water impoundment and thermokarst erosion equivalent to twice the area directly covered by gravel, or up to 1,200 acres. Unlike the situation for ice structures, the same locations would be affected by gravel structures each year over the life of the fields.

Over the life of development resulting from multiple sales, spills could degrade water quality of 6 to 27 ponds or small lakes, with resultant toxicity persisting and eliminating sensitive species in their waters for about 7 years. Water quality could be degraded over a few weeks along a short stretch of the Colville from a 325-bbl spill. The spreading of a similar-sized spill over about 60 acres of Teshekpuk Lake (0.03% of the lake surface) for a few weeks could be considered an effect on water quality.

For multiple sales under the alternative, the oil-spill-risk analysis estimates a most likely number of zero to one spill ≥1,000 bbl along the TAPS tanker route. This spillage could individually contaminate receiving water over several tens of square miles to levels above chronic criteria but below acute criteria

Conclusion—Multiple Sales: Longer-term (decade-or-more) effects of multiple sales would slightly greater than for a single sale. Oil spills could result in waters of up to 27 ponds or small lakes remaining toxic to sensitive species for about 7 years. Water quality could be degraded over a few weeks along a short stretch of the Colville from a 325-bbl spill. The spreading of a similar-sized spill over about 60 acres of Teshekpuk Lake (0.03% of the lake surface) for a few weeks could be considered an effect on water quality. A spill along the TAPS tanker route could contaminate receiving water over several tens of square miles to levels above chronic criteria but below acute criteria.

Effectiveness of Stipulations: Effectiveness of stipulations is similar to that under Alternative B.

5. Air Quality:

a. Activities Other than Oil and Gas Exploration and Development: The ground-impacting-management activities that would affect air quality under Alternative D would be the same as those under Alternative A. The impacts of these activities would be the same as those under Alternative A.

b. Oil and Gas Exploration and Development Activities:

(1) Exploration: Exploration activities within the planning area that may affect air quality under Alternative D are drilling and pad construction, the same as for Alternative C. Under Alternative D, the number of exploratory wells drilled per year would be twice the number under Alternative C.

(2) Development: Development activities within the planning area that may affect air quality under Alternative D are drilling, facility and pipeline construction, and production, the same as under Alternative C. Total number of wells drilled for Alternative D would be approximately one-quarter more that Alternative C. Total emissions from these activities would be limited through permits obtained from the State of Alaska to less than the Clean Air Act standards.

Conclusion—First Sale: Effects of oil and gas activities under Alternative D are similar to those under Alternative C. Annually, air quality would be affected by drilling and construction activities at levels less than the PSD criteria. Effects of activities other than oil and gas are negligible, as in Alternative A.

Multiple Sales: The effects on air quality from multiple sales should result in air emissions that remain below the maximum allowable PSD Class II increments. The concentrations of criteria pollutants in the ambient air would remain well within the air-quality standards. Consequently, a minimal effect on air quality with respect to standards is expected.

Conclusion—Multiple Sales: Activities associated with multiple sales would result in sequential effects which would remain small and localized. Concentrations would remain within the PSD Class II limits and effects would remain low.

Effectiveness of Stipulations: Current laws and regulations are assumed to be in place for the analysis of the IAP, and effects levels reflect this assumption.

6. Vegetation: Ground-impacting-management actions within the planning area that may affect vegetation under Alternative D include those analyzed under Alternative A and those resulting from oil exploration and development analyzed under Alternative B. The impacts of management actions described under Alternative A would be similar under Alternative C, except that the total areal extent of archaeological/paleontological excavations may increase to 5 acres per year and seismic survey activity would increase (see below).

a. Exploration: Impacts of exploration drilling under Alternative D would be of the same types as under Alternative B, but there would be 9 to 28 wells drilled rather than 1 to 10. This scenario could result in the death of vegetation on the perimeters of oversummer ice pads of 0.2 to 0.6 acres of vegetation spread among 5 to 14 different sites. Construction of well collars would cause the destruction of vegetation on 0.05 to 0.2 acres.

The types of impacts of seismic exploration would remain the same as under Alternative B. It is assumed that the number of 2-D surveys would remain the same at one per winter, but that this frequency would continue for about 15 years rather than 10 before decreasing to alternate winters. Because the tundra can recover from about 90 percent of these impacts in 9 years, it is expected that this change would result in little increase in area affected at any one point in time. It also is assumed that the number of 3-D surveys would increase from zero to two over 5 years to two to seven over 15 years. This would result in 92,000 to 322,000 acres impacted by 3-D surveys.

b. Development: The impacts of development would be of the same types under Alternatives B and D. It is assumed the number of pump stations would remain 0-1, but the number of s developed might increase to 1-4 from 0-1, with a proportional increase in the extent of area impacted. The gravel pads of these s would bury 100 to 400 acres of vegetation. Dust effects would cover 36 to 144 acres, and the effects of a changing moisture regime might affect 200 to 800 acres. Material sites would cause the destruction of 40 to 160 acres, with moisture-regime changes around them affecting another 20 to 80 acres. Pipeline miles would increase, causing vegetation impacts to increase to 2.5-3.7 acres (or more, if any portion of a pipeline would be buried). Finally, the occurrence of oil spills would increase, affecting 1.4 to 6.0 acres, and the probability of seawater pipeline spills would increase.

Conclusion—First Sale: Impacts to vegetation from activities other than oil exploration and development under Alternative D would be the same as those under Alternative A, except that the effects of archaeological excavation might increase from 1 to 5 acres. The impacts of oil exploration and development would be of the same types as for Alternative B, but greater in areal extent. The maximum acreage affected by 3-D seismic surveys would increase from 0 to 92,000 acres to 92,000 to 322,000 acres. The combined effect of development activities would cause the destruction of vegetation on 140 to 600 acres rather than 0 to 180 acres and the alteration in plant species composition of another 220 to 940 acres instead of 0 to 280 acres, for a total of effects over 360 to 1,540 acres rather than 0 to 460 acres. Finally, the occurrence of spills would increase, affecting 1.4 to 6.0 acres instead of 0.5 to 2.6 acres, but the probability of a blowout would remain low.

Multiple Sales: It is assumed that additional lease sales under Alternative D would result in additional exploration activities and a total of two to seven s being developed. More acreage would be impacted by seismic surveys, but it would be over a longer period of time. It is expected that recovery from at least 90 percent of the impacts from the earliest surveys would be complete before additional seismic operations would commence as a result of multiple sales. The total number of exploratory wells is assumed to increase to 12-44 from 4-11 and delineation wells to 12-36 from 5-17, for a total of 24 to 80 wells drilled from ice pads. Vegetation destruction from well collars would increase to affect 0.1 to 0.5 acres, and vegetation death around ice-pad perimeters would increase to 0.6 to 2.0 acres. Tundra would recover from the latter in 1 to a few years.

With the assumption of two to seven s developed, the vegetation that might be destroyed by burial under gravel fill would increase to 200 to 700 acres. The area of vegetation around gravel pads that would undergo change from dust or moisture-regime impacts would be 400 to 1400 acres. The impacts of developing material sites would increase correspondingly to the number of s. This would mean the destruction of vegetation on 80 to 280 acres and effects of moisture-regime changes on 40 to 140 acres. It is assumed that the number of pump stations would remain at 0 to 1, resulting in the burial of 0 to 40 acres and dust or moisture- regime changes on an additional 0 to 60 acres. The number of pipeline miles would increase somewhat under multiple sales, with a total of 105 to 185 mi, resulting in the destruction or alteration of a total of 3.1 to 5.5 acres (or more, if any portion of a pipeline would be buried). The incidence of oil spills would also increase, affecting 2.7 to 12.0 acres of vegetation.

Conclusion—Multiple Sales: The impacts of oil exploration would include more vegetation disturbance from seismic work than under a single-sale scenario, but the extended period of time over which it would occur, coupled with the recovery time for disturbed areas, would result in a small increase in the amount of disturbance that would be evident at any one time. Exploration activities would also result in 0.1 to 0.5 acres of permanent vegetation destruction around well collars and alteration of 0.6 to 2.0 acres around ice pads. The activities of development that would impact vegetation include construction of gravel pads, roads, and airstrips for each ; potential construction of one pump station within the planning area; excavation of material sites; and construction of pipelines. The combined effect of these activities would cause the destruction of vegetation on 280 to 1,020 acres and the alteration in plant species composition of another 440 to 1,600 acres, for a total of effects over 720 to 2,620 acres. The duration of these impacts would be permanent, assuming that the gravel pads would remain after oil production ends, and recovery thus would be moot. Oil spills would affect 2.7 to 12.0 acres of vegetation within the planning area. Recovery from spills would take a few years to 2 decades. The probability of a blowout would remain low.

Effectiveness of Stipulations: The effectiveness of stipulations would remain the same as under Alternative B, i.e., there are no stipulations beyond existing management practices that would reduce the above impacts to vegetation.

7. Fish:

a. Activities Other Than Oil and Gas Development: Actions associated with Alternative D that may affect fish include the establishment of large work camps at pre-existing airstrips; small scientific excavations for paleontological, geologic, and soils-related information; the sport harvest of fish by workers; and those associated with fuel spills at fuel-storage sites. The establishment of work camps, scientific excavations, and the sport harvest of fish are not expected to have a measurable adverse effect on arctic fish populations. Fuel spills at fuel-storage sites may adversely affect arctic fish populations.

b. Oil and Gas Exploration and Development Activities: Alternative D also involves several management actions associated with oil and gas development. These include seismic surveys; the construction of gravel drill pads, roads, airstrips, pipelines; and oil spills (drill pad, pipeline, and supply barge). The individual effects of these actions and the chemical agents associated with them have been discussed in previous Beaufort Sea EIS's (e.g., USDOI, MMS, 1996a), which are incorporated here by reference. The remainder of this analysis focuses on differences in the amount of exposure arctic fish are likely to have to each of these actions in Alternative D as compared to Alternative B. Because the number and/or location of seismic surveys, drill pads, roads, airstrips, and pipelines are unknown for Alternative D, the overall effect of these individual activities on arctic fish cannot be quantified or compared directly to those of other alternatives. What is known is that more of the planning area is exposed to oil and gas development in Alternative D (90%), than in Alternative B (53%). This additional area supports a greater number and diversity of fish than the fish-bearing waters of Alternative B. Additionally, Alternative D exposes more of the more productive fish habitat (e.g., Teshekpuk lake) in the planning area to oil and gas development than is exposed by Alternative C. These differences increase the probable number of oil- and gas-related activities, the probability of their affecting arctic fish populations (roughly 4-5 times higher), and the probable overall effect of Alternative D on fish over that of Alternative B.

(1) Effects of Disturbance:

(a) Effects from Seismic Surveys: Arctic fish are likely to be adversely affected by seismic surveys located above overwintering areas. Likely effects would include avoidance behavior and short-term added stress but also could result in the death of some of the more sensitive lifestages (e.g., juveniles). However, the effect on most overwintering fish is expected to consist of only short-term, sublethal effects. While Alternative D is likely to involve more seismic surveys than Alternative A and thereby would increase the probability of seismic activity occurring above overwintering habitat, such events are likely to be infrequent. Hence, seismic surveys associated with Alternative D are expected to have the same overall effect

on fish as discussed for Alternative A (i.e., no measurable effect on arctic fish populations). While Alternative D is likely to involve more fuel spills than Alternative A, the amount of fuel entering fish habitat is not expected to increase significantly. Hence, fuel spills associated with Alternative D are expected to have the same overall effect on fish as discussed for Alternative A (i.e., no measurable effect on arctic fish populations).

(b) Effects from Construction:
Construction-related activities that may affect arctic fish include the construction of drill pads, roads, airstrips, pipelines; and possibly gravel extraction. The individual effects of these activities for Alternative D are expected to be the same as discussed for Alternative B and are summarized below. However, the likelihood of the above construction-related activities occurring and affecting fish habitat is roughly two to three times greater in Alternative D than in Alternative B. Depending on the specific level and location of implementation, this could result in a corresponding increase in the overall effect of these activities in Alternative D over that of Alternative B.

Construction during exploration would involve freshwater withdrawals for the construction of ice- drill pads, roads, and airstrips. Ice roads or airstrips constructed through overwintering areas <10 ft deep would freeze to the bottom and form a barrier to water circulation, resulting in reduced levels of dissolved oxygen. This could have lethal effects on the fish affected by the barrier. The construction of ice roads and airstrips in non-overwintering areas is expected to have no measurable effect on arctic fish. Freshwater withdrawals may to adversely affect fish, if the water is taken from areas where they are overwintering. Under-ice withdrawals from areas having water and dissolved oxygen levels barely to moderately sufficient to support to overwintering fish would be likely to kill many of the fish overwintering there. The recovery of affected fish populations would be expected in 5 to 10 years. However, withdrawals from freshwater sources that do not support resident fish populations, or from areas having sufficient under-ice reserves of water and dissolved oxygen, are not likely to adversely affect overwintering fish.

Construction during production would involve the construction of gravel drill pads, roads, and airstrips. The difference in the estimated number of gravel drill pads (up to 2 for Alternative B and up to 6 for Alternative D, respectively) is not expected to make a measurable difference in effects on arctic fish in Alternative D. Of far greater significance is the specific location of these drill pads, roads, and airstrips. The effects of gravel construction and gravel extraction activities in high density spawning and overwintering habitat, or in access corridors used by migratory fish, are expected to be spawning failure and mortality for many of the fish affected (an estimated 10-year recovery). No measurable effects on arctic fish populations are expected in low-density areas. The same applies to gravel extraction activities that might occur outside of the planning area. The effects of pipeline trenching through overwintering or spawning habitat are likely to be spawning failure and/or mortality of many fish, and a 5 to 10-year recovery period. Trenching that avoids these habitats is not expected to adversely affect fish. The difference in the estimated number of pipeline miles (up to 75 mi for Alternative B and up to 105 mi for Alternative D, respectively) is not expected to make a measurable difference in effects on arctic fish in Alternative D. Alternative D may also involve the construction of a coastal docking facility to offload supply barges into the planning area. The effect of a docking facility on arctic fish would depend on its location, size, and design characteristics. The construction of a large docking facility in offshore waters, requiring a long access road, could adversely affect the movement of some coastal marine and migratory fish. However, the construction of a facility that provides for the movement of these fish is not likely to adversely affect them. Because supply barges are shallow draft vessels, the docking facility for Alternative D is expected to be constructed in shallow nearshore waters. Also, the size of the facility for Alternative D is expected to be relatively small (up to several hundred feet), and to provide for the movement of coastal fish. Hence, the construction of a coastal docking facility associated with Alternative D is not expected to have a measurable effect on arctic fish.

(2) Effects of Spills: The individual effects of oil on fish for Alternative D are the same as discussed for Alternatives A and B. As discussed therein, lethal effects on fish due to a petroleum-related spill seldom are observed outside the laboratory environment. Sublethal effects are more likely and include changes in growth, feeding, fecundity, and survival rates and temporary displacement. Other possibilities include interference with movements to feeding, overwintering, or spawning areas; localized reduction in food resources; and consumption of contaminated prey. The specific effect of oil on fish generally depends on the concentration of petroleum present, the time of exposure, and the stage of fish development involved (eggs, larva, and juveniles are most sensitive). The oil-spill assessment estimates that the amount of oil spilled during the life of the field would be 656 bbl for Alternative D and 280 bbl for Alternative B. However, neither this difference, nor the fact that oil- and gas-related activities are estimated to be four to five times more likely to affect fish in Alternative D, are expected to alter the overall effect of oil spills on arctic fish. Hence, oil spills associated with Alternative D are expected to have the same overall effect on arctic fish as discussed for Alternative B (no measurable effects on arctic fish populations in the planning area over the production life of

the field). The effects of a seawater pipeline spill on arctic fish populations are expected to be similar to that of Alternative B (no measurable effects on arctic fish populations in the planning area over the production life of the field).

Conclusion—First Sale: The effect of fuel spills on arctic fish populations in Alternative D are expected to be similar to Alternative A. The individual effects of seismic surveys, construction related activities, and oil and seawater spills are expected to be similar to that of Alternative B. However, the likelihood of their occurrence is estimated to be roughly four to five times higher for Alternative D than for Alternative B. Depending on the actual level and location of implementation, this could result in a corresponding increase in the overall effect of these activities on arctic fish populations in Alternative D over that of Alternative B.

Multiple Sales: The actions most likely to affect arctic fish for the first lease sale have been discussed herein and include seismic surveys, construction related activities, fuel spills, and oil spills. While additional northeastern NPR-A lease sales would involve more seismic surveys than the first sale, and thereby would increase the probability of seismic activity occurring above overwintering habitat, such events are likely to be infrequent. Seismic surveys associated with multiple sales in Alternative D are expected to have the same overall effect on fish as discussed for the first sale (i.e., no measurable effect on arctic fish populations). For additional northeastern NPR-A lease sales that may occur in the future, the number of production pads and pipeline miles have been estimated (Table IV.A.1.b-7). That table estimates that there would be about twice the number of gravel pads as the first sale (see Table IV.A.1.b-5). On the basis of this estimate, gravel pads for multiple sales are likely to have about twice the effect on arctic fish as the first sale. Because there is little difference in the estimated number of pipeline miles for multiple sales (up to 150) and the first sale (up to 105), they are expected to have a similar effect as discussed for the first sale. It is estimated that up to 1312 bbl of crude oil would be spilled for multiple sales, or about 2 times that of the first sale (estimated at up to 656 bbl). On the basis of this estimate, crude oil spills for multiple sales are expected to have about twice the effect on acrtic fish as the first sale. However, if there were not enough time between sales to allow for full recovery, or if the level of activity of the selected alternatives were significantly greater than that of the first sale, the effect of each additional sale on arctic fish populations is likely to be greater than estimated herein for multiple sales.

Conclusion—Multiple Sales: Seismic surveys and pipelines associated with multiple sales are expected to have the same overall effect on arctic fish as the first sale. Gravel pads are expected to have about twice the effect as the first sale. Fuel and oil spills are likely to have a greater effect on arctic fish than the first sale. Insufficient recovery time between sales and/or greater levels of activity would be likely to result in greater effects than estimated herein for multiple sales.

Effectiveness of Stipulations: The stipulations having the most beneficial effect on arctic fish are the same as discussed for Alternative B. However, due to the increased level of potential oil and gas activity associated with Alternative D over that of Alternative B, the absence of these stipulations may increase adverse effects on arctic fish populations.

8. Birds: This section discusses potentially adverse effects of ground-impacting-management actions on nonendangered birds within the planning area under Alternative D. Such actions potentially may result in disturbance factors, habitat alteration or loss, and fuel or oil spills. Effects on birds exposed to such factors would be similar in type to those discussed under Alternative B.

a. Activities Other than Oil and Gas Exploration and Development: Management actions other than oil and gas exploration and development under Alternative D, and their potential effects, differ from Alternative A approximately as discussed under Alternative B, differing from B primarily in that the Colville River would be recommended for inclusion as a "recreational" river in the WSR System rather than as a "wild" (Alt. B) river. These differ as follows: (1) mineral leases are allowed in the river corridor; (2) roads/trails can be maintained on both sides of the river, including on river banks, with several bridge crossings and numerous access points, and motorized travel on existing roads is permitted; and (3) major public facilities are allowed within the river corridor. These specifications are expected to allow greater levels of habitat degradation and disturbance than Alternatives A, B, or C. Without stipulations to assure avoidance of important habitat areas, raptor nesting success and passerine populations in developed areas of the river corridor are expected to decline under this classification in comparison to the preceding alternatives.

b. Oil and Gas Exploration and Development Activities: Oil and gas leasing would be allowed on most (approximately 90%) of the planning area (Fig. II.C.1-4; Table IV.A-1), except in the Goose Molting Habitat LUEA. One or more areas of higher density concentration for six species would be exposed to potential impact from oil and gas development under this alternative that were not available for leasing under Alternative B. Among these the yellow-billed loon (1 additional area exposed of a total of 8 high-density areas within the northeastern NPR-A) probably is the most vulnerable as a result of relatively low

population and productivity. Other species include the greater white-fronted goose, northern pintail, oldsquaw, king eider, scaup, and the shorebird group. Exploration and development activity under Alternative D will be substantially greater than under Alternative B, with 8 to 18 additional exploratory and delineation wells drilled (9-28 versus 1-10), 1 to 4 additional production pads, and 30-80 additional miles of pipeline (Tables IV.A.1.b-5 and 7). Additional drilling would prolong the period during which disturbance and habitat unavailability would occur two to three winter seasons. Additional production pads would displace any nesting birds from 60 to 110 acres each for the duration of production, and additional pipeline would result in a negligible increase in disturbance during monitoring flights.

Gravel mining outside the planning area is assumed to occur in the Nuiqsut area and be transported to site on ice roads during winter. This activity could cause minor local disturbance and temporary displacement of the three resident species along the road route and at the mine site. During the breeding season, nesting individuals would be displaced to undisturbed habitats with potential for lowered productivity. The additional acreage leased could result in potential exposure of additional areas of concentration for some waterbird species, as well as raptors along the Colville and other rivers (stipulations would mitigate potential effects).

If a 325-bbl crude-oil spill entered Teshekpuk Lake, small numbers of waterfowl and/or raptors could be exposed. Numbers of individuals oiled would depend primarily upon wind conditions, and numbers and location of birds following entry of the spill into the lake. If the spill entered the Colville River, a variety of waterfowl could be present and Canada geese breed on bluffs along the river. Gyrfalcons, peregrine falcons, and rough-legged hawks could become secondarily oiled by preying on oiled birds. If the spill moved into the delta area additional waterfowl species that breed there or stop during migration would be at risk. A spill entering the river in spring could contaminate overflow areas or open water where spring migrants of several waterfowl species concentrate prior to occupying nesting areas.

Considerably more coastal area would be available for oil and gas leasing under this alternative than for Alternative B. An oil spill at a well within 2 mi of the coast is expected to have similar effects as other onshore spills discussed above. Effects are likely to be more severe if the oil enters aquatic habitats. Because of the oil-absorptive capacity of tundra habitats and the distance from the coast, it is not likely that the spill would enter the marine environment.

It is assumed for Alternative D that a crude-oil spill from an offshore site would occur. The spill could contact loons and large flocks of brant, oldsquaw, and/or eiders staging in protected coastal habitats (e.g., Harrison Bay) or waters farther offshore. Effects on individual birds would be the same as described for Alternative B. Lethal effects are expected to result from moderate to heavy oiling of any birds contacted. Light to moderate exposure could reduce future reproductive success as a result of pathological effects caused by oil ingested by adults during preening or feeding that interfere with the reproductive process. Some broodrearing, molting, or staging brant, Canada geese, and snow geese could contact oil in coastal habitats. Mortality of molting oldsquaw from a spill entering protected areas could be substantial, but the population effect would be difficult to determine because numbers are stable in some areas, declining in others (Conant, 1997). Large flocks of staging eiders could contact oil in areas farther offshore. The king eider population has declined 50 percent in 20 years so substantial mortality could be significant. Common eiders, nesting on barrier islands and along the coastal, could be contacted by a marine spill. Also, several thousand shorebirds could encounter oil in shoreline habitats (e.g., Colville River delta), and the rapid turnover of migrants during the migration period suggests many more could be exposed. A spill that enters open water off river deltas in spring, or nearshore areas in fall, could contact migrant loons and eiders.

A pipeline spill of seawater used in waterflood enhancement of production would kill salt-intolerant tundra vegetation near the pipeline. The amount of tundra habitat affected is expected to be no more than a few acres; this small area of degraded habitat is not likely to result in loss of productivity by displaced breeders that is detectable at the population level.

These differences are expected to result in effects on bird populations that are two to three times greater than those discussed for Alternative B.

Conclusions: Effects of actions other than oil and gas activity under Alternative D are expected to be essentially the same as for Alternative B, except in the Colville River corridor where increased activity would result in substantially greater effects. Effects of oil and gas activity are expected to be two to three times greater than discussed for Alternative B; this does not represent a significantly greater effect for any species. As a result of their small average size, onshore oil spills reaching aquatic habitats are expected to cause losses of tens of individuals, but the effect of such losses may not be detectable above the natural fluctuations of the population.

A crude-oil spill from an offshore site in the marine environment during August or September could contact

loons and flocks of brant, oldsquaw, and/or eiders staging in protected coastal habitats or waters farther offshore. Some broodrearing, molting, or staging brant, Canada geese, snow geese, oldsquaw, king eiders, and common eiders could be contacted in coastal habitats. Mortality of molting oldsquaw could be substantial, but the effect would be difficult to determine because of an uncertain population status. Because of an apparently declining population, substantial king eider mortality could be significant. Also, several thousand shorebirds could encounter oil in shoreline habitats. A spill that enters open water off river deltas in spring, or nearshore areas in fall, could contact migrant loons and eiders.

Multiple Sales: If multiple sales occur in the area available for leasing under Alternative D, intensive construction activity could last 15 to 30 years, tapering off as existing infrastructure is used for each succeeding development. Approximately three times the number of exploration and delineation wells may be drilled (24-80 versus 9-28), the number of fields developed doubling (2-7 versus 1-4), and production pads are expected to at least double (3-12 versus 1-6), with multiple sales (Tables IV.A.1.b-4, 5, 6, and 7). Pipeline miles (80-105 mi) are expected to increase to 95 to 150 mi. Surface, air, and foot traffic is expected to increase substantially in some areas if facilities are grouped in high resource-interest areas; if these coincide with high bird-concentration areas greater numbers of individuals are expected to be displaced and more species involved than with a single sale. Such increases may cause substantial changes in planning area bird population levels and/or distribution. Effects from disturbance and habitat alteration or loss on birds is expected to increase throughout most of the planning area with multiple sales under Alternative D.

The estimated number of onshore oil spills >1 bbl is expected to increase to 17-82 for multiple sales from 9-41 for the first sale (Tables IV.A.2-3a, -3b); this doubling of spills is expected to cause substantially greater loss of individuals and increased number of species involved. An increase to 172-766 small refined-oil spills for multiple sales from 86 to 383 for the first sale (average size of 29 gal) is expected over the production life of the planning area (Tables IV.A.2-3a, IV A2-3b, IV A 2-6a and IV A 2-6b). Although these small, chronic spills generally are contained and cleaned up on pads and roads, a doubling of their occurrence is expected to have similar increased effect on birds and their habitats as with the first sale under Alternative D. Habitat contamination is expected to increase locally at the spill sites and along any streams contaminated by these spills. Any habitat contamination that is not effectively cleaned up is expected to persist for several years but is not expected to affect populations significantly.

Conclusion—Multiple Sales: Displacement of birds from disturbance and habitat alteration or loss is expected to increase in developed areas that may occur in most of the planning area under Alternative D with multiple sales, substantially changing planning area local bird population levels and/or distribution. Increases in oil and refined oil spills are expected to result in greater loss of numbers of birds than under the first sale, but these losses are not likely to be detectable above the natural fluctuations of the population and survey methods/data available. Overall effect is expected to increase substantially from that discussed for the first sale.

Effectiveness of Stipulations: Effectiveness of stipulations under Alternative D is expected to be essentially the same as described under Alternatives A, B, and C.

9. Mammals:

a. Terrestrial Mammals: Among the terrestrial mammal populations that could be affected under Alternative D are TLH and CAH caribou. Moose, muskoxen, grizzly bears, wolves, wolverines, and arctic foxes may be locally affected by planning-area activities.

(1) Activities Other than Oil and Gas Exploration and Development: The level of activities such as resource inventories, aerial surveys, and research camps is expected to increase somewhat under Alternative D as compared to Alternative A, but the level of effect is expected to be about the same.

(2) Oil and Gas Exploration and Development Activities: Under Alternative D, one to four oil fields are assumed to be discovered and developed. Primary effects on terrestrial mammals would come from motor-vehicle traffic within the oil field(s). Other effects could come from foot traffic near facilities and camps; from aircraft traffic; from small, chronic crude-oil and fuel spills contaminating tundra, stream, and coastal habitats; and from habitat alteration associated with gravel mining and construction. (Please see Alternative B, Sec. IV.C.9.a, for a discussion of general effects of disturbance and spills.) The planning area is divided into thirds—northern (including Teshekpuk Lake and the Beaufort coast), middle (the area generally west and southwest of Nuiqsut), and southern. Under Alternative D, portions of the northern area and all the middle and southern areas would be open for leasing and development (Fig. II.C.1-4).

(a) Effects of Disturbance: If a field is developed in the northern planning area south and west of Teshekpuk Lake, production pads, pipelines, within-field roads, and other facilities (housing, airfield, processing plant) would be located within the southern portion of the TLH calving area (Fig. III.B.5.a-1). Some calving is

expected to be displaced within 1.86 to 2.48 mi (3-4 km) of within-field roads. Movements of some cows and calves across these roads is expected to be reduced, and cow caribou may avoid crossing the roads during the calving season. Some displacement of calving caribou is expected to occur. Some TLH movements during the insect-relief season (late June-August 15) are expected to be adversely affected by pipelines and road traffic. However, most caribou movements to coastal insect-relief areas occur to the east of the lake and are not expected to be affected.

Gravel extraction (outside of the planning area), hauling of the gravel on ice roads (into the planning area), and deposition of gravel in the lease areas would result in local disturbance-displacement (within no more than 1 mi of the operations) of small numbers of individual mammals but wouldn't affect the distribution and abundance of caribou, muskoxen, moose, or other terrestrial mammals.

Trenching for and burial of pipelines at river crossings would have very local effects on tundra and riparian vegetation and would not significantly affect terrestrial mammal habitats.

If a field is developed in the middle planning area, there would be no effect on TLH calving or the TLH calving area. Some TLH migration movements may be adversely affected by air and surface traffic along pipelines and roads within the oil field. If a field is developed in the southern planning area, some members of the CAH, WAH, and TLH caribou would encounter the field during their fall-migration route and within a portion of their winter range. However, neither the pipeline to the TAPS nor facilities within the oil field would be expected to significantly affect the movement of caribou or alter their distribution or abundance.

A pipeline from the oil field(s) would connect to the TAPS through facilities at the Alpine and Kuparuk River fields. The pipeline would be constructed during winter. So that no permanent road would be associated with the pipeline, ice roads would be used. During construction, air traffic would include several flights per day, which temporarily could disturb some of the TLH and CAH caribou and other terrestrial mammals within about 1.2 mi (2 km) of the pipeline. Disturbance effects on caribou and other terrestrial mammals are expected to be short term, interference with their movements would be temporary (probably a few minutes to less than a few days), and they eventually would cross the pipeline area. Also, disturbance reactions would diminish after construction, and flights would decrease to about one or two per day at most. The abundance and overall distribution of terrestrial mammals are not expected to be affected by pipeline construction or operation.

Under Alternative D, some terrestrial mammals could be affected by possible oil exploration offshore from an ice island and subsequent oil development on the coast of the NPR-A in Harrison Bay from about Kogru Inlet south to a small area south of Atigaru Point (Figure II.C.1-4). Effects of these activities would be local and are not likely to affect terrestrial mammal populations.

(b) Effects of Spills: For general information on the effects of oil spills on terrestrial mammals, please see the discussion under Alternative B (Sec. IV.C.9.a). Chronic crude-oil and fuel spills from onshore activities and possible marine transportation probably would result in the loss of small numbers of terrestrial mammals. Under Alternative D, approximately 9 to 41 (>1 bbl) crude-oil spills (averaging 4 bbl) and 86 to 383 small, refined-oil spills (averaging 29 gal) are assumed to occur onshore over the production life of the planning area (Tables IV.A.2-2 and 2-6). These small, chronic spills including a potential oil spill contacting Teshekpuk Lake or the Colville River, are expected to have about the same effect on terrestrial mammals and their habitats as under Alternative B.

If seawater were used for waterflood enhancement of oil production under Alternative C, a saltwater spill could occur within the NPR-A. This spill would have adverse effects on salt- intolerant vegetation near the pipeline but the amount tundra habitat affected would be small, no more than a few acres. This potential saltwater spill is not likely to affect forage availability of caribou, muskoxen, moose, or other terrestrial mammals in the planning area.

Conclusion—First Sale: Activities other than oil and gas are expected to increase somewhat under Alternative D as compared to Alternative A, but the increase is not expected to affect terrestrial mammal populations. For oil and gas activities, effects of Alternative D are expected to be significantly greater than those of Alternative B, with more helicopter disturbance of caribou and other terrestrial mammals. Increased habitat alteration would include the development of one to four oil fields and a pipeline to the TAPS. Some CAH and TLH caribou are expected to be disturbed and their movements delayed along the pipeline during periods of air traffic. Near the oil fields, surface, air, and foot traffic are expected to increase and to displace some terrestrial mammals, but not significantly affect Arctic Slope populations. If a field is developed in the area south and west of Teshekpuk Lake, some TLH caribou calving is expected to be displaced within 1.86 to 2.48 mi (3-4 km) of roads and other production facilities over the life of the project. The number of small, chronic crude-oil and fuel spills including a potential oil spill contacting Teshekpuk Lake or the Colville River, are likely to result in the loss of small numbers of terrestrial mammals, with recovery expected within 1 to 2 years. Trenching for and

burial of pipelines at river crossings would have very local effects on tundra and riparian vegetation and would not significantly affect terrestrial mammal habitats.

Under Alternative D, some terrestrial mammals could be affected by possible oil exploration offshore from an ice island and subsequent oil development on the coast of the NPR-A in Harrison Bay from about Kogru Inlet south to a small area south of Atigaru Point (Figure II.C.1-4). Effects of these activities would be local and are not likely to affect terrestrial mammal populations.

Multiple Sales: If several lease sales occur under Alternative D, considerably more exploration activity is expected to occur along the coast of the Colville River Delta-southern Harrison Bay area, with the number of exploration wells drilled increasing to 12-44 for multiple sales from the 4-11 wells for the first sale. The amount of development also is expected to increase. The number of oil fields would increase to 2-7 for multiple sales from the 1-4 fields for one sale, the number of production pads would increase to 3-12 for multiple sales from the 1-6 pads for the one sale, and pipeline miles would increase to 95-150 mi for multiple sales from 80 to 105 mi for the first sale. Although most of the increase in human activities associated with oil exploration and development is expected to occur inshore, south of the coast, an increase the potential displacement of calving TLH caribou could occur along roads between the production pads and other facilities assumed to be located south of Teshekpuk Lake. An increase in the number or miles of roads and other facilities with development under multiple sales is also expected to increase the impedance of TLH caribou movements to insect-relief areas along the coast, north of Teshekpuk Lake. The displacement of calving caribou represents a functional loss of habitat within 1.86 to 2.48 mi (3-4 km) of within-field roads. This effect is expected to persist over the life of the oil fields and may reduce productivity and abundance of the TLH.

Under Alternative D, the number of small crude-oil spills (>1 bbl) is expected to increase to 17-82 (average size of 4 bbl) for multiple sales from an estimated 9-41 for the first sale. Small fuel-oil spills would increase to 172-766 for multiple sales from 86-383 for the first sale (average size of 29 gal). The small crude- and fuel-oil spills are estimated to occur onshore over the production life of the planning area (Tables IV.A.2-3a, IV.A.2-3b, IV.A.2-6a, and IV.A.2-6b). These small, chronic spills are expected to have about the same effect on terrestrial mammals and their habitats as under Alternative D with the first sale but with a loss of individual mammals to the spills and habitat contamination increasing locally at the spill sites and along any streams contaminated by these spills. These spills are expected to result in the loss of small numbers of terrestrial mammals, with recovery expected within 1 year. Any habitat contamination that is not effectively cleaned up is expected to persist for several years but is not expected to affect terrestrial mammal populations.

Conclusion—Multiple Sales: The effect of multiple sales under Alternative D is expected to result in an increase in the amount of displacement of calving TLH caribou within 1.86 to 2.48 mi (3-4 km) of field roads assumed to be built between production pads south of Teshekpuk Lake. This effect is expected to persist over the life of the oil fields and may reduce productivity and abundance of the TLH caribou. Some increase in the impedance of TLH caribou movements to insect-relief areas along the coast, north of Teshekpuk Lake is expected under multiple sales. The number of small, chronic crude- and fuel-oil spills is expected to increase and result in the loss of small numbers of terrestrial mammals, with recovery expected within 1 year.

Effectiveness of Stipulations: Stipulations described in Section II.C.7 in regard to solid- and liquid-waste disposal, fuel handling, and spill cleanup are expected to reduce the potential effects of spills and human refuse on terrestrial mammals. Stipulations on overland moves and seismic work are expected to minimize alteration of terrestrial mammal habitats. The stipulation on aircraft to maintain a 1,000-ft AGL (except for takeoffs and landings) over caribou winter ranges from October through May 15, and to maintain a 2,000-ft AGL over the Teshekpuk Lake Caribou Habitat LUEA from May 16 through July 31, is expected to minimize disturbance of caribou. The designation of the Colville River as a "recreational" river under the Wild and Scenic Rivers System is not expected to provide any significant reduction in potential effects of caribou or other terrestrial mammals.

Stipulations on oil and gas exploration and development, including facility design and construction, are expected to minimize alteration of terrestrial-mammal habitat and interference with caribou movements. Stipulations that restrict permanent surface occupancy of oil and gas facilities within 2 mi of the coast and east of Teshekpuk Lake to Kogru Inlet are expected to reduce disturbance and interference with caribou movements, in particular the movements of caribou to and from the coast for insect relief and the movements of TLH cow caribou to calving habitats north of the lake. Stipulations requiring elevated pipelines and roads to be separated at least 500 ft and to place pipelines on the appropriate side of the road (depending on general movements of caribou in the area) significantly could reduce interference with caribou movements.

b. Marine Mammals: Under Alternative D, coastal areas near the Colville River Delta and in southern Harrison Bay would be open to oil and gas leasing. Six

species of marine mammals—ringed, spotted, and bearded seals, walruses, polar bears, and belukha whales—commonly occur year-round or seasonally in coastal habitats adjacent to the planning area. Under Alternative D, some individual members of these species may be exposed to effects from oil and gas exploration and development as well as other activities.

(1) Activities Other than Oil and Gas Exploration and Development: Such activities along the coast that may affect marine mammals include aerial surveys (including surveys of wildlife); ground activities such as resource inventories, paleontological excavations, research and recreation camps; and overland moves. Effects under Alternative D would be similar to those for Alternative A—local and short term, with no significant adverse effects to the populations as a whole.

(2) Oil and Gas Exploration and Development Activities: Oil and gas exploration and development activities along the coast that may affect marine mammals are noise and disturbance from air and surface traffic and geophysical seismic activities. Small onshore crude- and fuel-oil spills associated with Alternative D are not expected to reach the marine environment and affect marine mammals. However, a small number of seals and no more than a few polar bears might be adversely affected or killed by a 325-bbl crude-oil spill contacting the Colville River and some of the oil reaching marine waters, but these losses would not be significant to marine mammal populations.

(a) Effects of Noise and Disturbance: Noise associated with oil and gas activities is a main source of disturbance of seals, polar bears, and belukha whales. For a discussion of the nature of airborne- and underwater-noise effects on pinnipeds, polar bears, and belukha whales, see the Sale 124 Final EIS (USDOI, MMS, 1990). A discussion of noise and disturbance effects specific to the planning area follows.

The primary source of noise and disturbance would come from air traffic along the coast of the planning area from the Colville River Delta west to Kogru Inlet, specifically from helicopters associated with the assumed oil exploration and production activities. Aircraft traffic (several helicopter round trips/day during exploration and development) centered out of Deadhorse-Prudhoe Bay and perhaps Camp Lonely, traveling to and from NPR-A exploration and production facilities, is assumed to be a source of disturbance to ringed or spotted seals hauled out on ice or beaches, respectively, and polar bears using coastal habitats.

During the summer, some of the air traffic to and from exploration and production facilities could disturb spotted seals hauled out along the coast, causing them to charge in panic into the water. Because of frequent low visibility due to fog, aircraft may not always be able to avoid disturbing hauled-out seals. The number of seals affected would depend on the number of disturbance incidents. Aircraft disturbance of hauled-out seals in the planning area could result in injury or death to young seal pups. Although air-traffic disturbance would be very brief, the effect on individual seal pups could be severe. Aircraft disturbance of small groups of spotted and ringed seals hauled out along the coast is not likely to result in the death or injury of large numbers of seals, although increases in physiological stress caused by the disturbance might reduce the longevity of some seals if disturbances were frequent.

Under Alternative D, seals and polar bears could be affected by possible oil exploration offshore from an ice island and subsequent oil development on the coast of the NPR-A in Harrison Bay from about Kogru Inlet south to a small area south of Atigaru Point (Figure II.C.1-4). Effects of these activities would be local and are not likely to affect marine mammal populations.

If exploratory drilling occurs during the winter (early December-mid-April) near the coast, polar bears could be attracted to the oil field camps by food odors and curiosity. Some polar bears could be unavoidably killed to protect oil workers. However, the number of bears lost as a result of such encounters is expected to be very low.

(b) Effects of Geophysical Seismic Activities: Effects would be similar to those under Alternative A—short-term effects on a small number of polar bears that den along the coast of the planning area could occur.

Conclusion—First Sale: For marine mammals, the effects of activities other than oil and gas under Alternative D are expected to be similar to those under Alternative A—local and short term, with no significant adverse effects to the populations as a whole. The effects of oil and gas activities for Alternative D are expected to increase over the effects of Alternative B. Although most of the increase in human activities associated with oil exploration and development is expected to occur inshore, south of the coast, some increase in potential noise and disturbance effects are expected to occur in the Colville River Delta-southern Harrison Bay area. A small number of seals and no more than a few polar bears might be adversely affected or killed by a 325-bbl crude-oil spill contacting the Colville River and some of the oil reaching marine waters but, these losses would not be significant to marine mammal populations. Under Alternative D, seals and polar bears could be affected by possible oil exploration offshore from an ice island and subsequent oil development on the coast of the NPR-A in Harrison Bay from about Kogru Inlet

south to a small area south of Atigaru Point (Figure II.C.1-4). Effects of these activities would be local and are not likely to affect marine mammal populations.

Multiple Sales: If several lease sales occur under Alternative D, considerably more exploration activity is expected to occur along the coast of the Colville River Delta-southern Harrison Bay area, with the number of exploration wells drilled increasing to 12-14 for multiple sales from the 4-11 wells for the first sale. The amount of development also is expected to increase, The number of oil fields would increase to 2-7 for multiple sales from the 1-4 for the first sale, the number of production pads would increase to 3-12 for multiple sales from the 1-6 for the first sale, and pipeline miles would increase to 95-150 mi for multiple sales from the 80-105 mi for the first sale. Although most of the increase in human activities associated with oil exploration and development is expected to occur inshore, south of the coast, some increase in potential noise and disturbance effects on polar bears and seals is expected to occur in the Colville River Delta-southern Harrison Bay area. This increased activity could result in an increase in aircraft disturbance of seals hauled out on the ice along the coast in Harrison Bay and the Colville River Delta. An increase in onshore surface-traffic activity (seismic exploration, overland moves, construction activities along the coast) could result in more disturbance of polar bears denning and foraging along the coast. However, these effects are expected to be local and short term, with no significant adverse effects to the polar bear and seal populations as a whole.

Conclusion—Multiple Sales: Multiple sales under Alternative D are expected to have effects similar to those under Alternative D with the first sale, i.e., local and short term, with no significant adverse effects to marine mammal populations as a whole.

Effectiveness of Stipulations: The effectiveness of stipulations is expected to be the same as under Alternative A.

10. Endangered and Threatened Species:

a. Activities Other Than Oil and Gas Exploration and Development: Such activities associated with the management plan still would occur under this alternative. Ground-impacting-management actions within the planning area that may affect bowhead whales and spectacled and Steller's eiders under Alternative D include aerial surveys (including wildlife) and ground activities such as hazardous- and solid-material removal and remediation, which occur during the summer/early fall. A description of these activities and potential effects on these species is contained in Section IV.B.10 (Alternative A) and summarized herein. The potential effects from these activities are expected to be essentially the same as described for Alternative A. A detailed discussion of all management actions is found in Section II.

Bowhead whales are not likely to be affected by any activities associated with the management plan. Some eiders may be affected by activities associated with aircraft traffic and hazardous- and solid-material removal and remediation. Under Alternative D, there would be an increase in the number of aircraft flights for point-to-point flights, aerial wildlife surveys, and other aerial surveys. Point-to-point flights would increase from occasional to daily flights. Aerial wildlife surveys would increase from 14 days to 21 days during June and July, and other aerial surveys would increase from occasional flights to several 2- to 3-week periods (Table II.D.3). Summertime aircraft flights over sensitive areas for eiders may affect nesting females and their broods. Eiders breeding, nesting, or rearing young in coastal habitats north, west, and east of Teshekpuk Lake (Spectacled Eider LUEA, Fig. II.B.3) may be overflown by aircraft (both helicopters and fixed wing) on a regular basis during the summer months and may experience temporary, nonlethal effects lasting probably less than an hour. Because of the relatively low density of eiders in the area, substantial disturbance is not expected to occur and is likely to be limited to within a few kilometers of the activities. Such short-term and localized disturbances are not expected to cause significant population effects. However, disturbance of some individuals over the life of the project is expected to be unavoidable. Disturbance, depending on its nature and duration, could be considered a "take" under the ESA.

b. Oil and Gas Exploration and Development Activities: Under Alternative D, oil and gas leasing would occur in the planning area, although most of the Spectacled Eider LUEA, an area north and east of Teshekpuk Lake, would be unavailable for oil and gas leasing. This analysis is based on a development scenario presented in Section IV.A.1.b of this EIS. Please refer to these sections for a discussion of resource-recovery rates and quantities, timing of infrastructure development, platform emplacement, wells drilled, and resource production timeframes and other information relevant to the development of the resources of the proposed action. The BLM proposes to conduct multiple oil and gas lease sales within the planning area. Multiple sales are discussed later in this section. Under Alternative D, oil resources for the initial sale are expected to be in the 185- to 825-MMbbl range with from one to four fields, which is considered a reasonable range of resource development and activity level for the portion of the planning area open to leasing (Table IV.A.1.b-4). Information on the number of exploration, delineation, and production wells anticipated to be drilled and pipeline miles can be found in Table

IV.A.1.b-5. Differences in effects on the species as a result of noise and disturbance over this range of scenarios are expected to be minor. Differences in effects on the species as a result of an oil spill during the development/ production scenario (185-825-MMbbl-resource range) also are expected to be minor.

For Alternative D, the estimated number of oil spills that would occur over the assumed production life of the IAP is from 28 to 123 spills <1 bbl and from 9 to 41 spills >1 bbl (Table IV.A.2-3a). For the purposes of analysis, this EIS assumes an average spill size of 4.0 bbl and that the estimated number of crude-oil spills over the assumed production life of the planning area would range from 37 to 164 spills (Table IV.A 2-2a). Information pertaining to oil spills can be found in Section IV.A.2.

(1) Effects on the Bowhead Whale: The potential effects on bowhead whales from discharges, noise and disturbance, and oil spills associated with oil and gas activities or other activities associated with the management plan are expected to be essentially the same under this alternative as under Alternative B. Although a larger portion of coastline is available for leasing under this alternative, it is unlikely that any spilled oil will reach the marine environment. Onshore spills are generally fairly small with most of the spills occurring on the drilling pad. Those spills that occur on or reach the surrounding environment generally cover a small area ($\leq$500 ft^2). If any spilled oil did reach the marine environment it would likely be in the Harrison Bay area, which has a relatively low occurrence of bowhead whales. Such a spill is likely to be a very small amount and is unlikely to have any effect on bowhead whales.

(2) Effects on the Spectacled and Steller's Eiders: The potential effects on spectacled and Steller's eiders from discharges, seismic surveys, construction activities, seawater spills, and oil spills associated with oil and gas activities are expected to be essentially the same under this alternative as under Alternative B. Due to the potential for oil and gas activities in proximity to Teshekpuk Lake under this alternative, there would be increased potential for an oil spill to contact Teshekpuk Lake. For the purpose of analysis, it is assumed that a 325 bbl spill reaches the lake in early June. As a continuous spill, it would cover approximately 61 acres as a very thin film after 30 days. It likely would move around the lake as individual spillets with the prevailing wind direction. By the end of summer, all of the oil not cleaned up will be trapped along the lake's vegetated margins either on the water's surface or on the bottom. Some mortality of spectacled eiders may occur, if they are contacted by spilled oil. Spectacled eiders may be present in low densities on the lake during the breeding season, particularly the southwestern portion of the lake. There are little data regarding the presence or abundance of eiders on the lake during the remainder of the year. The potential effects as a result of noise and disturbance associated with oil and gas activities, such as aircraft traffic, vessel traffic, and perhaps drilling of development and production wells and oil-spill-cleanup activities, may increase slightly, although most spectacled eider breeding and nesting areas are in an area unavailable for oil and gas activities under this alternative. One area to the west and southwest of Teshekpuk Lake, part of the Spectacled Eider LUEA, is available for drilling and has a relatively high density of eiders compared to areas south of Teshekpuk Lake. Eiders exposed to noise and disturbance from oil and gas activities may experience temporary, nonlethal effects lasting probably less than an hour but possibly continuing all summer, in the case of summer drilling operations. However, most of the spectacled eider breeding and nesting areas are closed to oil and gas activities under this alternative. Some disturbance could occur in the marine environment, if new staging areas are created or if a discovery is made and a waterflood program using seawater is initiated. It is likely that existing staging areas will be used to the extent possible, and there would be no effects from construction activities on eiders. Disturbance to eiders in the marine environment from construction of a staging area or a waterflood program may cause a few individuals to be displaced from the nearshore coastal area in the vicinity of the project. However, the effects on eiders are likely to be negligible. Although Steller's eiders are present in the planning area, it isn't known for sure if they actually breed in the planning area. Because no oil and gas activities would occur in this area, those eiders will not be affected by oil and gas activities. Some Steller's eiders in the remainder of the planning area may experience some noise and disturbance as a result of oil and gas activities and may experience temporary, nonlethal effects lasting probably less than an hour but possibly continuing all summer in the case of summer drilling operations. However, it is unlikely that the primary Alaskan nesting area, located south and southeast of Barrow, would be affected much by these activities; so significant disturbance of nesting or broodrearing eiders is not expected to occur. The effects to eiders should be limited, with only a few eiders exposed to oil and gas activities.

Conclusion—First Sale: The potential effects on bowhead whales from discharges, noise and disturbance, seawater spills, and oil spills are expected to be essentially the same under this alternative as under Alternative B. The potential effects on spectacled and Steller's eiders from discharges, some noise and disturbance, and oil spills associated with oil and gas activities are expected to be essentially the same under this alternative as under Alternative B. Some mortality of spectacled eiders could occur if spilled oil managed to reach Teshekpuk Lake, although eiders appear to be present in low densities during the breeding season.

Little information is available for the rest of the season. Most spectacled eider breeding and nesting areas are protected under this alternative, because no oil and gas activities are permitted in most of the sensitive area. Some eiders in the area open to oil and gas activities may experience temporary, nonlethal effects as a result of increased aircraft traffic, vessel traffic, and perhaps drilling of development and production wells and oil-spill-cleanup activities. Some Steller's eider breeding and nesting areas also would be protected under this alternative, although some eiders in the remainder of the planning area may experience some noise and disturbance as a result of oil and gas activities and may experience temporary, nonlethal effects lasting probably less than an hour but possibly continuing all summer in the case of summer drilling operations. There also may be an increase in potential effects on eiders from activities associated with the management plan other than oil and gas activities, due to an increase in summertime aircraft flights over sensitive areas, that may affect nesting females and their broods. Under this alternative there will be an increase in the number of aircraft flights for aerial wildlife surveys and other aerial surveys. Aerial wildlife surveys in late June and early July increase from 14 days to 21 days. Spectacled and Steller's eiders breeding, nesting, or rearing young in coastal habitats may be overflown by support aircraft and may experience temporary, nonlethal effects lasting probably less than an hour. In the central portion of the planning area, Steller's eiders may occasionally be overflown by support aircraft and may experience temporary, nonlethal effects lasting probably less than an hour. It is unlikely that the primary Alaskan nesting area, located south and southeast of Barrow, would be affected much by these activities; so significant disturbance of nesting or broodrearing eiders is not expected to occur. Such short-term and localized disturbances are not expected to cause significant population effects. However, disturbance of some individuals over the life of the project is expected to be unavoidable. Disturbance, depending on its nature and duration, could be considered a "take" under the ESA.

Multiple Sales: Under the multiple-sales approach, the resource estimate for Alternative D increases from a range of 185 to 825 MMbbl in one to four oil fields (Table IV.A.1.b-4) to a range of 370 to 1650 MMbbl in two to seven oil fields (Table IV.A.1.b-6). The number of exploration wells increases from a maximum of 11 to 44, delineation wells increase from a maximum of 17 to 36, and production wells increase from a maximum of 248 on 6 pads to 495 on 12 pads. Pipeline miles increase from 105 to 150 mi (Tables IV.A.1.b-5 and 7). Multiple sales would occur over a longer period of time and, depending on frequency of sales and results from exploratory drilling operations, possibly increase the timeframe for oil and gas activities in the planning area by a couple of decades.

For Alternative D, it is estimated that the number of spills <1 bbl would increase from a range of 28 to 123 spills to a range of 56 to 246 spills, and the number of spills >1 bbl would increase from a range of 9 to 41 spills to a range of 17 to 82 spills over the assumed production life of the planning area (Tables IV.A.2-3a and IV.A.2-3b). The estimated number of crude-oil spills over the assumed production life of the planning area would increase from a range of 37 to 164 spills to a range of 74 to 328 spills (Tables IV.A 2-2a and IV.A.2-2b). Information pertaining to oil spills can be found in Section IV.A.2.

Conclusion—Multiple Sales: The effects of multiple sales and increased potential for noise-producing activities and oil spills on endangered and threatened species at the resource ranges and activity levels described are expected to be essentially the same as described above for the first sale.

Effectiveness of Stipulations: The effectiveness of stipulations for noise and disturbance from oil and gas activities are the same as for Alternative B, and from activities other than oil and gas, such as aerial wildlife surveys and other aerial surveys, the same as Alternative A.

11. Economy:

a. Activities Other Than Oil and Gas Exploration and Development: Alternative D would generate recreation-field employment is generated by 30, 1-week long float-trip parties per year (Table II.H.3.b), which is equal to one person working for 8 months each year.

b. Oil and Gas Exploration and Development Activities: Increased revenues and employment are the most significant economic effects that would be generated by Alternative D. Increased property-tax revenues and new employment would be created with the construction, operation, and servicing of facilities associated with oil and gas activities. These facilities are described in Table IV.A.1.b-1 and are summarized as follows. For exploration, 4 to 11 exploration and 5 to 17 delineation wells would be drilled between 2000 and 2009; for development, 56 to 248 production and service wells would be drilled, 1 to 6 production pads constructed, and 80 to 105 mi of onshore pipeline installed between 2006 and 2016. The number of workers needed to operate the infrastructure is determined by the scale of the infrastructure and not by the amount of oil produced. A wide range of production volume can be handled by a given level of infrastructure. Once the infrastructure is constructed, the number of workers needed to operate it does not depend on the amount of product flowing through it. Effects include employment generated by seismic surveys during exploration. State property-tax revenues are in proportion to the value of onshore facilities. State

Table IV.E.11-1
Summary of Employment Forecasts, Alternative D

	IAP Employment in Enclave			NSB Resident Employment		
	Without IAP Activity	With IAP Activity		Without IAP Activity	*Increase* with IAP Activity	
Year		$18/bbl	$30/bbl		$18/bbl	$30/bbl
1999	0	0	0	1,865	0	0
2000	0	99	99	1,825	2	2
2001	0	179	259	1,794	8	9
2002	0	179	339	1,767	12	19
2003	0	199	519	1,746	13	27
2004	0	59	299	1,730	12	31
2005	0	429	589	1,716	13	28
2006	0	1,318	2,452	1,701	45	77
2007	0	951	1,544	1,685	46	66
2008	0	894	1,599	1,662	21	36
2009	0	775	3,008	1,614	17	72
2010	0	565	1,631	1,565	17	34
2011	0	476	3,270	1,513	11	74
2012	0	550	2,237	1,470	14	61
2013	0	496	2,087	1,431	16	66
2014	0	496	2,110	1,393	16	72
2015	0	536	1,300	1,357	20	55
2016	0	536	1,300	1,350	20	55
2017	0	536	1,200	1,330	20	55
2018	0	536	1,200	1,310	20	50
2019	0	536	1,200	1,290	20	50
2020	0	536	1,200	1,290	20	50
2021	0	536	1,200	1,310	20	50
2022	0	536	1,200	1,330	20	50
2023	0	536	1,200	1,350	20	50
2024	0	536	1,200	1,370	20	50
2025	0	536	1,200	1,390	20	50
2026	0	536	1,200	1,410	20	50
2027	0	536	1,200	1,430	20	50
2028	0	536	1,200	1,450	20	50

Sources: Resident employment 1999–2015, Rural Alaska Model, North Slope Borough, 1996; IAP employment and resident employment 2016–2028, Manpower Model and MMS.

Table IV.E.11-2
Summary of NSB Population Forecasts, Alternative D

Year	Resident Population No IAP Activity	Increase in Resident Population		Year	Resident Population No IAP Activity	Increase in Resident Population	
		IAP Activity $18/bbl	IAP Activity $30/bbl			IAP Activity $18/bbl	IAP Activity $30/bbl
1999	6,067	0	0	2014	6,582	48	216
2000	6,134	6	6	2015	6,423	51	165
2001	6,213	24	27	2016	6,300	51	165
2002	6,301	36	57	2017	6,200	51	165
2003	6,391	39	81	2018	6,100	51	150
2004	6,488	36	93	2019	6,000	51	150
2005	6,684	39	84	2020	6,000	51	150
2006	6,695	135	231	2021	6,100	51	150
2007	6,820	138	198	2022	6,200	51	150
2008	6,918	63	108	2023	6,300	51	150
2009	7,011	51	216	2024	6,400	51	150
2010	7,050	51	102	2025	6,500	51	150
2011	7,004	33	222	2026	6,600	51	150
2012	6,891	42	183	2027	6,700	51	150
2013	6,743	48	198	2028	6,800	51	150

Sources: For years 1999–2015, Rural Alaska Model, North Slope Borough, 1996. For 2016–2028, MMS.

royalty income and State severance tax are in proportion to production. Peak yearly production is estimated at 16 to 61 MMbbl. (For complete descriptions of resources and associated activity, see Sec. IV.A.1.b.)

(1) North Slope Borough Revenues and Expenditures: Exploration, development, and production are projected to generate increases in property taxes above the levels without Alternative D activities starting in 2000 and averaging about 2 to 4 percent each year through the production period, or about $4 to $8 million. For revenues shared by the State see subpart (4) below.

(2) NSB Employment: The gains from Alternative D in direct employment would include jobs in petroleum exploration, development, and production and jobs in related activities (Table IV.E.11-1). Direct employment is anticipated to peak in the range of 1,300 to 3,200 jobs during the development phase, and decline to a level in the range of 500 to 1,200 during production from 2017 to 2028.

Total NSB resident employment is anticipated to increase in the range of 46 to 77 jobs in the peak of development and level off to 20 to 50 during production after 2017 (Table IV.E.11-1). The peak increase in resident employment is about 3 to 5 percent greater with Alternative D than without during development, and about 1 to 4 percent greater during production. The increase in employment opportunities may partially offset declines in other job opportunities and delay expected outmigration. Increases in resident population will correspond to increases in employment (Table IV.E.11-2).

No workers will be needed to clean up numerous small oil spills beyond those already employed in the workers' enclave.

(3) Effects of Subsistence Disruptions on the NSB Economy: Disruptions to the harvest of subsistence resources could affect the economic well-being of NSB residents primarily through the direct loss of subsistence resources. See Section IV.E.13 for effects on subsistence-harvest patterns.

(4) Local, State, and Federal Revenues: Local, State, and Federal revenues will increase as a result of Alternative D. Property-tax revenues to the State will be approximately 25 percent of the revenues to the NSB, or $1 to $2 million annually. The annual royalty will be $10 to $87 million for the Federal Government and $10 to $87 million for the State and NSB. The average annual State severance tax is estimated to be $17 to $147 million.

(5) Southcentral Employment: Workers in the enclave centered at Prudhoe Bay probably would commute to permanent residences in Southcentral Alaska, Fairbanks, and outside the State. However, for the purpose of this analysis, it is assumed all of the enclave workers (Table IV.E.11-1) commute to Southcentral and have permanent residences there except during peak construction years.

Population in Southcentral generated directly and indirectly by enclave workers during production will be in the range of 7,500 to 18,000, or 2 to 4.8 percent of the Southcentral population. In the 7-year period of the exploration and development phases, the population directly and indirectly associated with Alternative D would rise to the level sustained during production.

Conclusion—First Sale: For activities other than oil and gas exploration and development for Alternative D, approximately 50 jobs for 4½ months associated with seismic surveys and recreation employment equivalent to one person working 8 months per year would be generated. For oil and gas exploration and development activities, production in Alternative D is projected to generate increases above the levels of Alternative B as follows: NSB property taxes, 2 percent ($4-$5 million); direct oil-industry employment, 500 (5 times this in additional jobs) residing in Southcentral Alaska; NSB resident employment, 1 to 2 percent; and annual revenues of $1 to $1.25 million property tax to the State, $6 to $50 million royalty to the Federal Government, $6 to $50 million royalty to the State and NSB, and $11 to $85 million severance tax to the State.

Multiple Sales: The effect of multiple sales for Alternative D is projected to be approximately two times that of the first sale for Alternative D.

Conclusion—Multiple Sales: The effect of multiple sales for Alternative D is projected to be approximately two times that of the first sale for Alternative D.

Effectiveness of Stipulations: Stipulations would not change potential economic effects.

12. Cultural Resources:

a. Activities Other than Oil and Gas Exploration and Development: Cultural resources (the physical remains resulting from the activities of historic or prehistoric humans) are nonrenewable. Once they are adversely impacted and/or displaced from their natural context, the damage is irreparable.

Under Alternative D, the management-action impacts generally would be the same as under Alternative A, except the intensity of the actions would increase due to potential oil and gas exploration.

b. Oil and Gas Exploration and Development Activities:

(1) Effects of Disturbance from Exploration: The types of oil and gas exploration activities that would occur under Alternative D would be the same as those that would occur under Alternative B. However, the level or intensity of these exploration activities would increase dramatically under Alternative D. The number of exploration/delineation wells drilled would increase from 10 in Alternative B to 28, and as many as 6 might be drilled during a single winter season. This would increase the area of potential impact nearly 200 percent over Alternative B.

(2) Effects of Exploration Spills: These effects would be the same as those under Alternative B, except the possibility of impacts would be increased by almost 200 percent.

(3) Effects of Disturbance from Development: The types of oil and gas development activities that would occur under Alternative D would be the same as those that would occur under Alternative B. However, the level or intensity of these development activities would increase under Alternative D. The number of production pads would increase from two in Alternative B to six in Alternative D, and pipeline miles would increase by 30 for a total of 105 mi under Alternative D. The potential for pump stations also increases in Alternative D. However, as mentioned previously, the variability in causal factors is great enough to make quantification difficult. These factors would increase significantly the potential for impacts over Alternative B.

(4) Effects of Development Spills: These effects would be the same as those under Alternative B, although the possibility of spills would be greatly increased.

Conclusion—First Sale: Under Alternative D, impacts to cultural resources from management activities other than oil and gas exploration and development would be similar in nature but may be significantly increased in magnitude over Alternative B. Under Alternative D, most of the impacts to cultural resources would result from oil and gas exploration and development, although there is a possibility that no such activities would impact cultural resources sites. When compared with Alternative B, the potential for impact to cultural resources would be significantly greater under Alternative D.

Multiple Sales: The potential impacts to cultural resources under Alternative D could increase by as much as 300 percent compared to Alternative B.

Conclusion—Multiple Sales: Under Alternative D, potential impacts to cultural resources from management activities other than oil and gas exploration and development would be similar in nature to Alternative B, but the probability of impacts occurring would increase. Under Alternative D, the potential impacts to cultural resources from oil and gas exploration and development would increase by at least 300 percent compared to Alternative B.

Effectiveness of Stipulations: The effectiveness of stipulations would be the same as under Alternative B.

13. Subsistence-Harvest Patterns:

This section analyzes the impacts of ground-management actions and oil and gas leasing on the subsistence-harvest patterns of communities in or near the planning area. This analysis is organized by types of effects and discusses effects on subsistence-harvest patterns on each affected community as a result of disturbance and oil spills. Analytical descriptions of affected resources and species, a more in-depth discussion of the parameters for subsistence-harvest patterns impact analysis, as well as indigenous Inupiat knowledge concerning effects are described in more detail in the discussion for Alternative B (Sec. IV.C.13).

Under Alternative D, only the high-value Goose Molting Habitat LUEA would be made unavailable to oil and gas leasing, making the Teshekpuk Lake Watershed, Spectacled Eider Breeding Range, Fish Habitat, and Teshekpuk Lake Caribou Habitat LUEA's available to oil and gas leasing (4.15 million acres would be available and .51 million would be unavailable to oil and gas leasing). The Colville River would be recommended as a "recreational" river in the Wild and Scenic Rivers System and managed as such. Lease-specific stipulations to protect water quality; fish habitat; wetlands; caribou-calving, -migration, and insect-relief areas; and subsistence resources and access would be in place to minimize impacts to these resources.

Portions of the Colville River would remain available to oil and gas leasing, aboveground pipelines, and gravel extraction. Raptor, passerine, and moose areas on the Colville River and recreation and scenic areas would also be available to oil and gas leasing with certain restrictions for the siting of pipelines and roads. The BLM would recommend the Secretary of the Interior establish the Pik Dunes and the Ikpikpuk Paleontological Sites as special areas.

a. Ground-Impacting-Management Actions:

(1) Activities Other than Oil and Gas Exploration and Development: Even though use levels by researchers, recreationists, and seismic surveyors would increase under this alternative, effects from ground-impacting-management actions are expected to be the same

as those under Alternative A. Disturbance impacts from increased aircraft traffic associated with resource inventories and surveys to birds caribou, moose, muskoxen, and other terrestrial mammals would cause brief disturbance reactions lasting from a few minutes up to an hour, potentially causing terrestrial mammals to avoid research, survey, and recreation camps during the 4- to 6-week field season. No overall increase is expected in disturbance effects to subsistence resources and harvest patterns of the communities nearby the planning area, even with this increased disturbance from aircraft flights. For a more in-depth discussion of activities other than oil and gas exploration and development, see impacts discussion for subsistence-harvest patterns under Alternative A.

(2) Oil and Gas Exploration and Development Activities: Oil-exploration activities—seismic activity and exploration drilling—would occur in winter (early December-mid-April). Transportation of construction materials (and gravel for pads), personnel, and fuel would be done over winter ice roads on low-ground-pressure vehicles from existing infrastructure at Prudhoe Bay and Kuparuk. Large equipment could be barged to coastal staging areas in the summer and moved inland the following winter. Seismic surveys would continue on the NPR-A, if a leasing program occurs. Under Alternative D, 1 to 4 fields with a resource range of 185 to 825 MMbbl of oil are estimated. Four to 11 exploration wells would be drilled. For development, 5 to 17 delineation and from 56 to 248 production and service wells would be drilled, as well as from 80 to 105 mi of pipeline constructed.

(a) Effects of Disturbance: Sources for disturbance from exploration and development essentially would be the same as those discussed for Alternative B, except for possible barge-resupply traffic. Because of projected summer supply barge traffic in the open water, potential impacts from noise to migrating bowhead whales could occur, although normal migration would tend to keep the whales offshore and away from nearshore barge traffic.

(b) Effects of Spills: Under Alternative D, one to four fields with a resource range of 185 to 825 MMbbl are estimated. Oil-spill-occurrence estimates over the assumed production life of the planning area range from 37 to 164 crude oil spills, with a volume range from 148 to 656 bbl (average spill size equals 4 bbl). For spills >1 bbl, the range is from 9 to 41 spills. For TAPS spills resulting from NPR-A production, the number of spills ranges from 3 to 12, with a volume ranging from 3 to 13 bbl. Oil-spill-occurrence estimate for TAPS tanker spills resulting from NPR-A resources is a 40- to 82-percent chance of 0 spills (with an average spill size of 30,000 gal) occurring. Eighty-six to 383 refined-oil spills (diesel fuel, aviation fuel, engine lube, fuel oil, gasoline, grease, hydraulic oil, transformer oil, and transmission oil), with an estimated volume ranging from 59 to 265 bbl (average spill size equals 29 gal) are estimated. Historically, by volume, diesel fuels account for 75 percent of the refined-oil spills. All NPR-A scenarios call for an onshore pipeline for oil delivery to TAPS, and there is the potential for a pipeline spill contaminating the Colville River. Adequate data are not available to estimate a chance of such an occurrence. Records indicate four pipeline leaks, with the largest discharge being 125 bbl. A spill entering the Colville River potentially could affect fish populations, disrupt subsistence-fishing activity, and curtail the subsistence hunt as resources well may be tainted or, even if available, the perception of tainting would substantially affect the subsistence harvest (see Secs. III.B.5, Marine Mammals and IV.C.13, Subsistence).

Because of possible summer supply-barge traffic in the open water, potential impacts from noise and fuel spills to migrating bowhead whales could occur, although normal migration would tend to keep the whales offshore and away from nearshore barge traffic, and fuel resupply by barge is not expected to be the preferred scenario.

b. Effects on Subsistence Species:

(1) Terrestrial Mammals:

(a) Effects from Disturbance: For oil and gas activities, effects of Alternative D are expected to be significantly greater than those of Alternative B, with more helicopter disturbance of caribou and other terrestrial mammals. Increased habitat alteration would include the development of one to four s and a pipeline to TAPS. Some CAH and TLH caribou are expected to be disturbed and their movements delayed near the pipeline during periods of air traffic. Surface, air, and foot traffic near the s is expected to increase and to displace some terrestrial mammals but not significantly affect Arctic Slope populations. If a field is developed in the area south and west of Teshekpuk Lake, some TLH caribou calving is expected to be displaced within 1.86 to 2.48 mi (3-4 km) of roads and other production facilities over the life of the project (Secs. IV.C.9 and IV.E.9).

(b) Effects of Spills: The number of small, chronic crude-oil and fuel spills is expected to increase and result in the loss of small numbers of terrestrial mammals, with recovery expected within 1 to 2 years (Secs. IV.C.9 and IV.E.9).

(2) Fish:

(a) Effects of Disturbance: The individual effects of actions related to oil and gas development are the same for Alternative D as for Alternative B. However, the likelihood of their occurrence is estimated to be roughly

four to five times higher for Alternative D than for Alternative B. Depending on the actual level and location of implementation, this could result in a corresponding increase in the overall effects of drill pad, road, airstrip, and pipeline construction on arctic fish populations in Alternative D over those of Alternative B. Effects on fish resources from seismic and construction disturbance would increase under this alternative with increased chronic, short-term impacts on the subsistence fisheries of Barrow and Nuiqsut; Atqasuk's subsistence fishery does not quite reach the western edge of the planning area. Seismic surveys associated with Alternative D are expected to have the same overall effect on arctic fish as discussed for Alternative B (Secs. IV.C.7 and IV.E.7). Effects on fish resources from seismic and construction disturbance would increase under this alternative with increased chronic, short-term impacts on the subsistence fisheries of Barrow and Nuiqsut; Atqasuk's subsistence fishery does not quite reach the western edge of the planning area.

(b) Effects of Spills: Oil spills associated with Alternative D are expected to have the same overall effect on arctic fish as discussed for Alternative B (Secs. IV.C.7 and IV.E.7).

(3) Birds:

(a) Effects of Disturbance: Under Alternative D, most disturbance effects associated with ground transport, seismic surveys, exploratory drilling, construction in winter, and moderate flight frequency supporting large and small camps and aerial surveys, moderate increases of boat traffic on the Colville River, air transport of recreational parties, development well drilling, and spill-cleanup activities in summer are expected to be localized to within several hundred yards to 1 mi of the disturbing activity and temporary, ranging from brief (<1 day) in the case of response to a few aircraft flights or presence of ground or boat activity to 3 months or more for well drilling or ground-transport operations. Recovery in these instances is expected to require no more than 1 year. More intense activity, such as substantially increased boat or foot traffic along rivers, still is expected to require no more than one season for recovery for most species (Secs. IV.C.8 and IV.E.8).

Overall disturbance effects to important subsistence species of feeding, molting, and nesting white-fronted geese, black brant, eiders, oldsquaw, and other species are expected to be localized (within 100 yards to 0.6 mi of the activity) and temporary (ranging from <1 day for aircraft flight to 3 months for well drilling and ground operations). Recovery in these instances is expected to require no more than 1 year.

(b) Effects of Spills: Oil or fuel spills entering lakes with staging waterfowl populations are expected to require no more than one season for recovery for most species (Secs. IV.C.8 and IV.E.8).

(4) Bowhead Whales:

(a) Effects of Disturbance: The potential effects on bowhead whales from discharges and noise and disturbance are expected to be essentially the same under this alternative as under Alternative B (Secs. IV.C.10 and IV.E.10).

(b) Effects of Oil Spills: The potential effects on bowhead whales from oil spills are expected to be essentially the same under this alternative as under Alternative B (Secs. IV.C.10 and IV.E.10).

(5) Other Marine Mammals:

(a) Effects of Disturbance: The effects of oil and gas activities for Alternative D are expected to increase over the effects of Alternative B. Although most of the increase in human activities associated with oil exploration and development is expected to occur inshore, south of the coast, some increase in potential noise and disturbance effects are expected to occur in the Colville River delta-southern Harrison Bay area (Secs. IV.C 9 and IV.E.9).

(b) Effects of Spills: Small, onshore crude- and fuel- oil spills associated with Alternative D are not expected to reach the marine environment and affect marine mammals (Secs. IV.C 9 and IV.E.9).

c. Effects on Communities: Effects on Barrow, Atqasuk, and Nuiqsut from oil-industry-development disturbance are discussed in detail in Section IV.B.10 of the Beaufort Sea Sale 170 Final EIS (USDOI, MMS, 1998). See previous discussions in this section of effects on the primary subsistence species: caribou (and other terrestrial mammals), fish, birds, bowhead whales, and other marine mammals. Effects assessments from these sections are summarized below; for a synthesis of traditional knowledge (where available), see effects discussion for Subsistence under Alternative B and the Preferred Alternative (Secs. IV.C.13 and IV.G.13).

(1) Barrow, Atqasuk, and Nuiqsut—Effects from Disturbance and Spills: Ongoing short-term, localized impacts from disturbance and oil spills would increase under Alternative D. Caribou could experience increased habitat alteration and some CAH and TLH caribou would experience disturbance and delays in their movements. Caribou displacement would increase near s, but there would be no significant effects to caribou

populations. Fatalities and health effects from oil spills are expected to impact only a small number of terrestrial mammals and birds, with recovery in 1 to 2 years. Increased effects to the TLH and CAH, other terrestrial mammals, fish, birds, and other marine mammals harvested by subsistence hunters from these three communities are not expected to have increased effects on overall subsistence harvests. No increases in effects are expected to bowhead whales. Under Alternative D, it is expected that subsistence-hunter concerns about access to resources and resource contamination would be addressed by in-place stipulations and from protection afforded by other management actions (see Effectiveness of Stipulations below).

(2) Other Communities—Effects from Disturbance and Spills: Other communities within or adjacent to the NPR-A are the Chukchi Sea villages of Point Lay and Wainwright to the west and the inland community of Anaktuvuk Pass to the south and east. Subsistence-harvest areas for these communities are not within or adjacent to the planning area, although recent research indicates that movement by the TLH does bring the herd into the traditional subsistence-harvest areas of the communities of Wainwright and Point Lay. Historically, Anaktuvuk Pass caribou hunters have ranged to the southerly boundary of the planning area, and movement by the TLH would bring it into the harvest area of Anaktuvuk Pass subsistence hunters as well, although they primarily hunt the WAH (and to a lesser extent the CAH). Short-term and localized impacts from disturbance and oil spills to the TLH and CAH would have little impact on subsistence-caribou harvests for these three communities. Stipulations specific to this alternative further would minimize impacts to caribou.

Impacts to subsistence users farther from the planning area, including those in the Yukon-Kuskokwim Delta, would not be significant. The populations of waterfowl used by subsistence users south of the Brooks Range are not expected to be significantly impacted, because key waterfowl habitat would not be leased.

Conclusion—First Sale: Overall effects associated with Alternative D on subsistence-harvest patterns in the communities of Barrow, Atqasuk, and Nuiqsut, and other nearby communities from oil and gas activities in the planning area as a result of impacts from disturbance and oil spills are expected to increase over Alternative B. Periodic impacts to subsistence resources are expected but no resource would become unavailable, undesirable for use, or experience overall population reductions, and there would be no significant impacts to overall subsistence harvests and harvest patterns.

Multiple Sales: Under the multiple-sales approach, the resource estimate for Alternative D increases from a range of 185 to 825 MMbbl in one to four oil fields to a range of 370 to 1650 MMbbl in two to seven oil fields. The number of exploration wells increases from a maximum of 11 to 44, delineation wells increase from a maximum of 17 to 36, and production wells increase from a maximum of 248 on 6 pads to 495 on 12 pads. Pipeline miles increase from 105 to 150 mi. Multiple sales would occur over a longer period of time and, depending on frequency of sales, the timeframe for oil and gas activities in the planning area would extend to at least 2 decades.

For Alternative D, it is estimated that the number of spills <1 bbl would increase from a range of 28 to 123 spills to a range of 56 to 246 spills, and the number of spills >1 bbl would increase from a range of 9 to 41 spills to a range of 17 to 82 spills over the assumed production life of the planning area. The estimated number of crude oil spills over the assumed production life of the planning area would increase from a range of 37 to 164 spills to a range of 74 to 328 spills.

Effects of oil and gas activities under multiple sales are expected to increase over those for Alternative D with one sale. An increased potential displacement of calving TLH caribou along roads between the increased number of production pads and other facilities south of Teshekpuk Lake is expected. An increase in the number or miles of roads and other facilities with development under multiple sales is also expected to increase the impedance of TLH caribou movements to insect relief areas along the coast, north of Teshekpuk Lake. The displacement of calving caribou represents a functional loss of habitat within 1.86 to 2.48 mi (3-4 km) of field roads. This effect is expected to persist over the life of the oil fields and may reduce productivity and abundance of the TLH. Small, chronic oil spills are expected to have about the same effect on terrestrial mammals and their habitats as under Alternative D with one sale but with loss of individual mammals to the spills and habitat contamination increasing locally at the spill sites and along any streams contaminated by these spills. These spills are expected to result in the loss of small numbers of terrestrial mammals, with recovery expected within 1 year. Any habitat contamination that is not effectively cleaned up is expected to persist for several years but is not expected to affect terrestrial mammal populations. Effects to arctic fish populations from additional sales from increases in the number of gravel pads are likely to have about twice the effect on arctic fish as discussed for Alternative D. Also, because the number of pipeline miles for multiple sales and Alternative D are similar, they are expected to have a similar effect. It is assumed that each additional lease sale would be expected to have similar effects on arctic fish as described for Alternative D. However, if there were not enough time

between sales to allow for full recovery, or if the level of activity for the selected alternative was greater than that of Alternative D, the effects of each additional sale on arctic fish are likely to be greater.

Displacement of birds from disturbance and habitat alteration or loss is expected to increase in developed areas that may occur in most of the planning area under Alternative D with multiple sales, substantially changing planning area local bird population levels and/or distribution. Increases in oil and refined oil spills are expected to result in greater loss of numbers of birds than under the first sale, but these losses are not likely to be detectable above the natural fluctuations of the population and survey methods/data available. Overall effects are expected to increase substantially from that discussed for the first sale. The effects of multiple sales and increased potential for noise-producing activities and oil spills on bowhead whales at the resource ranges and activity levels described essentially are expected to be the same as described for Alternative B. Considerably more exploration activity is expected to occur along the coast of the Colville River delta-southern Harrison Bay area. Although most of the increase in human activities associated with oil exploration and development is expected to occur inshore, south of the coast, some increase in potential noise and disturbance effects on polar bears and seals is expected to occur in the Colville River delta-southern Harrison Bay area. This increased activity could result in an increase in aircraft disturbance of seals hauled out on the ice along the coast in Harrison Bay and the Colville delta. An increase in onshore surface traffic activity (seismic exploration, overland moves, construction activities along the coast) could result in more disturbance of polar bears denning and foraging along the coast. However, these effects are expected to be local and short term, with no significant adverse effects to the polar bear and seal populations as a whole.

Conclusion—Multiple Sales: Effects from multiple sales under Alternative D are expected to result in an increase in the amount of displacement of calving TLH caribou within 1.86 to 2.48 mi (3-4 km) of field roads assumed to be built between production pads south of Teshekpuk Lake. This effect is expected to persist over the life of the oil fields and may reduce productivity and abundance of the TLH. Some increase in the impedance of TLH caribou movements to insect relief areas along the coast, north of Teshekpuk Lake is expected under multiple sales. The number of small, chronic crude-oil and fuel spills is expected to increase and result in the loss of small numbers of terrestrial mammals, with recovery expected within 1 year. Based on the assumptions discussed in the text, each additional lease sale is expected to have similar effects on arctic fish as described for Alternative D. However, if there are increased levels of activity associated with future lease sales, and/or insufficient recovery time between sales, greater adverse effects than described for Alternative D are likely to occur. Increased disturbance and displacement effects and increased oil-spill risks are expected for birds, but timing of the sales again is critical to recovery. With extended intervals between sales, impacted bird populations are expected to recover from noise and disturbance effects in 1 year. The effects of multiple sales and increased potential for noise-producing activities and oil spills on bowhead whales at the resource ranges and activity levels described are expected to be the same as described for Alternative B. Effects to marine mammal populations as a whole from multiple sales under Alternative D are expected to be similar to those under Alternative D with one sale—local and short term, with no significant adverse effects.

Given that resource estimates and development scenarios project an increase in resources and increases in the number of drill pads and pipeline miles, logic would assume increased effects to potentially affected resources, except for the fact that these effects would be spread over two decades. The biological analyses expect increases in effects with little overall effect to resource populations; therefore, effects associated with multiple sales on subsistence-harvest patterns in the communities of Barrow, Atqasuk, and (especially) Nuiqsut as a result of impacts from disturbance and oil spills are expected to make no subsistence resource unavailable, undesirable for use, or experience overall population reductions. In any case, the cumulative effect of multiple sales under Alternative D would clearly be an increased development "footprint" and consequent increased habitat loss to resources and use area loss to hunters. This could affect subsistence harvests in the communities of Barrow, Atqasuk, and (especially) Nuiqsut and could alter caribou distributions sufficiently to make subsistence-hunter access more difficult. Impacts would be minimized from proposed stipulations and from the work of the Subsistence Advisory Panel designed to address local subsistence and cultural issues throughout the life of the plan.

Effectiveness of Stipulations: Stipulations that specifically would protect subsistence resources are discussed in Sections IV.E.7, Fish Resources, IV.E.8, Birds, IV.E.9, Mammals, and IV.E.10, Endangered and Threatened Species. The effectiveness of stipulations for protecting subsistence practices is the same as for Alternative B, most important of which being a BLM proposal to establish a Subsistence Advisory Panel to monitor subsistence issues and concerns arising from oil and gas activity on the NPR-A.

14. Sociocultural Systems: This discussion is concerned with those communities that could be impacted by ground-management actions and oil and gas leasing in

the planning area—Barrow, Atqasuk, and Nuiqsut. Under Alternative D, only the high-value Goose Molting Habitat LUEA would be made unavailable to oil and gas leasing, essentially making the Teshekpuk Lake Watershed, Spectacled Eider Breeding Range, Fish Habitat, and Teshekpuk Lake Caribou Habitat LUEA's available to oil and gas leasing (4.15 million acres would be available and .51 million would be unavailable to oil and gas leasing). The Colville River would be recommended as a "recreational" river in the WSR System and managed as such. Lease-specific stipulations to protect water quality; fish habitat; wetlands; caribou-calving, -migration, and insect-relief areas; and subsistence resources and access would be in place to minimize impacts to these resources.

Portions of the Colville River would remain available to oil and gas leasing, aboveground pipelines, and gravel extraction. Raptor, passerine, and moose areas on the Colville River and recreation and scenic areas would also be available (with certain restrictions) to oil and gas leasing and the siting of pipelines and roads. The BLM would recommend the Secretary of the Interior establish the Pik Dunes and the Ikpikpuk Paleontological Sites as special areas.

The primary aspects of the sociocultural systems covered in this analysis are (1) social organization and (2) cultural values, as described in Section III.C.3. For the purpose of effects assessment, it is assumed that effects on social organization and cultural values could be brought about at the community level, predominantly by industrial activities, increased population, increased employment, and effects on subsistence-harvest patterns associated with the sale. For a more in-depth discussion of the parameters for sociocultural effects analysis, see the discussion for Alternative B (Sec. IV.C.13).

a. Ground-Impacting-Management Actions:

(1) Activities Other than Oil and Gas Exploration and Development: Even though use levels by researchers, recreationists, and seismic surveyors would increase under this alternative, effects from ground-impacting-management actions are expected to be the same as those under Alternative A. Disturbance impacts from increased aircraft traffic associated with resource inventories and surveys to birds, caribou, moose, muskoxen, and other terrestrial mammals would cause brief disturbance reactions lasting from a few minutes up to an hour, potentially causing terrestrial mammals to avoid research, survey, and recreation camps during the 4- to 6-week field season. No overall increase is expected in disturbance effects to subsistence resources and harvest patterns of the communities nearby the planning area, even with this increased disturbance from aircraft flights. For a more in-depth discussion of activities other than oil and gas exploration and development, see impacts discussion for subsistence-harvest patterns under Alternative A.

(2) Oil and Gas Exploration and Development Activities: Oil-exploration activities—seismic activity and exploration drilling—would occur in winter (early December-mid-April). Transportation of construction materials (and gravel for pads), personnel, and fuel would be done over winter ice roads from existing infrastructure at Prudhoe Bay and Kuparuk. Large equipment would be barged to coastal staging areas in the summer, stockpiled (at Camp Lonely), and moved inland the following winter, and seismic surveys would continue on the NPR-A, if a leasing program occurs. Under Alternative D, 1 to 4 fields with a resource range of 185 to 825 MMbbl are estimated. Four to 11 exploration wells would be drilled. For development, 5 to 17 delineation and from 56 to 248 production and service wells would be drilled, as well as from 80 to 105 mi of pipeline constructed.

(a) Disturbance from Exploration and Development: Sources for disturbance from exploration and development would be essentially the same as those discussed for Alternative B (Sec. IV.C.14, Sociocultural Systems).

(b) Spills and Spill Cleanup: See Section IV.E.13., Subsistence, for a discussion of Alternative D oil spills.

b. Population and Employment: Under Alternative D, oil and gas leasing in the planning area is projected to affect the population of the NSB through two types of effects on regional employment: (1) more petroleum-industry-related jobs as a consequence of NPR-A exploration and development and production activities and (2) more NSB-funded jobs as a result of higher NSB operating revenues and expenditures (Sec. IV.B.11.). Employment projections as a consequence of NPR-A activities are provided in Section IV.C.11. Throughout the development and production phase, total petroleum-related employment would range from 1,318 to 3,270 jobs during the peak development and production years between 2006 and 2011. Resident employment as a result of NPR-A activities would peak at 46 to 77 jobs during the peak years 2006 and 2007. Most workers are expected to permanently reside outside of the North Slope. The NPR-A oil and gas activities are projected to increase resident employment 3 to 5 percent during the development phase and 1 to 4 percent during the production phase above the declining existing-condition projections between 2000 and 2015 (Tables IV.E.11-1 and IV.E.11-2). The NPR-A development under Alternative D is projected to increase the NSB population above the existing-condition level.

c. Subsistence-Harvest Patterns: Effects could be expected on subsistence-harvest patterns in the planning area as a result of disturbance to Barrow, Atqasuk, and Nuiqsut's subsistence harvests due to seismic disturbance, aircraft noise, supply vessel traffic, offshore exploration, onshore-construction, gravel extraction, pipeline trenching, and oil spills (see discussion for Alternative B, Sec. IV.C.13).

d. Effects on Barrow, Atqasuk, and Nuiqsut: This section analyzes effects of industrial activities, population and employment changes, and subsistence-harvest-pattern impacts on North Slope social organization, cultural values, and other issues. This discussion focuses on the North Slope as a whole and with a discussion for each community.

(1) Social Organization: The social organization of communities that might be affected by oil and gas activities in the planning area includes typical features of Inupiat culture: kinship networks that organize much of a community's subsistence-harvest, consumption, and sharing activities; informally derived systems of respect and authority; strong extended families (although not always living in the same household); stratification between families focused on success in the subsistence harvest; and access to subsistence technology (Sec. III.C.2). However, activities generated by oil and gas activities in the planning area are not likely to bring about the effects to these features in the communities in question (see discussion for Alternative B, in Sec. IV.C.14).

(2) Cultural Values: Cultural values and orientations (as described in Sec. III.C.2) can be affected by changes in the population, social organization and demographic conditions, economy, and alterations of the subsistence cycle. Of these, the only changes that could be expected to occur would be in Nuiqsut's social organization and the subsistence cycle in Barrow, Atqasuk and Nuiqsut (see discussion for Alternative B, Secs. IV.C.13, IV.C.14, and IV.E.13).

Periodic, short-term, localized impacts from disturbance and oil spills would increase under Alternative D. Caribou could experience increased habitat alteration and some CAH and TLH caribou would experience disturbance and delays in their movements. Caribou displacement would increase near oil fields but there would be no significant effects to caribou populations. Fatalities and health effects from oil spills are expected to impact only a small number of terrestrial mammals and birds with recovery in 1 to 2 years. Increased effects to the TLH and CAH, other terrestrial mammals, fish, birds, and other marine mammals harvested by Barrow, Atqasuk, and Nuiqsut subsistence hunters are not expected to have increased effects on the overall subsistence harvests for these communities. No increases in effects are expected to bowhead whales. Under Alternative D, it is expected that subsistence-hunter concerns about access to resources and resource contamination would be addressed by inplace stipulations.

Overall effects associated with Alternative D on subsistence-harvest patterns in the communities of Barrow, Atqasuk, and Nuiqsut, and other nearby communities from oil and gas activities in the planning area as a result of impacts from disturbance and oil spills are expected to increase over Alternative B. Subsistence resources would be periodically impacted, but no resource would become unavailable, undesirable for use, or experience overall population reductions, resulting in no significant impacts to overall subsistence harvests and harvest patterns. Short-term disruptions of subsistence-harvest activities would cause periodic disruption to institutions and sociocultural systems but would not displace existing institutions.

(3) Social Health: Effects on sociocultural systems often are evidenced in rising rates of mental illness, substance abuse, and violence. This has proven true for Alaskan Natives, who have been faced since the 1950's with increasing acculturative pressures. The rates of these occurrences far exceed those of other American populations such as Alaskan non-Natives, American Natives, and other American minority groups (see discussion for Alternative B, Sec. IV.C.13). Although there may be additional reasons for differences in social problems in local communities, it is clear that the proximity to industrial enclaves enables residents easier access to drugs and alcohol, thereby affecting the social health of the community—a situation that could intensify in Nuiqsut as a result of NPR-A oil and gas activity. Any effects on social health would have ramifications in the social organization, but NSB Native communities have, in fact, proven quite resilient to such effects by local voter insistence on these communities being "dry" and by the NSB's continued support of Inupiat cultural values and its strong commitment to health, social service, and other assistance programs.

Nuiqsut is the most likely community in the region to experience additional sale-related effects in social health and well-being. These effects on social health could have direct consequences on the sociocultural system but would not have a tendency toward displacement of existing institutions above the displacement that already has occurred with the current level of development. Effects on the institutions and sociocultural systems in Barrow and Atqasuk would be periodic but not displace existing institutions.

Conclusion—First Sale: Effects from management actions and oil and gas activities in the planning area under Alternative D are unlikely to disrupt sociocultural systems.

Periodic, short-term disturbance effects would be expected on the sociocultural systems of Barrow, Atqasuk, and Nuiqsut but these disturbances are not expected to disrupt or displace institutions and sociocultural systems; community activities; and traditional practices for harvesting, sharing, and processing subsistence resources. Periodic disruptions to subsistence resources could occur, but any disruptions that occurred from oil and gas activities potentially would be mitigated by BLM in-place stipulations designed to protect caribou, waterfowl, fish, moose, and subsistence resources and harvest practices. Overall effects under Alternative D to the sociocultural systems of the communities of Barrow, Atqasuk, and Nuiqsut would increase over those in Alternative B, but there would continue to be no disruption or displacement of cultural institutions or sociocultural systems.

Multiple Sales: If several lease sales occur under Alternative D, considerably more exploration activity is expected to occur in the planning area, and the levels of effects due to noise, disturbance, and habitat alteration are expected to increase. Given that resource estimates and development scenarios project an increase in resources and an increase in the number of drill pads and pipeline miles, logic would assume a substantial increase in the effects to potentially affected subsistence resources, except for the fact that these effects would be spread over 2 decades. The critical factor would be the timing between sales—a longer interval would allow more recovery for subsistence resources from aircraft, vehicular, and construction disturbance and for subsistence practices from increased access conflicts; less of an interval might not allow for sufficient recovery. In any case, the cumulative effect clearly would be an increased development "footprint" and consequent increased habitat loss to resources and use loss to hunters. This could affect subsistence harvests in the communities of Barrow, Atqasuk, and (especially) Nuiqsut and could alter caribou distributions sufficiently to make subsistence-hunter access more difficult. Impacts would be minimized from proposed stipulations and from the work of the Subsistence Advisory Panel designed to address local subsistence and cultural issues throughout the life of the plan.

Conclusion—Multiple Sales: Effects from management actions and oil and gas activities in the planning area for multiple sales under Alternative D could disrupt sociocultural systems for periods up to 1 year, but impacts would not be expected to displace institutions and sociocultural systems; community activities; or traditional practices for harvesting, sharing, and processing subsistence resources, the same level of effect anticipated for multiple sales under Alternative B.

Effectiveness of Stipulations: Stipulations that specifically would protect subsistence resources are discussed in Sections IV.E.7, Fish Resources, IV.E.8, Birds, IV.E.9, Mammals, and IV.E.10, Endangered and Threatened Species. The effectiveness of stipulations for protecting subsistence practices and sociocultural systems is the same as for Alternative B, most important of which being a BLM proposal to establish a Subsistence Advisory Panel to monitor subsistence issues and concerns arising from and oil and gas activity on the NPR-A.

15. Coastal Zone Management: Under Alternative D, approximately 4.1 million acres (nearly 90% of the planning area) would be available for oil and gas leasing, including coastal areas near the Colville River delta and in southern Harrison Bay. The Goose Molting Habitat LUEA (one-half million acres) would not be available to oil and gas leasing and industrial development. Aboveground pipelines could cross all lands within the planning area, and all lands would be available for seismic studies. These areas are subject to restrictions for siting pipelines and industrial structures. The Colville River in the planning area would be recommended and managed as a "recreational" river in the WSR System. Other protections include adding a Bird Conservation Area along the Colville River; designating the Ikpikpuk Paleontological Sites LUEA as a new Special Area to protect paleontological resources; and adding the Pik Dunes LUEA to the Teshekpuk Lake Special Area.

Federal lands within the NPR-A are excluded from the coastal zone; however, all uses and activities on Federal lands either occurring within the coastal zone or that may reasonably be expected to affect the coastal area and its resources must be consistent to the maximum extent practicable with enforceable standards of the ACMP, including State standards in 6 AAC 80 and enforceable policies of the NSB CMP. The primary goal of the NSB's local district program is to protect the subsistence lifestyle of the Borough's largely Inupiat population while encouraging and managing economic development.

a. Activities Other than Oil and Gas Exploration and Development: Ground-impacting-management actions described under Alternative D would be similar to those under Alternative A. Although the level of activities such as resource inventories, aerial surveys, and research camps is expected to increase somewhat under Alternative D, the level of effects is expected to be about the same as Alternative A. Disturbance impacts from increased aircraft traffic associated with resource inventories and surveys to birds, caribou, moose, muskoxen, and other terrestrial mammals would cause brief disturbance reactions lasting from a few minutes up to an hour, potentially causing terrestrial mammals to avoid research, survey, and recreation camps during the 4- to 6-week field season. Activities along the coast that may affect marine mammals include aerial surveys (including

wildlife surveys); ground activities such as resource inventories, paleontological excavations, research and recreation camps; and overland moves. Effects to marine mammals under Alternative D would be similar to those for Alternative A—local and short term, with no significant adverse effects to the populations as a whole. No overall increase is expected in disturbance effects to subsistence resources and harvest patterns of the communities nearby the planning area, even with these increased disturbances from aircraft flights.

b. Oil and Gas Exploration and Development Activities: Under Alternative D, the impacts from exploratory drilling and development activities are expected to be similar to, but with some increase over that of Alternative B, because the only area unavailable for leasing is the Goose Molting Habitat LUEA. Oil-exploration activities, including seismic survey activity and exploration drilling, would occur in winter (early December-mid-April). Construction materials (and gravel for pads), personnel, and fuel would be transported over winter ice roads using low-ground-pressure vehicles from existing infrastructure at Prudhoe Bay and Kuparuk. Large equipment could be barged to coastal staging areas in the summer and moved inland the following winter. Seismic surveys would continue on the NPR-A. Under Alternative D, 1 to 4 fields with a resource range of 185 to 825 MMbbl of oil are estimated. Four to 11 exploration wells would be drilled. For development, 5 to 17 delineation and from 56 to 248 production and service wells would be drilled, as well as from 80 to 105 mi of pipeline constructed.

Effects of Exploration and Development on the Alaska CMP: Potential conflict with coastal management standards under Alternative D may arise under the habitat, subsistence, and water- quality standards of the ACMP. Sources for disturbance from oil and gas exploration and development activities essentially would be the same as those discussed for Alternative B, except for possible barge-resupply traffic. Chronic, short-term, localized impacts from disturbance and oil spills would increase under Alternative D.

Increases in effects of disturbance from barge-resupply traffic along the coast may affect marine mammals, due to noise and disturbance from air and surface traffic, and seismic survey activities. Projected summer supply barge traffic in open water could result in potential impacts from noise and fuel spills to migrating bowhead whales, although normal migration would tend to keep whales offshore and away from near shore barge traffic. Six species of marine mammals —ringed. spotted, and bearded seals; walruses; polar bears; and belukha whales—commonly occur year-round or seasonally in coastal habitats adjacent to the planning area. Under Alternative D, some individual members of these species may be exposed to effects from oil and gas exploration and development as well as other activities.

Effects on fish resources from seismic surveys and construction disturbance would increase under this alternative with increased chronic, short-term impacts on the subsistence fisheries of Barrow and Nuiqsut. Atqasuk's subsistence fishery does not extend to the western edge of the planning area. Seismic surveys associated with Alternative D are expected to have the same overall effect on arctic fish as discussed for Alternative B (Secs. IV.C.7 and IV.E.7). All NPR-A scenarios call for an onshore pipeline for oil delivery to TAPS, and there is a potential for a pipeline spill contaminating the Colville River. However, estimating the chance of this occurring is uncertain at this time. A spill entering the Colville River potentially could affect fish populations, disrupt subsistence-fishing activity, and curtail substantial hunting as resources may be tainted, or even the perception of tainting substantially would affect the subsistence harvest (Secs. III-B.5, Marine Mammals, and IV.C.13, Subsistence).

Chronic, short-term, localized impacts to local communities, including Nuiqsut, Barrow, and Atqasuk, from disturbance and oil spills would increase under Alternative D. Effects of more helicopter disturbance to caribou and other terrestrial mammals are expected to be significantly greater than those of Alternative B. Caribou could experience increased habitat alteration and some CAH and TLH caribou would experience disturbance and delays in their movements. Caribou displacement would increase near oil fields but there would be no significant effects to caribou populations. Fatalities and health effects from oil spills are expected to impact only a small number of terrestrial mammals and birds with recovery in 1 to 2 years. Increased effects to the TLH and CAH, other terrestrial mammals, fish, birds, and other marine mammals harvested by Nuiqsut subsistence hunters are not expected to have increased effects on Nuiqsut's overall subsistence harvest. No increases in effects are expected to bowhead whales.

Potential conflict between Alternative D proposed activities and Statewide standards and NSB district policies could occur in conjunction with the NSB CMP 2.4.5.2(h) (NSBMC 19.70.050.K.8) that relates to both subsistence and cultural resource areas. This policy requires that development be located, designed, and maintained so as not to interfere with the use of a site that is important for significant cultural uses or essential for transportation to subsistence-use areas. Also, conflict with district policies may arise in the potential for adverse effects to subsistence resources. The NSB CMP policy 2.4.3(a) (NSBMC 19.70.050.A) relates to "extensive adverse impacts to a subsistence resource" that "are likely and cannot be

avoided or mitigated." In such an instance, "development shall not deplete subsistence resources below the subsistence needs of local residents of the Borough." Policy 2.4.5.1(a) (NSBMC 19.70.050.J.1) relates to "development that will likely result in significantly decreased productivity of subsistence resources or their ecosystems." Potential conflicts with these standards is anticipated, but effects will be minimized by stipulations developed for this lease sale.

Conclusion—First Sale: Potential conflict with the habitat and subsistence standards of the ACMP is anticipated. Overall effects of oil and gas activities for Alternative D are expected to increase effects to terrestrial mammals, marine mammals, and subsistence resources and activities of local communities, over the effects of Alternative B. Although most of the increase in human activities is expected to occur inland, south of the coast, some increase in potential noise and disturbance effects to marine mammals other than bowhead whales are expected to occur in the Colville River Delta-southern Harrison Bay area. The CAH and TLH caribou herds are expected to be disturbed and their movements delayed near the pipeline during periods of air traffic. Surface, air, and foot traffic near s is expected to increase and to displace some terrestrial mammals, but not significantly affect the Arctic Slope populations. If a field is developed in the area south and west of Teshekpuk Lake, some TLH caribou is expected to be displaced within 3 to 4 km of roads and other production facilities over the life of the project. Subsistence resources would be impacted, but no resource would become unavailable, undesirable for use, or experience overall population reductions, resulting in no significant impacts to overall subsistence harvests and harvest patterns.

Multiple Sales: Under the multiple-sales approach, the resource estimate for Alternative D increases from a range of 185 to 825 MMbbl in one to four s to a range of 370 to 1,650 MMbbl in two to seven s. The number of exploration wells increases from a maximum of 11 to 44, delineation wells increase from a maximum of 17 to 36, and production wells increase from a maximum of 248 on 6 pads to 495 on 12 pads. Pipeline miles increase from 105 to 150 mi. Multiple sales would occur over a longer period of time and, depending on frequency of sales, the timeframe for oil and gas activities in the planning area would extend to at least two decades.

Effects of oil and gas activities under multiple sales are expected to increase over those for one sale under Alternative D and may result in potential conflict with the habitat and subsistence standards of the ACMP. An increased potential displacement of calving TLH caribou along roads from increased production pads and other facilities and miles of roads south of Teshekpuk Lake is expected. The displacement of calving caribou represents a functional loss of habitat within 1.86 to 2.48 mi (3-4 km) of field roads. This effect is expected to persist over the life of the s and may reduce productivity and abundance of the TLH. Small, chronic oil spills are expected to have generally the same effect on terrestrial mammals and their habitats for multiple sales as for one sale under Alternative D, except that spills and habitat contamination may account for loss of individual mammals , particularly at the spill sites and along any streams contaminated by oil spills. Loss of small numbers of terrestrial mammals are expected, with recovery expected within 1 year (Sec. IV.C.9).

Effects on arctic fish populations from additional sales due to increases in the number of gravel pads are likely to have about twice the effect on arctic fish in the single-sale scenario as discussed for Alternative D. Each additional lease sale would be expected to have similar effects on arctic fish as described for a single sale under Alternative D. However, if there was insufficient time between sales to allow for full recovery on arctic fish, or if activity levels for the selected alternative were greater than assumed under Alternative D, the effects of each additional sale on arctic fish are likely to be greater than those for Alternative D. Increases in effects to bird populations from increased noise disturbance and local displacement could be expected with multiple sales over one sale under Alternative D, but recovery in these instances is still expected to require no more than 1 year.

The effects of multiple sales and increased potential for noise-producing activities and oil spills on bowhead whales at the resource ranges and activity levels described essentially are expected to be the same as described for the first sale. If several lease sales occur under Alternative D, considerably more exploration activity is expected to occur along the coast of the Colville River delta-southern Harrison Bay area. Although most of the increase in human activities associated with oil exploration and development is expected to occur inland, south of the coast, some increase in potential noise and disturbance effects on polar bears and seals is expected to occur in the Colville River delta-southern Harrison Bay area. This increased activity could result in an increase in aircraft disturbance of seals hauled out on the ice along the coast in Harrison Bay and the Colville delta. An increase in onshore surface traffic activity (e.g., seismic exploration, overland moves, and construction activities along the coast) could result in more disturbance of polar bears denning and foraging along the coast. However, these effects are expected to be local and short term, with no significant adverse effects to the polar bear and seal populations as a whole.

Conclusion—Multiple Sales: Effects from multiple sales under Alternative D may result in potential conflict with the habitat and subsistence standards of the ACMP.

Multiple-sales effects under Alternative D are expected to result in an increase in the amount of displacement of calving TLH caribou within 1.86 to 2.48 mi (3-4 km) of field roads assumed to be built between production pads south of Teshekpuk Lake. This effect is expected to persist over the life of the s and may reduce productivity and abundance of the TLH. Some increase in the impedance of TLH caribou movements to insect relief areas along the coast, north of Teshekpuk Lake is expected under multiple sales. Small, chronic crude-oil and fuel spills is expected to increase and result in the loss of small numbers of terrestrial mammals, with recovery expected within 1 year. Based on the assumptions discussed in the text, each additional lease sale is expected to have similar effects on arctic fish as described for the first sale. However, if there are increased levels of activity associated with future lease sales, and/or insufficient recovery time between sales, greater adverse effects than described for the first sale are likely to occur. Increased disturbance and displacement effects and increased oil-spill risks are expected for birds, but timing of the sales again is critical to recovery. With extended intervals between sales, impacted bird populations are expected to recover from noise and disturbance effects in 1 year. The effects of multiple sales and increased potential for noise-producing activities and oil spills on bowhead whales at the resource ranges and activity levels described essentially are expected to be the same as described for the first sale. Effects to marine mammal populations as a whole from multiple sales under Alternative D are expected to be similar to those with one sale—local and short term, with no significant adverse effects. Under Alternative D, it is expected that protections for birds, fish, waterfowl, and terrestrial mammals, water quality, and subsistence-hunter concerns about access to resources and resource contamination would be addressed by stipulations.

Effectiveness of Stipulations: Stipulations described in Section II.C.7.b were developed to provide protection to all high-value resources within the NPR-A, particularly in areas available to oil and gas leasing. These special stipulations are expected to provide protections to the wildlife and habitat resources within the NPR-A. Application of these measures reduces the potential for conflicts with the standards of the Alaska CMP.

Lease-specific stipulations to protect water quality; fish habitat; wetlands; caribou-calving, caribou-migration, and caribou insect relief areas; and subsistence resources and access would be in place to minimize impacts to these resources. Stipulations regarding solid- and liquid-waste disposal, fuel handling, and spill cleanup are expected to reduce the potential effects of spills and human refuse on terrestrial mammals. Stipulations on overland moves and seismic work are expected to minimize alteration of terrestrial mammal habitats. The stipulation requiring aircraft maintain a 1,000-ft AGL (except for takeoffs and landings) over caribou winter ranges from October through May 15, and to maintain a 2,000-ft AGL over the Teshekpuk Lake Caribou Habitat LUEA from May 16 through July 31, is expected to minimize disturbance of caribou.

The stipulations related to oil and gas exploration and development, including facility design and construction restrictions, are expected to minimize alteration of terrestrial-mammal habitat and interference with caribou movements. Stipulations requiring elevated pipelines and roads to be separated at least 500 ft and to place pipelines on the appropriate side of the road (depending on general movements of caribou in the area) could significantly reduce interference with caribou movements.

Several stipulations were developed to provide protection for birds. For example, disturbance of birds from ground transportation and other activities including oil and gas activities would be mitigated, and essential habitat protected by Stipulations 20b through m, minimizing and seasonally restricting vehicle use and seismic activity, and taking recommended precautions in Colville River LUEA (geese, raptors, and passerines affected). Stipulations 31 and 25 require avoidance of lakeshore margins for oil and gas activities, avoidance of lake margins, and establish a facility buffer around high-use lakes (geese, shorebirds). Stipulation 32 requires consolidation/integration of oil and gas facilities, and incorporate visual screening features for facilities near goose-molting lakes (geese). Stipulations 38, 39, and 44 establish facility setbacks along specified lakes and streams, facilities and mining sites located out of floodplains and 500 ft from lake basins, and no long-term occupancy of the Colville River LUEA (raptors, passerines, loons, broodrearing waterfowl). Aircraft disturbance of birds would be mitigated by Stipulations 56 and 57, maintenance of seasonal minimum flight altitudes over the Teshekpuk Lake and Colville LUEA's (loons, geese, shorebirds, raptors, passerines). Other potentially adverse situations would be mitigated by Stipulations 7 and 10, immediate cleanup of fuel spills using ADEC-approved materials stored at all fueling and maintenance areas. Stipulation 11 requires fuels be stored in lined/diked areas at least 100 ft from lakes and streams (loons, waterfowl, shorebirds, passerines), preparing a hazardous materials contingency plan for large fuel transport (loons, geese, shorebirds); Stipulation 18 restricts removing quantities of water from lakes that do not alter the lakes used by molting geese (geese, loons, shorebirds); Stipulation 1, taking precautions to avoid attracting wildlife (predators) to refuse; Stipulation 70 prohibits public access to the Goose Molting LUEA through s (geese, loons, shorebirds, passerine); and Stipulation 59, removal of gravel fill so as to prevent enhanced access to the Goose Molting LUEA (geese, loons). These stipulations would minimize

disturbance from most factors and prevent fuel or oil spilled on pads from reaching surrounding habitats.

The effectiveness of stipulations for protecting bowhead whales and other endangered species from noise and disturbance from oil and gas activities are the same as for Alternative B, and from activities other than oil and gas, such as aerial wildlife surveys and other aerial surveys, the same as Alternative A. For marine mammals, the effectiveness of stipulations is expected to be the same as under Alternative A. Lease-specific stipulations to protect water quality; fish habitat; wetlands; caribou-calving - migration, and insect-relief areas; and subsistence resources and access would be in place to minimize impacts to these resources in the Colville River.

The effectiveness of stipulations described above for protecting biological resources and habitat and for subsistence activities would reduce potential conflicts with the habitat and subsistence standards of the ACMP and NSB CMP policies.

16. Recreation and Visual Resources:

a. Activities Other than Oil and Gas Exploration and Development:

Disturbance: Activities other than oil and gas exploration and development expected under Alternative D are the same as under Alternative A. However, certain of these activities would increase as a result or in support of oil and gas development. For example, field activities associated with archeological site clearances, such as camps, excavations, and aircraft activity all likely would increase. Impacts would be minimal and short term in nature, as described under Alternative A, but the total area impacted could increase to 3,000 acres (from 1,500 in Alternative A).

Although the amount of supplies and material transported by winter overland moves may increase under this alternative, these moves generally follow the same route. Therefore, neither the length nor number of green trails is expected to noticeably increase from Alternative A.

b. Oil and Gas Exploration and Development Activities:

(1) Exploration: The types of oil and gas exploration activities that occur under Alternative D are similar to those under Alternative B. However, the level of some of these exploration activities would increase as compared to Alternative B, i.e., additional seismic-survey operations are expected, the number of exploration/ delineation wells drilled at any one time would increase from 1 to 4 , and the total number of these wells would increase from 10 to 28. Consequently, short-term impacts from ongoing seismic activity could increase from 500 acres affected under Alternative A and 1,000 acres under Alternative B to 1,500 to 2,000 acres affected under Alternative D. The area that could be impacted during drilling operations would increase from approximately 8,000 acres to 32,000 acres (winter only). Accumulating summer-season visual impacts from the greening of ice pads, roads, and airstrips would increase from about 500 acres (under Alternative B) to 1,400 acres. Several hundred miles of lineal green trails also would be visible from the air as a result of seismic operations; the number of miles visible would increase from Alternative B in direct relationship to increased seismic operations.

(2) Development: The types of oil and gas development activities that occur under Alternative D are similar to those under Alternative B. However, the number of production pads is anticipated to increase from two (under Alternative B) to six, and the number of miles of pipeline is expected to increase from 75 mi (under Alternative B) to 105 mi. Under Alternative D, the number of pump stations will remain the same as under Alternative B (one). Consequently under this alternative, there would be a long-term loss of scenic quality, solitude, naturalness, or primitive/unconfined recreation over an area of approximately 123,000 acres (i.e., [8,000 acres/pad x 6 pads] + [8,000 acres/pump station x 1 pump station] + [640 acres/mi x 105 mi of pipeline]). This is about 41,000 acres more than under Alternative B.

Effects of Spills: The effects of spills would be the same as analyzed for Alternative B.

Impacts to Wild and Scenic River Values: Under this alternative, resources on Federal lands and waters on and along the Colville River would receive the protection of a "recreational river" as afforded by the WSRA (Appendix G). As such, certain development not allowed in the designated river corridor under Alternative B would be allowed under this alternative. However, management priorities for a "recreational river" still require that outstandingly remarkable river values be protected. Therefore, while developments such as pipelines and roads would be allowed to cross or access the river, these developments would be designed to minimize or avoid impacts to outstandingly remarkable river values. Pipelines and roads could access and parallel the river but, through design and perhaps location restrictions, the impacts to identified outstandingly remarkable values would be minimized. Under this alternative, the potential impacts to outstandingly remarkable values on Federal lands and waters is greater than under alternative C, but nevertheless minimal. State and private lands and resources on and along the designated portion of the Colville would not be under Federal management or protection.

Conclusion—First Sale: As compared to Alternative A, there would be an increase of approximately 1,500 acres to 3,000 acres in adverse, short-term impacts to recreation values from activities other than oil and gas exploration and development. As compared to Alternative B, short-term impacts from ongoing oil and gas exploration activities would increase from approximately 9,000 acres to 34,000 acres. The greening of vegetation resulting from ice pads, roads, airstrips, and compacted snow would increase to about 1,400 acres, a 900-acre increase from Alternative B. Seismic operations would result in several hundred miles of green trails with likely increases over Alternative B directly corresponding to increases in seismic operations.

Oil and gas development would result in the long-term loss of scenic quality, solitude, naturalness, or primitive/unconfined recreation over an area of approximately 123,000 acres (or 2.5% of the planning area) for the life of production fields and pipelines. This is 41,000 acres more than under Alternative B.

Multiple Sales: The types of impacts resulting from additional lease sales would be the same as described above for a single sale. Short-term impacts such as green trails and disturbance resulting from noise, aircraft, and other ongoing activities would not accumulate. Impacts from long-term or permanent facilities such as roads, pipelines, gravel pads, and pits would accumulate to the extent such facilities are necessary to support additional exploration and production. It is anticipated that such facilities would increase about 67 percent over that needed for the first sale and affect a total of approximately 192,000 acres.

Conclusion—Multiple Sales: Long-term impacts would accumulate and increase about 67 percent above those of the first sale, ultimately affecting approximately 192,000 acres or about 4.2 percent of the planning area.

Effectiveness of Stipulations: The Upper Colville River upstream from about Umiat would be designated Visual Management Class II under this alternative. As such, no permanent visible structures would be allowed in this important recreation and scenic Class A area. The Colville River from about Umiat to Ocean Point, a scenic Class B area and also an important recreation area, would be managed as a Visual Management Class III area. Under Class III guidelines, construction may be visible but should not dominate the landscape. Mitigation required to meet the standards established by these management classes should prevent any significant long-term impacts to visual/recreation values in these two highly scenic and important recreation areas.

Under this alternative, the Kuukpik and Intensive Subsistence LUEA's would be managed as Visual Management Class IV areas rather than Class III areas, as under Alternative B. Under Class IV guidelines, construction may dominate the landscape in terms of scale. This would result in less aggressive efforts to mitigate visual impacts. An aboveground pipeline through this area may exceed Class III standards.

The remaining planning area is designated Visual Management Class IV, the same as under Alternative B.

As under other alternatives, impacts to recreation values from exploratory oil and gas activities and from overland moves are significantly reduced by restricting these activities to winter months. Few recreationists visit the area during winter months.

F. ALTERNATIVE E: Alternative E would include BLM's management actions described for Alternative A and a proposal for making approximately 4.60 million acres in the Northeast NPR-A Planning Area available to oil and gas leasing. Protection of the resources is to be achieved by establishing stipulations (Sec. II.C.7.b) consistent with technically and economically feasible development and by granting enhanced recognition to some resources; the status of the LUEA's for oil and gas leasing under Alternative E is show in Table IV.F-1. Seismic activities would be permitted throughout the planning area. In addition, the alternative includes (1) establishing a Bird Conservation Area that would incorporate part of Colville River valley, (2) creating a Special Area designated by the Secretary of the Interior along the Ikpikpuk River to protect paleontological resources, and (3) adding the Pik Dunes LUEA to the Teshekpuk Lake Special Area.

The types of activities that might impact the resources include those noted for Alternative A and those additional activities associated with oil and gas exploration and development as noted for Alternative B. The level of activities other than oil and gas would be similar to or slightly greater for Alternative E than for Alternative A (Table IV.A.1.a-1). The economically recoverable oil resources for the first oil and gas lease sale are estimated to range from 250 to 1,100 MMbbl (Table IV.A.1.b-4). The oil resources estimated for Alternative E are greater than those estimated for Alternative B (Table IV.A.1.b-4), and thus the levels of activities associated with Alternative E also are estimated to be greater than they are for Alternative B. These activities include drilling 11 to 38 exploration and delineation wells, constructing two to nine production pads, drilling 75 to 330 production and service wells, and constructing 80 to 205 mi of pipeline (Table IV.A.1.b-5). If the area available for oil and gas leasing under Alternative E results in multiple sales, 500 to 2,200 MMbbl of oil are estimated to be recovered (Table IV.A.b.1-6). The types of activities associated with multiple sales would be similar to those that might occur as the result of the first sale. The level of activities for multiple sales is shown in Table IV.A.1.b-7.

1. Soils: The types of activities that may affect soils under Alternative E include those analyzed under Alternatives A and B.

a. Activities Other than Oil and Gas Exploration and Development: The effects of management actions described under Alternative E are similar to Alternative A, except there may be an increase in excavations (Sec. IV.F.6).

b. Oil and Gas Exploration and Development Activities: Under Alternative E, the impacts from exploratory drilling and development activities would be the same as under Alternative B, except there would be an increase in the estimated level of activities. These activities could result in an estimated permanent loss of soils (based on loss of vegetation, as noted in Sec. IV.F.6).

Table IV.F-1
Land Use Emphasis Areas Status for Oil and Gas Leasing Under Alternative E[1]

Land Use Emphasis Area	Fig. No. II.B.	Oil and Gas Leasing Status
Teshekpuk Lake Watershed	1	Available
Goose Molting Habitat	2	Available
Spectacled Eider Nesting Concentrations	3	Available
Teshekpuk Lake Caribou Habitat	4	Available
Fish Habitat	5	Available
Colville River Raptor, Passerine, and Moose Area	6	Available
Umiat Recreation Site	8	Available
Scenic Areas	9	Available
Pik Dunes	10	Available
Ikpikpuk Paleontological Sites	11	Available
Kuukpik Corporation Entitlement	13	Available
Potential Colville Wild and Scenic River	14	Available

[1] Section II.

Impacts to soils from spills and spill cleanup, are also similar in area as those with impacts to Vegetation (Sec. IV.F.6).

Conclusion—First Sale: Estimated areas of impacts and losses of soils from all activities are similar to those areas discussed under Vegetation (Sec. IV.F.6).

Multiple Sales: Additional lease sales under Alternative E would result in additional exploration and development activities. The area of impacted soils is closely related to that of the disturbed vegetation (see Vegetation, Sec. IV.F.6, for acreage details).

Conclusion—Multiple Sales: Areas of impacts and losses of soils from all activities in multiple sales are similar to those areas discussed under Vegetation (Sec. IV.F.6).

Effectiveness of Stipulations: There are no stipulations beyond those identified in Section II.C.7 that could reduce the impacts to soils.

2. Paleontological Resources:

a. Activities Other than Oil and Gas Exploration and Development: Paleontological resources (plant and animal fossils) are nonrenewable. Once they are adversely impacted and/or displaced from their natural context, the damage is irreparable.

Under Alternative E, the management-action impacts generally are the same as under Alternative A, except the intensity of the actions would increase due to potential oil and gas exploration.

b. Oil and Gas Exploration and Development Activities: Paleontological resources are not ubiquitous in the planning area as are wildlife and habitat, and their occurrence is much less predictable. As a result, it is quite possible that no oil and gas exploration or development activities would impact a paleontological resources site. However, as the area open to exploration and development increases, as it does dramatically in Alternative E, the possibility of no impacts to paleontological resources decreases markedly.

(1) Effects of Disturbance from Exploration: The types of oil and gas exploration activities that would occur under Alternative E would be the same as those that would occur under Alternative B. However, the level or intensity of these exploration activities would increase dramatically under Alternative E. The number of exploration/delineation wells drilled would increase from 10 in Alternative B to 38, and as many as 6 wells might be drilled in a single winter season. This would increase the probability of potential impact nearly 300 percent over Alternative B.

(2) Effects of Exploration Spills: These effects would be the same as those under Alternative B, except the possibility of impacts would be increased by almost 300 percent.

(3) Effects of Disturbance from Development: The types of oil and gas development activities that would occur under Alternative E would be the same as those that would occur under Alternative B. However, the level or intensity of these activities would increase under Alternative E. The number of production pads would increase from two in Alternative B to six in Alternative E, and pipeline miles would increase by 130 for a total of 205 mi under Alternative E. Although difficult to quantify, the potential for the construction of pump stations, causeways, docks, and seawater pipelines also increases under Alternative E. Although unlikely, it also is possible that a causeway and/or dock be constructed along the coast. The possibility of a seawater pipeline also exists at about the same order or probability. All this activity dramatically increases the probability of potential impacts to paleontological resources beyond that of Alternative B.

(4) Effects of Development Spills: These effects would be the same as under Alternative B, although the possibility of spills would be greatly increased.

Conclusion—First Sale: Alternative E opens all of the planning area to oil and gas leasing. Under Alternative E, impacts to paleontological resources from management activities other than oil and gas exploration and development would be similar in nature but may be significantly increased in magnitude over Alternative B.

Multiple Sales: The potential impacts to paleontological resources under Alternative E could increase by as much as 400 percent compared to Alternative B.

Conclusion—Multiple Sales: Under Alternative E, potential impacts to paleontological resources from management activities other than oil and gas exploration and development would be similar in nature to Alternative B, but the probability of impacts occurring would increase. Under Alternative E, the potential impacts to paleontological resources from oil and gas exploration and development would increase by at least 400 percent compared to Alternative B.

Effectiveness of Stipulations: The effectiveness of stipulations would be the same as under Alternative B.

3. Water Resources:

a. Activities Other than Oil and Gas Exploration and Development: Ground-impacting-management actions within the planning area that may affect water resources under Alternative E would be similar to those under Alternative A, except that the number and frequency of camps and moves would increase slightly. The increase would depend on management actions in land, water, and resource monitoring as related to leasing activities. Because Alternative E emphasizes the least protection of surface resources, all of the areas adjacent to streams and lakes identified as critical aquatic habitat would be available to leasing. Therefore, many of the additional camps and moves likely would be near these critical aquatic habitat areas.

b. Oil and Gas Exploration and Development Activities:

(1) Disturbance: Exploration and development activities within the planning area that may affect water resources under Alternative E would be similar to those under Alternative B, except that the number and frequency of these activities would increase (Table IV.A.1.b-1). The increase would depend on the number of leases issued, the number of proposals for exploratory activity, and the locations of this activity. As noted previously (Sec. IV.F.3.a), some of the areas adjacent to streams and lakes identified as critical aquatic habitat would be available to leasing. Therefore, some of the additional exploration and development likely would be near these critical aquatic habitat areas. Annual water usage for oil and gas activities under Alternative E would vary depending upon the areas leased and number of exploration and developmental wells drilled. Tables III.A.2.a-4 and IV.C.3 estimate water availability and requirements for exploration and development. Stipulations limit drawdown to 15 percent of the under-ice water depth (Sec. II.C.7.b, Stipulation 20) in lakes with resident fish populations. The likelihood of exploration and development activities occurring in an area that contains more water resources and critical aquatic habitat areas than Alternatives B, C, and D increases the risk of disturbing stream banks and shorelines, disrupting drainage patterns, increasing erosion and sedimentation, and removing water from riverine pools and lakes.

(2) Spills and Spill Cleanup: Under Alternative E, the potential number and extent of oil spills and cleanup would increase from those under Alternatives B and D (Sec. IV.A.2). Alternative E, because it includes more of the critical lake and river habitat than Alternatives B, C, and D, would have greater adverse effects on water resources as compared to Alternatives B, C, and D.

Conclusion—First Sale: The impacts of activities other than oil and gas exploration and development under Alternative E are expected to be similar to those under Alternative A (and similar to those under Alternatives B, C, and D). The potential long-term impacts (melting of permafrost and disrupting drainage patterns) and short-term impacts (increasing erosion and sedimentation and removing water from riverine pools and lakes) of oil and gas exploration and development on the water resources in the planning is expected to be greater for Alternative E than for Alternatives B, C, and D.

Multiple Sales: While the effects of oil and gas exploration and development from multiple lease sales may be up to several times greater than the first sale, impacts would not necessarily go up proportionally. Indirect impacts, such as thermokarst and erosion and sedimentation due to channel alteration or gravel removal may not occur until many years after the original development. Shared use of infrastructure such as airfields, roads, camps, and pipelines significantly could reduce the size of the impacted areas and adverse effects to the water resources. Where infrastructure is not shared, both long and short-term impacts, as noted above, as well as recovery times could increase.

Conclusion—Multiple Sales: Adverse impacts from multiple lease sales may be up to several times greater than a single sale, while indirect impacts may take years to develop. Shared infrastructure could reduce the adverse effects to water resources of multiple sales, because combined facilities require less water for construction, maintenance, and camp use than separate, independent facilities. Where infrastructure is not shared, both long and short-term impacts, and recovery times could increase.

Effectiveness of Stipulations: The mitigating measures that would be effective in minimizing potential effects of the ground-impacting-management actions on the water resources in the planning area for Alternative E would be the same as for Alternative B.

4. Water Quality:

a. Activities Other Than Oil and Gas Exploration and Development: As discussed under Alternative A, ground-impacting-management actions other than seismic operations and other oil and gas activities would not impact water quality.

b. Oil and Gas Exploration and Development Activities:

(1) Exploration: Exploration activities within the planning area that may affect water quality under Alternative E are 2-D and 3-D seismic activity beyond that

described under Alternative A, ice-road construction, and ice-pad construction, as found for Alternative B. Under Alternative E, total miles of seismic trails and resulting water degradation would be about an order or magnitude greater than for Alternative A. Water quality would still be degraded over <5 acres.

For Alternative E, annual ice-pad and -road construction (330-840-acre footprint each year), drilling, and domestic (crew) needs for water could require winter pumping of unfrozen water from 120 to 320 acres of nearby lakes. Most of this water use would be for ice roads. Pad construction, drilling, and crew needs together would require water use equivalent to 4 to 8 acres of lake. The areas affected would shift each year, as the ice roads are realigned and shifted to avoid continued compaction of vegetation. Upslope impoundment of snowmelt waters by ice roads could occur briefly but would have no effect on water quality.

(2) Development: Development activities within the planning area that may affect water quality under Alternative E are ice-road and ice-pad construction and spills, as found for Alternative B.

Because of the continued need for ice roads, annual water use during development would be similar to that for exploration, requiring water from 120- to-310 acres' worth of intermediate-depth lakes to construct 320 to 820 acres of ice road. During the seasonal construction phase, annual water demand would be on the order of 37 acre-feet for each field, requiring water from an additional 12 acres of lake for each field. After major construction is finished, annual water demand would decrease to about 15 acre-feet/year for each field, requiring about 5 to 25 acres total of lake for water supply. The areas affected would shift each year as the ice roads are realigned and shifted to avoid continued compaction of vegetation. Upslope impoundment of snowmelt waters by ice roads could occur briefly but would have no effect on water quality.

The primary water quality effect from construction and placement of gravel structures is related to upslope impoundment and thermokarst erosion. Gravel construction of pads, within-field roads, and field airstrip would cover about a 100-acre footprint per field, or a total of 100 to 500 acres under Alternative E. In flat thaw-lake plains on the North Slope, gravel construction can be anticipated to result in upslope water impoundment and thermokarst erosion equivalent to twice the area directly covered by gravel, or 200 to 1,000 acres. Unlike the situation for ice structures, the same locations would be affected by gravel structures each year over the life of the field(s).

A dock may be needed for a staging area under Alternative E. If a new shore access structure is required, it is anticipated they will be relatively short (less than several hundred meters long) so as not to significantly affect the nearshore circulation regime. Material for a new dock would be mined at a permitted onshore site. Only the construction and abandonment of the dock would effect water quality (USDOI, MMS, 1996a).

The waters in a dock-construction zone are likely to be turbid. The turbidity would be no more than that observed for marine dredging operations in the Canadian Beaufort Sea. These operations produced turbidity plumes which disappeared shortly after operations ceased; they generally extended a few hundred meters to a few kilometers (km = 0.6 mi).

Suspended sediments have very low direct toxicity for sensitive species, with expected toxicity somewhere between that of a clay such as bentonite (LC_{50} >7,500 ppm for the eastern oyster) and that of calcium carbonate (LC_{50} >100,000 ppm for the sailfin molly). These are very low toxicities, falling into the ranges generally described as slightly toxic to nontoxic. Direct toxicity from suspended sediments, therefore, has not been considered a regulatory issue, and toxic or acute marine standards have not been formulated by either the State of Alaska or the USEPA.

Both State standards and the Federal criterion are directed toward protecting biota from chronic stresses rather than from acute toxicity, but the limits are very different in formulation. One State standard is 25 nephelometric-turbidity units, and the Federal criterion and a second State standard are no more than a 10-percent decrease in the seasonally averaged compensation depth for photosynthetic activity. A third State standard is no more than a 10-percent reduction in maximum secchi disk depth.

The size, duration, and amount of turbidity depend on the grain-size composition of the discharge, the rate and duration of the discharge, the turbulence in the water column, and the current regime. The increased turbidity from dock construction would be local and short term, and could exceed the chronic criterion of a 10-percent temporary change in photocompensation depth over a distance of ≤2 mi), a local water-quality effect.

The dock eventually would be abandoned once oil and gas production ended, and abandonment would include removal of the material used around the island perimeter to prevent erosion. With the removal of the shoreline-protection material, erosion of abandoned manmade islands can result in local but persistent turbidity plumes as the dock fill is reworked by waves and currents for a few to several years.

Spills are another impacting agent on water quality. A number of small crude spills averaging 4 bbl and smaller fuel spills averaging 0.7 bbl are projected to occur under Alternative E in freshwaters. Only about 8 percent of crude spills reasonably can be expected to reach tundra waters. For Alternative E, this calculation results in an estimate of 4 to 18 spills, each averaging 4 bbl, reaching tundra waters. Over the life of the fields, spills could affect the water quality of 4 to 18 ponds or small lakes, making their waters toxic to sensitive species for about 7 years.

For the purpose of analysis, the effects of 325-bbl spill reaching the Colville River in summer are also analyzed. The high rate of waterflow would preclude any effects on dissolved oxygen concentrations. Direct toxicity in the water column would be minimal and limited to the first few reservoir pools downcurrent of where the spill entered the river. Some toxicity might persist in these initial reservoir pools for a few days to weeks until toxic compounds were washed out of the oil trapped in the sediment or the oiled sediment was buried under cleaner sediment.

A similar spill reaching Teshekpuk Lake also would result in minimal effect on water quality. Dissolved oxygen levels would not be affected. Direct toxicity would be minimal because of the much greater dilution volume in Teshekpuk Lake than in the small ponds and lakes discussed earlier and because of the relatively unrestricted movement of slick and underlying water. The spreading of the spill over about 60 acres (0.03% of the lake surface) could be considered an effect on water quality. This effect would exist for less than a summer, until the slick was either cleaned up or the oil stranded on the shoreline.

With the high development in Alternative E, there is concern over the likelihood and possible effects of a spill from offshore platform, pipeline or fuel barge. In addition, the oil-spill-risk analysis estimates a most likely number of zero to one spill ≥1,000 bbl along the TAPS tanker route for this alternative.

The description of general effects of oil spills on water quality in Beaufort Sea and along the TAPS tanker route waters as contained in Section IV.B.1 of the Sale 170 Final EIS (USDOI, MMS, 1998), is incorporated here by reference. A summary, supplemented by additional material, as cited, follows.

Applicable ambient-water-quality standards for marine waters of the State of Alaska are (1) total aqueous hydrocarbons in the water column may not exceed 15 μg/l (0.015 ppm); (2) total aromatic hydrocarbons in the water column may not exceed 10 μg/l (0.010 ppm) and (3) surface waters and adjoining shorelines must be virtually free from floating oil, film, sheen, or discoloration. The State of Alaska criterion of a maximum of 0.015 ppm of total aqueous hydrocarbons in marine waters, about 15-fold background concentrations, provides the readiest comparison and is used in this discussion of water quality. This analysis considers 0.015 ppm to be a chronic criterion and 1.5 ppm, a 100-fold higher level, to be an acute criterion.

Major crude oil spills generally result in peak dissolved-hydrocarbon concentrations that are only locally and marginally at toxic levels—parts per million or more. A spill ≥1,000 bbl could temporarily, about a month, contaminate water over a few hundreds of square miles above the chronic criterion of 0.015 ppm. Concentrations above the 1.5-ppm-acute criterion may occur over a few tens of square miles during the first several days of such a spill.

A fuel spill ≥1,000 bbl in the Beaufort Sea near the NPR-A in the open-water season should behave similarly to the 2440-bbl *Minuk I-53* spill of diesel fuel in the Canadian Beaufort Sea in 1985 (Birchard and Nancarrow, 1986). The spill extended over 3 mi^2 as slick the first day, 8 mi^2 as a slick the second day, and 50 mi^2 as thin sheen containing only about 50 bbl by the third day. Thus, by the third day of the spill, most of the fuel had either evaporated (38%) or dispersed into the water (58%). A fuel spill this size could temporarily contaminate Beaufort Sea waters over few tens of square miles to levels above chronic criteria but below acute criteria. However, the oil-spill-rate statistic for U.S. barges is only 4.32 spills ≥1,000 bbl per billion barrels of oil transported (Prentki and Anderson, 1996). Application of this spill rate to any reasonable or foreseeable estimate of NPR-A fuel barging results in a near-zero probability of a significant spill. Thus, a fuel spill is not anticipated to result or affect marine water quality under this alternative.

Tankering of oil under Alternative E is projected to result in a most likely number of zero to one spills ≥1,000 bbl along multiple TAPS tanker routes. This spillage could individually contaminate receiving water over several tens of square miles to levels above chronic criteria but below acute criteria.

Conclusion—First Sale: Effects of oil and gas activities in Alternative E would be higher than in Alternative B. Effects of other activities would be similar to those in Alternative A. Long- term water quality over >3,000 acres could be affected by construction or placement of gravel roads, and other structures. Oil spills could result in waters of up to 18 ponds or small lakes remaining toxic to sensitive species for about 7 years. Water quality could be degraded over a few weeks along a short stretch of the Colville from a 325-bbl spill. The spreading of a similar-sized spill over about 60 acres of Teshekpuk Lake (0.03% of the lake surface) for a few weeks could be considered

an effect on water quality. Tankering of oil is projected to result in a most likely number of zero to one spills ≥ 1,000 bbl along multiple TAPS tanker routes. Such a spill would contaminate receiving water over several tens of square miles to levels above chronic criteria but below acute criteria.

Multiple Sales: During peak exploration, annual ice-pad and -road construction (400-1,100-acre footprint each year), drilling, and domestic (crew) needs for water could require winter pumping of unfrozen water from 150 to 430 acres of nearby lakes. Most of this water use would be for ice roads. Pad construction, drilling, and crew needs together would require water use equivalent to 6 to 10 acres of lake. Because of the continued need for ice roads, annual water use during development for ice-road construction would be similar to that for exploration, requiring extraction of water from 150 to 230 acres of intermediate-depth lakes. During the seasonal construction phase, annual water demand would be on the order of 37 acre-feet for each field, requiring water from an additional 12 acres of lake for each field. After major construction is finished, annual water demand would decrease to about 15 acre-feet/year for each field, requiring up to 10 to 40 acres of lake for water supply for all fields.

The primary water-quality effect from construction and placement of gravel structures is related to upslope impoundment and thermokarst erosion. Gravel construction of pads, within-field roads, and field air strip would cover about a 100-acre footprint per field, or a 200 to 800 acres total. In flat thaw-lake plains on the North Slope, gravel construction can be anticipated to result in upslope water impoundment and thermokarst erosion equivalent to twice the area directly covered by gravel, or up to 1,200 acres. Unlike the situation for ice structures, the same locations would be affected by gravel structures each year over the life of the fields.

Over the life of development resulting from multiple sales, spills could degrade water quality of 8 to 36 ponds or small lakes, with resultant toxicity persisting and eliminating sensitive species in their waters for about 7 years. Water quality could be degraded over a few weeks along a short stretch of the Colville from a 325-bbl spill. The spreading of a similar-sized spill over about 60 acres of Teshekpuk Lake (0.03% of the lake surface) for a few weeks could be considered an effect on water quality.

Significant marine spills are not anticipated offshore of NPR-A as a result of multiple sales in Alternative E. Multiple sales are projected to result in a most likely number of zero to two tanker spills ≥ 1,000 bbl along multiple TAPS tanker routes. This spillage could individually contaminate receiving water over several tens of square nautical miles to levels above chronic criteria but below acute criteria.

Conclusion—Multiple Sales: Longer term (decade-or-more) effects of multiple sales would be one-third greater than for a single sale. Oil spills could result in waters of up to 36 ponds or small lakes remaining toxic to sensitive species for about 7 years. Water quality could be degraded over a few weeks along a short stretch of the Colville from a 325-bbl spill. The spreading of a similar-sized spill over about 60 acres of Teshekpuk Lake (0.03% of the lake surface) for a few weeks could be considered an effect on water quality. The ≤ 2 most likely number of tanker spills along TAPS routes could individually contaminate receiving water over several tens of square nautical miles to levels above chronic criteria but below acute criteria.

Effectiveness of Stipulations: Effectiveness of stipulations is similar to that under Alternative B.

5. Air Quality:

a. Activities Other than Oil and Gas Exploration and Development: The ground-impacting-management activities that would affect air quality under Alternative E would be the same as those under Alternative A. The impacts of these activities would be the same as those under Alternative A.

b. Oil and Gas Exploration and Development Activities:

(1) Exploration: Exploration activities within the planning area that may affect air quality under Alternative E are drilling and pad construction, the same as for Alternative D. For Alternative E, the number of exploratory wells drilled per year would be one to four wells more than under Alternative D.

(2) Development: Development activities within the planning area that may affect air quality under Alternative E are drilling, facility and pipeline construction, and production, the same as those under Alternative D. Total number of wells drilled for Alternative E would be approximately half again as many than alternative D. Total emissions from these activities would be limited through permits obtained from the State of Alaska to less than the Clean Air Act standards.

Conclusion—First Sale: Effects of oil and gas activities under Alternate E would be similar to those under Alternative D. Annually, air quality would be affected by drilling and construction activities at levels less than the PSD criteria. Effects of activities other than oil and gas would be negligible, the same as under Alternative A.

Multiple Sales: The effects on air quality from multiple sales should result in air emissions that remain below the maximum allowable PSD Class II increments. The concentrations of criteria pollutants in the ambient air would remain well within the air-quality standards. Consequently, a minimal effect on air quality with respect to standards is expected.

Conclusion—Multiple Sales: Activities associated with multiple sales would result in sequential effects which would remain small and localized. Concentrations would remain within the PSD Class II limits and effects would remain low.

Effectiveness of Stipulations: Current laws and regulations are assumed to be in place for the analysis of the IAP, and effects levels reflect this assumption.

6. Vegetation: Ground-impacting actions within the planning area that may affect vegetation under Alternative E include those analyzed under Alternative A and those resulting from oil exploration and development analyzed under Alternative B. The impacts of management actions described under Alternative A would be similar under Alternative E, except that the total areal extent of archaeological/paleontological excavations may increase to 6 acres per year and seismic-survey activity would increase (see below).

a. Exploration: Impacts of exploratory drilling under Alternative E would be of the same types as under Alternative B, but there would be 11 to 38 wells drilled rather than 1 to 10. This scenario could result in the death of vegetation on the perimeters of oversummer ice pads of 0.3 to 0.9 acres of vegetation spread among 6 to 19 different sites. Construction of well collars would cause the destruction of vegetation on 0.06 to 0.2 acres.

The types of impacts of seismic exploration would remain the same as under Alternative B. It is assumed that the number of 2-D surveys would remain the same at one per winter, but that this frequency would continue for about 15 years rather than 10 before decreasing to alternate winters. Because the tundra can recover from about 90 percent of these impacts in 9 years, it is expected that this change would result in little increase in area affected at any one point in time. It is also assumed that the number of 3-D surveys would increase from 0 to 2 over 5 years to 2 to 10 over 20 years. This would result in 92,000 to 460,000 acres impacted by 3-D surveys.

b. Development: The impacts of development would be of the same types under Alternatives B and E. The number of s developed would increase to 1 to 5 under Alternative E from 0 to 1 under Alternative B, with a proportional increase in the extent of area impacted. The gravel pads of these s would bury 100 to 500 acres of vegetation. Dust effects would cover 36 to 180 acres, and the effects of a changing moisture regime might affect 200 to 1,000 acres. The number of pump stations required would increase to 0-2 from 0-1, covering 0 to 80 acres of vegetation and indirectly affecting 0 to 120 acres more. Material sites would cause the destruction of 40 to 200 acres, with moisture-regime changes around them affecting another 20 to 100 acres. Flowline and sales-oil pipeline miles would increase, and it is assumed that a 15 mi seawater pipeline for waterflooding also would be necessary. This would cause the total vegetation impacts from all pipelines to increase to 3.0-7.4 acres (or more, if any portion of a pipeline would be buried). Finally, the occurrence of oil spills would increase, affecting 1.8 to 8.0 acres, but the probability of a blowout would remain low.

Conclusion—First Sale: Impacts to vegetation from activities other than oil exploration and development under Alternative E would be the same as those under Alternative A, except that the effects of archaeological excavation might increase from 1 to 6 acres. The impacts of oil exploration and development would be of the same types as for Alternative B, but greater in areal extent. The maximum acreage affected by 3-D seismic surveys would increase from 0 to 92,000 acres to 92,000 to 460,000 acres. The combined effect of development activities would cause the destruction of vegetation on 140 to 780 acres rather than 0 to 180 acres and the alteration in plant species composition of another 220 to 1,220 acres instead of 0 to 280 acres, for a total of effects over 360 to 2,000 acres rather than 0 to 460 acres. Finally, the occurrence of oil spills would increase, and the probability of a seawater pipeline spill would also increase.

Multiple Sales: It is assumed that additional lease sales under Alternative E would result in additional exploration activities and a total of 2 to 10 s being developed. More acreage would be impacted by seismic surveys, but it would be over a longer period of time. It is expected that recovery from at least 90 percent of the impacts from the earliest surveys would be complete before additional seismic operations would commence as a result of multiple sales. The total number of exploratory wells is assumed to increase to 15-60 from 5-15, and delineation wells to 12-48 from 6 to 23, for a total of 27 to 108 wells drilled from ice pads. Vegetation destruction from well collars would increase to affect 0.2 to 0.6 acres, and vegetation death around ice-pad perimeters would increase to 0.7 to 2.7 acres. Tundra would recover from the latter in 1 to a few years.

With the assumption of 2 to 10 s developed, the vegetation that might be destroyed by burial under gravel fill would increase to 200 to 1,000 acres. The area of vegetation around oil field gravel pads that would undergo change

from dust or moisture regime impacts would be 400 to 2,000 acres. The impacts of developing material sites would increase correspondingly to the number of oil fields. This would mean the destruction of vegetation on 80 to 400 acres and effects of moisture regime changes on 40 to 200 acres. It is assumed that the number of pump stations required would remain 0 to 2, resulting in the burial of 0 to 80 acres and dust or moisture regime changes on an additional 0 to 120 acres. The number of pipeline miles would increase somewhat under multiple sales, with a total of 120 to 345 mi resulting in the destruction or alteration of a total of 3.5 to 10 acres (or more, if any portion of a pipeline would be buried). The incidence of oil spills would also increase, affecting 3.7 to 16.0 acres of vegetation, but the probability of a blowout would remain low.

Conclusion—Multiple Sales: The impacts of oil exploration would include more vegetation disturbance from seismic work than under a single-sale scenario, but the extended period of time over which it would occur, coupled with the recovery time for disturbed areas, would result in a small increase in the amount of disturbance that would be evident at any one time. Exploration activities would also result in 0.2 to 0.6 acres of permanent vegetation destruction around well collars and alteration of 0.7 to 2.7 acres around ice pads. The activities of development that would impact vegetation include construction of gravel pads, roads, and airstrips for each ; potential construction of up to two pump stations within the planning area; excavation of material sites; and construction of pipelines. The combined effect of these activities would cause the destruction of vegetation on 280 to 1,480 acres and the alteration in plant species composition of another 440 to 2,320 acres, for a total of effects over 720 to 3,800 acres. The duration of these impacts would be permanent, assuming that the gravel pads would remain after oil production ends, and recovery thus would be moot. Oil spills would affect 3.7 to 16.0 acres of vegetation within the planning area. Recovery from spills would take a few years to 2 decades.

Effectiveness of Stipulations: The effectiveness of stipulations would remain the same as under Alternative B, i.e., there are no stipulations beyond existing management practices that would reduce the above impacts to vegetation.

7. Fish Resources:

a. Activities Other Than Oil and Gas Exploration and Development: Activities associated with Alternative E that may affect fish include the establishment of large work camps at pre-existing airstrips; small scientific excavations for archaeological, paleontological, geologic, and soils-related information; the sport harvest of fish by workers; and actions associated with fuel spills at fuel-storage sites. The establishment of work camps, scientific excavations, and the sport harvest of fish are not expected to have a measurable effect on arctic fish populations. Fuel spills at fuel-storage sites may adversely affect arctic fish.

b. Oil and Gas Exploration and Development Activities: Alternative E also involves several management actions associated with oil and gas development. These include seismic surveys; the construction of gravel drill pads, roads, airstrips, and pipelines; and oil spills (drill pad, pipeline, and supply barge). The individual effects of these actions and the chemical agents associated with them have been discussed in previous Beaufort Sea EIS's (e.g., USDOI, MMS, 1996a), which are incorporated here by reference. The remainder of this analysis focuses on differences in the amount of exposure arctic fish are likely to have to each of these actions in Alternative C as compared to Alternative E. More of the planning area is exposed to oil and gas development in Alternative E (100%) than in Alternative B (53%). This additional area supports a greater number and diversity of fish than the fish-bearing waters of Alternative B. These differences increase the probable number of oil- and gas-related activities, the probability of their affecting arctic fish populations (roughly 5-6 times higher), and the probable overall effect of Alternative E on fish over that of Alternative B.

(1) Effects of Disturbance:

(a) Effects from Seismic Surveys: Arctic fish are likely to be adversely affected by seismic surveys located above overwintering areas. Likely effects would include avoidance behavior and short-term added stress but also could result in the death of some of the more sensitive lifestages (e.g., juveniles). However, the effect on most overwintering fish is expected to consist of only short-term, sublethal effects. While Alternative E is likely to involve more seismic surveys than Alternative A and thereby would increase the probability of seismic activity occurring above overwintering habitat, such events are likely to be infrequent. Hence, seismic surveys associated with Alternative E are expected to have the same overall effect on fish as discussed for Alternative A (i.e., no measurable effect on arctic fish populations). While Alternative E is likely to involve more fuel spills than Alternative A, the amount of fuel entering fish habitat is not expected to increase significantly. Hence, fuel spills associated with Alternative E are expected to have the same overall effect on fish as discussed for Alternative A (i.e., no measurable effect on arctic fish populations).

(b) Effects from Construction: Construction-related activities that may affect arctic fish

include the construction of drill pads, roads, airstrips, pipelines, and possibly gravel extraction. The individual effects of these activities for Alternative E are expected to be the same as discussed for Alternative B and are summarized below. However, the likelihood of these construction-related activities occurring and affecting fish habitat is roughly five to six times greater in Alternative E than in Alternative B. Depending on the specific level and location of implementation, this could result in a corresponding increase in the overall effect of these activities in Alternative E over that of Alternative B.

Construction during exploration would involve freshwater withdrawals for the construction of ice drill pads, roads, and airstrips. Ice roads or airstrips constructed through overwintering areas <10 ft deep would freeze to the bottom and form a barrier to water circulation, resulting in reduced levels of dissolved oxygen. This could have lethal effects on the fish affected by the barrier. The construction of ice roads and airstrips in areas not used for overwintering is expected to have no measurable effect on arctic fish. Freshwater withdrawals may adversely affect fish, if the water is taken from areas where they are overwintering. Under-ice withdrawals from areas having water and dissolved-oxygen levels barely to moderately sufficient to support overwintering fish would be likely to kill many of the fish overwintering there. The recovery of affected fish populations would be expected in 5 to 10 years. However, withdrawals from freshwater sources that do not support resident fish populations, or from areas having sufficient under-ice reserves of water and dissolved oxygen, are not likely to adversely affect overwintering fish.

Construction during production would involve the construction of gravel drill pads, roads, airstrips, and a coastal docking facility. The difference in the estimated number of gravel drill pads (up to 2 for Alternative B and up to 9 for Alternative E, respectively) is not expected to make a measurable difference in effects on arctic fish in Alternative E. Of far greater significance is the specific location of these drill pads, roads, and airstrips. The effects of gravel construction and gravel-extraction activities in high-density spawning and overwintering habitat, or in access corridors used by migratory fish, are expected to be spawning failure and mortality for many of the fish affected (an estimated 10-year recovery). No measurable effects on arctic fish populations are expected in low-density areas. The same applies to gravel-extraction activities that might occur outside of the planning area. The effects of pipeline trenching through overwintering or spawning habitat are likely to be spawning failure and/or mortality of many fish, and a 5 to 10-year recovery period. Trenching that avoids these habitats is not expected to adversely affect fish. The difference in the estimated number of pipeline miles (up to 75 mi for Alternative B and up to 205 mi for Alternative E) is not expected to make a measurable difference in effects on arctic fish in Alternative E. Alternative E also involves the construction of a coastal docking facility, which is needed to offload supply barges into the planning area. The effect of a docking facility on arctic fish would depend on its location, size, and design characteristics. The construction of a large docking facility in offshore waters, requiring a long access road, could adversely affect the movement of some coastal marine and migratory fish. However, the construction of a facility that provides for the movement of these fish is not likely to adversely affect them. Because supply barges are shallow-draft vessels, the docking facility for Alternative E is expected to be constructed in shallow nearshore waters. Additionally, the size of the facility for Alternative E is expected to be relatively small (up to several hundred feet) and provide for the movement of coastal fish. Hence, the construction of a coastal docking facility associated with Alternative E is not expected to have a measurable effect on arctic fish.

(2) Effects of Spills: The individual effects of oil on fish for Alternative E are the same as discussed for Alternatives A and B. As discussed therein, lethal effects on fish due to a petroleum-related spill are seldom observed outside the laboratory environment. More likely sublethal effects include changes in growth, feeding, fecundity, and survival rates and temporary displacement. Other possibilities include interference with movements to feeding, overwintering, or spawning areas; localized reduction in food resources; and consumption of contaminated prey. The specific effect of oil on fish generally depends on the concentration of petroleum present, the time of exposure, and the stage of fish development involved (eggs, larva, and juveniles are most sensitive). The oil-spill assessment estimates that the amount of oil spilled onshore during the life of the field would be 876 bbl for Alternative E and 280 bbl for Alternative B. For Alternative E, it also is assumed that a fuel-oil spill associated with the barging of supplies, would occur in the marine environment. However, neither these differences nor the fact that oil- and gas-related activities are estimated to be five to six times more likely to affect fish in Alternative E are expected to alter the overall effect of oil spills on arctic fish. Hence, oil spills associated with Alternative E are expected to have the same overall effect on arctic fish as discussed for Alternative B (no measurable effects on arctic fish populations in the planning area over the production life of the field). The effects of a seawater-pipeline spill on arctic fish populations are expected to be similar to that of Alternative B (no measurable effects on arctic fish populations in the planning area over the production life of the field).

Conclusion—First Sale: The effect of fuel spills on arctic fish populations in Alternative E are expected to be similar to Alternative A. The individual effects of seismic surveys,

construction-related activities, and oil and seawater spills are expected to be similar to that of Alternative B. However, the likelihood of their occurrence is estimated to be roughly five to six times higher for Alternative E than for Alternative B. Depending on the actual level and location of implementation, this could result in a corresponding increase in the overall effect of these activities on arctic fish populations in Alternative E over that of Alternative B.

Multiple Sales: The actions most likely to affect arctic fish for the first lease sale have been discussed herein and include seismic surveys, construction-related activities, fuel spills, and oil spills. While additional NPR-A planning area lease sales would involve more seismic surveys than the first sale and, thereby, would increase the probability of seismic activity occurring above overwintering habitat, such events are likely to be infrequent. Seismic surveys associated with multiple sales in Alternative E are expected to have the same overall effect on fish as discussed for the first sale (i.e., no measurable effect on arctic fish populations). For future (Table IV.A.1.b-7) NPR-A planning area lease sales, the number of production pads and pipeline miles is expected to be greater than for the first sale (Table IV.A.1. b-5). The number of production pads is expected to be twice that of the first sale. Pipeline miles are estimated to increase from 205 for the first sale to 280 for additional sales. On the basis of this estimate, gravel pads for multiple sales are likely to have about twice the effect on arctic fish as the first sale. Because there is little difference in the estimated number of pipeline miles for multiple sales (up to 280) and the first sale (up to 205), they are expected to have a similar effect as discussed for the first sale. Up to 1,752 bbl of crude oil are estimated to be spilled for multiple sales, or about twice that of the first sale (estimated at up to 876 bbl). On the basis of this estimate, crude oil spills for multiple sales are expected to have about twice the effect on acrtic fish as the first sale. However, if there were not enough time between sales to allow for full recovery, or if the level of activity of the selected alternatives were significantly greater than that of the first sale, the effect of each additional sale on arctic fish populations is likely to be greater than estimated herein for multiple sales.

Conclusion—Multiple Sales: Seismic surveys and pipelines associated with multiple sales are expected to have the same overall effect on arctic fish as the first sale. Gravel pads are expected to have about twice the effect as the first sale. Fuel and oil spills are likely to have a greater effect on arctic fish than the first sale. Insufficient recovery time between sales and/or greater levels of activity would be likely to result in greater effects than estimated herein for multiple sales.

Effectiveness of Stipulations: The stipulations having the most beneficial effect on arctic fish are the same as those discussed for Alternative B. However, because of the increased level of potential oil and gas activity associated with Alternative E over that of Alternative B, the absence of these stipulations may increase adverse effects on arctic fish populations.

8. Birds: This section discusses potentially adverse effects of ground-impacting management actions on nonendangered birds within the planning area under Alternative E. Such actions, including oil and gas exploration and development, potentially may result in disturbance factors, habitat alteration or loss, and fuel or oil spills. Effects on birds exposed to such factors would be similar in type but potentially of greater magnitude than those discussed under Alternative B because of the expanded lease area.

a. Activities Other than Oil and Gas Exploration and Development: Management actions other than oil and gas exploration and development under Alternative E, and their potential effects, differ from Alternative A as discussed for Alternative B except in the Goose Molting Habitat LUEA where increased activity could result in greater effects.

b. Oil and Gas Exploration and Development Activities: Oil and gas leasing would be allowed throughout the planning area (Fig. II.C.1-5; Table IV.A-1) including the Goose Molting Habitat LUEA. The additional acreage leased could result in potential exposure of additional waterbird concentration areas to disturbance. Exploration and development activity under Alternative E will be substantially greater than under Alternative B, with 10 to 28 additional exploratory and delineation wells drilled, 2 to 7 additional production pads, 1 additional field, and 80 to 130 additional miles of pipeline. It is expected that any development that occurs in the planning area will not assume the proportions of the Prudhoe Bay but will involve significantly smaller and integrated gravel structures with much less extensive interconnection. Additional drilling would prolong the period during which disturbance and habitat unavailability would occur by three to five winter seasons. Additional production pads would displace nesting birds from 60 to 110 acres each for the duration of production, and additional pipeline would result in a slight increase in disturbance from monitoring flights.

Depending on location and season, oil and gas activities in the Goose Molting Habitat LUEA potentially could cause increased disturbance of geese from routine aircraft operations, presence of facilities and associated vehicle and foot traffic, in comparison to other alternatives under which this area is not available for lease. Potentially hundreds to thousands of molting geese could be affected

to some extent by individual disturbance events (e.g., passage of an aircraft), although most incidents are expected to result in effects from which individuals would recover within hours to 1 day. However, the cumulative effect of repeated disturbance would be expected to extend for longer periods and potentially may adversely affect physiological condition, molt, and survival of individuals, and ultimately result in population-level effects. A potentially mitigating aspect of the Goose Molting Habitat LUEA is the existence of substantial interlake areas where structures could be constructed away from the immediate vicinity of lakes heavily used by molting birds (Fig. IV.B.4-2). Although this may suggest that in some instances relatively low numbers of birds would be disturbed or displaced by ground activities if development occurs in that area, the actual outcome of structure placement in the Goose Molting Habitat LUEA with regard to its continued use by molting geese is uncertain. This is due in part to the uncertain potential for these geese, that typically have little or no prior experience with oil field activities, to habituate to presence of facilities.

Also, although studies of the short-term effects of disturbance on brant have been done [Sec. IV.B.8.a(2)], comparable studies indicating the long-term effects on molting populations have not. As long as potentially adverse factors are uncontrolled to some degree the possibility will exist for disturbance of molting brant and other geese, with resultant energy cost and short-term implications for successful migration, and/or displacement from favored lakes with long-term implications for the brant's use of this area. Implementation of stipulations (see below and Sec. II.7), particularly those concerning proximity and timing of activities, structure placement, and buffering of high-use lakes would appear to remove much of the potential for disturbance or displacement, but long-term population effects probably will be determined only through long-term studies. Little is known of the quantitative short- or long-term responses for most other species.

Presence of roads and other facilities will displace breeding individuals of most species from the affected site and probably the immediate area. Such movements in succeeding breeding seasons may be to nearby comparable habitat as suggested by studies at Prudhoe Bay; such areas at Prudhoe Bay were sufficiently extensive for the nesting density of several species to increase (Troy and Carpenter, 1990). Such displacements are not expected to cause long-term effects on population productivity given the relatively small areas likely to be involved at a given site (TERA, 1993; Troy and Carpenter, 1990), but would be a long-term or permanent result.

Raptors nesting along the Colville and other rivers could experience somewhat greater effects under this alternative than under Alternative B, principally because of potentially greater levels of activity; however, there is little reason to expect more oil and gas activity near rivers than in other areas, particularly in view of the stipulated ½-mi setback for industrial facilities. Effects of activities other than oil and gas still are expected to be as described for Alternative B (minor).

Gravel mining outside the planning area is assumed to occur in the Nuiqsut area and be transported to site on ice roads during winter. This activity could cause minor local disturbance and temporary displacement of the three resident species along the road route and at the mine site. During the breeding season, nesting individuals would be displaced to undisturbed habitats with potential for lowered productivity.

The possibility of drilling and placement of pipelines in the Goose Molting habitat Area LUEA suggests a potential for greater oil spill effects during the period molting geese are present than elsewhere in the planning area. However, the small estimated average spill volume suggests that effects of individual spills will be similar to those discussed under Alternative B. Although the number of spills and total spill volume under this alternative is approximately three times that under alternative B (Table IV.A.2-2), the season of occurrence (presence of birds), type of waterbody entered (if any), and weather conditions at time of incident (wind) would strongly influence the overall effect on waterfowl. Total estimated spill volume still is <1,000 bbl, but the cumulative total mortality from many small spills could total hundreds of individuals. The potential effects of a large spill in this area when geese are present are discussed in Appendix B.8.

If a 325-bbl crude-oil spill entered Teshekpuk Lake, small numbers of waterfowl and/or raptors could be exposed. Numbers of individuals oiled would depend primarily upon wind conditions, and numbers and location of birds following entry of the spill into the lake. If the spill entered the Colville River, a variety of waterfowl could be present. Canada geese breed on bluffs along the river. Gyrfalcons, peregrine falcons, and rough-legged hawks could become secondarily oiled by preying on oiled birds. If the spill moved into the delta area additional waterfowl species that breed there or stop during migration would be at risk. A spill entering the river in spring could contaminate overflow areas or open water where spring migrants of several waterfowl species concentrate prior to occupying nesting areas.

Under Alternative E, the entire planning area coastline could be available for oil and gas leasing. An oil spill at a well within 2 mi of the coast is expected to have similar effects as other onshore spills discussed above. Effects are likely to be more severe if the oil enters aquatic habitats.

Because of the oil-absorptive capacity of tundra habitats and the distance from the coast, it is not likely that the spill would enter the marine environment.

It is assumed for Alternative E that a fuel-oil spill, associated with the barging of supplies, would occur in the marine environment during August or September when ice cover is <50 percent. A crude-oil spill from an offshore site also is assumed. Either spill could contact loons and large flocks of brant, oldsquaw, and/or eiders staging in protected coastal habitats (e.g., Harrison Bay) or waters farther offshore. Effects on individual birds would be the same as described for Alternative B. Lethal effects are expected to result from moderate to heavy oiling of any birds contacted. Light to moderate exposure could reduce future reproductive success as a result of pathological effects caused by oil ingested by adults during preening or feeding that interfere with the reproductive process. Some broodrearing, molting, or staging brant, Canada geese, and snow geese could contact oil in coastal habitats. Mortality of molting oldsquaw from a spill entering protected areas could be substantial, but the population effect would be difficult to determine because numbers are stable in some areas, declining in others (Conant, 1997). Large flocks of staging eiders could contact oil in areas farther offshore. The king eider population has declined 50 percent in 20 years so substantial mortality could be significant. Common eiders, nesting on barrier islands and along the coastal, could be contacted by a marine spill. Also, several thousand shorebirds could encounter oil in shoreline habitats (e.g., Colville River delta), and the rapid turnover of migrants during the migration period suggests many more could be exposed. A spill that enters open water off river deltas in spring could contact migrant loons and eiders.

Construction and presence of a dock assumed necessary for offloading supplies transported by barge is not expected to cause adverse effects on birds. However, common eiders may take advantage of such a structure for nesting activities. The overall population effect is expected to be minimal.

A pipeline spill of seawater used in waterflood enhancement of production would kill salt-intolerant tundra vegetation near the pipeline. The amount of tundra habitat affected is expected to be no more than a few acres; this small area of degraded habitat is not likely to result in loss of productivity by displaced breeders that is detectable at the population level.

Conclusions: Effects of actions other than oil and gas activity under Alternative E are expected to be essentially the same as for Alternative B (minor), except in the Goose Molting Habitat LUEA where increased activity could result in greater effects. Effects of routine oil and gas activities are expected to be substantially greater than discussed for Alternative B as a result of offering this LUEA for lease. Long-term effects on molting populations are uncertain because long-term studies have not been done.

Oil spill effects are expected to be considerably greater than under Alternative B because of the potential for a spill entering a lake occupied by molting geese. However, because the location of facilities and activities relative to bird concentrations is speculative, the potential effect is difficult to determine. As a result of their small average size, onshore oil spills reaching aquatic habitats are expected to cause losses of tens of individuals, but potentially hundreds of individuals could be killed by cumulative total mortality from many small spills. The effect of such losses may not be detectable above the natural fluctuations of the population.

A fuel-oil spill from a barge or a crude-oil spill from an offshore site during August or September could contact loons and large flocks of brant, oldsquaw, and/or eiders staging in protected coastal habitats or waters farther offshore. Effects on individual birds would be the same as described for Alternative B. Some broodrearing, molting, or staging brant, Canada geese, snow geese, oldsquaw, king eiders, and common eiders could contact oil in protected coastal habitats or waters farther offshore. Mortality of molting oldsquaw could be substantial, but the effect would be difficult to determine due to their uncertain population status. Because of an apparently declining population, substantial King Eider mortality could be significant. Common eiders, nesting on barrier islands and along the coastal, could be contacted by a marine spill. Also, several thousand shorebirds could encounter oil in shoreline habitats. A spill that enters open water off river deltas in spring, or nearshore areas in fall, could contact migrant loons and eiders.

Raptors are expected to experience minor effects under this alternative.

Multiple Sales: If multiple sales occur in the area available for leasing under Alternative E, intensive construction activity could last 15 to 30 years, tapering off as existing infrastructure is used for each succeeding development. Under a multiple-sale scenario, approximately two to three times the number of exploration and delineation wells may be drilled (27-108 for multiple sales versus 11-38 for the first sale, Tables IV.A.1.b-5, -7), the number of fields developed could double (2-10 versus 1-5 for the first sale, Tables IV.A.1.b-4, -6), and production pads are expected to approximately double (4-16 versus 2-9). Pipeline miles are expected to increase to 95-280 mi from 80-205 mi. Effects from disturbance factors and habitat alteration or loss are expected to be short-term and minor over most of the

planning area (see discussion for the first sale) except in the vicinity of development and production facilities. Surface, air, and foot traffic could increase substantially in some areas if facilities associated with multiple sales are grouped in high-resource-interest areas; if these are located in high-bird-concentration areas greater numbers of individuals are expected to be displaced and more species involved than with a single sale. Such effects may alter bird populations of these local areas substantially, and for species with more limited habitat preferences or tolerance to disturbance factors (e.g., loons, molting geese) effects could extend to regional populations and involve long-term changes in distribution.

The estimated number of onshore oil spills >1 bbl is expected to increase to 25-109 for multiple sales from 13-55 for the first sale (Tables IV.A.2-3a, IV A2-3b); this doubling of spills is expected to cause substantially greater loss of individuals and increased number of species involved. An increase to 232-1,021 small refined-oil spills for multiple sales from 116-510 for the first sale (average size of 29 gal) is expected over the production life of the planning area (Tables, IV A 2-6a and IV A 2-6b). Although generally these small chronic spills are contained and cleaned up on pads and roads, a doubling of their occurrence is expected to have a similar increased effect on birds and their habitats as with the first sale. Habitat contamination is expected to increase locally at the spill sites and along any streams contaminated by these spills. Any habitat contamination that is not effectively cleaned up is likely to persist for several years but is not expected to affect populations significantly. Recovery of cumulative lost productivity and recruitment may not be detectable above the natural fluctuations of the population and survey methods/data available.

Conclusion—Multiple Sales: Displacement of birds from disturbance and habitat alteration or loss is expected to increase substantially where development and production facilities are located. This could occur in numerous portions of the planning area if multiple sales are held, potentially altering local populations in these areas and for species that appear more vulnerable to habitat changes or disturbance (e.g., loons, molting geese) effects could extend to regional populations and involve long-term changes in distribution. However, most effects that are likely to occur throughout the planning area are expected to be short-term and minor. Increases in oil and refined oil spills are expected to result in the loss of substantial numbers of birds, but these losses and recovery of cumulative lost productivity and recruitment may not be detectable above the natural fluctuations of the population and survey methods/data available. Overall effect is expected to increase substantially from that discussed for the first sale.

Effectiveness of Stipulations: Effectiveness of stipulations under Alternative E is expected to be essentially the same as described under Alternatives A, B, C and D, except that several specific stipulations (e.g., 17, 20-l, 22, 25, 30, 32, 33, 34, 50-d, 54, 55, 77) would mitigate many of the disturbance and habitat degradation effects that could occur in the Goose Molting Habitat Area LUEA described above. In particular, helicopter traffic associated with oil and gas activities would be suspended in this LUEA from June 15 to August 20, when molting geese are present. Other protective measures include Stipulation 21 seasonally restricting drilling operations; Stipulations 22, 32, avoidance of critical lakeshore margin goose-feeding habitat during oil and gas activities; Stipulation 33, incorporation of visual screening features for facilities near goose-molting lakes; Stipulation 78, public access to goose molting through s prohibited (loons, waterfowl, shorebirds, passerines); Stipulation 60, sites rendered unusable for enhanced access to the Goose Molting LUEA when abandoned; and Stipulations (29, 30 minimizing pads and connecting roads, consolidation/integration of oil and gas facilities.

9. Mammals:

a. Terrestrial Mammals: Among the terrestrial mammal populations that could be affected under Alternative E are TLH and CAH caribou. Moose, muskoxen, grizzly bears, wolves, wolverines, and arctic foxes may be locally affected by planning area activities as described under Alternative B.

(1) Activities Other than Oil and Gas Exploration and Development: The level of activities such as resource inventories, aerial surveys, and research camps is expected to increase somewhat under Alternative E compared to Alternative A, but the level of effect is expected to be about the same.

(2) Oil and Gas Exploration and Development Activities: Under Alternative E, one to five oil fields are assumed to be discovered and developed. Primary effects on terrestrial mammals would come from motor-vehicle traffic within the oil field(s). Other effects could come from foot traffic near facilities and camps; from aircraft traffic; from small, chronic crude-oil and fuel spills contaminating tundra, stream, and coastal habitats; and from habitat alteration associated with gravel mining and construction. (Please see Alternative B, Sec. IV.C.9.a, for a discussion of general effects of disturbance and spills.) In the following discussion, for purposes of analysis, the planning area is divided into thirds—northern (including Teshekpuk Lake and the Beaufort coast), middle (the area generally west and southwest of Nuiqsut), and southern. The entire planning area is open for leasing and development under Alternative E (Fig. II.C.1-5).

(a) Effects of Disturbance: If a field or fields are developed in the northern planning area, production pads, pipelines, within-field roads, and other facilities (housing, airfield, processing plant) could be located within the TLH calving area to the north, south, and east of Teshekpuk Lake (Fig. III.B.5.a-1). Calving is expected to be displaced with 1.86 to 2.48 mi (3-4 km) of within-field roads. Movements of cows and calves across these roads is expected to be greatly reduced, and cow caribou may avoid crossing the roads during the calving season. If roads transect the caribou-calving movements between the east shoreline of Teshekpuk Lake and Kogru Inlet (Fig. III.B.5.a-1), cow caribou may avoid or reduce calving in habitats north and east of the lake. The caribou movement corridor and calving habitat located between the eastern shore of Teshekpuk Lake and Kogru Inlet was identified as crucial habitat for the TLH (Yokel, 1997; Fig. III.B.5.a-1). If east-west roads are located within the movement corridor, then a shift in the relative calving distribution of the TLH from the north side of the lake to the south is expected to occur (Fig. III.B.5.a-1). Under a worst-case scenario for the Teshekpuk Lake caribou herd, vehicular traffic crossing the corridor between Teshekpuk Lake and Kogru Inlet could result in the displacement of calving north of Teshekpuk Lake. This could represent a sizable portion of their calving range. Assuming recent information on TLH caribou calving locations in Figure III.B.5.a-1 are representative of calving range use, there could be a reduction in calving over about 50 percent of the range. However, it is uncertain whether calving habitat is limiting for the TLH caribou herd or for other herds.

Movements of the TLH to the coast of the planning area (Fig. III.B.5.a-1) during the insect-relief season (late June-August 15) also are expected to be adversely affected by pipelines and roads with vehicle traffic located east of Teshekpuk Lake.

If a field is developed in the middle planning area, there would be no effect on TLH calving or the TLH calving area. Some TLH migration movements may be adversely affected by air and surface traffic along pipelines and roads within the oil field. If a field is developed in the southern planning area, some members of the CAH and TLH would encounter the field during their fall migration route and within a portion of their winter range. However, neither the pipeline to the TAPS nor facilities within the oil field would be expected to significantly affect the movement of caribou or alter their distribution or abundance.

A pipeline from the oil field(s) would connect to the TAPS through facilities at the Alpine and Kuparuk River fields. The pipeline would be constructed during winter. So that no permanent road would be associated with the pipeline, ice roads would be used. During construction, air traffic would include several flights per day, which temporarily could disturb some of the caribou of the TLH and CAH and other terrestrial mammals within about 1.2 mi (2 km) of the pipeline. Disturbance effects on caribou and other terrestrial mammals are expected to be short term, interference with their movements would be temporary (probably a few minutes to less than a few days), and they eventually would cross the pipeline area. Also, disturbance reactions would diminish after construction, and flights would decrease to about one or two per day at most. The abundance and overall distribution of terrestrial mammals are not expected to be affected by pipeline construction or operation.

Gravel extraction (outside of the planning area), hauling of the gravel on ice roads (into the planning area), and deposition of gravel in the lease areas would result in local disturbance-displacement (within no more than 1 mi of the operations) of small numbers of individual mammals but would not affect the distribution and abundance of caribou, muskoxen, moose, or other terrestrial mammals.

Trenching for and burial of pipelines at river crossings would have very local effects on tundra and riparian vegetation and would not significantly affect terrestrial mammal habitats.

Under Alternative E, some terrestrial mammals could be affected by possible oil exploration offshore from an ice island and subsequent oil development on the coast of the NPR-A (Fig. II.C.1-4). Effects of these activities would be local and are not likely to affect terrestrial mammal populations.

(b) Effects of Spills: For general information on the effects of oil spills on terrestrial mammals, please see the discussion under Alternative B (Sec. IV.C.9.a). Chronic crude-oil and fuel spills from onshore activities and possible marine transportation probably would result in the loss of small numbers of terrestrial mammals. Under Alternative E, an estimated 13 to 55 (>1 bbl) crude-oil spills (averaging 4 bbl) and 116 to 510 small refined-oil spills (averaging 29 gal) are assumed to occur onshore over the production life of the planning area (Tables IV.A.2-2 and 2-6). These small, chronic spills including a potential oil spill contacting Teshekpuk Lake or the Colville River, are expected to have about the same effect on terrestrial mammals and their habitats as under Alternative B.

If barging of refined fuel oil occurs in association with Alternative E during the open-water season, TLH and CAH caribou that frequent coastal habitats from Prudhoe Bay to Camp Lonely-Pitt Point could be directly exposed to and contaminated by a potential fuel spill along beaches and in shallow waters during periods of insect-escape activities. However, even in a severe situation, a comparatively small

number of animals is likely to be directly exposed to the oil spill and die as a result of toxic-hydrocarbon inhalation and absorption. This loss probably would be small for any of the caribou herds, with these losses replaced within less than one generation (about 1 year).

If seawater were used for waterflood enhancement of oil production under Alternative E, a saltwater spill could occur within the NPR-A. This spill would have adverse effects on salt-intolerant vegetation near the pipeline but the amount tundra habitat affected would be small, no more than a few acres. This potential saltwater spill is not likely to affect forage availability of caribou, muskoxen, moose, or other terrestrial mammals in the planning area.

Conclusion—First Sale: Activities other than oil and gas are expected to increase somewhat under Alternative E compared to Alternative A, but the increase is not expected to affect terrestrial-mammal populations. For oil and gas activities, effects of Alternative E are expected to be significantly greater than those of Alternative B, with more helicopter disturbance of caribou and other terrestrial mammals. Increased habitat alteration would include the development of one to five oil fields and a pipeline to the TAPS. Some CAH and TLH caribou are expected to be disturbed and their movements delayed along the pipeline during periods of air traffic. Near the oil fields, surface, air, and foot traffic is expected to increase significantly and to displace some terrestrial mammals but not significantly affect Arctic Slope populations. If a field is developed in TLH caribou-calving areas, some calving is expected to be displaced within 1.86 to 2.48 mi (3- 4 km) of roads and other production facilities over the life of the project. The number of small, chronic crude-oil and fuel spills including a potential oil spill contacting Teshekpuk Lake or the Colville River, are expected to result in the loss of small numbers of terrestrial mammals, with recovery expected within 1 year. Trenching for and burial of pipelines at river crossings would have very local effects on tundra and riparian vegetation and wouldn't significantly affect terrestrial mammal habitats.

Under Alternative E, some terrestrial mammals could be affected by possible oil exploration offshore from an ice island and subsequent oil development on the coast of the NPR-A (Fig. II.C.1-4). Effects of these activities would be local and are not likely to affect terrestrial mammal populations.

Multiple Sales: If several lease sales occur under Alternative E, considerably more exploration activity is expected to occur in the Teshepuk Lake calving habitat of the TLH caribou, with the number of wells drilled increasing to 15-60 for multiple sales from the 5-15 wells for the first sale. The amount of development also is expected to increase. The number of oil fields would increasing to 2-10 for multiple sales from the 1-5 fields for the first sale, the number of production pads would increase to 4-16 for multiple sales from the 2-9 pads for one sale, and pipeline miles would increase to 95-280 for multiple sales from the 80-205 for the first sale. An increase the potential displacement of calving TLH caribou along roads between the increase number of production pads and other facilities. An increase in the number or miles of roads and other facilities with development under multiple sales is also expected to increase the impedance of TLH caribou movements to insect-relief areas along the coast, north of Teshekpuk Lake. The displacement of calving caribou represents a functional loss of habitat within 1.86 to 2.48 mi (3-4 km) of field roads. This effect is expected to persist over the life of the oil fields and may reduce productivity and abundance of the TLH.

Under Alternative E, the number of small crude-oil spills is expected to increase to 25-109 spills (averaging 4 bbl) for multiple sales from an estimated 13-55 (>1 bbl) for the first sale. Small, refined-oil spills are expected to increase to 232-1,021 (averaging 29 gal) for multiple sales from 116-510 spills for the first sale over the production life of the planning area (Tables IV.A.2-3a, IV.A2-3b, IV.A 2-6a, and IV.A.2-6b). These small, chronic spills are expected to have about the same effect on terrestrial mammals and their habitats as under Alternative B but with loss of individual mammals to the spills and habitat contamination increasing locally at the spill sites and along any streams contaminated by these spills. These spills are expected to result in the loss of small numbers of terrestrial mammals, with recovery expected within 1 year. Any habitat contamination that is not effectively cleaned up is expected to persist for several years but is not expected to affect terrestrial mammal populations.

Conclusion—Multiple Sales: The effect of multiple sales under Alternative E is expected to result in an increase in the amount of displacement of calving TLH caribou within 1.86 to 2.48 mi (3-4 km) of within-field roads. This effect is expected to persist over the life of the oil fields and may reduce productivity and abundance of the TLH. Some increase in the impedance of TLH caribou movements to insect relief areas along the coast, north of Teshekpuk Lake is expected under multiple sales. The number of small, chronic crude-oil and fuel spills is expected to increase and result in the loss of small numbers of terrestrial mammals, with recovery expected within 1 year.

Effectiveness of Stipulations: Stipulations described in Section II.C.7 in regard to solid- and liquid-waste disposal, fuel handling, and spill cleanup are expected to reduce the potential effects of spills and human refuse on terrestrial mammals. Stipulations on overland moves and seismic work are expected to minimize alteration of terrestrial mammal habitats. The stipulation on aircraft to maintain a

1,000-ft AGL (except for takeoffs and landings) over caribou winter ranges from October through May 15, and to maintain a 2,000-ft AGL over the Teshekpuk Lake Caribou Habitat LUEA from May 16 through July 31, is expected to minimize disturbance of caribou.

Stipulations on oil and gas exploration and development, including facility design and construction, and restrictions on use of oil field roads and airstrips for public use are expected to minimize alteration of terrestrial mammal habitat and interference with caribou movements. Stipulations that restrict permanent surface occupancy of oil and gas facilities within 2 mi of the coast and east of Teshekpuk Lake to Kogru Inlet are expected to reduce disturbance and interference with caribou movements, in particular the movements of caribou to and from the coast for insect relief and the movements of TLH cow caribou to calving habitats north of the lake. Stipulations requiring elevated pipelines and roads to be separated at least 500 ft and to place pipelines on the appropriate side of the road (depending on general movements of caribou in the area) significantly could reduced interference with caribou movements. A stipulation prohibiting permanent surface occupancy other than buried pipelines within the two narrow land corridors identified as crucial caribou movement corridors between Teshekpuk Lake and the Beaufort Sea further would reduce or avoid interference with THL caribou movements (Fig. III.B.5.a-1).

Implementation of all the above stipulations would reduce but not eliminate all effects on TLH caribou. Some level of displacement of calving still is expected to occur within 1.86 to 2.48 mi (3-4 km) of oil field roads, and some caribou movements during insect harassments would be temporarily disrupted when caribou encounter road and foot traffic in association with production facilities. These disruptions would have some adverse energetic effects on individual caribou.

b. Marine Mammals: Under Alternative E, the northern coast of the planning area, which extends from the Colville River delta west to Smith Bay, would be open to leasing. Six species of nonendangered marine mammals—ringed, spotted, and bearded seals, walruses, polar bears, and belukha whales—commonly occur year-round or seasonally in coastal habitats adjacent to the planning area. Under Alternative E, some individual members of these species may be exposed to effects from oil and gas exploration and development activities as well as from other activities.

(1) Activities Other than Oil and Gas Exploration and Development: Activities other than those associated with oil and gas exploration and development along the coast that may affect marine mammals include aerial surveys (including surveys of wildlife); ground activities such as resource inventories, paleontological excavations, research and recreation camps; and overland moves. Effects under Alternative E would be similar to those for Alternative A—local and short term, with no significant adverse effects to the populations as a whole.

(2) Oil and Gas Exploration and Development Activities: Oil and gas exploration and development activities along the coast that may affect marine mammals are noise and disturbance from air and surface traffic, geophysical seismic activities, and potential oil pollution of marine waters. (Some of the crude- and fuel-oil spills associated with Alternative E that are assumed to occur in the Teshekpuk Lake area may reach the marine environment and potentially affect marine mammals.)

(a) Effects of Noise and Disturbance: Noise associated with oil and gas activities is a main source of disturbance to seals, polar bears, and belukha whales. For a discussion of the nature of airborne and underwater noise effects on pinnipeds, polar bears, and belukha whales, see the Sale 124 Final EIS (USDOI, MMS, 1990). A discussion of noise and disturbance effects specific to the planning area follows.

The primary source of noise and disturbance would come from air traffic along the coast of the planning area, specifically from helicopters associated with the assumed oil exploration and production activities. Aircraft traffic (several helicopter round trips/year during exploration and development) centered out of Deadhorse-Prudhoe Bay and Camp Lonely, traveling to and from NPR-A exploration and production facilities, is assumed to be a source of disturbance to ringed or spotted seals hauled out on ice or beaches, respectively, and polar bears using coastal habitats.

During the summer, some of the air traffic to and from exploration and production facilities could disturb hauled-out seals, causing them to charge in panic into the water. This disturbance could result in injury or death to young seal pups. The number of seals affected would depend on the number of disturbance incidents.

Under Alternative E development, a dock with a barge and other vessel traffic briefly may disturb seals and polar bears along the coast. These disturbances are likely to be short-term (a few minutes to less than hour) and would not affect seal and polar distribution or abundance.

If exploratory drilling occurs in winter (December to mid-April) near the coast, polar bears could be attracted to the oil field camps by food odors and curiosity. Some polar bears could be unavoidably killed to protect oil workers.

However, the number of bears lost as a result of such encounters is expected to be very low.

Under Alternative E, seals and polar bears could be affected by possible oil exploration offshore from an ice island and subsequent oil development on the coast of the NPR-A (Fig. II.C.1-4). Effects of these activities would be local and are not likely to affect marine mammal populations.

(b) Effects of Geophysical Seismic Activities: Effects will be similar to those under Alternative A, i.e., short-term effects on a small number of polar bears that den along the coast of the planning area could occur.

(c) Effects of Oil Pollution: For a discussion of the effects of oil on marine mammals that commonly occur in offshore habitats adjacent to the planning area, see USDOI, MMS (1997). For detailed discussions of the various possible direct and indirect effects of oil on marine mammals, see OCS Reports, MMS 85-0031 and MMS 92-0012 (Hansen, 1985; 1992).

1) Effects from a Possible Spill in Marine Waters: A possible fuel spill that might occur nearshore within the marine environment could affect some ringed, bearded, and spotted seals. Assuming a fuel-oil spill occurred during the summer open-water period, a small number of ringed, spotted, and bearded seals might be contaminated. Small aggregations of ringed seals do occur in open water. Such an event could result in the contamination and possible loss of some seals out of populations of a few thousand to several thousand seals.

Fuel-oil contamination of walruses probably would not result in direct mortality of healthy individuals. However, contamination seriously could stress diseased or injured animals and stress young calves, causing some deaths. Perhaps a small number of calves and some adults could die from fuel-oil contamination, but such a loss is expected to be replaced within 1 year by natural recruitment in the population (out of a population >200,000 walruses). Little or no significant contamination of benthic food organisms and bottom-feeding habitats of walruses and bearded seals is expected, because the small fraction of the fuel spill expected to reach this area (such as 1-5%) is expected to be widely dispersed in the water column and to be weathered and degraded by bacteria (USDOI, MMS, 1997, Sec. IV.A.3, Spilled Oil Fate and Behavior in Marine Waters). The amount of benthic prey killed or contaminated by the fuel spill is likely to be very small and represent an insignificant proportion of the prey and benthic habitat available.

Polar bears would be most vulnerable to oil-spill contamination from Cape Halkett to Point Barrow (Fig. III.B.5.b). However, the number of bears likely to be contaminated or to be indirectly affected by a local reduction in seals probably would be small, considering the approximate density of one bear every 141 to 269 km^2 (54-103 mi^2) (Amstrup Stirling, and Lentifer, 1986). Even in a severe situation where a concentration of perhaps 10 bears (such as at a whale-carcass site) was contaminated by the fuel spill and all the bears died, this one-time loss is not expected to significantly affect the polar bear population of 1,300 to 2,500 animals. Annual recruitment (current growth rate of 2.4%) probably would replace lost bears within 1 year (given the potential biological removal rate or available yield of 48 bears/year and assuming equal sex ratio of removed bears and a subsistence harvest of 20-30 bears/year [USDOI, FWS, 1995]). Assuming a Beaufort Sea polar bear population of 2,000 and a sex ratio of 2:1 male to female, the sustainable yearly harvest would be about 76 bears, which is considerably more than recent annual subsistence harvest of bears from this population under the North Slope Borough/Inuvailuit Game Committee Management Agreement on Polar Bears (Nageak, Brower, and Schliebe, 1991). Thus, the additional loss of 10 bears from a possible fuel spill is not expected to significantly affect the population.

Belukhas of the western Beaufort population may have some contact with a spill (hydrocarbons in the water column or on the surface) that would temporarily contaminate the marine environment; however, few, if any, belukha whales are likely to be seriously affected, even in a severe situation, with no significant effect on the population.

2) Effects from Onshore Spills: A total of 13 to 55 crude-oil spills (>1 bbl) with an assumed size of 4 bbl and a total of 116 to 510 small fuel-oil spills with an average size of 29 gal are estimated to occur onshore under Alternative E (Tables IV.A.2-2 and IV.A.2-6). These small onshore spills are expected to have little effect on seals, walruses, and polar bears. If some of these spills occur in or contaminate streams in the Teshekpuk Lake area that drain into marine waters, small numbers of seals, polar bears, and other marine mammals might be exposed to contamination in nearshore habitats and suffer lethal or sublethal effects. A small number of breeding ringed seals and their pups could be contaminated by any of these spills that reach the marine environment during early winter, resulting perhaps in the death of some pups (perhaps 10-30 animals, because of the small size of these spills and the sparse distribution of pupping lairs). Even smaller numbers of polar bears, walruses, and belukha whales are expected to be exposed to and affected by these small spills.

Impact of an Oil Spill Contacting the Colville River: Assuming a 325-bbl crude-oil spill reached the Colville River during the open-water season, some of the oil would end up in marine waters in Harrison Bay. An estimated 50 percent would be in the sediment plume flowing out of the river and settle out on the sea-bottom near the river delta. A spill of this small size would be dispersed quickly and is not expected to affect many seals and polar bears that may be in the spill area. A small number of spotted seals that haul out along the river delta may come in contact with the oil directly or might consume fish exposed to the oil. A few polar bears might come in contact with the oil and be adversely affected. Other marine mammals such as ringed and bearded seals and beluga whales are not likely to come in contact with this small spill. The number of seals and polar bears adversely affected or killed by this spill likely would be small (<100 seals and no more than a few bears) and would not be significant to marine mammal populations.

Conclusion—First Sale: For marine mammals, the effects of activities other than oil and gas under Alternative E are expected to be similar to those under Alternative A—local and short term, with no significant adverse effects to the populations as a whole. The effects of oil and gas activities for Alternative E are expected to increase over the effects of Alternative B. Although most of the increase in human activities associated with oil exploration and development is expected to occur inshore, south of the coast, some increase in potential noise and disturbance and oil pollution effects is expected to occur along the coast. A small number of seals and no more than a few polar bears might be adversely affected or killed by a 325-bbl crude-oil spill contacting the Colville River, but these losses would not be significant to marine mammal populations. Under Alternative E, seals and polar bears could be affected by possible oil exploration offshore from an ice island and subsequent oil development on the coast of the NPR-A (Fig. II.C.1-4). Effects of these activities would be local and are not likely to affect marine mammal populations.

Multiple Sales: If several lease sales occur under Alternative E, considerably more exploration activity is expected to occur along the coast of the Teshekpuk Lake area, with the number of wells drilled increasing to 15-60 for multiple sales from the 5-15 wells for the first sale. The amount of development also is expected to increase. The number of oil fields would increase to 2-10 for multiple sales from the 1-5 fields for the first sale, the number of production pads would increase to 4-16 for multiple sales from the 2-9 for the first sale, and pipeline miles would increase to 95-280 mi for multiple sales from 80-205 mi for the first sale. This increased activity could result in an increase in aircraft disturbance of seals hauled out on the ice along the coast north of Teshekpuk Lake, and an increase in onshore surface traffic activity (seismic exploration, overland moves, construction activities along the coast) could result in more disturbance of polar bears denning and foraging along the coast. However, these effects are expected to be local and short term, with no significant adverse effects to the polar bear and seal populations as a whole.

Under Alternative E, the number of small crude-oil spills is expected to increase to 25-109 spills (averaging 4 bbl) for multiple sales from an estimated 13-55 (>1 bbl) for the first sale. Small refined-oil spills are expected to increase to 232-1,021 (averaging 29 gal) for multiple sales from 116-510 spills for the first sale over the production life of the planning area (Tables IV.A.2-3a, IV.A2-3b, IV.A.2-6a, and IV.A.2-6b). These small onshore spills are expected to have little effect on seals, walruses, and polar bears. If some of these spills occur in or contaminate streams in the Teshekpuk Lake area that drain into marine waters, small numbers of seals, polar bears, and other marine mammals might be exposed to contamination in nearshore habitats and suffer lethal or sublethal effects.

Conclusion—Multiple Sales: Multiple sales under Alternative E are expected to have similar effects to those under Alternative E in the first sale, i.e., local and short term, with no significant adverse effects to marine mammal populations as a whole.

Effectiveness of Stipulations: The effectiveness of stipulations is expected to be the same as under Alternative A. However, Stipulation 26, which generally would require that facilities be 2 mi from the coast, may offer some protection from spills reaching the marine environment.

10. Endangered and Threatened Species:

a. Activities Other Than Oil and Gas Exploration and Development: Such activities associated with the management plan still would occur under this alternative. Ground-impacting management actions within the planning area that may affect bowhead whales and spectacled and Steller's eiders under Alternative E include aerial surveys (including that of wildlife) and ground activities, such as hazardous- and solid-material removal and remediation, which occur during the summer/early fall. A description of these activities and potential effects on these species are discussed in Alternative A and summarized herein. The potential effects from these activities are expected essentially to be the same as described for Alternative A. A detailed discussion of all management actions is found in Section II.

Bowhead whales are not likely to be affected by any activities associated with the management plan. Some

eiders may be affected by activities associated with aircraft traffic and hazardous- and solid-material removal and remediation. Under this alternative, there would be an increase in the number of aircraft flights for point-to-point flights, aerial wildlife surveys, and other aerial surveys. Point-to-point flights increase from occasional to daily flights. Aerial wildlife surveys increase from 14 to 21 days during June and July, and other aerial surveys increase from occasional flights to several 2- to 3-week periods. Summertime aircraft flights over sensitive areas for eiders may affect nesting females and their broods. Eiders breeding, nesting, or rearing young in coastal habitats north, west, and east of Teshekpuk Lake (spectacled eider LUEA, Fig.II.B.3) may be overflown by aircraft (both helicopters and fixed-wing) on a regular basis during the summer months and may experience temporary, nonlethal effects. Due to the relatively low density of eiders in the area, substantial disturbance is not expected to occur and is likely to be limited to within a few kilometers of the activities. Such short-term and localized disturbances are not expected to cause significant population effects. However, disturbance of some individuals over the life of the project is expected to be unavoidable. Disturbance, depending on its nature and duration, could be considered a "take" under the ESA.

b. Oil and Gas Exploration and Development Activities: Under Alternative E, oil and gas leasing would occur throughout the planning area. The analysis contained in this section is based on a development scenario presented in Section IV.A.1.b of this EIS. Please refer to these sections for a discussion of resource-recovery rates and quantities, timing of infrastructure development, platform emplacement, wells drilled, and resource-production timeframes and other information relevant to the development of the resources of the proposed action. The BLM proposes to conduct multiple oil and gas lease sales within the planning area. Multiple sales are discussed later in this section. Under Alternative E, oil resources for the initial sale are expected to be in the 250- to 1,100-MMbbl range from one to five fields, which is considered a reasonable range of resource development and activity level for the portion of the planning area open to leasing (Table IV.A.1.b-4). Information on the number of exploration, delineation, and production wells anticipated to be drilled and pipeline miles can be found in Table IV.A.1.b-5. Differences in effects on the species as a result of noise and disturbance over this range of scenarios are expected to be minor. Differences in effects on the species as a result of an oil spill during the development/ production scenario (250-1,100-MMbbl-resource range) also are expected to be minor.

For Alternative E, the number of oil spills estimated to occur over the assumed production life of the IAP is from 37 to 164 spills <1 bbl and from 13 to 55 spills >1 bbl (Table IV.A.2-3a). For the purposes of analysis, this EIS assumes an average spill size of 4.0 bbl and that the estimated number of crude-oil spills over the assumed production life of the planning area would range from 50 to 219 spills (Table IV.A.2-2a). Information pertaining to oil spills can be found in Section IV.A.2. It is also assumed for Alternative E that a fuel-oil spill, associated with the barging of supplies, would occur in the marine environment during August or September.

(1) Effects on the Bowhead Whale: The potential effects on bowhead whales from discharges, noise and disturbance, and oil spills associated with oil and gas activities or other activities associated with the management plan are expected essentially to be the same under this alternative as under Alternative B. If a discovery is made adjacent to the coast, there is a small possibility that noise from drilling activities during the fall whale migration may affect some whales migrating closer to shore. Affected bowheads may respond to noise from drilling units by slightly changing their migration speed, swimming direction, or some other minor change in behavior, although such effects are unlikely. However, due to sound attenuation from onshore drilling operations and the distance sound would have to travel to reach the whales, it is unlikely that any noise from drilling operations would reach bowhead whales. Although a discovery adjacent to the coast would increase the potential for an oil spill reaching marine waters, no oil spills are expected to occur in the marine environment due to the small size of most spills that are likely to occur in the area. Small onshore spills are unlikely to reach the marine environment. It is very unlikely that oil spills would have any effect on bowhead whales. Assuming a fuel-oil spill occurred in bowhead whale habitat while bowheads were present, some whales could experience one or more of the following: skin contact, baleen fouling, respiratory distress caused by inhalation of hydrocarbon vapors, localized reduction in food resources, consumption of some contaminated prey items, and perhaps a temporary displacement from some feeding areas. The number of whales contacted would depend on the size, timing, and duration of the spill; the density of the whale population in the area of the spill; and the whales' ability or inclination to avoid contact with the spilled fuel-oil.

(2) Effects on the Spectacled and Steller's Eiders: The potential effects on spectacled and Steller's eiders from discharges, seismic surveys, and construction activities associated with oil and gas activities are expected essentially to be the same under this alternative as under Alternative B. Onshore oil spills generally are fairly small and are likely to occur primarily on the drilling pad, where they would be unlikely to affect eiders. Spills that occur on or reach the surrounding environment generally cover a small area ($\leq 500^2$). The FWS (USDOI, FWS, 1998)

anticipates that only those individuals or nests that are within 200 m are likely to be affected by oil spills. The potential for spilled oil to reach Teshekpuk Lake and the potential effects on spectacled eiders is expected to be essentially the same as discussed in Alternative D. If a discovery occurs and seawater is used for waterflooding during the production phase, it is possible that some seawater could be spilled on the tundra as a result of a pipeline leak. While mortality to eiders is unlikely, some habitat could be damaged or destroyed from the seawater. Assuming a fuel-oil spill occurred in marine waters while eiders were present, some mortality likely would occur as a result of hypothermia. Some eiders could ingest fuel oil from preening of oiled feathers and be prone to various pathological conditions such as endocrine dysfunction, liver-function impairment, weight loss, etc. Some disturbance could occur in the marine environment, if new staging areas are created or if a discovery is made and a waterflood program is initiated using seawater. It is likely that existing staging areas will be used to the extent possible, and there would be no effects from construction activities on eiders. Disturbance to eiders in the marine environment from construction of a staging area or a waterflood program may cause a few individuals to be displaced from the nearshore coastal area in the vicinity of the project. However, the effects on eiders are likely to be negligible. The potential effects as a result of noise and disturbance associated with oil and gas activities, such as aircraft traffic, vessel traffic, and perhaps drilling of development and production wells and oil-spill-cleanup activities, are likely to increase, because all of the eider breeding and nesting areas in the planning area are in areas available to oil and gas activities under this alternative. The area north, east, and west of Teshekpuk Lake (includes spectacled eider LUEA) is available for drilling and has a relatively high density of spectacled eiders compared to areas south of Teshekpuk Lake. Although Steller's eiders are present in the planning area, it is not known for certain if they actually breed in the planning area. It is unlikely that the primary Alaskan nesting area for Steller's eiders, located south and southeast of Barrow, would be affected much by these activities; so significant disturbance of nesting or broodrearing eiders is not expected to occur. Eiders exposed to noise and disturbance from oil and gas activities may experience temporary, nonlethal effects, probably lasting less than an hour but, in the case of summer drilling operations, could continue all summer. Some eiders may be displaced to habitat that may not be optimal for successful reproduction and survival. Adverse effects from such displacement likely would be minimal considering the relatively low density of eiders in the planning area and the likelihood that historic population levels using this habitat were much higher. Overall, substantial disturbance is not expected to occur and is likely to be limited to within a few kilometers of the activities. Therefore, the effects on eiders should be limited, with only a few eiders exposed to oil and gas activities. Disturbance of some individuals over the life of the project is expected to be unavoidable. Disturbance, depending on its nature and duration, could be considered a "take" under the ESA.

Conclusion—First Sale: The potential effects on bowhead whales from discharges, noise and disturbance, and oil spills are expected essentially to be the same under this alternative as under Alternative B. Some whales exposed to a fuel-oil spill could experience one or more of the following: skin contact, baleen fouling, respiratory distress caused by inhalation of hydrocarbon vapors, localized reduction in food resources, consumption of some contaminated prey items, and perhaps a temporary displacement from some feeding areas. The number of whales contacted would depend on the size, timing, and duration of the spill; the density of the whale population in the area of the spill; and the whales' ability or inclination to avoid contact with the spilled fuel oil. Some eiders exposed to a fuel-oil spill may suffer mortality as a result of hypothermia while others may ingest fuel oil from preening of oiled feathers and be prone to various pathological conditions such as endocrine dysfunction, liver-function impairment, and weight loss. The potential effects on spectacled and Steller's eiders from discharges, some noise and disturbance, seawater spills, and oil spills associated with oil and gas activities are expected essentially to be the same under this alternative as under Alternative B. Some spectacled and Steller's eiders in the planning area may be exposed to oil and gas activities and may experience temporary, nonlethal effects as a result of increased aircraft traffic, vessel traffic, and perhaps drilling of development and production wells and oil-spill-cleanup activities. There also may be an increase in potential effects on eiders from activities other than oil and gas associated with the management plan due to an increase in summertime aircraft flights over sensitive areas that may affect nesting females and their broods. Under this alternative, there would be an increase in the number of aircraft flights for aerial wildlife surveys and other aerial surveys. Aerial wildlife surveys in June and July increase from 14 days to 21 days. Spectacled and Steller's eiders breeding, nesting, or rearing young in coastal habitats may be overflown by support aircraft and may experience temporary, nonlethal effects. In the central portion of the planning area, Steller's eiders occasionally may be overflown by support aircraft and may experience temporary, nonlethal effects. It is unlikely that the primary Alaskan nesting area, located south and southeast of Barrow, would be affected much by these activities; so significant disturbance of nesting or broodrearing eiders is not expected to occur. Such short-term and localized disturbances are not expected to cause significant population effects. However, disturbance of some individuals over the life of the project is expected to be

unavoidable. Disturbance, depending on its nature and duration, could be considered a "take" under the ESA.

Multiple Sales: Under the multiple-sales approach, the resource estimate for Alternative E increases from a range of 250 to 1,100 MMbbl in 1 to 5 oil fields (Table IV.A.1.b-4) to a range of 500 to 2,200 MMbbl in 2 to 10 oil fields (Table IV.A.1.b-6). The number of exploration wells increases from a maximum of 15 to 60, delineation wells increase from a maximum of 23 to 48, and production wells increase from a maximum of 330 on 9 pads to 660 on 16 pads. Pipeline miles increase from 205 to 280 mi (Tables IV.A.1.b-5 and 7). Multiple sales would occur over a longer period of time and, depending on frequency of sales and results from exploratory drilling operations, possibly increase the timeframe for oil and gas activities in the planning area by a couple of decades.

For Alternative E, the estimated number of oil spills assumed to occur over the production life of the IAP would increase from a range of 37 to 164 spills to a range of 75 to 329 for spills <1 bbl and would increase from a range of 13 to 55 spills to a range of 25 to 109 for spills >1 bbl (Tables IV.A.2-3a and IV.A.2-3b). The estimated number of crude-oil spills over the assumed production life of the planning area would increase from a range of 50 to 219 spills to a range of 100 to 438 spills (Tables IV.A 2-2a and IV.A.2-2b). Information pertaining to oil spills can be found in Section IV.A.2.

Conclusion—Multiple Sales: The effects of multiple sales and increased potential for noise-producing activities and oil spills on endangered and threatened species at the resource ranges and activity levels described are expected to be essentially the same as described above for the single sale.

Effectiveness of Stipulations: The effectiveness of stipulations for noise and disturbance from oil and gas activities is the same as Alternative B; and from activities other than oil and gas, such as aerial wildlife surveys and other aerial surveys, would be the same as Alternative A.

11. Economy:

a. Activities Other Than Oil and Gas Exploration and Development: Alternative E would generate recreation-field employment by 22, 1-week long float-trip parties per year (Table II.H.3.b), which is equal to one person working for 6 months each year.

b. Oil and Gas Exploration and Development Activities: Increased revenues and employment are the most significant economic effects that would be generated by Alternative E. Increased property-tax revenues and new employment would be created with the construction, operation, and servicing of facilities associated with oil and gas activities. These facilities are described in Table IV.A.1-1 and are summarized as follows. For exploration, 5 to 15 exploration and 6 to 23 delineation wells would be drilled between 2000 and 2009; for development, 75 to 330 production and service wells would be drilled, 2 to 9 production pads constructed, and 80 to 205 mi of onshore pipeline installed between 2006 and 2017. The number of workers needed to operate the infrastructure is determined by the scale of the infrastructure and not by the amount of oil produced. A wide range of production volume can be handled by a given level of infrastructure. Once the infrastructure is constructed, the number of workers needed to operate it does not depend on the amount of product flowing through it. Effects include employment generated by seismic surveys during exploration. State property-tax revenues are in proportion to the value of onshore facilities. State royalty income and State severance tax are in proportion to production. Peak yearly production is estimated at 21 to 81 MMbbl. (For complete descriptions of resources and associated activity, see Section IV.A.1.b.)

(1) North Slope Borough Revenues and Expenditures: Exploration, development, and production are projected to generate increases in property taxes above the levels without Alternative E activities starting in 2000 and averaging about 3 to 6 percent each year through the production period, or about $6 to $12 million. For revenues shared by the State, see subpart (4) below.

(2) NSB Employment: The gains from Alternative E in direct employment would include jobs in petroleum exploration, development, and production and jobs in related activities (Table IV.F.11-1). Direct employment is anticipated to peak in the range of 2,200 to 4,200 jobs during the development phase, and decline to a level in the range of 700 to 1,400 during production from 2018 to 2028.

Total NSB resident employment is anticipated to increase in the range of 64 to 118 jobs in the peak of development and level off to 23 to 60 during production after 2017 (Table IV.F.11-1). The peak increase in resident employment is about 4 to 8 percent greater with Alternative E than without during development, and about 2 to 5 percent greater during production. The increase in employment opportunities partially may offset declines in other job opportunities and delay expected outmigration. Increases in resident population would correspond to increases in employment (Table IV.F.11-2).

No workers would be needed to clean up numerous small oil spills beyond those already employed in the workers' enclave.

Table IV.F.11-1
Summary of Employment Forecasts, Alternative E

	IAP Employment in Enclave			NSB Resident Employment		
	Without IAP Activity	With IAP Activity		Without IAP Activity	*Increase* with IAP Activity	
Year		$18/bbl	$30/bbl		$18/bbl	$30/bbl
1999	0	0	0	1,865	0	0
2000	0	99	118	1,825	2	2
2001	0	179	278	1,794	8	11
2002	0	179	358	1,767	12	20
2003	0	279	543	1,746	15	28
2004	0	59	323	1,730	15	33
2005	0	429	618	1,716	13	30
2006	0	2,241	3,505	1,701	64	85
2007	0	1,376	2,255	1,685	56	74
2008	0	1,262	2,262	1,662	29	50
2009	0	1,094	3,572	1,614	24	74
2010	0	702	1,997	1,565	14	42
2011	0	702	3,652	1,513	18	82
2012	0	731	2,734	1,470	22	73
2013	0	722	2,443	1,431	23	77
2014	0	722	4,195	1,393	23	118
2015	0	722	2,200	1,357	23	70
2016	0	722	2,000	1,350	23	70
2017	0	722	2,000	1,330	23	70
2018	0	722	1,400	1,310	23	60
2019	0	722	1,400	1,290	23	60
2020	0	722	1,400	1,290	23	60
2021	0	722	1,400	1,310	23	60
2022	0	722	1,400	1,330	23	60
2023	0	722	1,400	1,350	23	60
2024	0	722	1,400	1,370	23	60
2025	0	722	1,400	1,390	23	60
2026	0	722	1,400	1,410	23	60
2027	0	722	1,400	1,430	23	60
2028	0	722	1,400	1,450	23	60

Sources: Resident employment 1999–2015, Rural Alaska Model, North Slope Borough, 1996; IAP employment and resident employment 2016–2028, Manpower Model and MMS.

Table IV.F.11-2
Summary of NSB Population Forecasts, Alternative E

	Resident Population	Increase in Resident Population			Resident Population	Increase in Resident Population	
Year	No IAP Activity	IAP Activity $18/bbl	IAP Activity $30/bbl	Year	No IAP Activity	IAP Activity $18/bbl	IAP Activity $30/bbl
1999	6,067	0	0	2014	6,582	69	354
2000	6,134	6	6	2015	6,423	69	210
2001	6,213	24	33	2016	6,300	69	210
2002	6,301	36	60	2017	6,200	69	210
2003	6,391	45	84	2018	6,100	69	180
2004	6,488	45	99	2019	6,000	69	180
2005	6,684	39	90	2020	6,000	69	180
2006	6,695	192	255	2021	6,100	69	180
2007	6,820	168	222	2022	6,200	69	180
2008	6,918	87	150	2023	6,300	69	180
2009	7,011	72	222	2024	6,400	69	180
2010	7,050	42	126	2025	6,500	69	180
2011	7,004	54	246	2026	6,600	69	180
2012	6,891	66	219	2027	6,700	69	180
2013	6,743	69	231	2028	6,800	69	180

Sources: For years 1999–2015, Rural Alaska Model, North Slope Borough, 1996. For 2016–2028, MMS.

(3) Effects of Subsistence Disruptions on the NSB Economy: Disruptions to the harvest of subsistence resources could affect the economic well-being of NSB residents primarily through the direct loss of subsistence resources. See Section IV.F.13 for effects on subsistence-harvest patterns.

(4) Local, State, and Federal Revenues: Local, State, and Federal revenues would increase as a result of the Alternative E. Property-tax revenues to the State will be approximately 25 percent of the revenues to the NSB, or $1.5 to $3 million annually. The annual royalty will be $14 to $116 million for the Federal Government and $14 to $116 million for the State and NSB. The average annual State severance tax is estimated to be $24 to $196 million.

(5) Southcentral Employment: Workers in the enclave centered at Prudhoe Bay probably would commute to permanent residences in Southcentral Alaska, Fairbanks, and outside the State. However, for the purpose of this analysis, it is assumed all of the enclave workers (Table IV.F.11-1) commute to Southcentral Alaska and have permanent residences there except during peak construction years.

Population in Southcentral Alaska generated directly and indirectly by enclave workers during production would be in the range of 10,500 to 21,000, or 2.8 to 5.7 percent of the Southcentral population. In the 7-year period of the exploration and development phases, the population directly and indirectly associated with Alternative E would rise to the level sustained during production.

Conclusion—First Sale: Activities other than oil and gas exploration and development for Alternative E would generate recreation-field employment by 22, 1-week long float-trip parties per year (Table II.H.3.b), which is equal to one person working for 6 months each year. For oil and gas exploration and development activities for Alternative E, production in Alternative E is projected to generate increases above the levels of Alternative B as follows: NSB property taxes, 3 to 4 percent ($6 to $9 million); direct oil-industry employment, 700 (5 times this in additional jobs) residing in Southcentral Alaska; NSB-resident employment, 2 to 3 percent; and annual revenues of $1.5 to $2.25 million property tax to the State, $10 to $79 million royalty to the Federal Government, $10 to $79 million royalty to the State and NSB, and $18 to $134 million severance tax to the State.

Multiple Sales and Conclusion: The effect of multiple sales for Alternative E is projected to be approximately two times that of the first sale for Alternative E.

Effectiveness of Stipulations: There are no mitigating measures that would change potential economic effects.

12. Cultural Resources:

a. Activities Other than Oil and Gas Exploration and Development: Cultural resources (the physical remains resulting from the activities of historic or prehistoric humans) are nonrenewable. Once they are adversely impacted and/or displaced from their natural context, the damage is irreparable.

Under Alternative E, the management-action impacts generally would be the same as under Alternative A, except the intensity of the actions would increase due to potential oil and gas exploration.

b. Oil and Gas Exploration and Development Activities:

(1) Effects of Disturbance from Exploration: The types of oil and gas exploration activities that would occur under Alternative E would be the same as those that would occur under Alternative B. However, the level or intensity of these exploration activities would increase dramatically under Alternative E. The number of exploration/delineation wells drilled would increase from 10 in Alternative B to 38, and as many as six might be drilled during a single winter season. This would increase the area of potential impact nearly 300 percent over Alternative B.

(2) Effects of Exploration Spills: These effects would be the same as those under Alternative B, except the possibility of impacts would be increased by almost 300 percent.

(3) Effects of Disturbance from Development: The types of oil and gas development activities that would occur under Alternative E would be the same as those that would occur under Alternative B. However, the level or intensity of these development activities would increase under Alternative E. The number of production pads would increase from two in Alternative B to six in Alternative E, and pipeline miles would increase by 130 for a total of 205 mi under Alternative E. Although difficult to quantify, the potential for the construction of pump stations, causeways, docks, and seawater pipelines also increases under Alternative E. Although unlikely, it also is possible that a causeway and/or dock be constructed along the coast. The possibility of a seawater pipeline also exists at about the same order of probability. All this activity dramatically increases the probability of potential impacts to cultural resources beyond that of Alternative B.

(4) Effects of Development Spills: These effects would be the same as those under Alternative B, although the possibility of spills would be greatly increased.

Conclusion—First Sale: Alternative E opens all of the planning area to oil and gas leasing. Under Alternative E, impacts to cultural resources from management activities other than oil and gas exploration and development would be similar in nature but may be significantly increased in magnitude over Alternative A. Under Alternative E, most of the impacts to cultural resources would result from oil and gas exploration and development, although there is a possibility that no such activities (except seismic reconnaissance) would impact cultural resources sites. When compared with Alternative B, the potential for impact to cultural resources would be significantly greater under Alternative E.

Multiple Sales: The potential impacts to cultural resources under Alternative E could increase by as much as 400 percent compared to Alternative B.

Conclusion—Multiple Sales: Under Alternative E, potential impacts to cultural resources from management activities other than oil and gas exploration and development would be similar in nature to Alternative B, but the probability of impacts occurring would increase. Under Alternative E, the potential impacts to cultural resources from oil and gas exploration and development would increase by at least 400 percent compared to Alternative B.

Effectiveness of Stipulations: The effectiveness of stipulations would be the same as under Alternative B.

13. Subsistence-Harvest Patterns:

This section analyzes the impacts of ground-management actions and oil and gas leasing on the subsistence-harvest patterns of communities in or near the planning area. This analysis is organized by types of effects and discusses effects on subsistence-harvest patterns on each affected community as a result of disturbance and oil spills. Analytical descriptions of affected resources and species, a more in-depth discussion of the parameters for subsistence-harvest patterns impact analysis, as well as indigenous Inupiat knowledge concerning effects are described in more detail in the discussion for Alternative B (Sec. IV.C.13).

Under Alternative E, oil and gas leasing and development would be allowed in the entire planning area, making available to oil and gas leasing the Teshekpuk Lake Watershed, the high-value Goose Molting Habitat, Spectacled Eider Breeding Range, and Teshekpuk Lake Caribou Habitat LUEA's (4.66 million acres would be available to oil and gas leasing).

The Colville River would be available to oil and gas leasing, aboveground pipelines, and gravel extraction. Raptor, passerine, and moose areas on the Colville River and recreation and scenic areas would also be available (with certain restrictions) to oil and gas leasing and the siting of pipelines and roads. The BLM would recommend the Secretary of the Interior establish the Pik Dunes and the Ikpikpuk Paleontological Sites as special areas.

Leasing would be allowed on lands subject to pending Kuukpik Corporation conveyances, and royalties would be placed in escrow until Kuukpik entitlements were conveyed. Lease-specific stipulations to protect water quality; fish habitat; wetlands; and caribou-calving, -migration, and insect-relief areas. Specific stipulations for protecting subsistence harvest activities, particularly in the areas of monitoring impacts, access, conflict resolution, and protecting traditional sites would be in place to minimize impacts to these resources.

a. Ground-Impacting-Management Actions:

(1) Activities Other than Oil and Gas Exploration and Development: Under Alternative E, ground-impacting-management actions are expected to increase significantly, and even though use levels by researchers, recreationists, and seismic surveyors would increase under this alternative, effects from ground-impacting-management actions are expected to be the same as those under Alternative A. Disturbance impacts from increased aircraft traffic associated with resource inventories and surveys to birds, caribou, moose, muskoxen, and other terrestrial mammals would cause brief disturbance reactions lasting from a few minutes up to an hour, potentially causing terrestrial mammals to avoid research, survey, and recreation camps during the summer-long field season. However, no overall increase is expected in disturbance effects to subsistence resources and harvest patterns of the communities nearby the planning area, even with this increased disturbance from aircraft flights. For a more in-depth discussion of activities other than oil and gas exploration and development, see impacts discussion for subsistence-harvest patterns under Alternative A.

(2) Oil and Gas Exploration and Development Activities: Oil exploration activities—seismic activity and exploration drilling—would occur in winter (early December-mid-April). Transportation of construction materials (and gravel for pads), personnel, and fuel would be done over winter ice roads on low ground-pressure vehicles from existing infrastructure at Prudhoe Bay and Kuparuk. Large equipment would be barged to coastal staging areas in the summer, stockpiled at Camp Lonely, and moved inland the following winter. Umiat would also be used as a staging area. Seismic surveys would continue on the NPR-A, if a leasing program occurs. Under Alternative E, one to five fields with a resource range of 250 to 1,100 MMbbl of oil are estimated. Five to 15 exploration wells would be drilled. For development, 6 to

23 delineation and from 75 to 330 production and service wells would be drilled, and from 80 to 205 mi of pipeline constructed.

(a) Effects of Disturbance: Sources for disturbance from exploration and development essentially would be the same as those discussed for Alternative B, except for possible barge-resupply traffic. Because of projected summer supply-barge traffic in the open water, potential impacts from noise to migrating bowhead whales could occur, although normal migration would tend to keep the whales offshore and away from nearshore barge traffic. Overall, the chance of extensive fuel resupply by barge from this activity would be unlikely.

(b) Effects of Spills: Under Alternative E, one to five fields with a resource range of 250 to 1,100 MMbbl of oil are estimated. Oil-spill-occurrence estimates over the assumed production life of the planning area range from 50 to 219 crude-oil spills, with a volume range from 200 to 876 bbl of oil (average spill size equals 4 bbl). For spills >1 bbl, the range is from 13 to 55 spills. For TAPS spills resulting from NPR-A production, the number of spills ranges from 4 to 15, with a volume ranging from 4 to 17 bbl. Oil-spill- occurrence estimate for TAPS tanker spills resulting from NPR-A resources is a 30- to 76-percent chance of 0 to 1 spills (with an average spill size of 30,000 gal) occurring. One-hundred-sixteen to 510 refined-oil spills (diesel fuel, aviation fuel, engine lube, fuel oil, gasoline, grease, hydraulic oil, transformer oil, and transmission oil), with an estimated volume ranging from 80 to 352 bbl (average spill size equals 29 gal) are estimated. Historically, by volume, diesel fuels account for 75 percent of the refined oil spills. All NPR-A scenarios call for an onshore pipeline for oil delivery to TAPS, and there is the potential for a pipeline spill contaminating the Colville River. Adequate data are not available to estimate a chance of such an occurrence. Records indicate four pipeline leaks, with the largest discharge being 125 bbl. A spill entering the Colville River potentially could affect fish populations, disrupt subsistence fishing activity, and curtail the subsistence hunt as resources well may be tainted or, even if available, the perception of tainting would substantially affect the subsistence harvest (see Sec. IV.C.13, Subsistence).

Because of possible summer supply-barge traffic in the open water, potential impacts from noise and fuel spills to migrating bowhead whales could occur, although normal migration would tend to keep the whales offshore and away from nearshore barge traffic, and fuel resupply by barge is not expected to be the preferred scenario.

b. Effects on Subsistence Species:

(1) Terrestrial Mammals:

(a) Effects from Disturbance: For oil and gas activities, effects of Alternative E are expected to be significantly greater than those of Alternative B, with more helicopter disturbance of caribou and other terrestrial mammals. Increased habitat alteration would include the development of one to five oil fields and a pipeline to the TAPS. Some CAH and TLH caribou are expected to be disturbed and their movements delayed along the pipeline during periods of air traffic. Surface, air, and foot traffic near the s are expected to increase significantly and to displace some terrestrial mammals but not significantly affect Arctic Slope populations. If a field is developed in TLH caribou-calving areas, some calving is expected to be displaced within 1.86 to 2.48 mi (3- 4 km) of roads and other production facilities over the life of the project. Caribou are expected to experience chronic, local effects but would not become unavailable, undesirable for use, or experience overall population reductions. However, there remains some risk of long-term effects, including overall population reductions (Secs. IV.C.9 and IV.F.9).

(b) Effects from Oil Spills: The number of small, chronic crude-oil and fuel spills is expected to increase and result in the loss of small numbers of terrestrial mammals, with recovery expected within 1 to 2 years (Secs. IV.C.9 and IV.F.9).

(2) Fish:

(a) Effects from Disturbance: The individual effects of actions related to oil and gas development are the same for Alternative E as for Alternative B. However, the likelihood of their occurrence is estimated to be roughly five to six times higher for Alternative E than for Alternative B. Depending on the actual level and location of implementation, this could result in a corresponding increase in the overall effects of drill-pad, road, airstrip, and pipeline construction on arctic fish in Alternative E over that of Alternative B (Secs. III.B.3, IV.C.7 and IV.F.7). Effects on fish resources from seismic and construction disturbance would increase under this alternative with increased ongoing, short-term impacts on the subsistence fisheries of Barrow and Nuiqsut; Atqasuk's subsistence fishery does not quite reach the western edge of the planning area.

(b) Effects from Spills: Oil spills and seismic surveys associated with Alternative E are expected to have the same overall effect on arctic fish as discussed for Alternative B (Secs. IV.C.7 and IV.F.7).

(3) Birds:

(a) Effects from Disturbance: Under Alternative E most disturbance effects, associated with ground transport, seismic surveys, exploratory drilling, and construction in winter, and moderate flight frequency supporting large and small camps and aerial surveys, moderate increases of boat traffic on the Colville River, air transport of recreational parties, development well drilling, and spill cleanup activities in summer are expected to be localized, to within several 100 yards to 0.6 mi (few 100 m-1 km) of the disturbing activity, and temporary, ranging from brief (<1 day) in the case of response to a few aircraft flights or presence of ground activity to 3 months or more for well drilling or ground transport operations. Recovery in these instances is expected to require no more than 1 year. More intense activity, such as substantially increased boat or foot traffic along rivers, still is expected to require no more than one season for recovery for most species. Effects of routine oil and gas activities are expected to be substantially greater than discussed for Alternative B as a result of offering the Goose Molting LUEA for lease(Secs. IV.C.8 and IV.E.8).

Overall disturbance effects to important subsistence species of feeding, molting, and nesting white-fronted geese, black brant, eiders, oldsquaw, and other species are expected to be localized (within 100 yards to 0.6 mi of the activity) and temporary (ranging from <1 day for aircraft flight to 3 months for well drilling and ground operations). Recovery in these instances is expected to require no more than 1 year.

(b) Effects from Spills: For Alternative E, oil spill effects are expected to be considerably greater than for Alternative B because of the potential for a spill entering a lake occupied by molting geese; however, the significance is difficult to determine due the speculative aspect of facilities and activities location. A fuel-oil spill in the marine environment is expected to cause minimal effect on staging waterfowl (Secs. IV.C.8 and IV.E.8).

(4) Bowhead Whales:

(a) Effects from Disturbance: The potential effects on bowhead whales from discharges and noise and disturbance are expected essentially to be the same under this alternative as under Alternative B (Secs. IV.C.10 and IV.F.10).

(b) Effects from Oil Spills: Under Alternative E, leasing in the entire planning area would create the potential for a fuel-oil spill from a supply barge transporting equipment to coastal staging areas. The possibility of a spill reaching migrating bowheads is minimal, as barge traffic would be nearshore, the migration offshore, and the size of the spill small. Additionally, fuel resupply by barge is not expected to be the preferred scenario. Small onshore spills are unlikely to reach the marine environment. Although a discovery adjacent to the coast would increase the potential for an oil spill reaching marine waters, no oil spills are expected to occur in the marine environment due to the small size of most spills that are likely to occur in the area. Therefore, oil-spill effects on bowhead whales under Alternative E are expected to be same as Alternative B (Secs. IV.C.10 and IV.F.10).

(5) Other Marine Mammals:

(a) Effects from Disturbance: The effects on marine mammals of oil and gas activities for Alternative E are expected to increase over the effects of Alternative B. Although most of the increase in human activities associated with oil exploration and development is expected to occur inshore, south of the coast, some increase in potential noise and disturbance effects are expected to occur along the coast (Secs. IV.C.9 and IV.F.9).

(b) Effects from Oil Spills: For marine mammals, the effects of oil and gas activities for Alternative E are expected to increase over the effects of Alternative B. If some of these spills occur in or contaminate streams in the Teshekpuk Lake area, that drain into marine waters, small numbers of seals, polar bears, and other marine mammals might be exposed to contamination in nearshore habitats and suffer lethal or sublethal effects. A small number of breeding ringed seals and their pups could be contaminated by any of these spills that reach the marine environment during early winter, resulting perhaps in the death of some pups (perhaps 10-30 animals, because of the small size of these spills and the sparse distribution of pupping lairs). Even smaller numbers of polar bears, walruses, and belukha whales are expected to be exposed to and affected by these small spills. (Secs. IV.C.9 and IV.F.9).

c. Effects on Communities: Effects on Barrow, Atqasuk, and Nuiqsut from oil-industry-development disturbance are discussed in detail in Section IV.B.10 of the Beaufort Sea Sale 170 Final EIS (USDOI, MMS, 1998). See previous discussions in this section for effects on caribou, the primary subsistence species, other terrestrial mammals, fish, birds, bowhead whales, and other marine mammals. Effects assessments from these sections are summarized below; for a synthesis of traditional knowledge (where available), see effects discussion for Subsistence under Alternative B and the Preferred Alternative (Sec.IV.C.13 and IV.G.13).

(1) Barrow, Atqasuk, and Nuiqsut—Effects from Disturbance and Spills: Ongoing, short-term,

localized impacts from disturbance and oil spills would increase under Alternative E. Caribou could experience increased habitat alteration and some CAH and TLH caribou would experience disturbance and delays in their movements. Caribou displacement would increase near oil fields but there would be no significant effects to caribou populations. Fatalities and health effects from oil spills are expected to impact only a small number of terrestrial mammals and birds with recovery in 1 to 2 years. Increased effects to the TLH and CAH, other terrestrial mammals, fish, birds, and other marine mammals harvested by subsistence hunters from these three communities are not expected to cause increased effects on overall subsistence harvests. No increases in effects are expected to bowhead whales. Under Alternative E, it is expected that subsistence-hunter concerns about access to resources and resource contamination would be addressed by in-place stipulations and from protection afforded by other management actions (see Effectiveness of Stipulations below).

(2) Other Communities—Effects from Disturbance and Spills: Other communities within or adjacent to the NPR-A are the Chukchi Sea villages of Point Lay and Wainwright to the west and the inland community of Anaktuvuk Pass to the south and east. Subsistence-harvest areas for these communities are not within or adjacent to the planning area, although recent research indicates that movement by the TLH does bring the herd into the traditional subsistence-harvest areas of the communities of Wainwright and Point Lay. Historically, Anaktuvuk Pass caribou hunters have ranged to the southerly boundary of the planning area, and movement by the TLH would bring it into the harvest area of Anaktuvuk Pass subsistence hunters as well, although they primarily hunt the WAH (and to a lesser extent the CAH). Short-term and localized impacts from disturbance and oil spills to the TLH and CAH would have little impact on subsistence-caribou harvests for these three communities. Stipulations specific to this alternative further would minimize impacts to caribou.

Communities farther from the planning area, including those in the Yukon-Kuskokwim Delta, would be minimally affected. Although the goose-molting area would be made available for leasing, setbacks restricting oil and gas activities from the shores of lakes important for molting geese are expected to ensure that impacts to subsistence waterfowl species would be localized and temporary.

Conclusion—First Sale: Overall effects associated with Alternative E on subsistence-harvest patterns in the communities of Barrow, Atqasuk, and Nuiqsut, and other nearby communities from oil and gas activities in the planning area as a result of impacts from disturbance and oil spills are expected to increase over Alternative B. Periodic impacts to subsistence resources are expected, but no resource would become unavailable, undesirable for use, or experience overall population reductions. Overall, effects are not expected to have significant impacts on subsistence-harvest patterns in Barrow and Atqasuk, although oil-development activity under Alternative E could make Nuiqsut's pursuit of caribou more difficult for at least an entire harvest season.

Multiple Sales: Under the multiple-sales approach, the resource estimate for Alternative E increases from a range of 250 to 1,100 MMbbl in 1 to 5 s to a range of 500 to 2,200 MMbbl in 2 to 10 s. The number of exploration wells increase from a maximum of 15 to 60, delineation wells increase from a maximum of 23 to 48, and production wells increase from a maximum of 330 on 9 pads to 660 on 16 pads. Pipeline miles increase from 205 to 280 mi. Multiple sales would occur over a longer period of time and, depending on frequency of sales, the timeframe for oil and gas activities in the planning area would extend to at least 2 decades.

For Alternative E, it is estimated that the number of spills <1 bbl would increase from a range of 37 to 164 spills to a range of 75 to 329 spills, and the number of spills >1 bbl would increase from a range of 13 to 55 spills to a range of 25 to 109 spills over the assumed production life of the planning area. The estimated number of crude-oil spills over the assumed production life of the planning area would increase from a range of 50 to 219 spills to a range of 100 to 438 spills.

If several lease sales occur under Alternative E, considerably more exploration activity is expected to occur in the Teshepuk Lake calving habitat of the TLH caribou with the number of wells drilled increasing from 5 to 15 under the first sale to 15 to 60 under multiple sales. An increased potential displacement of calving TLH caribou along roads is expected between the increased number of production pads and other facilities. An increase in the number or miles of roads and other facilities with development under multiple sales is also expected to increase the impedance of TLH caribou movements to insect-relief areas along the coast, north of Teshekpuk Lake. The displacement of calving caribou represents a functional loss of habitat within 1.86 to 2.48 mi (3-4 km) of field roads. This effect is expected to persist over the life of the s and may reduce productivity and abundance of the TLH. Small, chronic spills are expected to have about the same effect on terrestrial mammals and their habitats as under Alternative B but with loss of individual mammals to the spills and habitat contamination increasing locally at the spill sites and along any streams contaminated by these spills. These spills are expected to result in the loss of small numbers of terrestrial mammals, with recovery expected within 1 year. Any habitat contamination that is

not effectively cleaned up is expected to persist for several years but is not expected to affect terrestrial mammal populations. Effects on Arctic fish populations from additional sales from increases in the number of gravel pads are likely to have about twice the effect on arctic fish as discussed for Alternative E. Also, because the number of pipeline miles for multiple sales and the single sale for Alternative E are similar, they are expected to have a similar effect as discussed for Alternative E. However, if there were not enough time between sales to allow for full recovery, or if the level of activity for the selected alternative was greater than that of Alternative E, the effect of each additional sale on arctic fish is likely to be greater than that of the single sale for Alternative E.

Displacement of birds from disturbance and habitat alteration or loss is expected to increase substantially where development and production facilities are located. This could occur in numerous portions of the planning area if multiple sales are held, potentially altering local populations in these areas. For species that appear more vulnerable to habitat changes or disturbance (e.g., loons, molting geese), effects could extend to regional populations and involve long-term changes in distribution. However, most effects that are likely to occur throughout the planning area are expected to be short-term and minor. Increases in oil and refined oil spills are expected to result in the loss of substantial numbers of birds, but these losses and recovery of cumulative lost productivity and recruitment may not be detectable above the natural fluctuations of the population and survey methods/data available. Overall effects are expected to increase substantially from those discussed for the first sale. The effects of multiple sales and increased potential for noise-producing activities and oil spills on bowhead whales at the resource ranges and activity levels described essentially are expected to be the same as described for the first sale. For marine mammals, increased activity could result in an increase in aircraft disturbance of seals hauled out on the ice along the coast north of Teshekpuk Lake, and an increase in onshore surface traffic activity (seismic exploration, overland moves, construction activities along the coast) could result in more disturbance of polar bears denning and foraging along the coast. However, these effects are expected to be local and short term, with no significant adverse effects to the polar bear and seal populations as a whole. Small onshore spills are expected to have little effect on seals, walruses, and polar bears. If some of these spills occur in or contaminate streams in the Teshekpuk Lake area that drain into marine waters, small numbers of seals, polar bears, and other marine mammals might be exposed to contamination in nearshore habitats and suffer lethal or sublethal effects.

Conclusion—Multiple Sales: The effect of multiple sales under Alternative E is expected to result in an increase in the amount of displacement of calving TLH caribou within 1.86 to 2.48 mi (3-4 km) of field roads. This effect is expected to persist over the life of the s and may reduce productivity and abundance of the TLH. Some increase in impeding TLH caribou movements to insect relief areas along the coast, north of Teshekpuk Lake is expected under multiple sales. The number of small, chronic crude-oil and fuel spills is expected to increase and result in the loss of small numbers of terrestrial mammals, with recovery expected within 1 year. Based on the assumptions discussed in the text, each additional sale is expected to have similar effects on arctic fish as described for the single sale for the first sale. However, if there are increased levels of activity associated with future lease sales, and/or insufficient recovery time between sales, greater adverse effects than described for Alternative E are likely to occur. Increased disturbance and displacement effects and increased oil-spill risks are expected for birds, but timing of the sales again is critical to recovery. With extended intervals between sales, impacted bird populations are expected to recover from noise and disturbance effects in 1 year. Generally, overall effects are expected to increase substantially from those discussed for the first sale. The effects of multiple sales and increased potential for noise-producing activities and oil spills on bowhead whales at the resource ranges and activity levels described essentially are expected to be the same as described for the first sale. For other marine mammals, multiple sales are expected to have similar effects to those under Alternative E in the first sale, i.e., local and short term, with no significant adverse effects to marine mammal populations as a whole.

Given that resource estimates and development scenarios project an increase in resources and large increases in the number of drill pads and pipeline miles, logic would assume increased effects to potentially affected resources, except for the fact that these effects would be spread over 2 decades. The biological analyses expect increases in effects with few overall effects to resource populations; therefore, effects associated with multiple sales on subsistence-harvest patterns in the communities of Barrow, Atqasuk, and (especially) Nuiqsut as a result of impacts from disturbance and oil spills are expected to make no subsistence resource unavailable, undesirable for use, or experience overall population reductions. On the other hand, the cumulative effect of multiple sales clearly would be an increased development "footprint" and consequent increased habitat loss to resources and use loss to hunters. This could affect subsistence harvests in the communities of Barrow, Atqasuk, and (especially) Nuiqsut and could alter caribou distributions sufficiently to make subsistence-hunter access more difficult. Impacts would be minimized from proposed stipulations and from the work of the Subsistence Advisory Panel designed to address local

subsistence and cultural issues throughout the life of the plan.

Effectiveness of Stipulations: Stipulations that specifically would protect subsistence resources are discussed in Sections IV.F.7, Fish Resources, IV.F.8, Birds, IV.F.9, Mammals, and IV.F.10, Endangered and Threatened Species. Implementation of all stipulations for caribou would reduce but not eliminate all effects on TLH caribou. Some level of displacement of calving still is expected to occur within 1.86 to 2.48 mi (3-4 km) of roads, and some caribou movements during insect harassments would be temporarily disrupted when caribou encounter road and foot traffic in association with production facilities. These disruptions would have some adverse energetic effects on individual caribou. The effectiveness of stipulations for protecting subsistence practices is the same as for Alternative B, most important of which is a BLM proposal to establish a Subsistence Advisory Panel to monitor subsistence issues and concerns arising from oil and gas activity on NPR-A.

14. Sociocultural Systems: This discussion is concerned with those communities that could be impacted by ground-management actions and oil and gas leasing in the planning area—Barrow, Atqasuk, and Nuiqsut. Under Alternative E, oil and gas leasing and development would be allowed in the entire planning area, making available to oil and gas leasing the Teshekpuk Lake Watershed, the high-value Goose Molting Habitat, Spectacled Eider Breeding Range, Teshekpuk Lake Caribou Habitat, and Fish Habitat LUEA's (4.66 million acres would be available to oil and gas leasing). Lease-specific stipulations to protect water quality; fish habitat; wetlands; and caribou-calving, -migration, and insect-relief areas. Specific stipulations for protecting subsistence harvest activities, particularly in the areas of monitoring impacts, access, conflict resolution, and protecting traditional sites would be in place to minimize impacts to these resources.

The Colville River would be open to oil and gas leasing, aboveground pipelines, and gravel extraction. Raptor, passerine, and moose areas on the Colville River and recreation and scenic areas would also be open (with certain restrictions) to oil and gas leasing and the siting of pipelines and roads. The BLM would recommend the Secretary of the Interior establish the Pik Dunes and the Ikpikpuk Paleontological Sites as special areas. Leasing would be allowed on lands subject to pending Kuukpik Corporation conveyances, and royalties would be placed in escrow until Kuukpik entitlements were conveyed.

The primary aspects of the sociocultural systems covered in this analysis are (1) social organization and (2) cultural values, as described in Section III.C.3. For the purpose of effects assessment, it is assumed that effects on social organization and cultural values could be brought about at the community level, predominantly by industrial activities, increased population, increased employment, and effects on subsistence-harvest patterns associated with the sale. For a more in-depth discussion of the parameters for sociocultural effects analysis, see the discussion for Alternative B (Sec. IV.C.13).

a. Ground-Impacting-Management Actions:

(1) Activities Other than Oil and Gas Exploration and Development: Under Alternative E, ground-impacting-management actions are expected to increase significantly, and even though use levels by researchers, recreationists, and seismic surveyors would increase under this alternative, effects from ground-impacting-management actions are expected to be the same as those under Alternative A. Disturbance impacts from increased aircraft traffic associated with resource inventories and surveys to birds, caribou, moose, muskoxen, and other terrestrial mammals would cause brief disturbance reactions lasting from a few minutes up to an hour, potentially causing terrestrial mammals to avoid research, survey, and recreation camps during the summer-long field season. However, no overall increase is expected in disturbance effects to subsistence resources and harvest patterns of the communities nearby the planning area, even with this increased disturbance from aircraft flights. For a more in-depth discussion of activities other than oil and gas exploration and development, see impacts discussion for subsistence-harvest patterns under Alternative A.

(2) Oil and Gas Exploration and Development Activities: Oil exploration activities—seismic activity and exploration drilling—would occur in winter (early December-mid-April). Transportation of construction materials (and gravel for pads), personnel, and fuel would be done over winter ice roads on low ground-pressure vehicles from existing infrastructure at Prudhoe Bay and Kuparuk. Large equipment would be barged to coastal staging areas in the summer, stockpiled at Camp Lonely, and moved inland the following winter. Umiat would also be used as a staging area. Seismic surveys would continue on the NPR-A, if a leasing program occurs. Under Alternative E, one to five fields with a resource range of 250 to 1,100 MMbbl of oil are estimated. Five to 15 exploration wells would be drilled. For development, 6 to 23 delineation and from 75 to 330 production and service wells would be drilled, and from 80 to 205 mi of pipeline constructed.

(a) Disturbance from Exploration and Development: Sources for disturbance from exploration and development essentially would be the same as those

discussed for Alternative B (Sec. IV.C.14, Sociocultural Systems).

(b) Spills and Spill Cleanup: See Section IV.F.13, Subsistence, for a discussion of Alternative E oil spills.

b. Population and Employment: Under Alternative E, oil and gas leasing in the planning area is projected to affect the population of the North Slope Borough through two types of effects on regional employment: (1) more petroleum-industry-related jobs as a consequence of planning area exploration and development and production activities and (2) more NSB-funded jobs as a result of higher NSB operating revenues and expenditures (Sec. IV.B.11). Employment projections as a consequence of planning area activities are provided in Sec. IV.F.11. Throughout the development and production phase, total petroleum-related employment would range from 2,241 to 4,195 jobs during the peak development and production years between 2006 and 2014. Resident employment as a result of activities would range from 64 to 118 jobs during the period. Most workers are expected to permanently reside outside of the North Slope. Planning area oil and gas activities are projected to increase resident employment 4 to 8 percent during the development phase and 2 to 5 percent during the production phase above the declining existing-condition projections (Tables IV.F.11-1 and IV.F.11-2). Any development in the NPR-A under Alternative E is projected to increase the NSB population above the existing-condition level.

c. Subsistence-Harvest Patterns: Effects could be expected on subsistence-harvest patterns in the planning area as a result of disturbance to Barrow, Atqasuk, and Nuiqsut's subsistence harvests due to seismic disturbance, aircraft noise, supply-vessel traffic, offshore exploration, onshore construction, gravel extraction, pipeline trenching, and oil spills (see discussion for Alternative B, Sec. IV.C.14).

d. Effects on Barrow, Atqasuk, and Nuiqsut: This section analyzes effects of industrial activities, population and employment changes, and subsistence-harvest-pattern impacts on North Slope social organization, cultural values, and other issues. This discussion focuses on the North Slope as a whole and with a discussion for each community.

(1) Social Organization: The social organization of communities that might be affected by oil and gas activities in the planning area includes typical features of Inupiat culture: kinship networks that organize much of a community's subsistence- harvest, consumption, and sharing activities; informally derived systems of respect and authority; strong extended families (although not always living in the same household); stratification between families focused on success in the subsistence harvest; and access to subsistence technology (Sec. III.C.2). However, activities generated by oil and gas activities in the planning area are not likely to bring about the effects to these features in the communities in question (see discussion for Alternative B, in Sec. IV.C.13).

(2) Cultural Values: Cultural values and orientations (as described in Sec. III.C.2) can be affected by changes in the population, social organization and demographic conditions, economy, and alterations of the subsistence cycle. Of these, the only changes that could be expected to occur would be in Nuiqsut's social organization and the subsistence cycle in Barrow, Atqasuk, and Nuiqsut (see discussion for Alternative B, Secs. IV.C.13 and IV.C.14; and Sec. IV.F.13).

Periodic, short-term, localized impacts from disturbance and oil spills would increase under Alternative E. Caribou could experience increased habitat alteration and some CAH and TLH caribou would experience disturbance and delays in their movements. Caribou displacement would increase near oil fields but there would be no significant effects to caribou populations. Fatalities and health effects from oil spills are expected to impact only a small number of terrestrial mammals and birds with recovery in 1 to 2 years. Increased effects to the TLH and CAH, other terrestrial mammals, fish, birds, and other marine mammals harvested by Barrow, Atqasuk, and Nuiqsut subsistence hunters are not expected to have increased effects on the overall subsistence harvests for these communities. No increases in effects are expected to bowhead whales. Under Alternative E, it is expected that subsistence-hunter concerns about access to resources and resource contamination would be addressed by in-place stipulations.

Overall effects associated with Alternative E on subsistence-harvest patterns in the communities of Barrow, Atqasuk, and Nuiqsut, and other nearby communities from oil and gas activities in the planning area as a result of impacts from disturbance and oil spills are expected to increase over Alternative B. Subsistence resources would be periodically impacted, but still no resource would become unavailable, undesirable for use, or experience overall population reductions. Overall, effects are not expected to have significant impacts on subsistence-harvest patterns in Barrow and Atqasuk, although oil-development activity under Alternative E could make Nuiqsut's pursuit of caribou more difficult for at least an entire harvest season.

(3) Social Health: Effects on sociocultural systems often can be seen in rising rates of mental illness, substance abuse, and violence. This has proven true for Alaskan Natives who have been faced since the 1950's

with increasing acculturative pressures. The rates of these occurrences far exceed those of other American populations such as Alaskan non-Natives, American Natives, and other American minority groups (see discussion for Alternative B, Sec. IV.C.13). Although there may be additional reasons for differences in social problems in local communities, it is clear that the proximity to industrial enclaves enables residents easier access to drugs and alcohol, thereby affecting the social health of the community—a situation that could intensify in Nuiqsut as a result of NPR-A oil and gas activity. Any effects on social health would have ramifications in the social organization, but NSB Native communities have, in fact, proven quite resilient to such effects by local voter insistence on these communities being "dry" and by the NSB's continued support of Inupiat cultural values and its strong commitment to health, social services, and other assistance programs.

Nuiqsut is the most likely community in the region to experience additional sale-related effects in social health and well-being. These effects on social health could have direct consequences on the sociocultural system but would not have a tendency toward displacement of existing institutions above the displacement that already has occurred with the current level of development. Effects on the institutions and sociocultural systems in Barrow and Atqasuk would be periodic but not displace existing institutions.

Conclusion—First Sale: Effects from management actions and oil and gas activities in the planning area under Alternative E are unlikely to disrupt sociocultural systems. Periodic, short-term disturbance effects would be expected to disrupt or displace institutions and sociocultural systems; community activities; and traditional practices for harvesting, sharing, and processing subsistence resources. Periodic disruptions to subsistence resources could occur, but any disruptions that occurred from oil and gas activities potentially would be mitigated by BLM in-place stipulations and mitigation measures designed to protect caribou, waterfowl, fish, moose, and specifically subsistence resources, subsistence practices, and hunter access. Overall effects under Alternative E to the sociocultural systems of the communities of Barrow, Atqasuk, and Nuiqsut would increase over those in Alternative B, but there would continue to be no disruption or displacement of cultural institutions or sociocultural systems.

Multiple Sales: If several lease sales occur under Alternative E, considerably more exploration activity is expected to occur in the planning area, and the levels of effects due to noise, disturbance, and habitat alteration are expected to increase. Given that resource estimates and development scenarios project an increase in resources and an increase in the number of drill pads and pipeline miles, logic would assume a substantial increase in the effects to potentially affected subsistence resources, except for the fact that these effects would be spread over 2 decades. The critical factor would be the timing between sales—a longer interval would allow more recovery to subsistence resources from aircraft, vehicular, and construction disturbance and subsistence practices from increased access conflicts; less of an interval might not allow for sufficient recovery. In any case, the cumulative effect clearly would be an increased development "footprint" and consequent increased habitat loss to resources and use loss to hunters. This could affect subsistence harvests in the communities of Barrow, Atqasuk, and (especially) Nuiqsut and could alter caribou distributions sufficiently to make subsistence-hunter access more difficult. Impacts would be minimized from proposed stipulations and from the work of the Subsistence Advisory Panel designed to address local subsistence and cultural issues throughout the life of the plan.

Conclusion—Multiple Sales: Effects from management actions and oil and gas activities in the planning area for multiple sales under Alternative E could disrupt sociocultural systems for periods up to 1 year, but impacts would not be expected to displace institutions and sociocultural systems; community activities; or traditional practices for harvesting, sharing, and processing subsistence resources, the same level of effect anticipated for multiple sales under Alternative B.

Effectiveness of Stipulations: Stipulations that specifically would protect subsistence resources are discussed in Sections IV.F.7, Fish Resources, IV.F.8, Birds, IV.F.9, Mammals, and IV.F.10, Endangered and Threatened Species. Implementation of all stipulations for caribou would reduce but not eliminate all effects on TLH caribou. Some level of displacement of calving still is expected to occur within 1.86 to 2.48 mi (3-4 km) of roads, and some caribou movements during insect harassments would be temporarily disrupted when caribou encounter road and foot traffic in association with production facilities. These disruptions would have some adverse energetic effects on individual caribou. The effectiveness of stipulations for protecting subsistence practices and sociocultural systems is the same as for Alternative B, most important of which being a BLM proposal to establish a Subsistence Advisory Panel to monitor subsistence issues and concerns arising from and oil and gas activity on the NPR-A.

15. Coastal Zone Management: Under Alternative E, all BLM-administered lands in the planning area would be available to oil and gas leasing (4.6 million acres). Aboveground pipelines could cross all lands within the planning area, and all lands would be available for seismic studies. These areas are subject to restrictions for

siting pipelines and industrial structures. The Colville River in the planning area would be recommended and managed as a "recreational" river in the WSR System. Other protections include adding a Bird Conservation Area along the Colville River; designating the Ikpikpuk Paleontological Sites LUEA as a new Special Area to protect paleontological resources; and adding the Pik Dunes LUEA to the Teshekpuk Lake Special Area.

Federal lands within the NPR-A are excluded from the coastal zone; however, all uses and activities on Federal lands either occurring within the coastal zone or that may reasonably be expected to affect the coastal area and its resources must be consistent to the maximum extent practicable with enforceable standards of the ACMP, including State standards in 6 AAC 80 and enforceable policies of the NSB CMP. The primary goal of the NSB's CMP is to protect the subsistence lifestyle of the Borough's largely Inupiat population, while also encouraging and managing economic development.

a. Activities Other than Oil and Gas Exploration and Development: The level of activities other than oil and gas would be similar to or slightly greater for Alternative E than for Alternative A (Table IV.A.1.a-1). Although use levels by researchers, recreationists, and seismic surveyors would increase under this alternative, effects from ground-impacting-management actions are expected to be the same as those under Alternative A. Disturbance impacts from increased aircraft traffic associated with resource inventories and surveys to birds, caribou, moose, muskoxen, and other terrestrial mammals would cause brief disturbance reactions lasting from a few minutes up to an hour, potentially causing terrestrial mammals to avoid research, survey, and recreation camps during the summer field season. No overall increase is expected in disturbance effects to subsistence resources and harvest patterns of the communities nearby the planning area, even with this increased disturbance from aircraft flights.

b. Oil and Gas Exploration and Development Activities: Under Alternative E, the impacts of disturbance from oil and gas exploration and development activities are expected to increase significantly over those under Alternative B. Under Alternative E, oil exploration activities, including seismic activity and exploration drilling, would occur in winter (early December-mid-April). Transportation of construction materials (and gravel for pads), personnel, and fuel would be done over winter ice roads on low ground-pressure vehicles from existing infrastructure at Prudhoe Bay and Kuparuk. Large equipment would be barged to coastal staging areas in the summer, stockpiled at Camp Lonely, and moved inland the following winter. Umiat would also be used as a staging area. Seismic surveys would be allowed in the entire planning area. Under Alternative E, one to five fields with a resource range of 250 to 1,100 MMbbl of oil are estimated. Five to 15 exploration wells would be drilled. For development, 6 to 23 delineation and from 75 to 330 production and service wells would be drilled, and from 80 to 205 mi of pipeline constructed.

Effects of Exploration and Development on the Alaska CMP: Under alternative E, all BLM-administered lands would be available for leasing. Potential conflicts with coastal management standards under Alternative E could occur in three main areas: under the habitat, subsistence, and water quality standards of the ACMP. Sources for disturbance from oil and gas exploration and development activities essentially would be the same as those discussed for Alternative B, except for possible barge-resupply traffic. Chronic, short-term, localized impacts from disturbance and oil spills would increase under Alternative E.

Effects of disturbance from oil and gas exploration and development activities essentially would be the same as those discussed for Alternative B, except for possible barge-resupply traffic. Under Alternative E, one to five fields with a resource range of 250 to 1,100 MMbbl of oil are estimated. Oil-spill-occurrence estimates over the assumed production life of the planning area range from 50 to 219 crude-oil spills, with a volume range from 200 to 876 bbl of oil (average spill size equals 4 bbl). For spills >1 bbl, the range is from 13 to 55 spills. For TAPS spills resulting from NPR-A production, the number of spills ranges from 4 to 15, with a volume ranging from 4 to 17 bbl. Oil spill occurrence estimates for TAPS tanker spills resulting from NPR-A resources is a 30- to 76-percent chance of 0 to 1 spills (with an average spill size of 30,000 gal) occurring.. All NPR-A scenarios call for an onshore pipeline for oil delivery to the TAPS, and there is the potential for a pipeline spill contaminating the Colville River. A spill entering the Colville River potentially could affect fish populations, disrupt subsistence fishing activity, and curtail the subsistence hunt as resources well may be tainted or, even if available, the perception of tainting would substantially affect the subsistence harvest (Sec. IV.C.13).

For oil and gas activities, effects of Alternative E on caribou and other terrestrial mammals are expected to be significantly greater than those of Alternative B, with more helicopter disturbance of caribou and other terrestrial mammals. Increased habitat alteration would include the development of one to five oil fields and a pipeline to the TAPS. Some CAH and TLH caribou are expected to be disturbed and their movements delayed along the pipeline during periods of air traffic. Surface, air, and foot traffic near the s is expected to increase significantly and to displace some terrestrial mammals, but not significantly

affect Arctic Slope populations. If a field is developed in TLH caribou-calving areas, some calving is expected to be displaced within 1.86 to 2.48 mi (3-4 km) of roads and other production facilities over the life of the project. Caribou are expected to experience chronic, local effects but would not become unavailable, undesirable for use, or experience overall population reductions; however, some risk of long-term effects and overall population reductions remain. The number of small, chronic crude-oil and fuel spills is expected to increase and result in the loss of small numbers of terrestrial mammals, with recovery expected within 1 to 2 years (Secs. IV.C.9 and IV.F.9).

The individual effects of disturbance on fish from actions related to oil and gas development are the same for Alternative E as for Alternative B. However, the likelihood of their occurrence is estimated to be roughly five to six times higher for Alternative E than for Alternative B. Depending on the actual level and location of implementation, this could result in a corresponding increase in the overall effects of drill-pad, road, airstrip, and pipeline construction on arctic fish in Alternative E over that of Alternative B. Effects on fish resources from seismic and construction disturbance would increase under this alternative with increased chronic, short-term impacts on the subsistence fisheries of Barrow and Nuiqsut. Oil spills and seismic surveys associated with Alternative E are expected to have the same overall effect on arctic fish as discussed for Alternative B (Secs. IV.C.7 and IV.F.7).

Under Alternative E, most disturbance effects to birds and important subsistence species of feeding, molting, and nesting white-fronted geese, black brant, eiders, old squaw, and other species are expected to be localized and temporary, ranging from brief (<1 day) in the case of response to a few aircraft flights or presence of ground activity to 3 months or more for well drilling or ground transport operations. These disturbance effects are associated with ground transport, seismic surveys, exploratory drilling, and construction in winter, and moderate flight frequency supporting large and small camps and aerial surveys, moderate increases of boat traffic on the Colville River, air transport of recreational parties, development well drilling, and spill cleanup activities in summer. Recovery in these instances is expected to require no more than 1 year. Oil or fuel spills entering lakes with staging waterfowl populations are expected to require no more than one season for recovery for most species (Secs. IV.C.8 and IV.E.8).

The potential effects on bowhead whales from discharges and noise and disturbance are expected essentially to be the same under Alternative E as under Alternative B. Leasing in the entire planning area would create the potential for a fuel-oil spill from a supply barge transporting equipment to coastal staging areas. The possibility of a spill reaching migrating bowheads is minimal, as barge traffic would be nearshore, the migration offshore, and the size of the spill small. In addition, fuel resupply by barge is not expected to be the preferred scenario. Small onshore spills are unlikely to reach the marine environment. Therefore, oil-spill effects on bowhead whales under Alternative E are expected to be same as Alternative B (Secs. IV.C.10 and IV.F.10).

The effects from disturbance and oil spills from oil and gas activities on marine mammals for Alternative E are expected to increase over the effects of Alternative B. Although most of the increase in human activities associated with oil exploration and development is expected to occur inshore, south of the coast, some increase in potential noise and disturbance effects are expected to occur along the coast, some increase in potential oil pollution effects is expected to occur along the coast (Secs. IV.C.9 and IV.F.9).

Ongoing, short-term, localized impacts from disturbance and oil spills on subsistence hunting activities to the communities of Barrow, Atqasuk and Nuiqsut would increase under Alternative E. Caribou could experience increased habitat alteration and some CAH and TLH caribou would experience disturbance and delays in their movements. Caribou displacement would increase near oil fields but there would be no significant effects to caribou populations. Fatalities and health effects from oil spills are expected to impact only a small number of terrestrial mammals and birds with recovery in 1 to 2 years. Subsistence-hunter concerns about access to resources and resource contamination under this alternative would be addressed by special stipulations developed to provide maximum protection to the resources (see effectiveness of stipulations).

Potential conflict between Alternative E proposed activities and Statewide standards and NSB district policies could occur, in conjunction with the NSB CMP 2.4.5.2(h) (NSBMC 19.70.050.K.8) that relates to both subsistence and cultural resource areas. This policy requires that development be located, designed, and maintained so as not to interfere with the use of a site that is important for significant cultural uses or essential for transportation to subsistence-use areas. Also, conflict with district policies could occur in the potential for adverse effects to subsistence resources. NSB CMP policy 2.4.3(a) (NSBMC 19.70.050.A) relates to "extensive adverse impacts to a subsistence resource" that "are likely and cannot be avoided or mitigated." In such an instance, "development shall not deplete subsistence resources below the subsistence needs of local residents of the Borough." Policy 2.4.5.1(a) (NSBMC 19.70.050.J.1) relates to "development that will likely result in significantly decreased productivity of subsistence resources or their

ecosystems." In addition, the NSB communities have expressed concern with restrictions to recreation activities. Potential conflicts with these standards is anticipated, but effects will be minimized by stipulations developed for this lease sale.

Conclusion—First Sale: Under Alternative E, conflicts could occur with the habitat, subsistence, and water quality standards of the ACMP. Overall effects of oil and gas activities for Alternative E are expected to significantly increase effects to terrestrial mammals, marine mammals, and subsistence resources and activities of local communities, over the effects of Alternative B. Conflicts could occur with specific Statewide standards and NSB CMP policies related to the potential for user conflicts between development activities and access to subsistence resources, and to adverse effects on subsistence resources. These effects would occur in the event of spilled oil contacting subsistence resources and habitats, and the activities associated with oil-spill cleanup. Overall effects associated with Alternative E on subsistence-harvest patterns in the communities of Barrow, Atqasuk, and Nuiqsut, and other nearby communities from oil and gas activities in the planning area as a result of impacts from disturbance and oil spills are expected to increase over Alternative B. Subsistence resources would be chronically impacted, but still no resource would become unavailable, undesirable for use, or experience overall population reductions. Overall, effects are not expected to have significant impacts on subsistence-harvest patterns in Barrow and Atqasuk, although oil-development activity under Alternative E could make Nuiqsut's pursuit of caribou more difficult for at least an entire harvest season.

Multiple Sales: Under the multiple-sales approach, the resource estimate for Alternative E increases from a range of 250 to 1,100 MMbbl in 1 to 5 s to a range of 500 to 2,200 MMbbl in 2 to 10 s. The number of exploration wells increase from a maximum of 15 to 60, delineation wells increase from a maximum of 23 to 48, and production wells increase from a maximum of 330 on 9 pads to 660 on 16 pads. Pipeline miles increase from 205 to 280 mi. Multiple sales would occur over a longer period of time and, depending on frequency of sales, the time frame for oil and gas activities in the planning area would extend to at least 2 decades. The number of spills <1 bbl would increase from a range of 37 to 164 spills to a range of 75 to 329 spills, and the number of spills >1 bbl would increase from a range of 13 to 55 spills to a range of 25 to 109 spills over the assumed production life of the planning area. The estimated number of crude-oil spills over the assumed production life of the planning area would increase from a range of 50 to 219 spills to a range of 100 to 438 spills.

Effects of oil and gas activities under multiple sales are expected to increase over those for one sale under Alternative E, and potential conflicts with the habitat, subsistence, and water quality standards of the ACMP could occur. If several lease sales occur under this alternative, considerably more exploration activity is expected to occur in the Teshekpuk Lake calving habitat of the TLH caribou with the number of wells drilled increasing from 5 to 15 under the first sale to 15 to 60 under multiple sales. An increased potential displacement of calving TLH caribou along roads is expected between the increased number of production pads and other facilities. An increase in the number or miles of roads and other facilities with development under multiple sales is also expected to increase the impedance of TLH caribou movements to insect-relief areas along the coast, north of Teshekpuk Lake. The displacement of calving caribou represents a functional loss of habitat within 1.86 to 2.48 mi (3-4 km) of field roads. This effect is expected to persist over the life of the s and may reduce productivity and abundance of the TLH. Small, chronic spills are expected to have about the same effect on terrestrial mammals and their habitats as under Alternative B but with loss of individual mammals to the spills and habitat contamination increasing locally at the spill sites and along any streams contaminated by these spills. These spills are expected to result in the loss of small numbers of terrestrial mammals, with recovery expected within 1 year. Any habitat contamination that is not effectively cleaned up is expected to persist for several years but is not expected to affect terrestrial mammal populations.

Effects on Arctic fish populations from additional sales from increases in the number of gravel pads are likely to have about twice the effect on arctic fish as discussed for Alternative E. Also, because the number of pipeline miles for multiple sales and Alternative E are similar, they are expected to have a similar effect as discussed for Alternative E. However, if there were not enough time between sales to allow for full recovery, or if the level of activity for the selected alternative was greater than that of Alternative E, the effect of each additional sale on arctic fish is likely to be greater than that of Alternative E. An increase in effects to bird populations from increased noise disturbance could be expected with multiple sales, with corresponding increases in disturbance and local displacement, but recovery in these instances is still expected to require no more than 1 year. Oil spills entering larger lakes with larger numbers of molting or brood rearing geese and other species may result in losses in the hundreds, requiring several breeding seasons for recovery. The effects of multiple sales and increased potential for noise-producing activities and oil spills on bowhead whales at the resource ranges and activity levels described essentially are expected to be the same as described for the first sale. For marine mammals, increased activity could

result in an increase in aircraft disturbance of seals hauled out on the ice along the coast north of Teshekpuk Lake, and an increase in onshore surface traffic activity (seismic exploration, overland moves, construction activities along the coast) could result in more disturbance of polar bears denning and foraging along the coast. However, these effects are expected to be local and short term, with no significant adverse effects to the polar bear and seal populations as a whole. If some of these spills occur in or contaminate streams in the Teshekpuk Lake area that drain into marine waters, small numbers of seals, polar bears, and other marine mammals might be exposed to contamination in nearshore habitats and suffer lethal or sublethal effects.

Conclusion—Multiple Sales: Effects from multiple sales under Alternative E are expected to result in potential conflict with the habitat, subsistence, and water-quality standards of the ACMP. The effect of multiple sales under Alternative E is expected to result in an increase in the amount of displacement of calving TLH caribou within 1.86 to 2.48 mi (3-4 km) of field roads. This effect is expected to persist over the life of the s and may reduce productivity and abundance of the TLH. Some increase in the impedance of TLH caribou movements to insect relief areas along the coast, north of Teshekpuk Lake is expected under multiple sales. The number of small, chronic crude-oil and fuel spills is expected to increase and result in the loss of small numbers of terrestrial mammals, with recovery expected within 1 year. Additional sales are expected to have similar effects on arctic fish as described for the first sale. However, if there are increased levels of activity associated with future lease sales, and/or insufficient recovery time between sales, greater adverse effects than described for the first sale are likely to occur. Increased disturbance and displacement effects and increased oil-spill risks are expected for birds, but timing of the sales again is critical to recovery. With extended intervals between sales, impacted bird populations are expected to recover from noise and disturbance effects in 1 year. The effects of multiple sales and increased potential for noise-producing activities and oil spills on bowhead whales at the resource ranges and activity levels described essentially are expected to have similar effects to those under Alternative E in the first sale, i.e., local and short term, with no significant adverse effects to marine mammal populations as a whole.

Effectiveness of Stipulations: Stipulations described in Section II were developed to provide maximum protection to all high-value resources within the NPR-A, particularly under Alternative E, where all BLM-administered lands are available for leasing. Under Alternative E, all stipulations identified in Section II would be adopted and required for any oil and gas exploration, development, or production activities, including seismic activities. Lease-specific stipulations to protect water quality; fish habitat; wetlands; and caribou calving, caribou migration, and caribou insect relief areas; and subsistence resources and access would be in place to minimize impacts to these resources. Stipulations regarding solid- and liquid-waste disposal, fuel handling, and spill cleanup are expected to reduce the potential effects of spills and human refuse on terrestrial mammals. Stipulations on overland moves and seismic work are expected to minimize alteration of terrestrial mammal habitats. The stipulation requiring aircraft to maintain a 1,000-ft AGL (except for takeoffs and landings) over caribou winter ranges from October through May 15, and to maintain a 2,000-ft AGL over the Teshekpuk Lake Caribou Habitat LUEA from May 16 through July 31, is expected to minimize disturbance of caribou.

The stipulations related to oil and gas exploration and development, including facility design and construction restrictions, and restrictions on the use of roads and airstrips for public use are expected to minimize alteration of terrestrial mammal habitat and interference with caribou movements. Stipulations that restrict permanent surface occupancy of oil and gas facilities within 2 mi of the coast and east of Teshekpuk Lake to Kogru Inlet are expected to reduce disturbance and interference with caribou movements, particularly, the movements of caribou to and from the coast for insect relief and the movements of TLH cow caribou to calving habitats north of the lake. Stipulations requiring elevated pipelines and roads be separated at least 500 ft and to place pipelines on the appropriate side of the road (depending on general movements of caribou in the area) could significantly reduce interference with caribou movements. A stipulation prohibiting permanent surface occupancy other than buried pipelines within the two narrow land corridors identified as crucial caribou movement corridors between Teshekpuk Lake and the Beaufort Sea would further reduce or avoid interference with TLH caribou movements (Fig. III.B.5.a-1). Implementation of all the above stipulations would reduce but not eliminate all effects on TLH caribou. Some level of displacement of calving still is expected to occur with 1.86 to 2.48 mi (3-4 km) of roads, and some caribou movements during insect harassments would be temporarily disrupted when caribou encounter road and foot traffic in association with production facilities. These disruptions would have some adverse energetic effects on individual caribou.

The stipulations having the most beneficial effect on arctic fish are the same as those discussed for Alternative B. However, due to the increased level of potential oil and gas activity associated with Alternative E over that of Alternative B, the absence of these stipulations may increase adverse effects on arctic fish populations. Several stipulations were developed to provide protection for birds.

For example, disturbance of birds from ground transportation and other activities including oil and gas activities would be mitigated, and essential habitat protected, by Stipulations 20b through m, minimizing and seasonally restricting vehicle use and seismic activity, and taking recommended precautions in Goose Molting and Colville River LUEA's (geese, raptors, passerines affected). Stipulations 21 and 33 require seasonal restrictions on drilling and major construction (geese, shorebirds). Stipulations 22, 25, and 31 require avoidance of lakeshore margins for oil and gas activities, avoidance of lake margins, and establish a facility buffer around high-use lakes (geese, shorebirds). Stipulations 29 and 32 require consolidation/integration oil and gas facilities, and incorporate visual screening features for facilities near goose molting lakes (geese). Stipulations 38, 39, and 44 establish facility setbacks along specified lakes and streams, facilities and mining sites located out of floodplains and 500 ft from lake basins, and no long-term occupancy of Colville River LUEA (raptors, passerines, loons, brood-rearing waterfowl). Stipulations 50 and 51 require seasonal restrictions of oil and gas ground traffic in Goose Molting LUEA and stockpiling major oil and gas equipment and materials (geese, shorebirds). Aircraft disturbance of birds would be mitigated by Stipulations 54 and 55, which require seasonal restrictions of oil and gas helicopter overflights and BLM authorized fixed-wing flight frequency in the Goose Molting LUEA (geese shorebirds), and 56 and 57, which require maintenance of seasonal minimum flight altitudes over the Teshekpuk Lake and Colville LUEA's (loons, geese, shorebirds, raptors, passerines). Other potentially adverse situations would be mitigated by Stipulations 7 and 10, immediate cleanup of fuel spills using ADEC-approved materials stored at all fueling and maintenance areas. Stipulation 11 requires fuels stored in lined/diked areas at least 100 ft from lakes and streams (loons, waterfowl, shorebirds, passerines), preparing a hazardous materials contingency plan for large fuel transport (loons, geese, shorebirds); Stipulation 18 restricts removing quantities of water from lakes that do not alter the lakes used by molting geese (geese, loons, shorebirds); Stipulation 1 requires precautions be taken to avoid attracting wildlife (predators) to refuse (most birds); Stipulation 70 prohibits public access to the Goose Molting LUEA through oil fields prohibited (geese, loons, shorebirds, passerines); and Stipulation 59, removal of gravel fill so as to prevent enhanced access to the Goose Molting LUEA (geese, loons). These stipulations would minimize disturbance from most factors and prevent fuel or oil spilled on pads from reaching surrounding habitats.

The effectiveness of mitigating measures for protecting bowhead whales and other endangered species from noise and disturbance from oil and gas activities is the same as Alternative B; and from activities other than oil and gas, such as aerial wildlife surveys and other aerial surveys, the same as Alternative A. For marine mammals, the effectiveness of stipulations is expected to be the same as under Alternative A.

The effectiveness of stipulations described above for protecting biological resources and habitat and for subsistence activities would reduce potential conflicts with the habitat and subsistence standards of the ACMP and NSB CMP policies.

16. Recreation and Visual Resources:

a. Activities Other than Oil and Gas Exploration and Development:

Disturbance: The kinds of activities other than oil and gas expected under Alternative E are the same as under Alternative A. However, certain of these activities would increase as a result or in support of oil and gas development. For example, field activities associated with archeological site clearances such as camps, excavations, and aircraft activity all likely would increase. Impacts would be minimal and short term in nature as described under Alternative A, but the total area impacted could increase to 3,000 acres (from 1,500 in Alternative A).

Although the amount of supplies and material transported by winter overland moves may increase under this alternative, these moves generally follow the same route. Therefore, neither the length nor number of green trails is expected to noticeably increase from Alternative A.

b. Oil and Gas Exploration and Development Activities:

(1) Exploration: The types of oil and gas exploration activities that would occur under Alternative E are similar to those under Alternative B. However, the level of some of these exploration activities would increase compared to Alternative B, i.e., additional seismic survey operations are expected, the number of exploration/ delineation wells drilled at any one time would increase from 1 to 4, and the total number of these wells would increase from 10 to 28. Consequently, short-term impacts from ongoing seismic activity could increase from 500 acres affected under Alternative A and 1,000 acres under Alternative B to 2,000 to 2,500 acres affected under Alternative E. The area that could be impacted during drilling operations would increase from approximately 8,000 to 32,000 acres (winter only). Accumulating summer-season visual impacts from the greening of ice pads, roads, and airstrips would increase from about 500 acres (under Alternative B) to 1,900 acres. Several hundred miles of lineal green trails also would be visible from the air as a result of seismic operations; the number of

miles visible would increase from Alternative B in direct relationship to increased seismic operations.

(2) Development: The types of oil and gas development activities that would occur under Alternative E are similar to those under Alternative B. However, the number of production pads is anticipated to increase from two (under Alternative B) to six; the number of miles of (oil) pipeline is expected to increase from 75 mi (under Alternative B) to 205 mi with an additional 15 mi of "water injection" pipeline expected, and the number of pump stations will increase to two under Alternative E. Consequently under this alternative, there would be a long-term loss of scenic quality, solitude, naturalness, or primitive/unconfined recreation over an area of approximately 228,000 acres (i.e. [8,000 acres/pad x 6 pads] + [8,000 acres/pump station x 2 pump stations] + [640 acres/mi x 220 mi of pipeline]). This is about 156,600 acres more than under Alternative B.

Effects of Spills: The effects of spills would be the same as analyzed for Alternative B.

Impacts to Wild and Scenic River Values: Under this alternative, outstandingly remarkable river values along the Colville River would not receive any special protection under the WSRA. Protection of these resources would be consistent with the provisions of the NPRA, Alternative E management objectives and as a result of project specific NEPA analysis. Accordingly, some impacts to outstandingly remarkable values could occur along certain portions of the river corridor. This is especially true along those portions of the Colville where oil and gas values are high. Development in these river segments could diminish the likelihood that these segments of the river would meet criteria for designation as a "wild" river. It is not likely that anticipated development would diminish outstandingly remarkable river values to the point that these segments of the river could not be designated as recreational.

Conclusion—First Sale: As compared to Alternative A, there will be an increase of approximately 1,500 acres to3,000 acres in adverse, short-term impacts to recreation values from activities other than oil and gas exploration and development. As compared to Alternative B, short-term impacts from ongoing oil and gas exploration activities would increase from approximately 9,000 acres to 34,500 acres in short-term impacts from active drilling operations. The greening of vegetation from ice pads, roads, airstrips, and compacted snow would increase to about 1,900 acres, a 1,400-acre increase from Alternative B. Oil and gas development would result in a long-term loss of scenic quality, solitude, naturalness, or primitive/unconfined recreation over an area of approximately 228,600 acres (or 5.0% of the planning area) for the life of production fields and pipelines. This is 156,600 acres more than under Alternative B.

Multiple Sales: The types of impacts resulting from additional lease sales will be the same as described above for the first sale. Short-term impacts such as green trails and disturbance resulting from noise, aircraft, and other on-going activities would not accumulate. Impacts from long-term or permanent facilities such as roads, pipelines, gravel pads, and pits would accumulate to the extent such facilities are necessary to support additional exploration and production. It is anticipated that such facilities will increase about 51 percent over that needed for a single sale and affect a total of approximately 307,000 acres.

Conclusion—Multiple Sales: Long-term impacts would accumulate and increase about 51 percent above those of the first sale, ultimately affecting approximately 307,000 acres or about 6.7 percent of the planning area.

Effectiveness of Stipulations: The Upper Colville River upstream from about Umiat would be designated Visual Management Class II under this alternative. As such, no permanent visible structures would be allowed in this important recreation and scenic Class A area. The Colville River from about Umiat to Ocean Point, a scenic Class B area and also an important recreation area, would be managed as a Visual Management Class III area. Under Class III guidelines, construction may be visible but should not dominate the landscape. Mitigation required to meet the standards established by these management classes should prevent any significant long-term impacts to visual/recreation values in these two highly scenic and important recreation areas.

Under this alternative, the Kuukpik and Intensive Subsistence LUEA's would be managed as Visual Management Class IV areas rather than Class III areas—the same as under Alternative B. Under Class IV guidelines, construction may dominate the landscape in terms of scale. This would result in less aggressive efforts to mitigate visual impacts. An aboveground pipeline through this area may exceed Class III standards. The remaining planning area is designated Visual Management Class IV, the same as under Alternative B.

As under other alternatives, impacts to recreation values from exploratory oil and gas activities and from overland moves are significantly reduced by restricting these activities to winter months. Few recreationists visit the area during winter months.

G. THE PREFERRED ALTERNATIVE: The Preferred Alternative would include BLM's management actions described for Alternative A and a proposal for making about 4.01 million acres of the Northeast NPR-A Planning Area available to oil and gas leasing. It combines elements mainly from Alternatives C and D and grants special protection to a number of riparian areas similar to Alternative B; Section II.C.1. The Preferred Alternative protects caribou calving areas by severely restricting oil and gas surface occupancy in a great majority of the Teshekpuk Lake Caribou Habitat LUEA, which Alternative C would have made unavailable to leasing. The Preferred Alternative maximizes protection for molting geese by making virtually all of the Goose Molting Habitat LUEA unavailable for leasing, similar to the action proposed in Alternative D. Stipulations identified in Section II.C.7.a will be applied to the Preferred Alternative. These stipulations are based on revisions to those stipulations presented in the draft IAP/EIS; these revisions are in response to public comments received on the draft IAP/EIS.

The types of activities that might impact the resources include those noted for Alternative A and those additional activities associated with oil and gas exploration and development as noted for Alternative B. The level of activities other than oil and gas would be similar to Alternative C (Table IV.A.1.a-1). The economically recoverable oil resources for the first sale are estimated to range from 90 to 420 MMbbl (Table IV.A.1.b-4). The oil resources estimated for the Preferred Alternative are within the range estimated for Alternatives C (75-410 MMbbl) and D (185-825 MMbbl). Thus, the levels of activities associated with the Preferred Alternative also are estimated to be within the levels estimated for Alternatives C and D (Table IV.A.1.b-5). These activities include drilling 4 to 17 exploration and delineation wells, constructing one to four production pads, drilling 30 to 132 production and service wells, and constructing 20 to 95 mi of pipeline (Table IV.A.1.b.5). If the area available for oil and gas leasing under the Preferred Alternative is subject to multiple sales, 130 to 600 MMbbl of oil are estimated to be recovered (Table IV.A.1.b-6). The types of activities associated with multiple sales would be similar to those that might occur as the result of the first sale. The level of activities for multiple sales is shown in Table IV.A.1.b-7; these levels also are with the range of activities estimated for Alternatives C and D.

The Preferred Alternative would prohibit construction of roads (other than temporary ice roads) connecting the planning area with the existing road network outside the planning area.

1. Soils: Ground-impacting-management actions within the planning area that may affect soils include oil and gas exploration and development, aircraft use, archaeological and paleontological excavation and collection, overland moves, ground activities, hazardous- and solid-material removal and remediation, camps, and recreation, all of which occur during summer to early fall (June-September), except for winter activities such as recreation and subsistence.

a. Activities Other than Oil and Gas Exploration and Development: If the vegetative cover remains unaltered, these activities generally would have only a small impact on soils. However, where these activities concentrate surface disturbance (e.g., foot traffic around a landing site or repeated snowmachine crossing of a drainage channel at the same site), there could be damage to vegetation and impacts on the soils. If the vegetative cover is disturbed or the surface organic mat is removed or worn, soil erosion is likely to occur; damage to vegetation is followed by impacts on soils. The effects of disturbing vegetation are analyzed in Section IV.G.6. Until details of project designs and results of the local soil survey are known, site specific impacts and recoveries are unknown. For more site-specific details, refer to studies that include impacts and long-term recoveries from various activities on soils and related resources (Everett,1980; Walker et al., 1987).

Generally, disturbance of vegetation alters the thermal balance, and those soils containing surplus ice may lose volume when there is thawing; subsidence, thermokarsting, and gullying follow. Removal of the surface organic mat exposes the mineral portion of the soils to the erosive forces. Wind and water will transport sediment from these soils, and this sediment may be deposited in sensitive areas. Excavation and removal activities likely would completely destroy the soils involved. In these instances, the impacts are local only and probably not widely distributed. In other instances with soils containing surplus ice, the impacts can be much broader. The dominantly ice-rich permafrost soils will warm and slump and release meltwater, which will pond. The ponded water will absorb more radiant energy and increase the area of warming soils. The process of warming, melting, and slumping can continue well beyond the area of initial disturbances and may take several years to stabilize, even if the soils are only lightly disturbed.

Oil spills also will impact soils only as the vegetation is altered. 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, and the soils are damaged. Oil-spill cleanup mitigates impacts on soils only if cleanup methods and operations are very carefully controlled; if cleanup activities involve minimal surface disturbance, the impact on soils likely will be minimal.

b. Oil and Gas Exploration and Development Activities: Those parts of the planning area subject to these activities will have additional impacts on soils. Sacrificing soils usually is part of development. Soils are destroyed through burial or truncation. Embankments such as work pads, camp pads, roads, and pump stations made from sand, gravel, or rock fragments completely cover the natural soils. Working material sites, conventional pipeline construction, digging, scraping, and excavating destroy the pedogenic horizons. Off-pad traffic (including foot traffic) and other surface-disturbing activities damage the vegetative cover and surface organic mat. The exposed mineral portion of the soils will erode. These activities also alter the thermal balance, and the risk of thermokarsting increases. Thermokarsts, gullies, and sediment impact other resources and land uses. Examples are difficult surface travel and access across gullies and thermokarsts. The amount of soil erosion increases with the amount of surface disturbance. The most effective mitigation is to keep the areas of surface disturbance (i.e., alteration of the vegetative cover or damage to the surface organic mat) as small as possible. All activities under the Preferred Alternative must disturb the least possible amount of surface area and vegetation. If the least amount of vegetation is distubed, then the least amount of soils also is disturbed. The amount of soil loss, based on the estimated areal extent of vegetation destruction, should be similar to that discussed under Vegetation (Sec. IV.G.6).

Impacts to soils from spills and spill cleanup are based on the impacts to Vegetation (Sec. IV.G.6).

Conclusion—First Sale: Soil stability depends closely on vegetative cover; where vegetation is disturbed, impacts on soils follow. All activities under the Preferred Alternative must disturb the least possible amount of surface area and vegetation; Stipulation 68 always must be complied with. Emphasis is on maintaining the thermal properties of the existing vegetation and surface organic mat or substituting other thermal insulation. Impacts to soils from management actions under the Preferred Alternative would involve either disturbance or destruction of relatively small areas. The duration of these impacts may be short term, ranging from several years if the vegetation is disturbed, and up to many decades if the soils are destroyed. Relatively, the overall impact to soils in the planning area is expected to be a small fraction of the total of more than 4 million acres in the entire planning area. The area of impacted soils will be similar to that of disturbed vegetation (see Vegetation, Sec. IV.G.6, for acreage details). More site-specific conclusions will follow project design and detailed soil survey.

Multiple Sales: Additional lease sales would result in additional exploration and development activities. The area of impacted soils is closely related to that of the disturbed vegetation (see Vegetation, Sec. IV.G.6, for details).

Conclusion—Multiple Sales: Areas of impacts and losses of soils from all activities in multiple sales would be similar to those areas discussed under Vegetation (Sec.IV.G.6).

2. Paleontological Resources: Paleontological resources (plant and animal fossils) are nonrenewable. Once they are adversely impacted and/or displaced from their natural context, the damage is irreparable. While much of the region is underlain by paleontological resources on a percent-of-area basis, most are of the marine plant and invertebrate variety and are so numerous that the potential impacts addressed here do not present a significant threat. Vertebrate fossils are much less common and are more likely to be impacted by the activities associated with oil and gas exploration and development.

a. Activities Other than Oil and Gas Exploration And Development: Under the Preferred Alternative, management-action impacts to vertebrate paleontological resources are unlikely to occur as there is only one activity, excavation and collection, that has the potential for causing measurable impacts on this resource. Because vertebrate paleontological resources are most often well buried, or outcropping "in situ" in areas of extreme relief, or occurring as "float" on stream gravel bars, other actions such as temporary camp set up and operation or overland moves (which occur only during winter) pose little threat (see overland moves/seismic under cultural resources in this section).

Excavation and collection normally occurs during the summer and usually is the result of archaeological research (Sec. IV.B.12), although the process is sometimes associated with geologic fieldwork. Archaeologists and geologists are trained to recognize and properly care for paleontological resources. Most vertebrate paleontological material is buried considerably deeper than cultural material and, therefore, not regularly encountered by chance. Some Pleistocene-age animal remains may be recovered in archaeological deposits, if the deposit is old enough. In such situations, the bones would represent subsistence use of the animal(s) by humans, and the faunal material would be considered part of the archaeological record as well as belong to the regional paleontological record.

b. Oil and Gas Exploration and Development Activities: In general, the types of geomorphological circumstances and the types of paleontological resources that might be impacted by exploration activities would be

similar to those described under activities other than oil and gas exploration and development.

(1) Effects of Disturbance from Exploration: In addition to yearly seismic-data-gathering activities (see overland moves/seismic under cultural resources in this section) drilling of 17 exploration/delineation wells is anticipated under the Preferred Alternative. However, no more than three wells are expected to be drilled during a single winter season because of the limited number of drill rigs available. Drilling the 17 wells probably would occur over the span of several winter seasons using drill pads, camp pads, roads, and airstrips made of ice and snow. Because no permanent pads, roads, or airstrips would be constructed and, therefore, no significant disturbance of the ground would occur, buried paleontological resources would not be impacted. In the unlikely event that surface or near-surface remains were present they would probably be adversely impacted. The only significant subsurface disturbance that would occur would be the drill hole. Drilling could impact significant, accessible, vertebrate paleontological material, but the likelihood is minuscule.

(2) Effects of Exploration Spills: Sixty-five to 80 percent of all spills are confined to a pad. Spills not confined to a pad usually are confined to an area adjacent to the pad. Therefore, it is assumed that most spills would occur on an ice pad, ice road, or during winter conditions where cleanup is less invasive than that resulting in response to a summertime terrestrial spill. It is highly unlikely that any of the previously mentioned activity would be occurring in a locale where vertebrate paleontological remains were on or near the surface. The actual spilling of hydrocarbons on a vertebrate paleontological resources site, in most cases, would have limited-impact. However, spill cleanup could pose a serious threat to the integrity of a surface or near-surface remains, perhaps resulting in their destruction.

(3) Effects of Disturbance from Development: The construction of as many as four production pads (with road connections), an airstrip for each well complex, a pump station, and 95 mi of pipeline is anticipated under the Preferred Alternative. Surface disturbance resulting from this work could impact approximately 300 acres. Additional disturbance could occur, depending on the source of the material used to construct the pads, etc. If the pad-material source is terrestrial, then extraction of material could impact paleontological resources. Pleistocene vertebrate fossils are commonly recovered during gravel-mining activities. It is anticipated that pipelines would not have associated all-weather roads or pads and would be constructed during the winter months from an ice road and pads. Therefore, aside from the previously mentioned impacts associated with ice-pad construction, the only significant surface impact resulting from aboveground pipeline construction will be associated with the placement of Vertical Support Members (VSM's) and check valves. Any vertebrate paleontological resources at the location of VSM's or check valves will be severely impacted or destroyed. If any or all of the pipeline(s) are to be buried, the potential for impact to paleontological resources increases.

(4) Effects of Development Spills: As previously mentioned, 65 to 80 percent of all spills are confined to a pad. Spills not confined to a pad usually are confined to an area adjacent to the pad. It is highly unlikely that any of the previously mentioned construction and operations activity would occur in locales where vertebrate paleontological remains were on or near the surface. The actual spilling of hydrocarbons on a vertebrate paleontological resources site, in most cases, would have limited impact. Spill cleanup however could pose a serious threat to the integrity of surface or near-surface remains, perhaps resulting in their destruction.

Conclusion—First Sale: Under the Preferred Alternative, impacts to vertebrate paleontological resources from management activities other than oil and gas exploration and development would be minimal. Most of the potential impacts to vertebrate paleontological resources would result from oil and gas exploration and development activities and have already been discussed.

Multiple Sales: The potential impacts may increase by a much as a factor of four. The realization of the potential increase depends on a suite of variables, including location, geomorphologic setting, and shared infrastructure. As previously mentioned, the scattered nature of vertebrate paleontological remains, and the fact that the location of most are unknown, make it somewhat difficult to assess the likelihood and severity of potential impacts.

Conclusion—Multiple Sales: The types and nature of impacts to vertebrate paleontological resources resulting from multiple lease sales are the same as described for a single sale. The potential impacts to vertebrate paleontological resources from management activities other than oil and gas exploration and development would be similar in nature to what has been mentioned previously; however, the probability of impacts occurring may increase with multiple sales. As a result of multiple sales, the potential impacts to vertebrate paleontological resources from oil and gas exploration and development could increase severalfold.

3. Water Resources:

a. Activities Other than Oil and Gas Exploration and Development: Ground-impacting-management actions within the planning area that may

affect water resources under the Preferred Alternative include resource inventories, paleontological and cultural excavations, research and recreational camps, and overland moves—all of which might occur during summer or early fall, except the latter, which occurs during the winter on snow-covered frozen tundra. The number and frequency of camps and moves would depend on management actions in land, water, and resource monitoring as related to leasing activities. Because the Preferred Alternative emphasizes protection of surface resources, the streams and lakes identified as critical habitat would be either unavailable to leasing or to surface occupancy. Therefore, most of the camps would be outside of these critical habitat areas, though some resource inventory and monitoring camps and overland moves could occur through out the planning area.

Small spills would be contained with bermed and lined storage areas, and there would be sufficient absorbents and petroleum containment and removal equipment onsite. No large spills are expected to occur from ground-impacting-management actions, because only small amounts of fuel would be stored onsite.

b. Oil and Gas Exploration and Development Activities:

(1) Exploration:

(a) Drilling Wastes: The preferred and normal means of disposing of drilling wastes, including muds and cuttings, is reinjection into wells. Cuttings may be stored temporarily to facilitate reinjection and/or backhaul operations. Use of mudpits may be allowed by BLM's Authorized Officer (AO). If muds and cuttings are stored on the surface, sediments and other contaminants could be flushed into the watershed. The potential for this impact, however, could be reduced by requiring that wastes be stored in lined and bermed areas and disposed of prior to spring breakup.

(b) Disturbance: Seismic activities involve seasonal occupation and transport using sledge-drawn trailers (wanigans)with camps at transitory locations. While historical trails are evident within the planning area, many of these were created by blading off the surficial organic mat, operating during periods of insufficient snow cover or confining travel to a narrow corridor (Lawson, 1986). Current stipulations (Sec. II.C.7.b, Stipulation 24) require that snow cover be sufficient to cover the tundra, lakes and rivers are frozen, clearing and blading ramps at stream crossings not disturb the natural ground or destroy the native vegetation, and trail activities be spread out along a wide corridor. Temporary camps would be sited on existing pads or on well-drained soils on the inactive floodplain or uplands, sited back from the stream or lake shore and with minimal surface disturbance. All fuel, waste, and hazardous materials would be stored onsite according to ADEC guidelines and removed seasonally (Sec. II.C.7.b, Stipulation 14). With these practices, the effects of seismic activities on the water resources would be minor diversions of shallow water tracks and limited ponding in places where track depression compresses the organic mat sufficiently to alter the thermal regime, melt surficial ground ice and alter the native vegetation (Emers and Jorgenson, 1997). By widely spacing the trails created by winter seismic and other overland move activities, significant disturbance to the water resources, as defined by events of such magnitude, extent, and duration to create the effects enumerated below under the development scenario, are not expected from these activities. However, there may be some sites that require remediation from earlier exploration or military activities.

Because the proposed exploratory drilling would occur in the winter, the principal effects on water resources would be the construction of ice roads and pads. Construction of ice roads allows winter overland transport of the equipment and material used in exploration- and delineation-well drilling. Ice pads are constructed to support drill rigs and staging activities. While this is preferable to summer surface activities, the ice roads and pads require large quantities of water be available—an estimated 1.0 to 1.5 million gallons per mile of road and 0.5 million gallons per pad. Water supply for drilling as well and camp use also will be significant—up to 1.65 million gallons per site (Sec. IV.A.1.b). Based on remote sensing (Mellor, 1987) and other surveys, a typical large tundra lake (about a mile long and >6 ft deep) used as a winter water source could hold from approximately 20 to 40 million gallons available for pumping, with the stipulation that drawdown is limited to 15 percent of the under-ice water depth (Sec. II.C.7.b, Stipulation 20). Water withdrawal from riverine pools is prohibited (Sec. II.C.7.b, Stipulation 20). Tables IV.G.3-1 and IV.G.3-2 estimate water availability and requirements for exploration. Because not all lakes have sufficient under-ice storage capacity, surface disturbing activities that exacerbate ice formation should be precluded. Removal or compaction of snow cover can increase the depth of freezing, greatly reducing the water quantity within a lake or pool. Altering travel to avoid crossing or clearing frozen lakes, as well as augmenting snow cover by using snow fences would not only reduce ice buildup on lakes and rivers, but melted snow could be used in ice roads. Use of aggregate ice chips created from crushed lake ice could reduce water usage on ice roads but would greatly increase the depth of freezing in the lakes used in this process. Shallow ponds and lakes that normally would freeze to the bottom are a potential source for this ice aggregate.

After each season of use, ice roads are abandoned and allowed to melt when spring snowmelt begins. Stipulations (Sec. II.C.7.b, Stipulation 24) require that ice ramps or

bridges that cross streams or lakes be removed or breached prior to spring breakup. While some ponding might occur during a rapid onset of snowmelt, melt-water channels would develop in the ice-road surface, similar to the melt-water channels that cut through naturally occurring river aufeis (overflow icing) and rapidly drain the impounded water (Sloan et al., 1975). Because the location of ice roads will be offset from year to year, the effects of these short-term impoundments should be negligible. Ice roads created to last several years have a greater impact on the underlying tundra mat, compacting and killing larger areas of vegetation (Walker, 1996). Because this could cause more thermokarst and subsequent drainage alteration, multiple-year ice roads should be avoided.

(c) Spills and Spill Cleanup: Under the proposed exploration activities, the most likely spill cleanup would involve refined-petroleum products, probably from fuel-storage areas or during use in the operations. The size of such spills is likely to be small. The types and amounts of spills estimated for this alternative are discussed in Section IV.A.2, while the fate and behavior of oils spills is discussed in Section IV.A.3. Storage of fuel in lined and bermed areas and the onsite availability of absorbents and removal equipment will help ensure that the size of any area affected by a spill is kept to a minimum.

Spills of chemicals and saline waters would be rapidly diluted in a large lake or river. In small lakes, tundra ponds, and shallow water tracks, spills could be pumped out or neutralized and then diluted with uncontaminated freshwater.

Because the Preferred Alternative has a restricted leasing area and surface occupancy limitations, spills from exploration activities into environmentally sensitive areas would be minimized.

(2) Development:

(a) Effects of Disturbance: The proposed development would involve constructing ice roads to haul equipment and gravel for the construction of production pads, roads connecting pads, and landing strips. The gravel most likely would be extracted from existing borrow sites east of the NPR-A (Sec. IV.A.1.b). While this type of proposal will help minimize adverse effects, the potential impacts of oil and gas development on the water resources in the planning area may include disturbance of stream banks or shorelines and subsequent melting of permafrost (thermokarst), blockages of natural channels and floodways that disrupt drainage patterns, increased erosion and sedimentation, and removal of gravel and water from riverine pools and lakes.

1) Thermokarst: Thermokarst refers to ground subsidence that occurs when the removal of surface cover exposes ice-rich permafrost to a higher temperature regime and subsequent melting. Stream banks and lakeshores are particularly vulnerable to thermokarst, because the wave action of the water will accelerate the removal of the degrading protective cover. Fine-grained sediments are the most likely to contain ice-rich permafrost, resulting not only in extensive thermokarst but also in increased sediment erosion and changes to stream channel and bed morphology. With the exception of the Colville and Ikpikpuk rivers and the largest lakes, most of the streams and lakes in the planning area have banks or shorelines that consist largely of fine-grained sediments.

2) Drainage Disruption: Natural drainage patterns can be disrupted when activities or structures divert, impede, or block flow in stream channels, lake currents, or shallow-water tracks. Blockages or diversions to areas with insufficient flow capacity can result in seasonal or permanent impoundments, especially where gravel roads have insufficient or poorly sited culverts. Diverting stream flow or lake currents also can result in increased bank or shoreline erosion and sedimentation as well as potential thermokarst. Proper siting and adequate design capacity of culverts, bridges, pipelines, and other structures will minimize drainage problems.

3) Erosion and Sedimentation: In addition to thermokarst and drainage alteration, erosion and sedimentation can be caused by construction activities or vehicular crossings, especially during periods of high stream flow or lake levels. Inadequate design or placement of structures, culverts, or bridges can alter natural sediment transport and deposition, creating scour holes or channel bars. Improper placement or sizing of gravel fill can result in erosion from pads or roadbeds adjacent to streams or lakes. Winter or low-water construction and transport activities and adequate bank stabilization will minimize erosion and sedimentation problems.

4) Gravel Removal: While much of the gravel used for the construction of permanent facilities will be obtained from permitted sites east of the planning area, some material sites may be required within the planning area. Improper siting of gravel-removal operations can result in changes to stream channel or lake configuration, stream-flow hydraulics or lake dynamics, erosion and sedimentation, and ice damming and aufeis formation. Locating gravel pits far enough away from streams and lakes to avoid breakup or storm flooding will greatly minimize these effects to water resources. While gravel sources are scarce in the planning area, sand and silt are more abundant. Composite or All Season pad designs, using a mixture of gravel, sand, and silt layered with

styrofoam and geotextiles, significantly can reduce gravel requirements (Sec. IV.A.1.b).

For gravel mining outside of the planning area, surficial sources currently are limited to existing pits adjacent to the Colville River. Another method for obtaining sand and gravel is dredging the active river channel and pumping the sand/gravel slurry directly to the construction site. While this minimizes surface transport and subsequent damage to the tundra mat, it creates deep pools within an active river channel, steepening the gradient of the riverbed and increasing upstream erosion (Walker, 1994). While some of this material will be replaced by the natural sediment transport processes of the river system, the long-term effects of this in-channel removal process in the Arctic are unknown.

5) Water Removal: Consumptive water use in the summer seldom is a problem on the coastal plain, as water generally is abundant. Exceptions would be in smaller coastal streams or most foothills streams during late summer, when shallow pools might be pumped dry. In the winter, however, all but the largest lakes and riverine pools are subject to dewatering if consumptive use is high. Winter water withdrawal from lakes is limited to 15 percent of the under-ice water depth, and withdrawal from riverine pools is prohibited (Sec. II.C.7.b, Stipulation 20). Tables III.A.2.a-4 and IV.C.3 estimate water availability and requirements for development. Limiting activities that remove or compact snow cover and augmenting snow cover by using snow fences not only would reduce ice buildup on lakes and rivers, but melting snow also could be used as a supplemental water source.

(b) Spills and Spill Cleanup: Because the Preferred Alternative emphasizes protection of surface resources, the streams and lakes identified as critical habitat would be either unavailable to leasing or to surface occupancy. The effects of spills on water resources from exploration and delineation activities would be minimized; the effects of spills on water quality are analyzed in Section IV.C.4

Under the proposed development activities, spills and spill cleanup would involve both crude oil and refined-petroleum products, probably from fuel-storage areas or handling operations. The types and amounts of spills estimated for this alternative are discussed in Section IV.A.2. While any oil spill and cleanup from production operations and pipelines could adversely affect streams and lakes, a large spill into Teshekpuk Lake, its tributaries, or the Colville River could have the most significant impacts to water resources. The fate and behavior of oils spills is discussed in Section IV.A.3. Spill cleanup in the watershed would involve containing the spill, diverting or isolating it within the waterbody, skimming off the oil, and treating the remaining oil-contaminated water and sediments. Prevention and rapid response with adequate removal equipment would minimize effects; spill-prevention and -response measures are described in Section IV.A.4.

Spills of chemicals and saline waters would be rapidly diluted in a large lake or river. In small lakes, tundra ponds, and shallow water tracks, spills could be pumped out or neutralized and then diluted with uncontaminated freshwater.

Conclusion—First Sale: The impacts of activities other than oil and gas exploration and development under the Preferred Alternative are expected to be similar to those under Alternative A. The potential long-term impacts of oil and gas development activities on the water resources in the planning area include disturbance of stream banks or shorelines and subsequent melting of permafrost (thermokarst) and blockages of natural channels and floodways that disrupt drainage patterns. The potential short-term impacts, primarily during construction, would increase erosion and sedimentation and water removal from riverine pools and lakes. While any surface-disturbing activity could affect water resources, the potential adverse effects of the Preferred Alternative, because it has a restricted leasing area and surface occupancy limitations that excludes the critical lake and river habitat from leasing or occupancy, these effects, while significant, could be minimized.

Multiple Sales: While the effects of oil and gas exploration and development from multiple lease sales may be up to several times greater than a single sale, impacts would not necessarily go up proportionally. Indirect impacts, such as thermokarst and erosion and sedimentation due to channel alteration or gravel removal may not occur until many years after the original development. Shared use of infrastructure such as airfields, roads, camps, and pipelines, significantly could reduce the size of the impacted areas and adverse effects to the water resources. Where infrastructure is not shared, both long and short-term impacts, as noted above, and recovery times could increase.

Conclusion—Multiple Sales: Adverse impacts from multiple lease sales may be up to several times greater than a single sale, while indirect impacts may take years to develop. Shared infrastructure could reduce the adverse effects to water resources of multiple lease sales, because combined facilities require less water for construction, maintenance, and camp use than separate, independent facilities. Where infrastructure is not shared, both long and short-term impacts, and recovery times could increase.

4. Water Quality:

a. Activities Other Than Oil and Gas Exploration and Development: Ground-impacting-management actions other than seismic operations and other oil and gas activities would not impact water quality. Excavation and collection activities would be by hand shovel or trowel over several square feet, with replacement of the vegetative layer. These activities are required to protect streams and lakes from siltation and to avoid or minimize disturbance to vegetation.

No fuel spills are anticipated from activities other than oil and gas exploration and development, and stipulations in place allow no storage in active lake floodplains and at least a 500-ft setback from any river, lake, or stream, with impermeable dikes around facilities >660 gal. Black water and sludge are to be incinerated or removed from public lands to ADEC-approved waste-disposal facilities. Recreational activities permitted by BLM are required to follow the National Outdoor Leadership School's "Leave No Trace, Alaskan Tundra" program in regard to minimizing impacts to vegetation, wastewater, human waste, and solid waste.

b. Oil and Gas Exploration and Development Activities:

(1) Exploration: Exploration activities within the planning area that may affect water quality under this alternative are 2-D and 3-D seismic activity, ice-road construction, pad construction, and drilling-fluid storage and disposal. Spillage is predominantly attributable to development activities, and a discussion of spillage is more appropriately deferred to the following analysis of development impacts.

(a) Effects from Seismic Operations: The Preferred Alternative allows seismic operations starting in late fall after the top foot of the active layer freezes and snow cover builds up. Seismic vehicles would be a combination of tracked vehicles from small Nodwell 110's for surveyor travel to Caterpillar tractors for pulling seismic camp trains. Buggy style vehicles such as Rolligons and Deltas are possible (Rice, 1997). Except for a new buggy design that may lessen the need to have a lead snowplow in deeper snow, most of the seismic vehicles in use are types that seismic operations have used on the North Slope for one to three decades.

Carefully regulated seismic operations conducted in the ANWR in 1984 to 1986 resulted in damage to vegetation in some tussock tundra and moist sedge-shrub tundra, but not to lower, moist sedge and wet tundra (Felix et al., 1989). Raynolds and Felix, 1989 found "medium-to-high impact" on 29 percent of the seismic trails. This damage occurred in vegetated river terraces, in more bumpy terrain (such as high-centered polygons or tussocks), and in areas with little snow cover. An example of a high-impact area found would be a swath denuded of vegetation 33 ft wide and up to 160 ft long. Wetter, flatter, and more vegetated sites were not impacted. Recovery of damaged seismic tracks takes many years (Walker, 1996).

Stipulation 24g allows clearing of drifted snow along a trail or seismic line as long as the tundra mat is not disturbed, decreasing the likelihood that the seismic operators would have to use tracked rather than wheeled (buggy) vehicles, and decreasing the likelihood of thermokarst erosion and water-quality effects. Stipulation 24i requires that average snow depth be 6 inches prior to starting seismic operations. This depth is the current operating requirement on the North Slope and is sufficient to protect waterbodies, aquatic vegetation, flooded tundra, wet tundra, and moist sedge/grass meadows (see Table IV.B.6-1). Although greater snow depths are required to protect vegetative cover in tussock and moist sedge-shrub tundra (Felix et al., 1989), the nature of vegetative damages in these latter areas is less likely to affect water quality.

For the Preferred Alternative, complete recovery of vegetative cover damaged during seismic studies could take a year to decades. Persistent high damage is likely to occur on <1,000 acres over all seismic surveys (see Sec. IV.G.6). Thermokarst erosion and effects on water quality could occur in high impact areas, if damage were persistent. Although thermokarst erosion of damaged winter seismic trails made under current practices generally has not been observed, such erosion is possible in the NPR-A, particularly because snow cover is less than in the ANWR. If it is assumed that 1 percent of the persistent high damage area results in thermokarst erosion, then about 10 acres could be affected. Thaw settlement also would affect long-term local hydrology, including downflow water quality, perhaps over twice this area, with the total area affected being about 20 acres.

Thermokarst erosion can result in water features with high turbidity/suspended-sediment concentrations. Measurements in a small stream near Barrow undergoing thermokarst erosion and meeting such conditions, found ≤27 milligrams per liter (mg/l) suspended solids and ≤11 Jackson turbidity units (JTU) upstream of the erosional feature, 820 mg/l (610 JTU) at the erosional cut, and 160-280 mg/l (250-470 JTU) farther downstream (Barsdate and Prentki, 1973). Although the applicable State turbidity standards are defined in nephelometric turbidity units (NTU), inconvertible with JTU, the standard for secondary water recreation (e.g.; fishing) generally limits turbidity to a 20-percent increase from the natural level. Both the JTU turbidity and suspended-sediment concentrations increased

much more than 20 percent, rather by an order of magnitude across the thermokarst feature.

To get such high turbidity, the peat mat must be sufficiently eroded to expose underlying mineral soils. The mineral soils also must be fine grained. These conditions rarely occur, even where tracked vehicles were used in multiple summer passes. Thus, thermokarst erosion could cause the State turbidity standard to be exceeded within and downflow of thermokarst features in rare cases over small areas, likely on the order of a fraction of an acre to a couple of acres total.

(b) Effects from Construction: The use of water for ice-road construction could affect water quality in four ways. Because ice roads would be rerouted every year to minimize tundra disturbance, effects on water quality from any of these mechanisms would be short term, lasting generally one season.

First, the winter extraction of water or ice from NPR-A waters could change the chemistry of those waters. Ice roads require 1.0 to 1.5 million gallons per mile of road over tens of miles distance. Alternatively, ice chips from frozen lakes could be used in conjunction, lessening the demand for unfrozen water sources.

Stipulation 20 limits water withdrawal from NPR-A waters. Water withdrawal from rivers and streams during winter is prohibited. Ice-road construction on the North Slope generally starts no sooner than December to ensure that the tundra is solidly frozen to avoid disturbance, and because ice building requires consistent, very cold temperatures. By December, shallow ponds and lakes, those less than about 3 ft deep, are frozen solid. Water would have to come from lakes deeper than this. Water withdrawal is prohibited during winter from lakes <7 ft deep, if they are interconnected with or subject to seasonal flooding by a fish-bearing stream. Water may be withdrawn from isolated lakes <7 ft deep that lack connection to or are not subject to seasonal flooding by a fish-bearing stream. After consultation with the appropriate Federal, State, and NSB regulatory and resource agencies, the AO may authorize withdrawals from any lake <7 ft deep, if the proponent demonstrates that no fish exist in the lake.

Because lakes ≤6 ft deep freeze solid by the end of winter, they do not contain fish and are an obvious target for water. Thus, road builders could extract the maximum possible from about a 6-ft deep lake, if it met Stipulation 20 requirements for lakes <7 ft deep, with perhaps extraction of most of the 3 ft of water not frozen by December. Water could be extracted from deeper lakes, but these lakes are likely to have fish that would be put at risk from water removal. The amount of water that could be removed from fish-bearing lakes is limited by stipulation.

The 7-ft water-depth standard for water withdrawal is based on the professional experience and technical position of the State of Alaska, Department of Fish and Game that 7 ft of water is adequate to protect overwintering fish populations and water quality within the planning area. Limiting water withdrawal to lakes ≥7 ft deep protects fish in such lakes from hypersalinity. The 7-ft standard is consistent with current State of Alaska permitting stipulations for oil and gas operations on the North Slope. Authorization by the AO to withdraw water from a nonfish-bearing lake <7-ft deep requires consultation with appropriate Federal, State, and NSB regulatory and resource agencies. Extraction of water from lakes ≥7 ft would be limited to 15 percent of the estimated ice-free volume. The average depth of lakes ≥7 ft deep likely are close to 8 ft on the North Slope; most lakes on the North Slope are <6 ft deep (Sloan, 1987). The average ice thickness by the start of the ice-road building season in December is 3.0 ft, giving a stipulation-allowable extraction of ¾ ft of water (15% of 5 ft of water). The stipulation would protect the water quality of fish-bearing lakes and lessen the effect on any single lake. However, it would take a 23-ft deep lake to provide the same amount of water/per unit lake area as a 6 ft deep lake.

As surface waters in the NPR-A freeze, salts are excluded from the forming ice into the underlying water, increasing salinity. In coastal tundra waters, the alkalinity is associated with the salt content, and increases and decreases in alkalinity parallel those of salinity. Pumping water from a freezing lake would remove the more saline and more alkaline water from under the lake ice. During snowmelt, the removed waters would be replaced by less saline, less alkaline runoff water. In lakes ≤6 ft deep, which freeze to the bottom, the salts normally would be frozen out of the entire water column and extruded into the sediment thaw bulb underlying the lake. These salts are then only slowly and partially leached back into the water column the following summer. For such lakes, the early summer condition would be low salinity, low alkalinity water, regardless of whether water was removed for ice-road construction. These lakes are only weakly, but still apparently adequately, buffered against acid snowmelt based on observed lake pH's (Sec. III.A.2.b).

In lakes >6 ft deep, the salts and alkalinity excluded from ice formation normally would remain in the never-frozen bottom water. These lakes start the summer with more saline, relatively strongly buffered waters underneath the melting ice. Winter removal of more saline water underneath the ice would result in less saline, less buffered lake waters in early summer following winter water extraction. Thus, following winter extraction of water, their early summer chemistry would be more similar to that of lakes ≤6 ft deep.

A second way that ice-road construction could affect water quality would be road construction over lakes deep enough not to freeze to the bottom. Many of these lakes are only a foot to a few feet deeper than the minimum 6-ft depth necessary to maintain some unfrozen bottom water in winter. An ice road across such an intermediate-depth lake would be designed to freeze the entire water column below the road, isolating portions of the lake basin and restricting circulation. With mixing thus reduced, isolated water pools with low oxygen could result. Dissolved oxygen concentrations could be reduced below the 5-ppm dissolved oxygen standard needed to protect resident fish (State of Alaska, ADEC, 1997).

A third way that ice-road construction could affect water quality would be through changes in water chemistry along the roadbed during and after meltout. As described above, the water withdrawn from lakes to construct the roadway is relatively saline, more saline than typical snowmelt waters. In addition, the salts frozen into the ice road would leach out of the ice prior to its melting during snowmelt, increasing initial salt content of the meltwater. This effect may be measurable during initial snowmelt, but the effect on water quality should be minimal and local, most likely expressed as a slight buffering of pH during initial snowmelt.

A fourth way that ice-road construction could affect water quality would be through modification of the local hydrology along the ice road. The minimum ice-road thickness would be 6 inches. Snow drifts against this low elevation would extend only a few feet beyond the roadbed with average water content of only a fraction of an inch. However, the 6 inch roadbed would dam waters upslope of the roadway, affect local drainage, and restrict water supply downslope of the roadway. Because snowmelt runoff is in excess of coastal tundra dead-storage capacity (Miller, Prentki, and Barsdate, 1980), the restricted water supply on the downslope side of the ice road should have a very local but otherwise negligible effect.

In Prudhoe Bay, flat, thaw-lake plains have been shown to be the land classification most vulnerable to hydrologic effects of road and pad construction (Walker et al., 1987, 1989; Robertson, 1989). In such terrain, impoundments (ponding) and thermokarst along gravel roads and pads equally covered as much additional area as did the pads and roads, despite drainage culverts. Ice roads can persist through a significant portion of the snowmelt period, for perhaps up to a month. However, their ability to impound upslope waters is negligible, and any impoundments last only a few days (see Sec. IV.C.3). Because the 6-in thickness of ice roads is only 4 to 10 percent of the 5- to 13-ft thickness of a gravel road, the impoundments upslope of an ice road should be proportionately less in area than for a gravel road, or ≤10 percent of the area covered by the ice road. The ecology of these less-persistent impoundments along ice roads should be a cross between those of wet tundra and ponded tundra, with no effect on water quality.

The thermokarst erosion along roads and pads at Prudhoe Bay was considered by Walker et al. (1987) to be a delayed, synergistic impact that occurred primarily on thaw-lake plains. It did not occur on river floodplains at Prudhoe Bay because of minimal ground ice. Thermokarst erosion was attributed to vegetative disturbance and to thermal effects of road dust, flooding, and flaring operations. Thermokarst effects are likely to be negligible for one-time use winter ice roads because of the lack of vegetative disturbance (see Sec. IV.C.6), the lack of road dust, and minimal upslope impoundment.

The use of water for construction, drilling, and domestic (crew) needs could affect water quality, as discussed for ice-road construction. Effects during exploration on water quality from any of these mechanisms would be short term, lasting generally one season.

For the Preferred Alternative, annual ice-pad and -road construction could cover about 90 to 380 acres during each year of exploration, assuming that ice-road length would be similar to the assumed connecting pipeline length for this alternative. This ice-road construction would require winter extraction of water that would affect 30 to 140 acres of intermediate depth (6-ft), nearby lakes. Pad construction, drilling, and crew needs together would require water use equivalent to 2 to 6 acres of lake. The areas affected would shift each year as the ice roads are realigned and shifted to avoid continued compaction of vegetation. Temporary upslope impoundment of snowmelt waters could cover another 40 acres for a few days, but without effect on water quality.

(c) Other Effects: Downhole disposal is identified as the preferred disposal method in Stipulation 4. This EIS assumes the preferred procedure, downhole disposal. Direct removal from public lands to ADEC-approved waste-disposal facilities, without storage in temporary mud pits also could occur but is less likely. The use of temporary mud pits is discouraged by the ADEC and is no longer the practice on the North Slope. Under this scenario, there likely will be no impact from drilling fluids used in exploration.

Nevertheless, cuttings may be stored temporarily to facilitate reinjection and/or backhaul operations and, in some cases, use of reserve pits may be allowed by BLM's AO under Stipulation 4. The AO has the authority under Stipulation 5 to allow the discharge of fluids from temporary mud (reserve) pits. Establishment of temporary reserve pits, thus, could degrade nearby water quality.

Elevated levels of trace metals in water (zinc and chromium) and sediments (copper, chromium, and lead) have been found in ponds at least as far as 700 ft from reserve pits elsewhere on the North Slope (Woodward et al., 1988). Elevated levels of petroleum hydrocarbons also were found in water and sediment in the same study. Waters from the reserve pits and some ponds within 160 ft but not at greater distances were found to be toxic to a sensitive zooplankton species in bioassays. Spread of contaminants from these reserve pits was attributed to overflow of the pits during snowmelt, to the practice of draining the snowmelt from pits on to the tundra, and to seepage.

Requiring the pits to be lined and bermed would not necessarily protect tundra from this contamination. Berms increase snow drifting, increasing the overflow problem. Historically, because clay is the standard liner for waste pits, the clay in drilling muds has been assumed on its own to be adequate as a pit liner. However, the chemical formulation of drilling muds is designed to keep the drilling mud dispersed, which can eliminate its ability to act as a seal. The potential for impact from pit-stored drilling fluids would be reduced, if fluids were properly disposed of prior to spring breakup.

(2) Development: Development activities within the planning area that may affect water quality under this alternative are ice-road and -pad construction and spills. There will be no impact from drilling fluids used in development. Mud pits and discharge of drilling fluids and produced waters will be prohibited. Muds and cuttings will be either disposed downhole or removed from public lands to ADEC-approved waste-disposal facilities. Produced waters will be reinjected. Some washed cuttings could be used in gravel-road or pad construction. Crude-oil and waterflood pipelines would be aboveground, and their construction and physical presence would have a negligible affect on water quality.

(a) Effects from Construction and Placement: For the Preferred Alternative, because of the annual rebuilding of ice roads, annual water use during development would be similar to that for exploration, needing water to construct 80-380 acres of ice road, with the water being obtained from about 30 to 140 acres worth of intermediate-depth lakes. During the seasonal construction phase, annual field-water demand would be on the order of 37 acre-feet, requiring at least a surface water source of 12 additional acres. After major construction is finished, annual field-water demand would decrease to about 15 acre-feet/year, requiring water removal from only about a 5-acre source. Some of this water likely would come from lakes >6-ft deep, because shallower lakes freeze solid by late winter. If extraction of water were from lakes deeper than 7 ft, Stipulation 20 would severely limit extraction volume, and the area of lakes needed would be about 4 times higher. The areas affected would shift each year as the ice roads are realigned and shifted to avoid continued compaction of vegetation. Temporary upslope impoundment of snowmelt waters could cover another 40 acres for a few days, but without effect on water quality.

Gravel construction of pads and within-field roads with airstrip for a field would cover about a 100-acre footprint for a single field, or 100 to 200 acres for the Preferred Alternative. Each field would require a million cubic yards of gravel. The preferred sources for gravel are existing borrow pits on the east side of the Colville River. In recent decades, suction dredges have been used in the NSB to mine sand and gravel from the Colville River Delta at Nuiqsut; the Mead and Kokolik rivers; lakes at Atqasuk and Barrow; and lagoons at Barrow, Wainwright, and Kaktovik (Walker, 1994). Dredged holes took a few to many years to refill. Dredging increased upriver-bottom erosion by steeping river slopes in the Colville River, but the primary environmental effect attributed to NSB dredging has been expansion of fish overwintering areas. Fish populations and, therefore, water quality do not appear to be adversely affected by this dredging activity (Walker, 1994). Because gravel is a scarce commodity, alternative construction technology could be refined to lessen gravel use and associated impacts, but such alternatives are not assumed.

The primary water-quality effect from construction and placement of gravel structures is related to upslope impoundment and thermokarst erosion (Walker et al., 1987). Thermokarst erosion can result in water features with high turbidity/suspended-sediment concentrations. The thermokarst erosion is due partly to the thermal effects of dust blown off the gravel onto the tundra. Thermokarst erosion could cause the State turbidity standard to be exceeded within and downflow of thermokarst features. In flat, thaw-lake plains on the North Slope, gravel construction can be anticipated to result in upslope water impoundment and thermokarst erosion equivalent to twice the area directly covered by gravel or over up to 200 acres for development in this alternative. The ecology of impounded waters appears to be similar to that of similarly sized ponds, but impoundments are more ephemeral (Kertell, 1996).

Although downslope drying of tundra because of upslope impoundment is possible, spring snowmelt generally is expected to be in excess of watershed dead storage in coastal tundra and would limit effect of downslope drying on water quality. Snow drifts develop on the sides of elevated roads that also limit downslope drying. In addition, most flowing water makes it across the road through culverts; the road-impounded waters are a small portion of the total flow. Standard North Slope practices in

gravel road construction includes culverts to limit disturbance of drainage patterns (Robertson, 1989). In defined drainages, multiple culverts are constructed to accommodate breakup flow as well as summer flow. In flatter tundra, single culverts are spaced at intervals to limit ponding of sheet flow during breakup.

(b) Effects from Oil Spillage: Spills are another impacting agent on water quality. Stipulations 14, 15, 39, and 41 limit hydrocarbon storage, major fueling activities, and facilities sitings from at least 500 ft up to 3 mi from active floodplains of NPR-A rivers, streams, and lakes. Because of these stipulations, refined-product spills of hydrocarbons are not expected to reach and contaminate NPR-A freshwaters. However, a number of small crude spills averaging 4 bbl and smaller fuel spills averaging 0.7 bbl are projected to occur under this alternative. Roughly 75 percent of crude spills and likely all fuel spills would occur on pads or roadbeds off the tundra surface. Spill response would remove almost 100 percent of a spill from frozen tundra prior to snowmelt for two-thirds of the year. During one-third of the year, late May through late September, spills could reach and impact tundra waters before oil-spill response is initiated or completed. Thus, at most, about 8 percent of crude spills (25% x 33%) could be reasonably anticipated to reach tundra waters. For the Preferred Alternative, this calculation results in an estimate of 1 to 7 spills, averaging 4 bbl, reaching tundra waters.

Dissolved-oxygen concentrations in tundra waters could be affected by spilled oil in summer. In one NPR-A experiment (Sec. IV.A.1.b.(2), 5 bbl of Prudhoe Bay crude was spilled into a 0.07-acre tundra pond. Dissolved-oxygen concentrations a week after the spill were reduced by about 4 mg/l below levels in a control pond, in some measurements to less than the 5 mg/l State standard for protection of wildlife. In 2 in of water underneath the spill, oxygen concentrations were measured at 0.7 to 0.9 mg/l versus 5 mg/l in the control pond. At 3-in water depth, oxygen concentrations under the slick increased to 3.9 to 6.9 mg/l versus 8.2 to 10.7 mg/l in the control pond. At 4-in water depth (average pond depth, Miller, Prentki, and Barsdate, 1980), outside the slick, oxygen concentration was within the expected normal range, 10.8 mg/l versus 11.4 mg/l in the control pond. The oxygen deficit under the slick and also in shallower waters of the control pond were attributable to decreased oxygen influx from the air and the relatively high rate of (natural) sediment respiration in coastal tundra ponds, not to oil-enhanced respiration in the pond.

In winter, even under ice, an oxygen deficit would not be expected to result from a small spill in most waters. In winter, sediment (and water column) respiration rates are negligible. In addition, sediment respiration has a lesser relative effect in the thicker water column of lakes deep enough not to freeze solid in winter. Such lakes, even those that hold fish, tend to be supersaturated with dissolved oxygen in winter, to levels above the State water-quality standard of 110 percent saturation (Sec. III.A.2.b). An exception might be if a spill occurred underneath thick ice cover in very restricted waters holding a concentrated overwintering fish population that has already depleted oxygen levels. Occasional low oxygen concentrations and overwintering fish kills have been observed North Slope waters in the past.

However, the primary effect of a small spill on tundra water quality would be from direct toxicity rather than from oxygen depletion or other secondary effects. Long-term toxicity (7 years) can result from a small spill, as shown in the NPR-A experimental pond spill. That spill killed the zooplankton, and the pond water remained toxic to more sensitive zooplankton species for 7 years.

In a real spill, response likely would recover the bulk of spilled oil, but sufficient oil could remain to promote long-term, local toxicity. Over the life of a field, spills could affect the water quality of about one to seven ponds or small lakes, making their waters toxic to sensitive species for about 7 years.

For the purpose of analysis, the effects of 325-bbl spill reaching the Colville River in summer also are analyzed. The high rate of waterflow would preclude any effects on dissolved oxygen concentrations. Direct toxicity in the water column would be minimal and limited to the first few reservoir pools downcurrent of where the spill entered the river. Some toxicity might persist in these initial reservoir pools for a few days to weeks until toxic compounds were washed out of the oil trapped in the sediment or the oiled sediment was buried under cleaner sediment.

A similar spill reaching Teshekpuk Lake would also result in minimal effect on water quality. Dissolved oxygen levels would not be affected. Direct toxicity would be minimal because of the much greater dilution volume in Teshekpuk Lake than in the small ponds and lakes discussed earlier and because of the relatively unrestricted movement of slick and underlying water. The spreading of the spill over about 60 acres (0.03% of the lake surface) could be considered an effect on water quality. This effect would exist for less than a summer, until the slick was either cleaned up or the oil stranded on the shoreline.

For the purpose of analysis, the effects are also analyzed for a possible marine spill from offshore development or fuel barge.

The description of general effects of oil spills on water quality in Beaufort Sea and along the TAPS tanker route waters as contained in Section IV.B.1 of the Sale 170 Final

EIS (USDOI, MMS, 1998), is herein incorporated by reference. A summary, supplemented by additional material, as cited, follows.

Applicable ambient-water-quality standards for marine waters of the State of Alaska are (1) total aqueous hydrocarbons in the water column may not exceed 15 μg/l (0.015 ppm); (2) total aromatic hydrocarbons in the water column may not exceed 10 μg/l (0.010 ppm) and (3) surface waters and adjoining shorelines must be virtually free from floating oil, film, sheen, or discoloration. The State of Alaska criterion of a maximum of 0.015 ppm of total aqueous hydrocarbons in marine waters—about 15-fold background concentrations—provides the readiest comparison and is used in this discussion of water quality. This analysis considers 0.015 ppm to be a chronic criterion and 1.5 ppm, a 100-fold higher level, to be an acute criterion.

Major crude oil spills generally result in peak dissolved-hydrocarbon concentrations that are only locally and marginally at toxic levels—parts per million or more. Effects of spills <1,000 bbl can be considered negligible. A spill ≥1,000 bbl could temporarily, about a month, contaminate water over a few hundreds of square miles above the chronic criterion of 0.015 ppm. Concentrations above the 1.5-ppm-acute criterion may occur over a few tens of square miles during the first several days of such a spill. However, such a spill is not anticipated to occur under this alternative.

A fuel spill ≥1,000 bbl in the Beaufort Sea near the NPR-A in the open-water season should behave similarly to the 2440-bbl *Minuk I-53* spill of diesel fuel in the Canadian Beaufort Sea in 1985 (Birchard and Nancarrow, 1986). The spill extended over 3 mi^2 as slick the first day, 8 mi^2 as a slick the second day, and 50 mi^2 as thin sheen containing only about 50 bbl by the third day. Thus, by the third day of the spill, most of the fuel had either evaporated (38%) or dispersed into the water (58%). A fuel spill this size could temporarily contaminate Beaufort Sea waters over few tens of square miles to levels above chronic criteria but below acute criteria. However, the oil-spill-rate statistic for U.S. barges is only 4.32 spills ≥1,000 bbl per billion barrels of oil transported (Prentki and Anderson, 1995). Application of this spill rate to any reasonable or foreseeable estimate of NPR-A fuel barging results in a near-zero probability of a significant spill. Thus, a fuel spill is not anticipated to result or affect marine water quality under this alternative.

A tanker spill along the TAPS routes could contaminate receiving water over several tens of square miles to levels above chronic criteria but below acute criteria. However, the oil-spill-risk analysis estimates a most likely number of zero spills ≥1,000 bbl along the TAPS tanker route and has not been assumed in this analysis.

(c) Effects from Saltwater Spillage: A saltwater spill, although unlikely, can be hypothesized. Such a spill would greatly exceed State water quality standards (State of Alaska, ADEC, 1997), which prohibit:

- total dissolved solids or salinity from exceeding 1,500 mg/l (1.5 $‰_0$ salinity) including natural conditions;
- increases in salinity exceeding one-third of the concentration of the natural condition of the waterbody.

In a year with high rainfall, some of the salt would be diluted and flushed from the tundra in summer. Some of the saltwater would settle into the deepest reaches of the contaminated waters. The freeze/thaw cycle in the Arctic and the depth of any lake reached by the spill would play a controlling role the fate of the remaining contaminating salts from a spill.

In winter, surface waters <6 ft deep freeze solid (Hobbie, 1984). In a saltwater spill into such waters, the remaining salt from the spill water would be excluded from downward-freezing ice in fall and forced into the underlying sediment (Prentki et al., 1980). Most of the salt would remain trapped in the sediment after the next spring's meltout, giving these waters an initial low salinity. During the summer, salinity would slowly increase as ice in the bottom sediment melts and the sediments compress (Miller, Prentki, and Barsdate, 1980).

In waters >6 ft, freezing of ice would force salt from a spill into the deeper water below the ice, increasing salinity of that water proportionately. During snowmelt, the lakes form moats—a ring of water at the shoreline. For deeper lakes, the winter ice cover persists through spring snowmelt and would protect the more saline water below the winter-formed pycnocline (the plane separating two layers of different density). Snowmelt waters flow just below the ice (O'Brien et al., 1995) or along the moated margins of the lakes, but above the pycnocline. These snowmelt waters pass through and exit over flooded tundra in sheet flow or through shallow outlets without contributing to or diluting concentrations of dissolved solids in the lake. Only after peak snowmelt and waterflow does the protective ice cover of deeper lakes melt and allow the wind to mix the water column, destroying the pycnocline. The net result of this flow regime in deeper lakes would act to preserve the contaminating salts from removal or dilution from snowmelt waters. Elevated salinity above State standards could persist for several years.

A waterflood pipeline could flow at 2.4 to 8.3 million gallons per day of Beaufort Sea water, equivalent to production rate from a single field (see Sec. IV.A.1.b and Table IV.A.1.b-3). If a spill resulted from catastrophic failure of the pipeline, it would be noticed quickly by

instrumentation and flow stopped, with perhaps spillage equivalent to an hour's flow. Alternatively, spillage up to 10 percent of throughput from a smaller leak might not be detected from input/output balances for about a day. This less-than-catastrophic spill would spill a greater volume, from 240,000 to 830,000 gal. During summer, flat coastal tundra develops a dead-storage capacity averaging 0.5 to 2.3 in (Miller, Prentki, and Barsdate, 1980), which would retain 13,000 to 63,000 gal/acre. Thus, the spill would spread over 4 to 64 acres.

Storm surges along the NPR-A coast have flooded nearshore coastal tundra in the past, resulting in salt contamination of much greater magnitude that hypothesized here. The lake used as a supply of freshwater at the Naval Arctic Research Laboratory in Barrow was flooded in a fall storm surge in the early 1960's. The laboratory pumped some of the saline bottomwater out of the lake over the next few years, but a more saline taste and off-flavors affected the potability for several years. However, the water was still used for water supply.

Summary: Primary affecting agents for the Preferred Alternative are water extraction, water impoundment, and thermokarst around structures, and roads, and spillage of oil and saltwater.

During exploration, annual ice-pad and -road construction (90-400-acre footprint each year), drilling, and domestic needs for water could require winter extraction of the unfrozen water from about up to 150 acres of nearby intermediate-depth lakes, or from 450 acres if from deeper lakes (>7 ft deep). Most of this water use is for ice roads. During the seasonal construction phase, annual field-water demand would be on the order of 37 acre-feet, requiring water from 12 additional acres of lake. After major construction is finished, annual field-water demand would decrease to about 15 acre-feet/year, requiring water removal from only about 5 acres of lake. The areas affected would shift each year as the ice roads are realigned and shifted to avoid continued compaction of vegetation.

For development, because of the annual rebuilding of ice roads, annual water use during development would be similar to that for exploration, needing water to construct 80 to 380 acres of ice road, requiring water from up to 140 acres of intermediate depth lakes or from 420 acres if from deeper lakes (>7 ft deep). Much smaller amounts of water would be needed for other purposes. The areas affected would shift each year as the ice roads are realigned and shifted to avoid continued compaction of vegetation.

The primary water-quality effect from construction and placement of gravel structures is related to upslope impoundment and thermokarst erosion. The thermokarst erosion is due partly to the thermal effects of dust blown off the gravel onto the tundra. In flat, thaw-lake plains on the North Slope, gravel construction can be anticipated to result in upslope water impoundment and thermokarst erosion equivalent to twice the area directly covered by gravel, or over up to 200 acres for development in this alternative. Unlike the situation for ice structures, the same 200 acres would be affected each year over the life of the field.

Over the life of a field, spills could degrade water quality of about six ponds or small lakes, with resultant toxicity persisting and eliminating sensitive species in their waters for about 7 years. Water quality could be degraded over a few weeks along a short stretch of the Colville from a 325-bbl spill. The spreading of a similar-sized spill over about 60 acres of Teshekpuk Lake (0.03% of the lake surface) for a few weeks could be considered an effect on water quality. A saltwater spill could contaminate up to 64 acres, with contamination persisting for several years in any affected, deeper lake.

Conclusion—First Sale: Longer-term (decade-or-more) effects of this alternative would occur over a few hundred acres because of the introduction of oil and gas activities construction or placement of ice roads. Oil spills could result in waters of about one to seven ponds or small lakes remaining toxic to sensitive species for about 7 years. Water quality could be degraded over a few weeks along a short stretch of the Colville from a 325-bbl spill. The spreading of a similar-sized spill over about 60 acres of Teshekpuk Lake (0.03% of the lake surface) for a few weeks could be considered an effect on water quality.

Multiple Sales: Effects of seismic trails would be similar to those for one sale, over less than a couple of acres. During peak exploration, annual ice-pad and -road construction could cover 90 to 440 acres, assuming that ice-road length would be similar to the assumed connecting pipeline length for this alternative. This ice road construction would require winter extraction of water from about up to 190 acres of nearby intermediate depth lakes or up to 760 acres if from deeper lakes (>7 ft). Pad construction, drilling, and crew needs together would require water use equivalent up to 11 acres of lake.

Because of the continued need for ice roads, annual water use during development for ice-road construction would be similar to that for exploration, requiring water from up to 160 aces worth of intermediate-depth lakes. During the seasonal construction phase, annual water demand would be on the order of 37 acre-feet for each field, requiring water from an additional 12 acres of lake for each field. After major construction is finished, annual water demand would decrease to about 15 acre-feet/year for each field, requiring up to 20 acres of lake for water supply for all fields.

The primary water-quality effect from construction and placement of gravel structures is related to upslope impoundment and thermokarst erosion. Gravel construction of pads, within-field roads, and field airstrip would cover about a 100-acre footprint per field, or 400 acres total. In flat thaw-lake plains on the North Slope, gravel construction can be anticipated to result in upslope water impoundment and thermokarst erosion equivalent to twice the area directly covered by gravel, or 800 acres. Unlike the situation for ice structures, the same locations would be affected by gravel structures each year over the life of the fields. Over the life of development resulting from multiple sales, spills could degrade water quality of 2 to 10 ponds or small lakes, with resultant toxicity persisting and eliminating sensitive species in their waters for about 7 years. Water quality could be degraded over a few weeks along a short stretch of the Colville from a 325-bbl spill. The spreading of a similar-sized spill over about 60 acres of Teshekpuk Lake (0.03% of the lake surface) for a few weeks could be considered an effect on water quality. Major marine oil spills are not likely for multiple sales under this alternative. Multiple sales would not result in additional waterflood pipelines (Sec. IV.A.1.b), and the effect of a waterflood spill would be the same as for one sale.

Conclusion—Multiple Sales: Longer-term (decade-or-more) effects of multiple sales would be similar to those for a single sale. Oil spills could result in waters of up to 10 ponds or small lakes remaining toxic to sensitive species for about 7 years. Water quality could be degraded over a few weeks along a short stretch of the Colville from a 325-bbl spill. The spreading of a similar-sized spill over about 60 acres of Teshekpuk Lake (0.03% of the lake surface) for a few weeks could be considered an effect on water quality.

5. Air Quality:

a. Activities Other than Oil and Gas Exploration and Development: There are no activities other than oil and gas activities planned under the Preferred Alternative that would affect air quality within the planning area. Helicopter and light-plane use would have a transitory effect on local air quality; however, no long-term effect would be noted.

b. Oil and Gas Exploration and Development Activities: This discussion analyzes the potential degrading effects on air quality by the activities and developments induced by the preferred alternative. Supporting materials and discussions are presented in Section III.A.3.b (Description of Air Quality).

(1) Effects of Routine Emissions: The following air pollutants would be produced during activities conducted as a result of this alternative: nitrogen oxides (NO_x), carbon monoxide (CO), sulfur dioxide (SO_2), particulate matter (PM), and volatile organic compounds (VOC).

Nitrogen oxide consists of both nitric oxide (NO) and nitrogen dioxide (NO_2). The nitrogen oxides (No_x) are formed from the oxygen and nitrogen in the air during combustion processes, and the rate of formation increases with the combustion temperature. Nitric oxide, the major component of the combustion process, will slowly oxidize in the atmosphere to form NO_2; NO_2 and VOC perform a vital role in the formation of photochemical smog. Nitrogen dioxide breaks down under the influence of sunlight, producing NO and atomic oxygen, which then combine with diatomic oxygen to form O_3 or with VOC to form various gaseous and particulate compounds that result in the physiological irritation and reduced visibility typically associated with petrochemical smog.

Carbon monoxide is formed by incomplete combustion. It is a problem mainly in areas where there is a high concentration of vehicle traffic. High concentrations of carbon monoxide present a serious threat to human health, because they greatly reduce the capacity of the blood to carry oxygen.

Sulfur dioxide is formed in the combustion of fuels containing sulfur and, in the atmosphere, SO_2 slowly converts to sulfate particles. Sulfates in the presence of fog or clouds may produce sulfuric-acid mist. It generally is recognized that entrainment of sulfur oxides or sulfate particles into storm clouds is a major contributor to the reduced pH levels observed in precipitation (acid rain) in the northeastern U.S.

Emissions of particulate matter associated with combustion consists of particles in the size range <10 microns in diameter (PM-10). Emissions of particulate matter associated with combustion consists of particulates, especially those in a certain size range of 1 to 3 microns, can cause adverse health effects. Particulates in the atmosphere also tend to reduce visibility.

The type and relative amounts of air pollutants generated by operations vary according to the phase of activity. There are basically three phases: exploration, development, and production. For the exploration phase, emissions would be produced by (1) diesel-power-generating equipment needed for drilling exploratory and delineation wells; (2) truck and other vehicles used in support of drilling activities; and (3) intermittent operations such as mud degassing and well testing. Pollutants generated primarily would consist of NO_X (these would consist of NO and NO_2 [nitrogen dioxide]; ambient air standards are set only for NO_2), CO, and SO_2. The impact of exploration and delineation activities conducted as a

result of this alternative would be limited to between 2 to 10 wells.

For the development phase, the primary emission sources would be (1) piston-driven engines or turbines used to provide power for drilling; (2) heavy construction equipment used to install modules and pipelines; and (3) various vehicles. The principal development-phase emissions would consist of NO_2 with lesser amounts of SO_2, CO, and PM.

For the production phase, the primary source of emissions would be from power generation for oil pumping and water injection. The emissions would consist primarily of NO_2 with smaller amounts of CO and PM. Another source of air pollutants would be evaporative losses (VOC) from oil/water separators, pump and compressor seals, valves, and storage tanks. Venting and flaring could be an intermittent source of VOC and SO_2. The impact of development and production activities associated with the Preferred Alternative would consist of the construction of four production pads drilling a maximum of 132 wells and constructing approximately 95 mi of pipelines. Production would reach a peak of 42 MMbbl per year. Clean Air Act standards would be used to establish the maximum concentrations of allowable pollutants for each operation proposed.

Other sources of pollutants related to operations are accidents such as blowouts and oil spills. Typical emissions from accidents consist of hydrocarbons; only fires associated with blowouts or oil spills produce other pollutants.

Federal and State statutes and regulations define air-quality standards in terms of maximum allowable concentrations of specific pollutants for various averaging periods. These maxima are designed to protect human health and welfare. However, one exceedance per year is allowed except for standards based on an annual averaging period. The standards also include Prevention of Significant Deterioration (PSD) provisions for NO_x, SO_2, and PM-10 to limit deterioration of existing air quality that is better than that otherwise allowed by the standards (an attainment area). Maximum allowable increases in concentrations above a baseline level are specified for each PSD pollutant. There are three classes (I, II, and III) of PSD areas, with Class I allowing the least degradation. Class I also restricts degradation of visibility. This area is a Class II, which allows for an incremental decrease in the air quality of the area. Baseline PSD-pollutant concentrations and the portion of the PSD increments already consumed are established for each location by the USEPA and the State of Alaska prior to issuance of air-quality permits. Air-quality standards do not directly address all other potential effects such as acidification of precipitation and freshwater bodies or effects on nonagronomic plant species.

(2) Effects of Accidental Emissions: Accidental emissions result from gas blowouts, evaporation of spilled oil, and burning of spilled oil. Soot from a fire is considered to be the major contributor to pollution from a fire event. This soot, which would be deposited on plant materials in the vicinity of the fire, would tend to slump and wash off vegetation in subsequent rains, limiting any health effects. Accidental emissions, therefore, are expected to have a minimal effect on onshore air quality.

(3) Other Effects on Air Quality: Other effects of air pollution from activities and other sources on the environment not specifically addressed by air-quality standards include the possibility of damage to vegetation and acidification. Effects may be short term (hours, days, or weeks), long term (seasons or years), regional (Arctic Slope), or local.

A significant increase in ozone concentrations is not likely to result from the exploration, development, or production scenario associated with the IAP. Photochemical pollutants such as ozone are not emitted directly but rather form in the air from the interaction of other pollutants in the presence of sunshine and heat. Although sunshine is present in the sale area most of each day during the summer, temperatures remain relatively low (Brower et al., 1988). Also, activities occurring as a result of the field-development scenario of the IAP are separated from each other, diminishing the combined effects from activities discussed in the IAP.

Olson (1982) reviewed susceptibility of fruticose lichen, an important component of the coastal tundra ecosystem, to sulfurous pollutants. There is evidence that SO_2 concentrations as low as 12.0 micrograms per cubic meter ($\mu g/m^3$) for short periods of time can depress photosynthesis in several lichen species, with damage occurring at 60 $\mu g/m^3$. Also, the sensitivity of lichen to sulfates is increased in the presence of humidity or moisture, conditions that are common on coastal tundra. However, because of the small size and number of sources of SO_2 emissions, the ambient concentrations at most locations may be assumed to be near the lower limits of detectability. Because of the distance of the proposed activities from shore, attendant atmospheric dispersion, and low existing levels of onshore pollutant concentrations, the effect on vegetation resulting from the IAP is expected to be minimal.

Summary: The effects on air quality from the Preferred Alternative should result in air emissions that are below the maximum allowable PSD Class II increments. The concentrations of criteria pollutants in the ambient air

would remain well within the air-quality standards. Consequently, a minimal effect on air quality with respect to standards is expected.

Conclusion—First Sale: Activity associated with the Preferred Alternative would result in a small, localized increase in the concentrations of criteria pollutants. Concentrations would be within the PSD Class II limits and National Air Quality Standards. Therefore, effects from the Preferred Alternative would be low. Effects of activities other than oil and gas are negligible, as in Alternative A.

Multiple Sales: The effects on air quality from multiple sales should result in air emissions that remain below the maximum allowable PSD Class II increments. The concentrations of criteria pollutants in the ambient air would remain well within the air-quality standards. Consequently, a minimal effect on air quality with respect to standards is expected.

Conclusion—Multiple Sales: Activities associated with multiple sales would result in sequential effects which would remain small and localized. Concentrations would remain within the PSD Class II limits and effects would remain low.

Effectiveness of Stipulations: There would be no stipulations for air quality for this alternative.

6. Vegetation: Ground-impacting management actions within the planning area that may affect vegetation under the Preferred Alternative include those from non-oil and gas related management activities and those related to exploration and development of petroleum resources.

a. Activities Other than Oil and Gas Exploration and Development: These actions include aerial surveys, paleontological and archaeological excavations, camps for research or recreation, and overland moves. Most of these activities, except for overland moves and some aerial surveys, occur during June to September.

Most off-runway landings during management surveys would be by fixed-wing aircraft using skis or floats; fewer would be by wheeled aircraft. Only wheeled aircraft have the potential to affect vegetation. Most wheeled-aircraft landings would occur on sand or gravel bars or possibly on dry, gravelly ridges. These landings have a potential to cause minor, short-term damage to the scattered vegetation present on bars or ridges. Because there are too many unknowns associated with this, the minor impacts anticipated cannot be quantified.

Archaeological digs are most likely to occur on drier soils, where a sod layer has formed. In this case, the sod may be removed and replaced causing a temporary disturbance rather than vegetation destruction. However, the surface vegetation may be destroyed in some archaeological digs and in most or all paleontological digs. The cumulative extent of such activities is not expected to exceed 4 acres per year.

Camps can result in vegetation trampling due to foot traffic and tent placement and small spills of stove or generator fuel. This can result in temporary (1 to a few growing seasons) disturbance to vegetation. Most recreational camps are expected to occur on river bars, where vegetative cover is minimal. Large camps for research or resource inventory are likely to occur on existing gravel pads, which also have minimal vegetative cover. The total land surface affected by camps is not expected to exceed 10 acres per year and would be scattered over several sites, with most containing little or no vegetation.

Most overland moves through the planning area involve traffic between Deadhorse and Barrow. Moves would occur in winter only, when the ground is frozen and covered with snow. The impact to vegetation varies with vehicle type, vegetation type, and snow conditions. Low-ground-pressure wheeled vehicles have less impact than tracked vehicles or sleds on skids. Less impact usually would be expected in the wetter tundra where the effect, if any, may be the compression of snow and dead matter leaving "green trails" visible for one to a few growing seasons (Sec. IV.B.16, Recreation and Visual). However, if a tracked vehicle makes a tight turn or drops its blade too deeply through the snow, surface vegetation may be disrupted. If this occurs in wet tundra, thermokarsting can cause impacts greater than those commonly experienced in drier tundra. Travel over low shrubs could cause plants to be broken, and travel over tussocks sometimes results in their tops being scraped off. Thus, overland moves may vary from having no observable effects in some situations to damaging vegetation and melting permafrost to the extent that it may take years or even decades (Emers and Jorgenson, 1997; Jorgenson and Martin, 1997) to heal. A trail across the planning area would be about 100 mi in length. If the trail is 12 ft wide, the impact potentially could affect about 150 acres.

b. Exploration:

(1) Disturbance:

(a) Effects of Construction: Construction with the potential to impact vegetation during exploration would be limited to the construction of ice pads for drilling exploratory or delineation wells, well collars, and ice roads to access some ice pads. Because vegetation is dormant when frozen and the ice pads/roads melt during the spring thaw along with snow and natural ice, this construction

may cause "green trails" but normally would have no adverse impact on vegetation. The exception would be if an ice pad were covered to prevent summer melt, so it could be used in a second winter. In that case, the vegetation would thaw underneath the timbers placed around the pad's perimeter to hold the cover down. Because that thawed vegetation would receive no sunlight, it would die (Hazen, 1997). Assuming that the average ice pad is 500 ft by 500 ft, this perimeter death would impact about 2,000 ft^2 or 0.05 acres. Under the Preferred Alternative, it is assumed that 2 to 7 exploration wells and 2 to 10 delineation wells would be drilled in the planning area, for a total of 4 to 17 wells on ice pads. If it is assumed that half of all ice pads would be maintained over the summer, this scenario could result in the death of 0.1 to 0.5 acres of vegetation spread among 2 to 9 different sites and over about 10 years. The vegetation would take 1 to a few years to recover.

Holes are dug in the earth for construction of well collars, causing the destruction of vegetation on the 16 ft^2 of ground (0.006 acres) involved and causing thermokarsting around them, which may change some vegetation cover to a wetter type. For 4 to 17 wells, this could result in the destruction of 0.02 to 0.10 acres of vegetation.

(b) Effects of Seismic Activities: Seismic exploration causes the same types of impacts to vegetation as those described above for overland moves. Under the Preferred Alternative, it is assumed there would be one crew active in the planning area each winter for 15 years and alternate winters thereafter, collecting about 250 line miles of 2-D seismic data. In addition, from one to three 3-D surveys would occur within about 10 years.

The exterior dimensions of each 2-D survey area are assumed to be about 600 mi^2 (384,000 acres) and the maximum area impacted by seismic lines to be 6,060 acres (250 mi x 200 ft wide). This figure is presented as a maximum, because not all of the area within a 200-ft wide line actually would be overrun by a vehicle. Trails also are made by camp-move vehicles, which traverse about the same distance as line miles of survey (Emers and Jorgenson, 1997). In addition, trails are made through the planning area while traveling to and from the survey area. A camp-move trail is about 12 ft wide, and it is assumed the camp train would involve two or three strings of trailers. These strings could use the same trail, but this would cause greater damage than to use separate trails. For this analysis, it is assumed that on average, 2.5 individual camp-train strings would use different trails to decrease overall damage and, thus, camp-move trails effectively would impact a path 30 ft wide. With 250 mi of trail within the survey area and an additional 106 mi entering and leaving the planning area, this would impact a total of 1,290 acres. Thus, the total area impacted by 2-D seismic surveys would be <7,350 acres each year because, as stated above, not all the area within a seismic line would be affected and after 15 years surveys are assumed to begin an alternate-years schedule.

A study of tundra disturbance by winter seismic surveys on the eastern portion of Alaska's North Slope (Jorgenson, In press) indicated that 1 to 2 years after a survey, the disturbance level to the affected tundra under seismic lines was little to none for 11 percent of the area, low for 64 percent, medium for 23 percent, and high for 2 percent. After 8 to 9 years, recovery had reduced the disturbance level to little or none on 97 percent of the affected area, and no areas of medium or high disturbance remained. The tundra under camp-move trails did not recover as rapidly. One to two years after the survey, the disturbance level to the affected tundra under camp-move trails was little to none for 22 percent of the area, low for 52 percent, medium for 24 percent, and high for 2 percent. After 8 to 9 years, recovery had reduced the disturbance level to little or none on only 85 percent, with low on 10 percent, medium on 4 percent, and high on 1 percent. Applying these data to the above scenario for 2-D seismic surveys in the planning area suggests that about 1,850 acres would experience medium to high disturbance each year for 15 years and, after 9 years of recovery for any single year's activity, that level of disturbance would remain evident on 65 acres.

It is assumed that a 3-D seismic operation would cover a total area of 150 mi^2 (96,000 acres), or 25 percent of the total area covered by a 2-D survey. However, the number of line miles covered within that area would be much greater, about 1,875. Thus, the tundra area impacted by seismic lines would be about 45,450 acres (1,875 mi by 200 ft wide). As for 2-D surveys, this figure is a maximum, because not all the area within the pair of 100-ft wide lines would be overrun by a vehicle. For 3-D surveys, the distance covered by camp-move vehicles would not be similar to line miles of survey as is the case for 2-D surveys. It is assumed that camp-move trails would approximate 25 percent (62.5 mi) of those for 2-D surveys, because the total area involved in a 3-D survey is only 25 percent of that covered by 2-D. There still would be an average of 106 additional miles traveled when entering and leaving the planning area. Thus, camp-move trails would impact about 610 acres of tundra per survey. Under the Preferred Alternative, one to three 3-D survey would occur, and about 610 to 1,830 acres would be impacted by camp-move vehicles and 45,450 to 136,350 acres by seismic line as a result of a first lease sale. Because 3-D seismic involves more tight turns by heavy equipment than does 2-D, the potential for vegetation damage is greater. For this reason, it can be assumed that the medium and high disturbance levels to tundra would occur in greater proportions from 3-D seismic lines than that presented for 2-D in Emers and Jorgenson (1997). The total area within

the planning area impacted by seismic surveys would be less than the total acreage of surveys presented here, because individual surveys would overlap one another. However, the decrease in acreage impacted would be countered by the higher level of disturbance possible in those areas of overlap.

It is assumed that impacts to vegetation from overland moves and seismic surveys would occur to different land-cover classes in proportion to their occurrence in the planning area (Table III.B.2-1), with the exception of the three water classes. Thus, these impacts, whether or not quantified as to area involved, would occur among the land-cover classes as presented in Table IV.B.6-1.

(2) Effects of Spills: Spills that might occur during exploratory work are covered under blowouts and refined-oil spills during development (below).

c. Development:

(1) Disturbance: There are four different aspects of development that would impact vegetation—construction of gravel pads, roads and airstrips for each; potential construction of one pump station within the planning area; excavation of material sites; and construction of pipelines.

(a) Gravel Pads, Roads, and Airstrips: It is assumed that the gravel fill for the average in the planning area would cover a total of 100 acres and that under the Preferred Alternative, 1 to 2 s would be developed. This would result in the destruction of 100 to 200 acres of vegetation.

The passage of vehicle traffic over gravel pads would result in dust and gravel being sprayed over vegetation within about 30 ft of the pad and a noticeable dust shadow out to about 150 ft or more. Beyond about 30 ft, the effects of dust on vegetation would be subordinate to those described below for changes in snow distribution and moisture regimes (Woodward-Clyde Consultants, 1993). Within 30 ft of pads, the dust and gravel may smother the original vegetation resulting in a shift to weedy species and thermokarsting, with the latter leading to the development of high-centered polygons with deep moats (Jorgenson, 1997, pers. comm.). For this analysis, it is assumed that the average in the planning area would consist of 5 mi of some combination of pads, roads, and airstrip with the potential for dust effects along a 10-mi perimeter. This could result in a total coverage of the above impacts over 36 acres per , corresponding to 36 to 72 acres under the Preferred Alternative.

The type of material used for gravel fill also can impact vegetation, because the material sometimes has a saline source. Sources for material to be used in the planning area currently are undetermined. If the material is saline, water draining off or leaching through the pad can pick up the salinity and cause the death of plants near the pad. The area of plant death eventually would be colonized by more halophytic species, resulting in an overall impact of change from one plant community to another.

The construction of gravel pads can result in a change in moisture regime of the nearby tundra through the accumulation of snow by drifting and the blockage of normal surface waterflow in summer. This can cause an increase in the depth of the active layer (soil that thaws during summer), which leads to an increase in graminoid and bryophyte production in wet habitats or a decrease in shrub and lichen production in moist or dry habitats within 164 ft of the pad (Woodward-Clyde Consultants, 1993). In the extreme case, shrubs may disappear altogether and the vascular plant community may become a *Carex aquatilis* monoculture (Jorgenson, 1997, pers. comm.). If all such effects occur within 164 ft of the pads, the total area impacted could be up to 200 acres per , or 200 to 400 acres under the Preferred Alternative.

Flooding caused the greatest indirect effect of construction on vegetation during the first 15 years (1968-1983) of development in the Prudhoe Bay (Walker et al., 1986, 1987). Flooding resulted when roads and pads intercepted the natural flow of water and caused ponding. Conditions of development in the NPR-A would require that natural drainage patterns be identified prior to and maintained during and after construction. Even if such conditions were not required or were not completely successful, the acreage of land impacted would not be greater than that affected by dust and snow drifting, as described above. However, the change in vegetation type could be different, resulting in more aquatic grasses and sedges.

(b) Pump Station: Depending on the number of fields produced, their location, and the diameter of pipe used to transport oil, one pump station may be needed within the planning area. A pump station with associated airstrip would result in about 40 acres of gravel fill. For this analysis, it is assumed the perimeter of this gravel fill would be 3 mi, resulting in 11 acres of potential dust effect or 60 acres of moisture-regime change.

(c) Material Sites: Any need for gravel fill resulting from proposed development may be met by existing borrow sites east of the NPR-A. However, if excavation of fill material occurs within the planning area, vegetation would be destroyed over the area of the borrow pit itself as well as where the overburden is stockpiled. For this analysis, it is assumed that there would be one material site within the NPR-A for each developed, with a total surface disturbance of 30 to 50 acres (average 40 acres). It

also is assumed that all associated work would occur in winter, resulting in no dust. Any moisture-regime changes as a result of snow drifting would be confined to <20 acres per material site. Under the Preferred Alternative, this would result in the destruction of 40 to 80 acres of vegetation and the alteration of the vegetation community over 20 to 40 acres. If some or all of the gravel resources come from outside the planning area, the total acreage affected would be the same or less, but correspondingly distributed between the planning area and other lands to the east. Material sites outside the planning area would most likely be within the Colville River floodplain where vegetative cover may be naturally reduced or absent.

(d) Pipelines: For this analysis, it is assumed that pipelines would involve a single VSM per pipe-supporting rack. The VSM would have a diameter of 12 in and would be placed 55 to 70 ft apart. Each developed would contain about 5 mi of flowline within it in addition to the transport pipeline carrying crude oil from it. Each VSM would have an approximately 20-in wide zone of disturbance around it in addition to the vegetation displaced by the VSM (Jorgenson, 1997, pers. comm.). The zone of disturbance would result from deposition of spoil material and thermokarsting and would result in a change in plant species composition. The total area disturbed by each VSM would be about 14 ft^2, 6 percent of which would be vegetation destruction/replacement by the VSM. This would result in 0.03 acres being disturbed per pipeline mile, or 0.6 to 3.2 acres under the Preferred Alternative.

Pipelines also could impact vegetation indirectly through snow drifting or shading. There is conflicting information about the occurrence of snow drifting associated with pipelines that have no parallel road. Jorgenson (1997, pers. comm.) has not seen drifting in such situations, but residents of Nuiqsut have said that it occurs. Insufficient information exists to describe any potential effects to vegetation.

Any vegetation under a pipeline would receive less direct sunlight during the growing season, potentially leading to a more shallow active layer in the soil and reduced photosynthesis by the plants. No data exist to address this possibility. Most existing pipelines are associated with a parallel road, and any effects of snow drifting, gravel spray, or dust would mask an effect of shading.

The assumptions for this analysis of impacts by pipelines would be invalidated by a decision to bury any portion of a pipeline under the tundra. In that case vegetation would be destroyed above the trench and altered in the adjacent areas due to temporary storage of earth on top of vegetation and impacts from earth-moving machinery. The latter impacts would be ameliorated by winter construction, but would still occur. If the zone of impacts from pipeline burial is assumed to be 12 feet wide, then the total impacts to vegetation would affect 1.5 acres per pipeline mile. It is assumed that pipeline burial under tundra would be the exception rather than the norm, meaning the additional acreage of vegetation disturbance would be minimal in comparison to the total acreage of vegetation impacts from petroleum development.

(2) Effects of Spills: Most oil spills occur on gravel pads and, consequently, their effects do not reach the vegetation. About 20 to 35 percent of past crude-oil spills have reached areas beyond pads. The corresponding proportion for refined oil spills probably is much less, but for this analysis it is assumed that 27 percent of all spills (except blowouts; see below) occur or reach beyond gravel pads. Because winter spans the majority of each year, most spills happen when there is sufficient snow cover that cleanup efforts occur before the oil reaches the vegetation; this situation occurs during about 60 percent of the year. Thus, for this analysis, it is assumed that 11 percent of all oil spills (except blowouts; see below) will affect vegetation.

Most oil spills cover <500 ft^2 (<0.01 acres) with a maximum coverage of 4.8 acres if the spill is a windblown mist. For this analysis, it is assumed that the average spill would cover 0.1 acre (98% at 0.01 acre, 2% at 4.8 acres). Under the Preferred Alternative, the total area of vegetation that would be impacted by spilled oil over the lifetime of developed s would be 0.7 to 3.1 acres. Overall, past spills on Alaska's North Slope have caused minor ecological damage, and ecosystems have shown a good potential for recovery (Jorgenson, 1997).

From 1958 to 1996, 2,933 wells were drilled on Alaska's North Slope. During this period, one blowout was reported, and no crude oil was spilled off the pad during that blowout. The chance of a blowout occurring in the planning area, with subsequent damage to vegetation beyond the drill pad, is considered low.

A pipeline spill of seawater used for waterflooding also has the potential to affect vegetation. The size of the area affected would depend on the terrain and landcover at the spill site and would be proportional to the amount of seawater spilled. If such a spill occurred within a community of halophytic plant species, there may be little effect. Otherwise, depending on the specific situation under which the spill occurred, the result may vary from little impact to total plant death in the area affected with eventual replacement of the vegetation community by halophytic species.

Summary: Under the Preferred Alternative, minor impacts to vegetation may occur from aircraft landings,

archaeological or paleontological excavations, camps, and overland moves. The duration of these impacts would be short term, ranging up to 5 months, and recovery could vary from 1 year to decades. Impacts also would occur from seismic work and the construction of well collars during exploratory drilling. The duration and recovery for seismic work would be similar to those for overland moves. The effects of well-collar construction would be permanent. The effects of development include the destruction of vegetation under gravel pads; material sites; pipeline VSM's and spilled oil; and the alteration of vegetation communities resulting from dust, salinity of gravel fill, snow drifts, and blockage of normal surface waterflow. These impacts are considered permanent except for those of oil spills, which are cleaned up immediately, allowing recovery within a few years to two decades.

Conclusion—First Sale: Impacts to vegetation from activities other than oil exploration and development under the Preferred Alternative would involve either disturbance or destruction. Since they would involve a very small fraction of the 4.6-million-acre planning area, the overall impact to vegetation communities would be minor to negligible. The impacts of oil exploration would include vegetation disturbance on about 7,350 acres per year from 2-D seismic work and 46,000 to 138,000 acres from 3-D surveys over the entire exploration period. About 17 percent of the disturbance from 2-D would be medium to high, with perhaps 20 percent at that level for 3-D. After 9 years, recovery would be about 90 percent for 2-D seismic work and probably somewhat less for 3-D. Exploration activities also would result in minor vegetation destruction and alteration from the construction of exploration well collars that would be permanent. The activities of development that would impact vegetation include construction of gravel pads, roads, and airstrips for each ; potential construction of one pump station within the planning area; excavation of material sites; and construction of pipelines. The combined effect of these activities would cause the destruction of vegetation on 140 to 320 acres and the alteration in plant species composition of another 220 to 500 acres, for a total of effects over 360 to 820 acres. The duration of these impacts would be permanent, assuming that the gravel pads would remain after oil production ends, and recovery thus would be moot. Oil spills are inevitable during exploration and development and would affect 0.7 to 3.1 acres of vegetation within the planning area. Spills would be cleaned up immediately, would cause minor ecological damage, and ecosystems would be likely to recover in a few years to 2 decades. Overall, the impacts of the Preferred Alternative would be very similar to those of Alternative C.

Multiple Sales: It is assumed that additional lease sales under the Preferred Alternative would result in additional exploration activities and a total of 1 to 3 s being developed. More acreage would be impacted by seismic surveys, but it would be over a longer period of time. It is expected that recovery from at least 90 percent of the impacts from the earliest surveys would be complete before additional seismic operations would commence as a result of multiple sales. The total number of exploratory wells is assumed to increase to 6-21 from 2-7, and delineation wells to 4-17 from 2-10, for a total of 10 to 38 wells drilled from ice pads. Vegetation destruction from well collars would then increase to affect 0.1 to 0.2 acres, and vegetation death around ice pad perimeters would increase to 0.3 to 1.0 acres. Tundra would recover from the latter in 1 to a few years.

With the assumption of 1 to 3 s developed, the vegetation that might be destroyed by burial under gravel fill would increase to 100 to 300 acres. The area of vegetation around gravel pads that would undergo change from dust- or moisture-regime impacts would be 200 to 600 acres. The impacts of developing material sites would increase correspondingly to the number of s. This would mean the destruction of vegetation on 40 to 120 acres and effects of moisture regime changes on 20 to 60 acres. It is assumed that the number of pump stations would remain at 0 to 1, resulting in the burial of 0 to 40 acres and dust- or moisture-regime changes on an additional 0 to 60 acres. The number of pipeline miles would increase somewhat under multiple sales, with a total of 25 to 125 mi resulting in the destruction or alteration of a total of 0.8 to 3.8 acres. The incidence of oil spills also would increase, affecting 0.9 to 7.4 acres of vegetation. The probability of a blowout would remain low.

Conclusion—Multiple Sales: The impacts of oil exploration would include more vegetation disturbance from seismic work than under a single-sale scenario, but the extended period of time over which it would occur, coupled with the recovery time for disturbed areas, would result in only a small increase in the amount of disturbance that would be evident at any one time. Exploration activities also would result in 0.1 to 0.2 acres of permanent vegetation destruction around well collars and alteration of 0.3 to 1.0 acres around ice pads. The activities of development that would impact vegetation include construction of gravel pads, roads, and airstrips for each ; potential construction of one pump station within the planning area; excavation of material sites; and construction of pipelines. The combined effect of these activities would cause the destruction of vegetation on 140 to 460 acres and the alteration in plant species composition of another 220 to 720 acres, for a total of effects over 360 to 1,180 acres. The duration of these impacts would be permanent, assuming that the gravel pads would remain after oil production ends, and recovery thus would be moot. Oil spills would affect 0.9 to 7.4 acres of vegetation within

the planning area. Recovery from spills would take a few years to two decades. Overall, the impacts of the Preferred Alternative would be very similar to those of Alternative C.

7. Fish:

a. Activities Other Than Oil and Gas Exploration and Development: Activities associated with the Preferred Alternative that may affect fish include the establishment of large work camps at pre-existing airstrips; small scientific excavations for paleontological, geologic, and soils-related information; the sport harvest of fish by workers; and those associated with fuel spills at fuel-storage sites. The establishment of work camps, scientific excavations, and the sport harvest of fish are not expected to have a measurable adverse effect on arctic fish populations. Fuel spills at fuel-storage sites have the potential to adversely affect arctic fish populations. Stipulations 7, 9-12, 15-17, 24m, and 24n were created to prevent fuel and oil spills from affecting arctic fish populations. If a fuel spill were to occur under the Preferred Alternative, the expected effects of that spill on arctic fish populations would be similar to those discussed below concerning crude oil spills.

b. Oil and Gas Exploration and Development Activities: The Preferred Alternative also involves several management actions associated with oil and gas development. These include seismic surveys; the construction of gravel drill pads, roads, airstrips, and pipelines; and oil spills (drill pad, pipeline, and supply barge). The individual effects of these actions and the chemical agents associated with them have been discussed in previous Beaufort Sea EIS's (e.g., USDOI, MMS, 1996a), which are incorporated here by reference. While the Preferred Alternative exposes about 80 percent of the planning area to oil and gas leasing, less than one-third of the area having a high potential for oil and gas discovery is available for oil and gas development. Stipulations precluding most oil and gas activity in surrounding areas also are expected to discourage oil and gas exploration and development under the Preferred Alternative. Hence, the Preferred Alternative is not expected to have any effect on arctic fish populations. If oil and gas activities were to occur under this alternative, the expected effects of those activities would be as described below.

(1) Effects of Disturbance:

(a) Effects from Seismic Surveys: Arctic fish are likely to be adversely affected by seismic surveys located above overwintering areas. Likely effects would include avoidance behavior and short-term added stress but also could result in the death of some individuals of the more sensitive lifestages (e.g., juveniles). However, the effect on most overwintering fish is expected to consist of only short-term, sublethal effects. No measurable effect on arctic fish populations would be expected. While there is no stipulation that precludes seismic surveys above overwintering areas, the likelihood of them occurring in such areas is considered low.

(b) Effects from Construction: Construction-related activities that may affect arctic fish include the construction of drill pads, roads, airstrips, pipelines; and possibly gravel extraction. Construction during exploration would involve freshwater withdrawals for the construction of ice drill pads, roads, and airstrips. Ice roads or airstrips constructed through overwintering areas <10 ft deep would freeze to the bottom and form a barrier to water circulation, resulting in reduced levels of dissolved oxygen. This could have lethal effects on the fish affected by the barrier. The recovery of the affected fish populations would be expected in 5 to 10 years. The adverse effects of ice roads and airstrips on overwintering areas are mitigated for the Preferred Alternative by Stipulations 24c and 24e. These stipulations recommend, among other things, that equipment crossing waterways stay a minimum of 100 ft from overwintering areas, and that crossings be made in shallow areas whenever possible. These stipulations could benefit overwintering arctic fish. If these stipulations result in the construction of ice roads and airstrips in nonoverwintering areas, no measurable effect on overwintering arctic fish is expected. Freshwater withdrawals for the construction of ice drill pads, roads, and airstrips may adversely affect fish, if the water is taken from areas where they are overwintering. Under-ice withdrawals from areas having water and dissolved-oxygen levels barely to moderately sufficient to support overwintering fish would be likely to kill many of the fish overwintering there. The recovery of affected fish populations would be expected in 5 to 10 years. The adverse effects of freshwater withdrawals on overwintering areas is mitigated for the Preferred Alternative by Stipulation 20, which prohibits withdrawals from rivers and streams in winter and limits withdrawals from fish-bearing lakes (or those seasonally connected to fish-bearing lakes) to 15 percent (excluding ice) of the estimated free-water volume. Stipulation 20 could benefit overwintering arctic fish. If this stipulation results in withdrawals from areas that do not support resident fish populations, or from areas having sufficient under-ice reserves of water and dissolved oxygen, no measurable effect on overwintering arctic fish is expected.

Construction during production would involve the construction of gravel drill pads, roads, airstrips, and pipelines. The difference in the estimated number of gravel drill pads (up to 2 for Alternative B and up to 4 for the Preferred Alternative) is not expected to make a measurable difference in effects on arctic fish for the Preferred Alternative Of far greater significance is the

specific location of these drill pads, roads, and airstrips. The effects of gravel construction and gravel extraction activities in high density spawning and overwintering habitat, or in access corridors used by migratory fish, are expected to be spawning failure and mortality for many of the fish affected (an estimated 5-10-year recovery). The effects of pipeline trenching through overwintering or spawning habitat are likely to be spawning failure and/or mortality of many fish, and a 5- to 10-year recovery period. Trenching that avoids these habitats is not expected to adversely affect fish. The difference in the estimated number of pipeline miles (up to 75 mi for Alternative B and up to 95 mi for the Preferred Alternative) is not expected to make a measurable difference in effects on arctic fish for the Preferred Alternative. The Preferred Alternative also may involve the construction of a coastal docking facility to offload supply barges into the planning area. The effect of a docking facility on arctic fish would depend on its location, size, and design characteristics. The construction of a large docking facility in offshore waters, requiring a long access road, could adversely affect the movement of some coastal marine and migratory fish. However, the construction of a facility that provides for the movement of these fish is not likely to adversely affect them. Because supply barges are shallow-draft vessels, the docking facility for the Preferred Alternative is expected to be constructed in shallow nearshore waters. Additionally, the size of the facility for the Preferred Alternative is expected to be relatively small (up to several hundred feet) and provide for the movement of coastal fish. Hence, the construction of a coastal docking facility associated with the Preferred Alternative is not expected to have a measurable effect on arctic fish.

The effects of gravel construction on arctic fish are mitigated by Stipulations 39, 41, and 43, which prohibit the construction of permanent facilities including roads, airstrips, and pipelines in fish-bearing waterbodies; establish setbacks ranging from 500 ft to ½ mi, depending on the waterbody involved; and prohibit any changes to natural drainage patterns due to the construction of these facilities. These stipulations could benefit overwintering or migrating arctic fish. If these stipulations result in the construction of permanent facilities in low density fish habitat, or in access corridors seldom used by migratory fish, no measurable effect on migrating or overwintering arctic fish is expected. The effects of gravel extraction in high-density spawning and overwintering habitat or in access corridors used by migratory fish are mitigated for the Preferred Alternative by Stipulation 40, which essentially prohibits the extraction of gravel from all waterbodies, and restricts the amount extracted elsewhere to the minimum needed for field development. Stipulation 40 could benefit overwintering or migrating arctic fish. If this stipulation results in the extraction of gravel from low-density fish habitat or from access corridors seldom used by migratory fish, no measurable effect on overwintering or migrating arctic fish is expected. The same applies to gravel extraction activities that might occur outside of the planning area.

(2) Effects of Spills: The effects of oil spills on fish have been discussed in previous Beaufort Sea EIS's (e.g., USDOI, MMS, 1996a), which are incorporated here by reference and summarized. Oil spills have been observed to have a range of effects on fish (see Rice, 1981; Starr, Kuwada, and Trasky, 1981; Hamilton, Starr, and Trasky, 1979; Malins, 1977, for a more detailed discussion). The specific effect depends on the concentration of petroleum present, the time of exposure, and the stage of fish development involved (eggs, larva, and juveniles are most sensitive). If lethal concentrations are encountered, or sublethal concentrations are encountered over a long-enough period, fish mortality is likely to occur. However, mortality caused by a petroleum-related spill is seldom observed outside the laboratory environment. Most acute-toxicity values (96-hour lethal concentration for 50% of test organisms [LC_{50}]) for fish generally are on the order of 1 to 10 ppm. Concentrations observed under the oil slick of former oil spills at sea have been less than the acute values for fish and plankton. For example, concentrations observed 0.5 to 1.0 m beneath a slick from the *Tsesis* spill (Kineman, Elmgren, and Hansson, 1980) ranged from 50 to 60 ppb. Extensive sampling following the *Exxon Valdez* oil spill (about 260,000 bbl in size) also revealed that hydrocarbon levels were well below those known to be toxic or to cause sublethal effects in plankton (Neff, 1991). The low concentration of hydrocarbons in the water column following even a large oil spill at sea appears to be the primary reason for the lack of lethal effects on fish and plankton.

The bodies of freshwater in the planning area are substantially smaller in size than the marine environment, where the effects of former oil spills have been observed. However, the size of oil spills associated with the Preferred Alternative also is likely to be much smaller. Additionally, most oil spills (65-80%) are expected to occur on the pad where they are stored and would not come in contact with fish habitat. Hence, the likelihood of lethal effects is expected to be generally similar to that observed for oil spills at sea (i.e., very low). Some fish and food resources in the immediate area of an off-pad oil spill could receive lethal or sublethal effects, particularly if the spill occurred where and when fish were migrating, in overwintering areas during winter, or in small waterbodies having restricted water exchange. If an oil spill of sufficient size occurred in a small waterbody containing fish with restricted water exchange, lethal and sublethal effects would be expected on most of the fish and food resources in that waterbody; and recovery may be ≥5 years.

Sublethal effects may include changes in growth, feeding, fecundity, and survival rates and temporary displacement. Other possibilities include interference with movements to feeding, overwintering, or spawning areas; localized reduction in food resources, and consumption of contaminated prey.

While oil spills in the surrounding off-pad environment may adversely affect arctic fish in the immediate area, their relatively small size is likely to preclude them from traveling far enough to get into large rivers and subsequently into coastal waters. Even if they did get into large waterbodies, such as the 325-bbl oil spill assumed to occur in Teshekpuk Lake and the Colville River, the studies mentioned above indicate that they are likely to have no measurable effect on arctic fish populations. Some fish in the immediate area of these oil spills may receive lethal or sublethal effects, particularly if the spill occurred where and when fish are migrating, in overwintering areas during winter, or in small waterbodies having restricted water exchange (an estimated 3-5 year recovery). However, because of the relatively small size of the fuel and oil spills anticipated, the lack of probable effect of oil on fish indicated by prior studies, the low diversity and abundance of fish in most of the planning area (particularly large resident fish), the unlikelihood of spills blocking fish migrations or occurring in overwintering areas, and the fact that the Preferred Alternative precludes oil and gas activity in or near all waters inhabited by fish, fuel and oil spills associated with the Preferred Alternative are not expected to have a measurable effect on arctic fish populations. The effects of fuel and oil spills on arctic fish are mitigated for the Preferred Alternative by stipulations 7, 9-12, 15-17, 24m, and 24n, which are intended to prevent fuel and oil spills from adversely affecting arctic fish populations. However, for the reasons mentioned above, fuel and oil spills associated with this alternative are not expected to have any measurable effect arctic fish. Hence, these stipulations are not expected have any beneficial effect on arctic fish populations.

The effects of a seawater pipeline spill on freshwater fish populations would depend on the specific location, size, and timing of the spill. No effect would be expected during the winter period, when the surface already is covered by ice. During the spring and summer, large quantities of seawater entering a fish-bearing freshwater environment would have from no effect to lethal effects on freshwater fish, depending on the specific waterbody involved, the size of the seawater spill into that waterbody, and the rate of freshwater exchange within that waterbody. Migratory fish are not likely to be affected by seawater spills due to their higher tolerance to seawater, and the probability that most already would have left the freshwater environment by spring in their migration to sea. In large waterbodies, seawater spills are expected to have from no effect to sublethal effects on freshwater fish. In small waterbodies with restricted water exchange, lethal effects are more likely to result from a medium to large seawater spill. Recovery would be expected within 1 to 3 years, depending on the rate of freshwater exchange. However, due to the small size of the seawater spills anticipated, the low diversity and abundance of freshwater fish in most of the planning area, and the fact that the Preferred Alternative precludes oil and gas activity in or near all waters inhabited by fish, seawater spills associated with the Preferred Alternative are not expected to have a measurable effect on arctic fish populations in the planning area over the production life of the field.

Conclusion—First Sale: The effects on arctic fish populations under the Preferred Alternative are not expected to be measurable, based on the assumptions discussed in the text, seismic surveys, construction (drill pads, roads, airstrips, pipelines, and gravel extraction); and fuel, oil, and seawater spills associated with the Preferred Alternative, and would be similar to those of Alternative C.

Multiple Sales: The actions most likely to affect arctic fish for the first lease sale have been discussed herein and include seismic surveys, construction related activities, fuel spills, and oil spills. While additional northeastern NPR-A lease sales would involve more seismic surveys than the first sale, and thereby would increase the probability of seismic activity occurring above overwintering habitat, such events are likely to be infrequent. Seismic surveys associated with multiple sales in the Preferred Alternative are expected to have the same overall effect on fish as discussed for the first sale. For additional northeastern NPR-A lease sales that may occur in the future, the number of production pads and pipeline miles have been estimated (Table IV.A.1.b-7). That table estimates that the number of gravel pads (5) for multiple sales would be similar to that of first sale (4). On the basis of this estimate, gravel pads and gravel extraction activities are likely to a similar to those of the first sale, but would likely have a slightly greater effect on arctic fish due to the additional production pad. Because there is little difference in the estimated number of pipeline miles for multiple sales (up to 110) and the first sale (up to 95), multiple sales pipelines are expected to have effects similar to those of the first sale. It is estimated that up to 476 bbl of crude oil would be spilled for multiple sales, or about 1.4 times that of the first sale (estimated at up to 336 bbl). On the basis of this estimate, crude oil spills for multiple sales are expected to have a slightly greater effect on arctic fish than the first sale. However, if there were not enough time between sales to allow for full recovery, or if the level of activity of the selected alternatives were significantly greater than that of the first sale, the effect of each additional sale on arctic fish populations is likely to be greater than estimated herein for multiple sales.

Conclusion—Multiple Sales: Seismic surveys, pipelines, and seawater pipeline spills are expected to have the same overall effect on arctic fish as the first sale. Gravel pads, gravel extraction, and fuel and oil spills are expected to have a slightly greater effect on arctic fish populations than the first sale. Insufficient recovery time between sales and/or greater levels of activity would be likely to result in greater oil spill related effects than estimated herein for multiple sales.

8. Birds: This section discusses potentially adverse effects of various activities within the Northeast NPR-A Planning Area on nonendangered birds under the Preferred Alternative. Such activities, including those associated with oil and gas exploration and development, may result in disturbance, habitat alteration or loss, and fuel or oil spills. The primary effects on birds exposed to these factors would be altered behavior resulting from disturbance during the breeding, molting, or migration periods; decreased productivity, survival, and recruitment; and altered distribution and abundance. Nearly all of the approximately 80 species of regularly occurring birds are migratory, seasonally occupying a variety of wetland, tundra, riverine, and marine habitats in or adjacent to the planning area.

a. Activities Other than Oil and Gas Exploration and Development: Activities such as logistical air traffic, wildlife and other aerial surveys, overland traffic (winter), seismic surveys (winter), research and construction camps, excavations, hazardous material removal, resource inventories, and recreational camps and boating are expected to have relatively short-term effects on birds. Factors that influence productivity and/or survival may have population effects that are relatively long term.

(1) Effects of Disturbance: Noise from human activities, as well as visual presence of humans and/or equipment, may disturb birds during any phase of the annual cycle. Birds may be disturbed easily during sensitive periods as when attending a nest, broodrearing young, or in a flightless molt condition. Potentially disturbing activities (Table IV.A.1a-1) include ground-based activities and aircraft traffic.

(a) Effects from Ground-Based Activities: Included here are winter ground transport, seismic surveys, ground-based resource surveys, activities associated with camps, waste removal, and recreational traffic. Attraction of predators to sites of activity may increase predation on birds.

1) Winter Transport: Winter (December-April) trips between Prudhoe Bay or Oliktok Point and Barrow (20-100 annually) over offshore ice would not affect birds. The effect of occasional overland traffic (e.g., 1 trip/week) along the coast could temporarily displace resident ptarmigan, gyrfalcons, and snowy owls present in the area for ≤1 day (Stalmaster and Newman, 1978); if traffic is more routine (e.g., 1 trip/1.5 days), these species may vacate the vicinity of the route.

2) Seismic Surveys: Seismic operations in winter (e.g., 10 vehicles, up to 60 workers) traversing gridlines 5 to 10 mi apart could displace small numbers of these species from the vicinity of each 5- to 10-mi segment of up to 250 mi (402 km) of gridline for perhaps 3 to 7 days. Because the areas of potential disturbance and resident birds both would be scattered over a large area, only small numbers of individuals are expected to be affected with minor overall effect. Recovery to original distribution and abundance is expected to occur following cessation of these activities in late spring.

3) Resource Survey Camps: Large camps (≥15 persons) potentially located at Inigok Creek airstrip, Umiat, Lonely DEW-Line site (Fig. III.C.7-3), and possibly the abandoned Ikpikpuk well site (Fig. III.A.1.f-1) could disturb the local bird community perhaps 0.6 mi (1 km) from each camp (776 acres; 3.14 km^2) for the 12-week duration of operation. Humans on foot and noise-generating activities are expected to cause waterfowl responses ranging from moving to the safety of a nearby lake to departure from the area for several hours (e.g., Burgess and Ritchie, 1989). Nest attempts and success are expected to decline in camp areas, but the effect probably would vary considerably depending on the availability of optimal habitat for each species (there may be little undisturbed comparable habitat in the vicinity of these sites in which to relocate), the intensity of disturbance factors, the sensitivity of each species to disturbance, and the potential for habituation to particular factors (e.g., Haugh, 1982; Johnson and Noel, 1996). Adverse effects on composition and distribution of the local bird community are expected to be significant during the seasons camps are occupied, but population-level effect from lost productivity is likely to be minor for most species.

No known high-density areas for species recorded on the breeding pair surveys (King, 1997, pers. comm.) coincide with any of these sites except for the tundra swan, northern pintail, and oldsquaw in the Lonely area (Figs. III.B.4-6, -12, -13), and possibly postbreeding concentrations of shorebirds near the Ikpikpuk site (Fig. III.B.4-17). Density values and waterfowl behavior observations (Murphy and Anderson, 1993) suggest that breeding efforts of a maximum of 3 swans, 11 oldsquaw, and 20 pintail could be disturbed, if the area were entirely suitable habitat populated by typical densities of these species. Each of the identified sites has medium- and low-density areas of virtually all species recorded on breeding-pair surveys and,

presumably, various shorebirds, passerines, and raptors. Studies in the Prudhoe Bay area indicate that numerical response to development may range from a substantial decrease to a substantial increase in nesting density (TERA, 1993, Fig. 16). Local populations of those species adversely affected are expected to experience only minor declines in breeding success in summers when the camps are occupied, and the lost productivity may not be detectable above the natural fluctuations of the population and survey methods/data available. Likewise, broodrearing or molting birds probably would be displaced from the vicinity of these camps, but the small area and numbers involved is expected to result in negligible loss of foraging habitat for these local groups of individuals and negligible declines in survival and recruitment.

Activities at small resource-survey camps along the Colville and Ikpikpuk and other rivers potentially may disturb nesting passerines for short periods (3-5 days) during a 6- to 12-week interval, but the population effect of such short-term presence on productivity is likely to be negligible. However, raptor nest sites exposed to disturbance of such duration might be expected to exhibit a more significant adverse response, although Ritchie (1987) found that short-term disturbance of peregrine falcon nest sites did not cause significant alteration of activity patterns and no significant change in productivity of fledglings. These camps are occupied for up to 6 weeks in the central planning area, may disrupt some nesting attempts by waterfowl, shorebirds, and/or passerines but are expected to cause only minor local loss of productivity.

4) Waste Removal: Disturbance during hazardous-waste and solid-material removal and remediation activity involving operation of heavy equipment for up to 3 to 4 weeks, or cleanup of fuel spills reaching off-site areas during the breeding season, temporarily may displace a small number of nesting, broodrearing or molting birds from the immediate area, but effects are not expected to extend beyond 700 ft to 0.6 mi. Either activity may cause local disruption of some breeding attempts or foraging activities, but the losses probably would not be detectable above the natural fluctuations of the population.

5) Boat Traffic: Boat travel from June to September for recreation, hunting, or transport to resource-survey camps on the Colville River, and potentially the Ikpikpuk and Kogosukruk rivers, could expose a substantial proportion of the Alaskan arctic peregrine falcon population, as well as gyrfalcons and rough-legged hawks, to human presence (Ritchie, 1987). The current float-trip traffic (up to 14 parties ≤5 persons each/season or about 1/week passing peregrine eyries—5 of these occurring below Umiat where peregrine density is higher than above; Fig IV.B.4-18) has not prevented the regional peregrine population from increasing. There is no indication that this level of activity is adversely affecting the other two species. Traffic would increase below Umiat to 13 parties/season under this alternative, a 260 percent increase, suggesting that frequent monitoring for any effects would be required. The tall-shrub riparian habitat along these rivers is important habitat for nesting passerine birds. Studies to determine the effect of varying traffic levels in this situation have not been done, but any severe effects are likely to be localized primarily where river parties concentrate their onshore activities.

6) Predator Attraction: The attraction of predators on birds (glaucous gull, common raven, arctic fox, grizzly bear) to uncontained refuse is well known. It is not certain if predator populations with access to refuse are larger than they would be in its absence. Nor is it certain in most instances what effect predation by these species has on overall reproductive success and local population trends, although some studies have demonstrated a high correlation between presence or absence of predators and reproductive success. Fox and gull predation on island-nesting species or those that are colonial has been implicated in nest losses ranging from substantial to total failure (e.g., snow goose: Burgess and Rose, 1994; Johnson and Noel, 1996; common eider: Quinlan and Lehnhausen, 1982). Several studies have correlated nest success with fox predation pressure (e.g., brant and shorebirds: Underhill et al., 1993). Because permitted users are required to handle and dispose of waste in a manner that does not attract wildlife, which in turn would prevent enhancement of potential predator populations, this is not expected to be a significant problem. The large summer camps will be in place for sufficient periods to attract all four species but in most cases is not likely to cause other than minor local losses. If arctic foxes are attracted and remain in the area, breeding success of local bird communities may be affected substantially. The extent of any effect is not known but specifically could involve tundra swans, northern pintail, oldsquaw, and probably other waterfowl species present at lower densities in the Lonely area, and these species or any of several shorebird and passerine species there and at other proposed sites. Overall productivity and recruitment lost from the local area may not be detectable above the natural fluctuations of the population and survey methods/data available.

(b) Effects from Aircraft Operations: Both fixed-wing aircraft and helicopters are used for summer-season (June-September) aerial surveys, support of ground-based surveys and camps, and support of recreational activities. Primarily fixed-wing aircraft would be used for support of seismic surveys.

1) Large Camp Support: Establishment and maintenance of large summer camps (see above)

requires aircraft support several times per week and flights for transport to worksites and for aerial wildlife and other surveys. Routine overflight of high bird-concentration areas by aircraft supplying or operating out of these camps could cause effects ranging from abandonment of nesting efforts or lower survival of young in extreme cases to avoidance of certain areas of favorable habitat for future nesting attempts or excessive activity/weight loss in the case of molting geese. The Ikpikpuk wellsite, between southwest Teshekpuk Lake and the Ikpikpuk River, is located west of concentrations of five species recorded on surveys of the arctic coastal plain near the lake—yellow-billed loon, Pacific loon, greater white-fronted goose, oldsquaw, and king eider areas east of the lake (Figs. III.B.4-3, -4, -9, -13, -14). High-concentration areas of white-fronted goose, northern pintail (Fig. III.B.4-12), and oldsquaw are recorded at the Lonely site. In addition, the second most heavily used goose-broodrearing lake (Fig. III.B.4-7), and many of the lakes most heavily used by molting geese occur along eastern approaches to Lonely (Fig. III.B.4-2), and concentrations of the red-throated loon, tundra swan, and Sabine's gull (Figs. III.B.4-5, -6, -19) also occur in the vicinity of this site. Few concentrations of coastal plain survey species other than scaup (Fig, III.B.4-15) are recorded in the immediate vicinity of the Inigok Creek site, and the survey area does not include Umiat. Any of the sites may have local concentrations or presence of one or more duck, shorebird, and/or passerine species, and pairs of glaucous and Sabine's gulls, arctic tern, jaegers, or raptors may be nesting in the vicinity.

2) Aerial Surveys: Wildlife aerial surveys based at large camps are expected to involve daily flights for 2 weeks, primarily in June and July in several wildlife areas, although caribou tagging may continue through July. Aerial surveys for eiders in early to mid-June and waterfowl-breeding pairs in late June-early July cover much of the arctic coastal plain each year, and 200 lakes north and east of Teshekpuk Lake are censussed for molting geese in mid- to late July. Such flights have a considerable potential for disturbance, because they require low-altitude operation over areas occupied by birds in sensitive phases of the annual cycle (nesting, broodrearing, molting). Occasional BLM resource aerial surveys will occur during several 1- to 2-week periods from June to August. Use of aircraft to establish or move small recreational or agency camps and carry out aerial surveys could be additive to routine supply operations. Any surveys for hazardous- and solid-waste sites may concentrate in the Teshekpuk Lake and Colville River Special Areas, where waterfowl and raptor concentrations could experience additional stress from aircraft overflights. An estimated minimum 18 flights/week may result from combined activities in the planning area; more importantly, at least 7/week are expected to occur in the Goose Molting Habitat LUEA, although these would be exclusively fixed-wing no larger than Twin-Otter within established flight corridors by stipulation and thus not as disturbing as helicopters. Peak flight frequency is associated with periods of aerial survey activity in late June and late July.

3) Types of Aircraft Effects: The overall impact of aircraft would depend on the character of the operations—type of aircraft, flight frequency, altitudes, routes used (lateral distance), season of operation—and the sensitivity of the population segment exposed to characteristics potentially causing disturbance. Few systematic studies of aircraft effects on breeding birds have been done. Displacement of birds from preferred foraging habitat by aircraft suggests energetic costs as yet not directly measured: (1) added cost of behavior to escape the disturbance area (temporary in the case of nesting birds that do not abandon the nest), and (2) depletion of energy reserves needed to complete the nesting cycle, or the greater cost of accumulating energy required for feather growth and fat deposits for use during migration, in potentially inferior foraging habitat. Brant weight loss in the Teshekpuk Lake area was modeled under various disturbance intensities (frequency, altitude from helicopters flying between abandoned airstrips at Lonely and Kogru sites (Derksen, et al., 1992; Miller, 1994). While this study does not directly apply to this alternative, because molting brant are stipulated not to be disturbed by helicopter, the results indicated that about 65 percent of molting brant disturbed by a helicopter at 1,500 ft (457 m) experienced light weight loss. The model does not predict a weight threshold below which brant could experience significantly reduced survival, successful migration to their staging area, or recruitment. Theoretical predictions of the model with regard to weight loss or related effects have not been verified experimentally, and it is uncertain if or to what extent brant can adjust their forage intake (Ward and Stehn, 1989). In the planning area, estimated flight frequency associated with anticipated reasonably foreseeable actions that involve aircraft operations (Table IV.A.1.a-1) mostly to and from large camps plus occasional surveys and daily wildlife survey flights over specific areas generally would average between 1.1 and 2.6 per day. Based on the results of the Teshekpuk Lake brant study, this level of activity probably would cause only light weight loss in this species in a few local areas. The ultimate result of such an effect in terms of reproductive success or survival of young or adults has not been determined for any species; any lost productivity or recruitment may not be detectable above the natural fluctuations of the population and survey methods/data available.

4) Sensitivity to Aircraft: Although bird species vary in sensitivity to disturbance, any breeding or postbreeding birds exposed to routine aircraft disturbance could be displaced from local habitats and/or subject to

increased energy demands. For example, helicopter disturbance of one gyrfalcon pair did not cause nest abandonment or reduced productivity, but the pair did not occupy that site the following year (Platt, 1977).

(2) Effects of Refined Oil Spills: Birds experiencing moderate to heavy contact of refined-oil products (primarily fuels and lubricants) are not expected to survive. However, because such spills (estimated average volume 0.7 bbl) are likely to occur on pads (or ice roads in winter) where they can be contained and removed, significant exposure of birds is not expected to occur. If fuel reaches a small lake with relatively low numbers of molting geese, loss of tens of individuals is possible. Although there are 21 lakes where a maximum count of 1,000 or more individuals has been made at least once, and many more with counts in the hundreds, suggesting larger numbers could be contacted by a larger fuel release. However, a larger fuel release entering a major goose-molting lake and affecting several hundred individuals or more is unlikely, given the locations of camps where large amounts of fuel would be stored, the small estimated average spill size, the fact that for 180 of the surveyed lakes maximum numbers observed are <1,000 and, to contact large numbers, most of the birds would have to be clumped in a downwind area. In any case, recovery to the original population status may not be detectable above the natural fluctuations of the population and survey methods/data available.

b. Oil and Gas Exploration and Development Activities: Under the Preferred Alternative, oil and gas leasing would be allowed on approximately 87 percent of the planning area (Table IV.A.1). Most oil and gas surface activities are not allowed in the northern portion of the Teshekpuk Lake Special Area or along the Colville River and several other rivers and streams. One or two fields are assumed to be discovered and developed south of the Teshekpuk Lake area. Infrastructure and associated construction required for development and production is expected to include 2 to 4 approximately 10-acre production pads separated by about 3 mi of connecting road/airstrip (60-110 acres in total), and pipeline system for oil transportation (20-95 mi). Exploration would occur during the winter season for up to 10 years and involve about 60 persons, while development and production activity would be year-round for 2 to 5 years and require about 350 persons during the construction phase.

(1) Effects of Disturbance: Noise from human activities and visual presence of humans and/or equipment and facilities, may disturb birds during any phase of the annual cycle; birds are particularly sensitive when attending a nest, accompanying fledged young, or in a flightless molt condition. Disturbance may cause individuals to abandon local nesting, feeding, broodrearing, molting, or staging areas; to expend energy stores essential for completing the annual cycle; and to experience higher rates of predation by predators attracted to facilities, all of which may contribute to decreased productivity, survival, and/or recruitment. Habitat alteration or loss may result in many of these same effects Potentially disturbing activities include seismic surveys, aircraft operations, marine-vessel traffic, drilling operations, construction activities, vehicle traffic, oil-spill-cleanup operations, and movement of personnel near facilities. Natural disturbance factors include potential predators and other individuals of the same or closely related species.

(a) Effects from Seismic Surveys: It is assumed that seismic surveys will occur during winter months (December-April), when nearly all birds are absent from the region. Effects of seismic surveys are expected to be as discussed above (brief, <1 day, local disturbance) with minor effect on the three resident species present.

(b) Effects from Aircraft Operations: Oil and gas activities in the planning area will be supported primarily by fixed-wing aircraft, with helicopters used mainly for emergencies, and pipeline inspection outside the Goose Molting Habitat LUEA.

1) Winter: Because one flight every other day would be required to service either seismic or exploration-drilling operations (winter only), the potential level of disturbance may be greater near a single exploration pad than at each succeeding seismic location. A pipeline from the oil field(s) would connect to the TAPS to the east. The pipeline would be constructed during winter using ice roads. Air traffic supporting construction would be several flights/day, which could disturb the three resident species. Potential effects of these activities could range from minor temporary (<1 day) behavioral alterations or displacement of a few resident ptarmigan, gyrfalcons, or possibly snowy owls near survey gridlines or drill-sites, to avoidance of the immediate area of routinely used airstrips for the winter season. No population- level effects are expected.

2) Summer: If a commercial oil discovery is made, drilling operations and associated activities supported by aircraft may occur throughout the year, with one to two flights/day anticipated at up to four sites. The overall impact of aircraft would depend on the character of the operations—type of aircraft, flight frequency, altitude, lateral distance to individuals, route used, season of operation—and the sensitivity of the population segment exposed to characteristics potentially causing disturbance. If aircraft supplying or operating out of these sites overfly bird-concentration areas routinely, an adverse noise/visual aspect to the environment could be introduced potentially causing abandonment of nesting

efforts or lower survival of young in the vicinity, and may contribute to avoidance of the immediate area for future nesting attempts. Several areas where 1 to 4 species of 12 routinely recorded on waterfowl breeding pair surveys, occur at high density (especially pacific loon, yellow-billed loon, tundra swan, king eider, oldsquaw, scoters, jaegers) are located within the area proposed for oil and gas leasing (Fig. III.B.4-1).

3) Sensitivity to Aircraft: Lateral distance at which observable responses occur or percent individuals responding have been quantified for few species: twin engine fixed-wing aircraft (e.g., Twin Otter) approaching within 0.6 mi (1 km) of nesting snow geese on Howe Island east of Prudhoe Bay elicited minor responses of alert posture and short movements in 9 to 57 percent of individuals (Burgess and Ritchie, 1989); most (81-100%) Canada, greater white-fronted, and snow geese in the Lisburne area at Prudhoe Bay showed no reaction when approached within 0.3 mi (0.5 km); most brant (84%), a more sensitive species, moved away from their position under the same circumstances (Murphy, et al., 1990); at Izembek Lagoon, 31, 73, and 79 percent of staging Canada, emperor geese and brant, respectively, responded to similar test conditions (Ward and Stehn, 1989).

4) Responsiveness: As a result of these levels of response to aircraft, nesting activity for most waterfowl is expected to variably decrease within 0.3 to 0.6 mi (0.5-1 km) of any corridor used by routine air traffic, especially under takeoff and landing corridors near the facility, for the duration of each well drilled (approximately 3 months), and subsequent maintenance activity. Estimated numbers of individuals exposed along such a corridor, for example, could include 1 to 11 yellow-billed loons, 0 to 20 king eiders, or 5 to 358 oldsquaw, depending on the specific facility location. Low-level pipeline-inspection flights are expected to displace a small number of nesting attempts away from the immediate vicinity of a pipeline for <1 day. Overall effect of aircraft operations on bird populations at such sites is expected to be localized displacement and minor decrease in reproductive success, but any lost productivity or recruitment may not be detectable above the natural fluctuations of the population and survey methods/data available.

5) Raptors: Raptors also are sensitive to close approach by humans, other raptors, and potential predators, but exhibit more variable response to aircraft and vehicles (Awbrey and Bowles, 1990; Haugh, 1982; Platt, 1977; Ritchie, 1987). Ritchie (1987), recording peregrine falcon reactions to potential disturbance along the Sagavanirktok River, found no nest abandonment or reduced productivity and all sites were reoccupied the following year. He found that peregrines displayed (1) moderate reaction (preflight intention behavior) to helicopters averaging 2,358 ft (719 m) from a nest and mild or no reaction at 3,684 ft (1,123 m); (2) moderate reaction to fixed-wing aircraft averaging 1,750 ft (533 m) distant and mild/none at 2,768 ft (844 m). These data suggest a ½ mi (2,640 ft; 805 m) setback along the Colville and other rivers would be sufficient to eliminate moderate or more severe reactions of peregrines to potential aircraft disturbance. Near Umiat, Haugh (1982) found that peregrine falcons nesting within 3 mi (4.8 km) of the airstrip apparently were not affected by activities associated with drilling an exploratory well, including supporting air traffic (nest site was not overflown). During construction and drilling, one pair nested at a previously unoccupied site within 1 mi (1.6 km) of the airstrip even though more suitable isolated sites were available. Likewise, a pair of gyrfalcons moved their nest site between years to within 1.2 mi (1.9 km) of a wellsite airstrip and successfully raised young.

(c) Effects from Vessel Operation: Some heavy equipment, supplies, or gravel may be transported by barge from existing infrastructure to coastal staging areas during the open-water season, but the probability of interaction with eiders, oldsquaw, or other waterfowl staging in lagoon or offshore waters, or broodrearing geese in coastal fringe areas, is considered low. No species is expected to experience significant displacement from foraging areas as a result of exposure to vessel traffic.

(d) Effects from Drilling Activities: Noise and activity associated with exploration drilling in winter potentially could displace small numbers of resident ptarmigan from the site, and any gyrfalcons and possibly snowy owls present may be displaced by the activity. Because such sites would affect a small area (3-10 acres), there is not expected to be a significant population effect. If a commercial discovery is made, noise and activity of summer drilling may disturb a small number of nesting waterfowl or other species, causing some localized displacement but significant affects on reproductive success are not expected. Data obtained in the vicinity of facilities in the Prudhoe Bay area indicate that spectacled eiders, for example, are quite tolerant of noise and activity (TERA, 1996).

(e) Effects from Construction Activities and Vehicle Traffic: Onshore construction likely will occur in winter, including trenching and burial of pipelines at river crossings, and result in effects similar to those caused by drilling (small numbers of resident birds displaced from immediate area). If development and production occur, construction on pads and vehicle traffic on roads connecting drill pads in the is expected to result in minimal displacement of nesting birds from the vicinity of routinely used pads and roads, depending on tolerance to noise and activity of potentially affected species. Summer

traffic will be limited to transport and maintenance within the fields, because no road access to the s from existing systems is planned.

Construction and presence of a dock assumed necessary for offloading supplies transported by barge is not expected to cause adverse effects on birds. However, common eiders may take advantage of such a structure for nesting activities. The overall population effect is expected to be minimal.

(f) Effects from Spill Cleanup: No spills are expected to occur in marine areas, and no effects on birds occupying marine habitats are anticipated. Approximately 65 to 80 percent of onshore crude-oil spills averaging 4.0 bbl occur on pads and are contained before entering the surrounding area; thus, most potentially disturbing cleanup activity would be confined to the immediate pad area. Because routine activities occurring on the pad during the breeding season are likely to have displaced sensitive species at least several hundred feet (a few hundred meters) away from the pad area, the incidental spill-cleanup activity is expected to cause minimal additional disturbance effect among remaining birds nesting, broodrearing, or molting in the pad vicinity—potentially a few clutches or broods could be lost to predators if adults are disturbed and leave the nest unprotected, but the most likely effect would be brief behavioral responses. Mueller (1997, pers. comm.) reports that a pipeline spill on December 30, 1993, at drill site 5, well 23, misted a fine oil spray over a tundra area of 100 to 145 acres. Of the off-pad spills that occur, many contact snow, which is cleaned up before the oil reaches the tundra. The ADEC database documents that a spill at Point McIntyre covered approximately 23 acres of snow-covered tundra with 142 bbl of crude oil. Because this area was snow covered, there was little impact to the surrounding environment. Any spills that reach the surrounding environment may spread more widely, especially if aquatic habitats are involved, and require greater cleanup effort that may cause more widespread disturbance effects—these still are expected to be minor local effects.

(g) Effects from Predator Attraction: All feasible precautions to avoid attracting wildlife (including predators of birds) to food and garbage must be taken. Any effects are expected to be as described above under activities other than oil and gas development. Oil and gas development and production facilities could attract predators even if conditions are closely controlled, but in the short term this is not expected to cause other than a temporary affect on local breeding success. The extent of any effect is not known but could involve any of the species likely to occur in the planning area. Overall effect on bird populations is not expected to be detectable above the natural fluctuations of the population and survey methods/data available.

(2) Effects from Habitat Alteration and Loss: Alteration of habitats may have short term (ice) or long term (gravel) consequences.

(a) Ice Pads/Roads: Habitats underlying ice pads and ice roads are temporarily altered/lost for bird use as a result of delayed thaw, soil compaction, and vegetation disturbance. In the summer following pad/road use delayed melt would make the area unavailable until after most species begin nesting. This would be expected to affect species with strong nest site fidelity (e.g., shorebirds, ptarmigan), although displaced individuals may use other available habitat in the vicinity (Troy and Carpenter, 1990). Compaction of soil and vegetation (decreased concealment) or drainage effects (Sec. III.A.2.a) could persist for a longer period. Pads range from 3 to 10 acres and roads from 5 to 6 acres/mi; the length of road required is uncertain at present, but several hundred acres in the planning area could be unavailable for a season, with some degradation persisting several years. For example, an ice road from the planning area boundary to an exploration site south of Teshekpuk Lake might remove 370 acres, equivalent to 0.008 percent of the planning area. Areas subject to such minor disturbance are expected to recover almost fully within a relatively few years (Jorgenson and Joyce, 1994) and to support the original plant and animal communities. Effects on bird productivity are expected to be minor, because adjacent undisturbed habitat would be available for most species, and recovery of the area would be relatively rapid.

(b) Gravel Structures/Mine Sites: Gravel pad, road, and airstrip construction and gravel mining would result in loss of habitat for the duration of production; this alteration would be permanent unless restoration is completed successfully. Current techniques are expected to restore such areas to usable habitat, but rarely would they duplicate the original habitat characteristics (Jorgenson and Joyce, 1994). As the most abundant habitat types, tussock tundra, dwarf shrub, and moist sedge-grass meadow probably are the habitats that would be most affected, but the proportion lost would be small relative to their abundance. Although presence of gravel structures will be long-term and habitat alteration severe the area involved is relatively small (<60 acres; <110 acres if gravel must be mined locally). Displaced individuals may use adjacent undisturbed habitats with variable nesting results (Moiteret, Walker, and Martin, 1996; Post, 1990; Troy and Carpenter, 1990) including typical nest success in comparable habitat, no attempt to nest (loss of year's productivity), and lower fecundity/success/productivity or survival/recruitment in suboptimal habitat. The population effect is complicated

by variable numbers of displaced individuals finding comparable habitat to occupy and, no doubt, variable success among those that do nest caused by behavioral factors such as territoriality and competition with individuals in the alternate area as well as differences in food availability and predation. At present adequate data is lacking to allow accurate determination of effects at various levels of success for most species. Successful nesting in undisturbed habitat could range from 0 to 100 percent, but the small area likely to be removed under this alternative (about 60 acres) even at 0 percent success would imply a minor effect at the population level (e.g., semipalmated sandpiper = 16 birds/km^2 at one site in the northeastern NPR-A, = 4/60 acre tract—most species are present at much lower density), unless it concerned uncommon or rare species with specialized or limited habitat options and/or small populations. Degradation or burial of habitat occupied by species whose world populations are small or breeding range limited (e.g., buff-breasted sandpiper) would represent worst case situations; these are expected to occur infrequently.

(c) Effects from Gravel Extraction Outside the Planning Area: Gravel mining under the Preferred Alternative is assumed to occur in the Nuiqsut area and be transported to site on ice roads during winter. This activity could cause minor local disturbance and temporary displacement of the three resident species along the road route and at the mine site. During the breeding season, nesting individuals would be displaced to undisturbed habitats with potential for lowered productivity as discussed above.

(d) Other Habitat Alterations: Habitat use by birds may be altered along roads and other structures by dust fallout, gravel spray, snow accumulations, thermokarst, impoundments, water withdrawal, and contaminants; habitat fragmentation from road networks also may affect use.

1) Dust: Dust fallout effects would be most pronounced within 35 ft of the source (ARCO, 1996); this would approximate 34 acres at the expected facility (Fig. IV.A.1.b-1). The principal effects of dust fallout would include advanced snowmelt (up to 2 weeks early); increased depth of thaw; thermokarst; reduced plant photosynthesis; decreases in some common moss, lichen, and shrub species; and development of barren areas (Everett, 1980; Klinger, Walker, and Weber, 1983; Walker, Lederer, and Walker, 1985; Walker and Everett, 1987). Early melt provides waterfowl and ptarmigan prenesting access to exposed forage (Murphy and Anderson, 1993), but also exposes them to risk of vehicle strikes. Likewise, shorebirds may be attracted to areas adjoining light-traffic roads because of earlier availability of nesting habitat in combination with an acceptable level of disturbance (Troy, 1988; TERA, 1993).

2) Thermokarst: Thermokarst from surface disturbance may result in enhanced growth and nutrient concentration in forage plants, which might be expected to attract birds, but the evidence appears insufficient to assess the net effect on populations (Truett and Kertell, 1992). Water temporarily impounded by roads and pads, in combination with early habitat availability caused by dust fallout and delayed availability due to persistent snowdrifts resulting from differing traffic levels, has been found to attract some shorebird species while others are found in lower densities than in undisturbed areas (Troy, 1986). For example, TERA (1993) in an extreme case found habitat use by semipalmated sandpipers along a heavily traveled road at Prudhoe Bay reduced 40 percent from that in an undisturbed area. Most other species examined in this study showed declines of lesser magnitude; red-necked phalarope exhibited higher density.

3) Hydrologic Change: Water withdrawal from lakes could alter the local hydrologic regime resulting in less suitable habitat for some species but more favorable for others, e.g., dominant nesting species in such an area could change from red phalarope with preference for wetter habitat and access to open water, to pectoral sandpiper preferring drier habitat. The potential field layout (Fig. IV.A.1.b-1) does not appear to cause habitat fragmentation as occurred with road networks in the Prudhoe Bay area. In any case, TERA (1993) found little support for the hypothesis that fragmentation affects bird use of areas surrounded by facilities.

There is little doubt that bird use of habitats is altered when these are near roads and pads, and that effects vary among species and phase of the summer season. However, potential facility size and design suggests that only a small amount of habitat will be altered by the proposed oil and gas development resulting in no greater than minor effects on local bird populations.

(3) Effects of Spills: It is assumed that no crude oil would be released during exploration. A spill assumed to occur in an offshore area is likely to contact birds occupying the marine environment, although spills originating on land, either as runoff from pads/roads or at pipeline river crossings, may reach marine habitats. Approximately 65 to 80 percent of onshore crude-oil spills, averaging 4.0 bbl, occur on pads where they are contained before entering the surrounding area; thus, a substantial proportion of spills are not expected to adversely affect bird populations. Probability of exposure and species exposed to the 20 to 35 percent of spills that occur on or reach tundra habitats would depend on the season of occurrence and, if occurring in the open-water season,

whether they enter nonaquatic or aquatic habitats. Spills reaching nonaquatic habitats generally remain in limited areas (<538 ft^2 = 50 m^2), and the small volume likely to be spilled suggests that only a few foraging or broodrearing shorebirds or passerines potentially would contact the oiled area; population effects under these circumstances are expected to be insignificant and are not likely to be detectable above the natural fluctuations of the population.

(a) Contact with Crude Oil: Birds exposed to spilled oil in aquatic habitats are not expected to survive moderate to heavy contact. Oil ingestion by adults during preening or feeding may reduce breeding success and causes various pathological conditions including impaired endocrine and liver function and reduced nestling growth (Burger and Fry, 1993; Harvey, Phillips, and Sharp, 1982; Holmes, 1985; Holmes and Cavanaugh, 1990; Hughes, Kassera, and Thomas, 1990; Koth and Vank-Hentzelt, 1988; Peakall et al., 1980; Stubblefield et al., 1995). Oil contamination of eggs by adults significantly reduces hatching success (Albers, 1980; Butler, et al., 1988; Harfenist, Gilman, and Maus, 1990; King and Lefever, 1979; Stickel and Dieter, 1979). In addition, oil in tundra ponds can have long term effects on invertebrate prey populations and emergent vegetation thereby reducing food availability and escape cover for waterbirds in the area impacted by the spill (Barsdate et al., 1980; Hobbie, 1982). The occurrence of these effects may be increased by contamination of food, lakeshores, and marine shorelines. At greatest risk would be loons and waterfowl occupying open waterbodies or streams. However, the small average spill volume (average 4.0 bbl) suggests that only a small proportion of the surface of any but the smallest lakes (<1.2 mi^2 = 3 km^2) would be covered by oil, and most small lakes typically have <100 individuals; in these situations, contact is expected to be on the order of tens of individuals, depending on the direction and velocity of wind driving the slick. Spills entering streams or rivers during the breeding season could contact waterfowl adults and/or young. Oil entering coastal lagoon habitats occupied by broodrearing or staging waterfowl (e.g., oldsquaw) potentially could contact substantial numbers of individuals, but the small estimated average spill size suggests that only minor contact and effect would be expected.

(b) Marine Oil Spill: It is assumed for the Preferred Alternative that a fuel-oil spill, associated with the barging of supplies, would occur in the marine environment during August or September when ice cover is <50 percent. A crude-oil spill from an offshore site also is assumed. Either spill could contact large flocks of loons, brant, oldsquaw, and/or eiders staging in protected coastal habitats (e.g., Harrison Bay) or waters farther offshore. Effects on individual birds would be the same as described above. Some broodrearing, molting, or staging brant, Canada geese, and snow geese could contact oil in coastal habitats. Mortality of molting oldsquaw from a spill entering protected areas could be substantial, but the population effect would be difficult to determine because numbers are stable in some areas and declining in others (Conant, 1997). Large flocks of staging eiders could contact oil in areas farther offshore. The king eider population has declined 50 percent in 20 years so substantial mortality could be significant. Common eiders, nesting on barrier islands and along the coastal, could be contacted by a marine spill. Also, several thousand shorebirds could encounter oil in shoreline habitats (e.g., Colville River delta), and the rapid turnover of migrants during the migration period suggests many more could be exposed. A spill that enters open water off river deltas in spring, or nearshore areas in fall, could contact migrant loons and eiders.

(c) Contact with Refined Oil Spills: Because spills of refined oil products (primarily fuels and lubricants) are likely to occur on pads or roads where they can be contained and removed, and the small estimated average spill volume (0.7 bbl =29 gal), significant exposure of birds is not expected to occur. If any contaminant reaches tundra habitat, the amount affected is expected to be slight; this small area of degraded habitat is not likely to result in displaced breeders or loss of productivity.

(d) Oil Spill in Teshekpuk Lake or Colville River: If a 325-bbl crude-oil spill entered Teshekpuk Lake or the Colville River, small numbers of waterfowl and/or raptors could be exposed. Species observed on Teshekpuk Lake during breeding-pair surveys at greater than the lowest density for the species include Pacific and red-throated loons, tundra swan, greater white-fronted goose, oldsquaw, king eider, scaup, and scoters. At 30 days, the spill nominally would cover 61 acres but would disperse as patches so the effective size would become much larger, especially if winds were variable following the spill. If winds were more from a prevailing direction, the oil could pile up on a section of shoreline and expose few individuals. Thus, numbers of individuals oiled would depend primarily upon wind conditions and numbers and location of birds following entry of the spill into the lake.

If the spill entered the Colville River, a variety of loon, goose, or duck species could be present. Canada geese breed on bluffs along the river. Gyrfalcons, peregrine falcons, and rough-legged hawks could become secondarily oiled by preying on oiled waterfowl. If the spill moved into the delta area, additional waterfowl species that breed there or stop during migration would be at risk. A spill entering the river in spring could contaminate overflow areas or open water where spring migrants of several waterfowl species concentrate prior to occupying nesting

areas. Information concerning numbers of waterfowl seasonally present on the river is lacking.

(4) Seawater Pipeline Spill in Planning Area: A pipeline spill of seawater used in waterflood enhancement of production would kill salt-intolerant tundra vegetation near the pipeline. The amount of tundra habitat affected is expected to be no more than a few acres; this small area of degraded habitat is not likely to result in loss of productivity by displaced breeders that is detectable at the population level.

(5) Indirect Effects: During the period November to May, species that breed or molt in the northeastern NPR-A area migrate along well-known flyways and other major corridors to other areas in Alaska, the lower-48 states, Canada, Russia, or Mexico and south, where they are the focus of a wide range of user groups. These stakeholders—including nonconsumptive users, subsistence and recreational hunters, and wildlife managers—are concerned about the conservation and management of birds and the potential for adverse effects that arctic slope projects represent. Any effects that result in lowered productivity or survival of the various bird species could affect the access of stakeholder groups to this resource to some degree by decreasing bird population levels along migration corridors or in wintering areas. Because overall effects of management actions on birds in the northeastern NPR-A are expected to be minor, and these birds in general disperse over large migration and wintering areas, effects on stakeholder groups also are expected to be minor. However, detailed information that could allow accurate analysis of this effect is not readily available or has not been compiled in a usable format.

Conclusions: Under the Preferred Alternative, most disturbance effects not associated with oil and gas activities are expected to be localized and temporary, ranging from brief (<1 day) in the case of response to a few aircraft flights or presence of ground or boat activity to several months for extended ground-transport operations, although lost productivity decreased survivorship of nesting species is not likely to be detectable above the natural fluctuations of the population. Although more intense activity, such as the combination of large camp activity and associated aircraft operations, substantially increased river-boat traffic, fuel spills entering lakes with substantial waterfowl populations, or potential attraction of predators to these sites is expected to result in more substantial losses, population-level effects still would be considered minor. Even with greater losses in the latter circumstances, recovery of lost productivity and recruitment probably will not be detectable above the natural fluctuations of the population. Fuel spills are expected to be contained and cleaned up while on gravel structures. Losses of tens of individuals are expected if a fuel spill of the small estimated average size enters a lake populated with molting waterfowl. Most raptors exposed to disturbance factors at distances ≤½ mi are expected to exhibit minor behavioral changes.

Overall effect of aircraft operations supporting oil and gas activities, and most other activities causing disturbance, on productivity or recruitment of bird populations in the vicinity of drill sites is expected to be localized and minor and may not be detectable above the natural fluctuations of the population. Displacement of nesting birds from gravel structures and pits is expected to have primarily minor local effects on productivity, because displaced individuals may use undisturbed habitats, although probably with variable success. Current data are inadequate for predicting the ultimate effect of this and other disturbance factors for most species and areas. Given the small areas and low-density local populations involved, population-level effects are expected to be minor. Effect of other habitat alterations is expected to be minor except in the proximity of roads, where populations of most nesting species are likely to decline. As a result of their small average size, oil spills reaching aquatic habitats are expected to cause losses of tens of individuals, but the effect of such losses is not likely to be detectable above the natural fluctuations of the population. An oil spill entering Teshekpuk Lake or the Colville River is expected to cause no greater than minor effects on waterfowl and/or raptors. Because overall effects of management actions on birds in the Northeast NPR-A Planning Area are expected to be minor, effects on stakeholder groups also are expected to be minor.

Effects under the Preferred Alternative are expected to be: (a) *significantly greater* than effects under Alternative A; (b) *slightly greater* than effects under Alternative B; (c) *less* than effects under Alternative C; (d) *considerably less* than effects under Alternative D; and (e) *significantly less* than under Alternative E.

Multiple Sales: If multiple sales occur in the area available for leasing under the Preferred Alternative, intensive construction activity could last 15 to 30 years, tapering off as existing infrastructure is used for each succeeding development. Approximately three times the number of exploration wells may be drilled, and the number of fields developed, production pads, and pipeline mileage (Tables IV.A.1.b-4 to -7) are expected to increase slightly with multiple sales. Surface, air, and foot traffic are expected to increase somewhat near oil field facilities with multiple sales and to displace greater numbers of individuals and involve more species than with a single sale, although the increase is not expected to significantly affect populations. Effects from disturbance and habitat alteration or loss on birds is expected to increase in the southern two-thirds of the planning area with multiple sales.

The estimated number of onshore crude oil spills >1 bbl (average size 4.0 bbl) and refined-oil spills ≥1 gallon (average 0.7 bbl = 29 gal.) over the production life of the planning area is expected to increase somewhat with multiple sales. These small, chronic spills are expected to have a similar effect on birds and their habitats as under the first sale but with increased numbers of species involved and increased loss of individuals; habitat contamination is expected to increase locally at the spill sites and along any streams contaminated by these spills. These spills are expected to result in the loss of small numbers of birds that is not likely to be detectable above the natural fluctuations of the population and survey methods/data available. Any habitat contamination that is not effectively cleaned up is expected to persist for several years but is not expected to affect populations significantly.

Conclusions—Multiple Sales: Displacement of birds from disturbance and habitat alteration is expected to increase slightly in the southern two-thirds of the planning area under the Preferred Alternative with multiple sales but still not significantly affect coastal plain populations. Increases in crude and refined oil spills are expected to result in the loss of small numbers of birds that is not likely to be detectable above the natural fluctuations of the population and survey methods/data available. Overall effect is expected to increase somewhat from that discussed for the first sale.

9. Mammals:

a. Terrestrial Mammals: Among the terrestrial-mammal populations that could be affected under the Preferred Alternative are TLH, CAH, and WAH caribou. Moose, muskoxen, grizzly bears, wolves, wolverines, and arctic foxes may be locally affected by activities in the planning area. Small rodents (such as lemmings and voles) and their predators (such as short-tailed weasels) could be affected locally along seismic lines, pipelines, gravel pads, and other facilities. However, these losses are expected to be insignificant to populations on the Arctic Slope of Alaska.

(1) Activities Other than Oil and Gas Exploration and Development: Activities such as resource inventories, aerial surveys, and research camps would have short-term effects on terrestrial mammals.

(a) Effects of Disturbance: Activities that may affect terrestrial mammals include aerial surveys (including those for wildlife) and ground activities such as resource inventories, paleontological excavations, research camps, recreational camps (hunting and river floating), seismic operations, and overland moves. Overland moves and seismic activities occur during the winter on frozen tundra, ice roads, or stable shorefast ice. The other activities occur from summer to early fall (June-September). The primary potential causes of disturbance of terrestrial mammals from seismic (up to about 60 workers) and inventory activities and overland moves are helicopter traffic (1-2 round trips/day for 3-6 weeks/survey party), fixed-wing aircraft traffic (2/week/party), surface-vehicular traffic on ice roads, and humans on foot. These activities are expected to cause short-term (few minutes to <1 hour) displacements and/or harassments of terrestrial mammals. Recreational camps in some cases may attract bears and result in the shooting of bears that learn to associate humans with food sources. Such losses by themselves are expected to be minor or insignificant to the bear population but will contribute to cumulative adverse effects.

Small rodents (such as lemmings and voles) and their predators (such as short-tailed weasels) are expected to be affected locally (direct mortality and loss of habitat of individuals or small groups of lemmings and voles) at paleontological excavations and by overland moves. However, these losses are expected to be insignificant to populations on the Arctic Slope of Alaska.

(b) Effects of Spills: Very small fuel spills (probably <1 bbl) may occur in association with resource-inventory surveys, recreational activities, and overland moves. These spills are likely to involve aviation fuel and other light-fraction hydrocarbon fuels that would evaporate and disperse rapidly in the environment with only a local effect on vegetation. Fuel spills are required to be cleaned up immediately, if possible, under current BLM stipulations. Such events are not expected to have any significant effects on terrestrial mammals in the planning area.

The effects of the Preferred Alternative on terrestrial mammals are expected to be local, within about 1 to 2 km of activities, and short term, with no significant adverse effects on mammal populations (except the arctic fox, which may increase in abundance near permanent camp facilities).

(2) Oil and Gas Exploration and Development Activities: Under the Preferred Alternative, one to two oil fields are assumed to be discovered and developed south of the Teshekpuk Lake area. Primary effects on terrestrial mammals would come from motor-vehicle traffic within the oil field(s). Other effects could come from foot traffic near facilities and camps; from aircraft traffic; from seismic operations; from small, chronic crude-oil and fuel spills contaminating tundra, stream, and coastal habitats; and from habitat alteration associated with gravel mining and construction.

(a) Effects of Disturbance: If a field is developed in the middle planning area west and southwest of Nuiqsut, production pads, pipelines, within-field roads, and other facilities (housing, airfield, processing plant) would be located far to the south of the TLH calving area. No (surface occupancy) oil field facilities would be located on caribou calving habitat south of Teshekpuk Lake. Oil and gas leasing would not occur north or east of the lake nor within the migration corridor between Teshekpuk Lake and Kogru Inlet. No TLH calving would be affected. Some TLH migration movements south of the lake may be temporary affected by air and surface traffic along pipelines and roads within the oil field(s).

Some members of the CAH, WAH, and TLH would encounter the oil field(s) during their spring and/or fall migrations south of the Teshekpuk Lake area and within a portion of their winter range. However, neither the pipeline to the TAPS nor facilities within the oil field(s) significantly would affect the movement of caribou or alter their distribution or abundance.

A pipeline from the oil field(s) would connect to the TAPS through facilities at the Alpine and Kuparuk River fields. The pipeline would be constructed during winter. So that no permanent road would be associated with the pipeline, ice roads would be used. During construction, air traffic would include several flights per day, which temporarily could disturb some of the caribou of the TLH and CAH and other terrestrial mammals within about 1.2 mi (2 km) of the pipeline. Disturbance effects on caribou and other terrestrial mammals are expected to be short term, interference with their movements would be temporary (probably a few minutes to less than a few days), and they eventually would cross the pipeline area. Disturbance of important riparian habitats would be avoided. No oil field facilities (other than buried pipeline) would be located within 1 mi of major stream drainages (such as Fish, Judy, and Kealok creeks and the Kikiarorak and Kogorakuk rivers). Also, disturbance reactions would diminish after construction, and flights would decrease to about one or two per day at most. The abundance and overall distribution of terrestrial mammals are not expected to be affected by pipeline construction or operation.

Pipelines and roads within the oil field and the pipeline to the TAPS are not expected to affect moose and muskoxen habitat use and movements, although individual animals may be disturbed briefly by air and surface traffic. Some grizzly bears are expected to be attracted to oil field facilities, and a few could be lost due to interactions with humans. Some wolverines may be displaced within a few miles of oil field facilities. Arctic fox abundance is expected to increase near the oil field due to increased food sources and shelter.

Trenching for and burial of pipelines at river crossings would have very local effects on tundra and riparian vegetation and would not significantly affect terrestrial mammal habitats.

Under the Preferred Alternative, some terrestrial mammals could be affected by possible oil exploration offshore drilling from an ice island and subsequent oil development on the coast of the NPR-A in Harrison Bay in a small area south of Atigaru Point (Fig. II.C.1). Barging of supplies also may occur in this area but is not expected to affect terrestrial mammals. Noise and disturbances from these activities would be local and are not likely to affect terrestrial mammal populations.

(b) Effects of Spills: Caribou and other terrestrial mammals may become oiled or may ingest contaminated vegetation. Caribou, moose, and muskoxen that become oiled are not likely to suffer from a loss of thermoinsulation during the summer, although toxic hydrocarbons could be absorbed through the skin or inhaled. However, the oiling of young calves could significantly reduce thermoinsulation, leading to their death. Oiled caribou, moose, and muskoxen hair would be shed during the summer before the winter fur is grown. Toxicity studies of crude-oil ingestion in cattle (Rowe, Dollahite, and Camp, 1973) indicate that anorexia (significant weight loss) and aspiration pneumonia leading to death are possible adverse effects. Caribou, moose, and muskoxen that become oiled by contact with a spill in contaminated lakes, ponds, rivers, or coastal waters could die from toxic-hydrocarbon inhalation and absorption through the skin.

Chronic crude-oil and fuel spills from onshore activities and possible marine transportation probably would result in the loss of small numbers of terrestrial mammals. Under the Preferred Alternative, approximately 5 to 21 small (>1 bbl) crude-oil spills (averaging 4 bbl) and 42 to 195 small refined-oil spills ≥ 1 gallon (averaging 29 gal) are assumed to occur onshore over the production life of the planning area (Tables IV.A.2-3 and 2-6). These small, chronic spills are expected to not only result in the loss of small numbers of caribou and other terrestrial mammals but to have an additive effect, perhaps increasing contamination of terrestrial habitats along pipeline corridors.

If a pipeline spill occurred, some tundra vegetation within the pipeline corridor would become contaminated. However, caribou (also moose and muskoxen) probably would not ingest oiled vegetation, because they tend to be selective grazers and are particular about the plants they consume (Kuropat and Bryant, 1980). It also is likely that control and cleanup operations (ground traffic, air traffic, and personnel) at the spill site would frighten caribou, moose, and muskoxen away from the spill and prevent the

possibility of these animals grazing on the oiled vegetation. Thus, onshore oil spills associated with the Preferred Alternative are not expected to significantly affect caribou, moose, and muskoxen through ingestion of oiled vegetation.

Oil spills on wet tundra kill the moss layers and aboveground parts of vascular plants and sometimes kill all macroflora at the site (McKendrick and Mitchell, 1978). Damage to oil-sensitive mosses may persist for several years, if the site is not rehabilitated (e.g., by applying phosphorus fertilizers) (McKendrick and Mitchell, 1978). For the most part, onshore oil spills would be very local (1-2 acres) in their effects and would not be expected to significantly contaminate or alter caribou, moose, and muskoxen range. However, some local contamination of tundra vegetation is expected to occur near production wells and processing facilities. Spills that occur within or near streams and lakes may affect foraging habitat along these streams.

The small spills assumed to occur under the Preferred Alternative could result in the loss of small numbers of grizzly bears through ingestion of contaminated prey or carrion. However, such losses are not expected to be significant to the population on the Arctic Slope.

Summary: The primary sources of disturbance to caribou, muskoxen, moose, and other terrestrial mammals associated with oil exploration are activities associated with seismic operations. The primary source of disturbance associated with oil development is road traffic within the oil field; other sources of disturbance are expected to include air traffic (helicopter and fixed-wing) to and from the oil field and humans on foot.

Under the Preferred Alternative, one to two oil fields are assumed to be discovered and developed south of the Teshekpuk Lake Special Area. The TLH calving range lies either north of the area available to leasing or within the zone of no surface occupancy in which oil field facilities would not be located. Thus, the Preferred Alternative is expected to have little effect on caribou movements within the calving range, and no calving activity is expected to be displaced. Some TLH and CAH migration movements may be temporarily affected by air and surface-vehicle traffic along pipelines and roads. However, caribou movements to coastal insect-relief areas north of Teshekpuk Lake would be affected.

Moose and muskoxen habitat use and movements are not expected to be affected by the pipelines and roads within the oil field(s) and the pipeline to the TAPS, although individual animals may be disturbed briefly by air and surface traffic. Some grizzly bears are expected to be attracted to oil field facilities, and a few could be lost due to interactions with humans. Some wolverines may be displaced within a few miles of oil field facilities. Arctic fox abundance is expected to increase near the oil field because of increased food sources and shelter.

Gravel extraction (outside of the planning area), hauling of the gravel on ice roads (into the planning area), and deposition of gravel in the lease areas would result in local disturbance-displacement (within no more than 1 mi of the operations) of small numbers of individual mammals but would not affect the distribution and abundance of caribou, muskoxen, moose, or other terrestrial mammals.

Trenching for and burial of pipelines at river crossings would have very local effects on tundra and riparian vegetation and would not significantly affect terrestrial mammal habitats.

Under the Preferred Alternative, some terrestrial mammals could be affected by possible oil exploration offshore from an ice island and subsequent oil development on the coast of the NPR-A in Harrison Bay in a small area south of Atigaru Point (Fig. II.C.1). Effects of these activities would be local and are not likely to affect terrestrial mammal populations.

Small rodents (such as lemmings and voles) and their predators (such as short-tailed weasels) would be affected locally (direct mortality and loss of habitat of individuals or small groups of lemmings and voles) along seismic lines, pipelines, gravel pads, and other facilities. However, these losses are expected to be insignificant to populations on the Arctic Slope of Alaska.

Assuming the occurrence of small crude-oil and fuel spills (averaging 4 bbl and 29 gal, respectively), caribou of the TLH and CAH, moose, muskoxen, grizzly bears, and other terrestrial mammals could be directly exposed to and contaminated by the spill at river crossings, contaminated ponds or lakes, along the beaches, and in shallow waters during periods of insect-relief activities. Grazing animals could be exposed through ingestion of or contact with oiled vegetation. However, even in a severe situation, a comparatively small number of animals are likely to be directly exposed to oil spills and die as a result of toxic-hydrocarbon inhalation and absorption and/or loss of thermoinsulation. These losses probably would be small for any of these terrestrial mammal populations and are expected to be replaced within less than one generation (about 1 year). For the most part, the effect of pipeline spills would be very local and would contaminate tundra in the immediate vicinity of the pipeline; these spills would not be expected to significantly contaminate or alter terrestrial mammal ranges within the pipeline corridors.

Assuming a 325-bbl crude-oil spill reached or occurred within Teshekpuk Lake or reached the Colville River some TLH caribou, moose, muskoxen, and other terrestrial mammals would be exposed to part of this spill. The number of animals lost to these two spills is not likely to exceed more than a few hundred caribou, and smaller numbers of muskoxen, moose, and other terrestrial mammals are likely to be lost these two spills. These losses of terrestrial mammals are likely to be replaced within 1 year and not affect populations in the Arctic Slope.

If seawater were used for waterflood enhancement of oil production under the Preferred Alternative, a saltwater spill could occur within the NPR-A. This spill would have adverse effects on salt-intolerant vegetation near the pipeline, but the amount tundra habitat affected would be small, no more than a few acres. This potential saltwater spill is not likely to affect forage availability of caribou, muskoxen, moose, other terrestrial mammals in the planning area.

Gravel Extraction Outside of the Planning Area: Gravel mining associated with oil and gas exploration and development under the Preferred alternative is assumed to occur in the Nuiqsut area and be transported to the NPR-A in winter over ice roads. This activity would have local disturbance effects on terrestrial mammals along the ice roads and at the excavation-mine sites and on the specific lease area. Caribou, muskoxen, moose, and other terrestrial mammals that overwinter near these activities could be temporarily displaced near (within no more than about 1 mi) operations over the winter season. Gravel extraction (outside of the planning area), transportation (into the planning area), and deposition of gravel in the lease areas would result in local disturbance-displacement (within no more than 1 mi of the operations) of small numbers of individual mammals but would not affect the distribution and abundance of caribou, muskoxen, moose, or other terrestrial mammals.

Impact of an Oil Spill on Teshekpuk Lake and the Colville River: Assuming a 325-bbl crude-oil spill reached or occurred within Teshekpuk Lake or reached the Colville River, some THL caribou, moose, muskoxen, and other terrestrial mammals would be exposed to part of this spill. Caribou, moose, and muskoxen that become oiled by contact with a spill along the shoreline of Teshekpuk Lake or contaminated while crossing the Colville River could die from toxic-hydrocarbon inhalation and absorption of hydrocarbons through the skin. These species are selective grazers and probably would not ingest oiled vegetation along the lake shore or along the river. The number of animals lost to these two spills likely would not exceed more than a few hundred caribou, and smaller numbers of muskoxen, moose, and other terrestrial mammals are likely to be lost these two spills. These losses of terrestrial mammals are likely to be replaced within 1 year and not affect populations in the Arctic Slope.

Seawater Pipeline Spill in the Planning Area: If seawater were used for waterflood enhancement of oil production under the Preferred Alternative, a saltwater spill could occur within the NPR-A. This spill would have adverse effects on salt-intolerant vegetation near the pipeline but the amount tundra habitat affected would be small, no more than a few acres. This potential saltwater spill is not likely to affect forage availability of caribou, muskoxen, moose, other terrestrial mammals in the planning area.

Conclusion—First Sale: For activities other than oil and gas, air traffic, humans on foot, and the presence of resource-inventory-survey camps are expected to be local, within about 1 to 2 km of activities, and short term, with no significant adverse effects on mammal populations (except the arctic fox, which may increase in abundance near permanent camp facilities). For oil and gas activities, caribou of the CAH, WAH, and TLH could be temporarily disturbed and their movements delayed along the pipeline during periods of air overflights, but these disturbances are not expected to affect migrations and overall distribution and habitat use. The TLH caribou calving and migration movements in the Teshekpuk Lake area would not be affected by leasing under the Preferred Alternative. Near oil field facilities south of Teshekpuk Lake, surface, air, and foot traffic would temporarily displace some caribou, moose, muskoxen, grizzly bears, wolves, and wolverines but not significantly affect Arctic Slope populations. Small, chronic crude-oil and fuel spills and a potential spill contacting Teshekpuk Lake or reaching the Colville River might result in the loss of small numbers of terrestrial mammals, with recovery expected within about 1 year.

Trenching for and burial of pipelines at river crossings would have very local effects on tundra and riparian vegetation and would not significantly affect terrestrial mammal habitats.

Under the Preferred Alternative, some terrestrial mammals could be affected by possible oil exploration offshore from an ice island and subsequent oil development on the coast of the NPR-A in Harrison Bay in a small area south of Atigaru Point (Fig. II.C.1). Effects of these activities would be local and are not likely to affect terrestrial mammal populations.

Multiple Sales: If several lease sales occur under the Preferred Alternative, considerably more exploration activity is expected to occur south of the Teshekpuk Lake Area, with the number of exploration wells drilled increasing to 6-21 for multiple sales from the 2-7 wells for the first sale. The amount of development also is expected to increase. The number of oil fields would increase to 1-2

for multiple sales from the 1-2 fields for the first sale, the number of production pads would increase to 1-5 for multiple sales from the 1-4 pads for the first sale, and pipeline miles would increase to 20-110 for multiple sales from the 20-95 mi for the first sale. The level of effects on caribou and other terrestrial mammals, including noise, disturbance, and habitat alteration, is expected to increase somewhat, primarily in the southern half of the planning area. Surface, air, and foot traffic near the oil fields is expected to increase and to displace some terrestrial mammals but not significantly affect Arctic Slope populations.

Under the Preferred Alternative, multiple sales, the number of small crude-oil spills (>1 bbl) is expected to increase to 7-29 spills (average size of 4 bbl) for multiple sales from an estimated 5-21 for the first sale. Small fuel-oil spills would increase to 60-557 for multiple sales from 42-195 for the first sale (average size of 29 gallons). These small, crude- and fuel-oil spills are estimated to occur onshore over the production life of the planning area (Tables IV.A.2-3a, 3b, 6a, and 6b). These small, chronic spills could result in the loss of individual mammals and habitat contamination increasing locally at the spill sites and along any streams contaminated by these spills. Recovery of losses is likely within 1 year. Any habitat contamination that is not effectively cleaned up is expected to persist for several years but is not expected to affect terrestrial mammal populations.

Conclusion—Multiple Sales: Surface, air, and foot traffic near the oil fields is expected to increase and to displace some terrestrial mammals but not significantly affect Arctic Slope populations. The number of small, chronic crude-oil and fuel spills is expected to increase somewhat and result in the loss of small numbers of terrestrial mammals, with recovery expected within 1 year.

b. Marine Mammals:

(1) Activities Other than Oil and Gas Exploration and Development: Ground-impacting-management actions along the coast within the planning area that may affect nonendangered marine mammals under the Preferred Alternative include aerial surveys (including surveys of wildlife); ground activities such as resource inventories, paleontological excavations, and research and recreational camps (hunting and river floating), seismic exploration, and overland moves. Overland moves and seismic operations occur during the winter on stable sea ice or frozen tundra. The other activities take place in summer and early fall (June-September). The primary potential causes of disturbance of marine mammals are helicopter traffic (1-2 round trips/day for 3-6 weeks/survey party), fixed-wing aircraft traffic (2/week/party), and humans on foot. These activities, if they occur along the coast of the planning area, may cause short-term (<1 hour) displacements or harassments of hauled-out seals and polar bears.

It is assumed that geophysical surveys would use 60 persons and would collect 5 to 10 line miles of 3-D seismic data/day and would be conducted entirely in winter (early December-mid-April) using ice roads. Under the Preferred Alternative, seismic surveys conducted near the coast could expose a few denning polar bears to seismic-activity noise and associated disturbances. This activity could result in the displacement of a few maternal polar bears and their cubs, leading to the abandonment of the den site and possible loss of a small number of cubs. Few polar bears are expected to be affected, however, because of the low number of recorded maternal den sites in and adjacent to the planning area (Fig. III.B.5.b). Seismic surveys also would be prohibited near known polar bear den sites in the planning area.

Onshore seismic activity is not expected to have any effects on other marine mammals. Ringed seals den during the winter; however, denning ringed seals are not expected to be exposed to the noise and activity associated with onshore seismic operations, because their denning habitat is located in the floating-fast ice zone generally some distance offshore.

Overland moves typically occur each winter, travel from Prudhoe Bay or Oliktok Point to Barrow, follow a route offshore over stable sea ice, and include 20 to 100 trains of 1 to 6 vehicles and attached sleds. These moves could be a disturbance to denning ringed seals, if the routes cross floating fast-ice areas, and may temporarily displace seals within a short distance of the traffic route. Polar bears also may be temporarily disturbed within about 1 mi of this traffic.

Recreational camps in some cases may attract bears, and this could result in the shooting of bears that learn to associate humans with food sources. Such losses by themselves are expected to be minor or insignificant to the bear population but will contribute to cumulative adverse effects.

Very small fuel spills (probably <1 bbl) are expected to occur in association with resource inventories and surveys, recreational activities, and overland moves. These spills are likely to involve aviation fuel and other light-fraction hydrocarbon fuels that would evaporate and disperse rapidly with only local effect on vegetation. Fuel spills are required to be cleaned up immediately, if possible, under current BLM stipulations. Such events are not expected to have any significant effects on marine mammals in the planning area.

The effects of activities other than oil and gas exploration and development under the Preferred Alternative on marine mammals (seals and polar bears) would be local and short term, with no significant adverse effects to the populations.

(2) Oil and Gas Exploration and Development Activities: Some potential noise and disturbance from aircraft traffic and seismic activities could occur along the coast, primarily in the Colville River Delta-inner Harrison Bay area, and these effects are expected to be local and short term (generally <1 year). Small onshore crude- and fuel-oil spills associated with the Preferred Alternative are not expected to reach the marine environment and affect marine mammals.

The primary source of noise and disturbance would come from air traffic along the coast of the planning area, specifically from helicopters associated with the assumed oil exploration and production activities. Aircraft traffic (several helicopter round trips/day during exploration and development) centered out of Deadhorse-Prudhoe Bay, traveling to and from NPR-A exploration and production facilities, is assumed to be a potential source of disturbance to ringed or spotted seals hauled out on the ice or beaches, respectively, along the coast and polar bears using coastal habitats.

During the summer, some of the air traffic to and from exploration and production facilities could disturb ringed, bearded, and spotted seals hauled out on the ice along the coast, causing them to charge in panic into the water. Because of frequent low visibility due to fog, aircraft may not always be able to avoid disturbing hauled-out seals. The number of seals affected would depend on the number of disturbance incidents. Aircraft disturbance of hauled-out seals in the planning area could result in injury or death to young ringed and bearded seal pups. Although air-traffic disturbance would be very brief, the effect on individual seal pups could be severe. Aircraft disturbance of small groups of spotted and ringed seals hauled out along the coast is not likely to result in the death or injury of any seals, although increases in physiological stress caused by the disturbance might reduce the longevity of some seals, if disturbances were frequent.

If exploratory drilling occurs during the winter (December to mid-April) near the coast, polar bears could be attracted to the oil field camps by food odors and curiosity. Some polar bears could be unavoidably killed to protect oil workers. Under the Marine Mammal Protection Act, the oil companies would be required to have a permit to take or harass polar bears. Consultation between the companies and the FWS on this matter is expected to result in the use of nonlethal means of protection in most cases. In any event, the number of bears lost as a result of such encounters is expected to be very low.

Under the Preferred Alternative, seals and polar bears could be affected by possible oil exploration offshore drilling from an ice island and subsequent oil development on the coast of the NPR-A in Harrison Bay in a small area south of Atigaru Point (Fig. II.C.1). Effects of these activities would be local and are not likely to affect marine mammal populations.

Impact of an Oil Spill Contacting the Colville River: Assuming a 325-bbl crude oil spill reached the Colville River during the open-water season, some of the oil would end up in marine waters in Harrison Bay. An estimated 50 percent of the oil would be in the sediment plume flowing out of the river and settling out on the seabottom near the river delta. A spill of this small size would be dispersed quickly and is not expected to affect many seals and polar bears that may be in the spill area. A small number of spotted seals that haul out along the river delta may come in contact with the oil directly or might consume fish exposed to the oil. A few polar bears might come in contact with the oil and be adversely affected. Other marine mammals such as ringed and bearded seals, and beluga whales are not likely to come in contact with this small spill. The number of seals and polar bears adversely affected or killed by this spill likely would be small (<100 seals and no more than a few bears) and would not be significant to marine mammal populations.

Conclusion—First Sale: For the Preferred Alternative, the effects of activities other than oil and gas are expected to be on marine mammals, particularly polar bears and seals, along the coast of the planning area and are expected to be local and occur within about 1 mi of resource-inventory-survey activities, survey and recreational camps, and overland moves. The effects of oil and gas activities are expected to result in a small increase in potential noise and disturbance along the coast, primarily in the Colville River Delta-inner Harrison Bay area, and these effects are expected to be local and short term (generally <1 year). Under the Preferred Alternative, seals and polar bears could be affected by possible oil exploration offshore from an ice island and subsequent oil development on the coast of the NPR-A in Harrison Bay in a small area south of Atigaru Point (Fig. II.C.1). Effects of these activities would be local and are not likely to affect marine mammal populations.

A small number of seals and no more than a few polar bears might be adversely affected or killed by a 325-bbl crude-oil spill contacting the Colville River, but these losses would not be significant to marine mammal populations. The effects of the Preferred Alternative are expected to be short term, with no significant adverse effects on marine mammal populations.

Multiple Sales: If several lease sales occur under the Preferred Alternative, considerably more exploration activity is expected to occur in the southern and central part of the planning area, with the number of exploration wells drilled increasing to 6-21 for multiple sales from the 2-7 wells for one sale. The amount of development also is expected to increase. The number of oil fields would increase to 1-3 for multiple sales from 1-2 for one sale, the number of production pads would increase to 1-5 for multiple sales from the 1-4 pads for one sale, and pipeline miles would increase to 20-110 for multiple sales from 20-95 mi for one sale. However, most oil and gas activities under the Preferred Alternative are expected to occur inshore and far to the south of the coast. Only a small increase in potential noise and disturbance effects on marine mammals is expected along the coast, primarily in the Colville River Delta-inner Harrison Bay area, and these effects are expected to be local and short term (generally <1 year).

Conclusion—Multiple Sales: The effect of oil and gas activities under the Preferred Alternative with multiple sales is expected to be about the same as for the single sale, but the duration and extent of activities would be over a longer period of time, as would potential disturbance effects.

10. Endangered and Threatened Species:

a. Activities Other Than Oil and Gas Exploration and Development: Ground-impacting-management actions within the planning area that may affect bowhead whales and spectacled and Steller's eiders under the Preferred Alternative include aerial surveys (including that of wildlife) and ground activities, such as hazardous- and solid-material removal and remediation, which occur during the summer/early fall. Overland moves and seismic surveys, which occur during the winter on ice roads or frozen tundra, are discussed but are unlikely to have an effect on these species. A description of these activities and the potential effects from these activities on these species are discussed below. A detailed discussion of all management actions is found in Section II.

(1) Effects on the Bowhead Whale: Bowhead whales may be present in the area offshore of the planning area primarily from August through October during their fall migration from Canadian waters to wintering areas in the Bering Sea. Bowhead whales are not likely to be affected by activities associated with the IAP. No stipulations are anticipated to protect bowhead whales.

(2) Effects on the Spectacled and Steller's Eiders: Spectacled and Steller's eiders may be adversely affected by activities associated with the IAP. Spectacled eiders are widely distributed throughout the coastal plain portion of the planning area and are essentially absent from the area from October to May. Most nesting on the Arctic Slope occurs along this coastline, particularly west from the Sagavanirktok River. Larned and Balogh (1994) observed spectacled eiders throughout the survey area from the mouth of the Canning River to 50 km south of Point Lay, but they were most abundant within 60 km of the coast between Barrow and Wainwright and in the Teshekpuk Lake area. The highest densities of nesting spectacled eiders in the planning area occur in the Spectacled Eider Breeding Range to the north, west, and east of Teshekpuk Lake (Fig. II.B.3). Postbreeding male spectacled eiders leave the planning area by late June. Females are present in the breeding area from May to September. Females with young typically are found offshore later when the ice usually is farther from the coast (Petersen, 1997, pers. comm.). Steller's eiders are relatively sparsely distributed throughout the planning area and are essentially absent from the area from late October to May. Males leave the nesting areas in late June to early July. Females with broods are present in the breeding area from early June to late August or early September. A discussion of potential effects on spectacled and Steller's eiders follows.

(a) Effects of Noise and Disturbance: Human-caused noise and activities and human presence may result in disturbance of spectacled and Steller's eiders in the planning area. Noise-producing activities, including aircraft traffic and hazardous- and solid-material removal and remediation, are the activities most likely to affect spectacled and Steller's eiders. Overland traffic and seismic surveys also are discussed but are not likely to affect eiders.

1) Effects from Aircraft Activities: Aircraft will be used to support activities associated with the IAP. Both fixed-wing aircraft and helicopters would be used to transport people, supplies, and equipment for fieldwork and to fly aerial surveys. Light helicopters are commonly used, and medium helicopters and fixed-wing planes occasionally are used. Helicopters normally fly low and slow, whereas fixed-wing aircraft usually fly higher and faster. Almost all aircraft activity would be in the summer. Aircraft likely will fly over nearly all of the planning area, but many flights apparently will be over waterfowl habitat areas in the lake areas to the north, west, and east of Teshekpuk Lake. The highest densities of spectacled eiders in the planning area occur in this area (Spectacled Eider Breeding Range) and eiders may use some of these lakes and other habitat in the area for breeding, nesting, and rearing their young. Eiders that are breeding, nesting, or rearing young in this coastal habitat may be overflown by aircraft (both helicopters and fixed-wing) on a regular basis during the summer months and may experience temporary, nonlethal effects probably

lasting less than an hour. Some Steller's eiders also may use some of these lakes and other habitat in the area and may be affected by these activities. Substantial disturbance is not expected to occur and is likely to be limited to within a few kilometers of the activities. Such short-term and localized disturbances are not expected to cause significant population effects.

Under the Preferred Alternative, point-to-point flights are regular but not daily flights (Table IV.A.1a-1). Aerial wildlife surveys, some of which may be low-level flights, occur 21 days during June and July over caribou and waterfowl areas. Other aerial surveys increase from occasionally to several 1- to 2-week periods. Helicopters may be used during some of the studies, such as collaring caribou in the lake areas to the north and east of Teshekpuk Lake. In addition, more intense surveys will be flown for hazardous and solid wastes in the Teshekpuk Lake Special Area. Some eiders may be affected by activities associated with aircraft traffic and hazardous- and solid-material removal and remediation, which may continue for as long as 3 to 4 weeks.

A substantial portion of Spectacled Eider Breeding Range to the north, west, and east of Teshekpuk Lake may be affected by aircraft activities under this alternative. Balogh (1997) indicated that fixed-wing aircraft flown at an altitude of 150 ft often cause spectacled eiders to flush, although helicopters flown at similar altitudes around Prudhoe Bay do not cause them to flush. Reactions of eiders to aircraft are not well understood. Nests are regularly located in a wetland within 1 km of the Deadhorse Airport (TERA, 1995), and a nest was located <250 m from the Deadhorse runway (Martin, 1997), indicating that some individuals are tolerant of aircraft activity in the vicinity of nests. Behavioral reactions of prenesting birds to aircraft overflights may not be representative of behavior of incubating or broodrearing birds. Some eiders may be disturbed by aircraft activities and may experience temporary, nonlethal, effects probably lasting less than an hour. Some displacement of nesting eiders along flight-survey routes near airstrips could occur as a result of the numerous aircraft overflights and landings in the sensitive areas. Relatively few nest sites are expected to be affected, because spectacled eider nest sites are scattered at relatively low density over much of the northern portion of the planning area and at even lower densities in the rest of the planning area. Steller's eiders in other portions of the planning area are less likely to be affected by aircraft flights, because fewer flights are likely to be conducted in those areas, and Steller's eiders are present at low densities. Some aircraft stipulations in Section II.C.7.b are applicable to all ground-impacting activities and should provide some protection to eiders during the conduct of these activities. However, several of the aircraft stipulations pertaining to flight-timing restrictions apply primarily to oil and gas activities and to some, but not all, ground-impacting activities. Noise and disturbance from aircraft traffic associated with these ground-impacting activities, such as aerial wildlife surveys and other aerial surveys conducted in the lake areas to the north, west, and east of Teshekpuk Lake, have the potential to affect breeding and nesting eiders. Therefore, the stipulations associated with flight-timing restrictions of aircraft may not be adequate to protect spectacled eiders and Steller's eiders from aircraft disturbance associated with aerial wildlife surveys and other surveys conducted in the lake areas to the north, west, and east of Teshekpuk Lake. Disturbance of some individuals over the life of the project is expected to be unavoidable. Due to the relatively low density of eiders in the area, substantial disturbance is not expected to occur; and any disturbance is likely to be temporary and limited to within a few kilometers of the activities. Such short-term and localized disturbances are not expected to cause significant population effects. Disturbance, depending on its nature and duration, could be considered a "take" under the ESA.

2) Effects from Hazardous- and Solid-Material Removal and Remediation: There are three phases to addressing hazardous and solid materials in the planning area—site characterization, removal, and remediation. Site characterization involves small helicopters and fixed-wing aircraft conducting fairly intensive surveys in the Teshekpuk Lake Special Area and other areas. The effects of aircraft disturbance on eiders was discussed previously. Removal and remediation involves activity on the ground at the location. Drill rigs, hydropunches, or backhoes are used to determine and assess the nature and extent of contamination of the site. These activities may continue for as long as 3 to 4 weeks. Because these activities are conducted during the summer months, they could cause disturbance to eiders that are breeding, nesting, or rearing young in the area and may displace a few eiders. Disturbance of eiders due to cleanup activities is likely to be limited to within a few kilometers of the activities but could continue for as long as 4 weeks. Applicable stipulations in Section II.C.7.b pertaining to waste prevention, handling, and disposal, and spills could provide some additional protection to eiders during the conduct of these activities.

3) Effects from Overland Moves: The BLM issues permits to authorize overland moves. Overland moves typically are conducted from Prudhoe Bay or Oliktok Point during the winter between December and April. There should be no effects on spectacled and Steller's eiders as a result of overland moves.

4) Effects from Seismic Activities: Some 2-D seismic exploration will occur each winter and some 3-D seismic exploration will likely occur in alternate

winter seasons. No effects on spectacled and Steller's eiders are expected to occur as a result of seismic surveys, because seismic activities would occur during the winter.

b. Oil and Gas Exploration and Development Activities: Under the Preferred Alternative oil and gas leasing would occur in the planning area, although the northern portion of the planning area is unavailable for oil and gas leasing. Oil and gas leasing would be allowed in the 5- to 6-mi band along the west and southern edge of Teshekpuk Lake, but no surface occupancy would be allowed. No leasing would occur in the the northern portion of the Spectacled Eider Breeding Range, but leasing could occur in the portion of the breeding range west of Teshekpuk Lake, an area of higher density spectacled eider nesting. This analysis is based on a development scenario presented in Section IV.A.1.b. Please refer to these sections for a discussion of resource-recovery rates and quantities, timing of infrastructure development, platform emplacement, wells drilled, and resource production timeframes and other information relevant to the development of the resources of the IAP. The BLM also proposes to conduct multiple oil and gas lease sales within the planning area over a number of years, which is likely to result in a larger resource range. Multiple sales are discussed later in this section.

Under the Preferred Alternative, oil resources for the initial sale are expected to be in the 90- to 420-MMbbl range with from one to two fields (Table IV.A.1.b-4). Information on the number of exploration, delineation, and production wells anticipated to be drilled and pipeline miles can be found in Table IV.A.1.b-5. Resources at the low end of the resource range (90 MMbbl) are not economically viable as stand-alone fields. Differences in effects on the species as a result of noise and disturbance over this range of scenarios are expected to be minor. Differences in effects on the species as a result of an oil spill during the development/production scenario (90-420-MMbbl-resource range) also are expected to be minor.

For the Preferred Alternative, the estimated number of oil spills assumed would occur over the production life of the IAP is from 14 to 63 spills <1 bbl and from 5 to 21 spills >1 bbl (Table IV.A.2-3a). For the purposes of analysis, this EIS assumes an average spill size of 4.0 bbl and that the estimated number of crude oil spills over the assumed production life of the planning area would range from 18 to 84 spills (Table IV.A 2-2a). Information pertaining to oil spills can be found in Section IV.A.2.

(1) Effects on the Bowhead Whale: Bowhead whales may be present in the area offshore of the planning area primarily from August through October during their fall migration to the Bering Sea. Bowhead whales are not likely to be affected by activities associated with the IAP other than oil and gas exploration and development. The following discussion describes how bowhead whales may be affected by oil and gas activities.

(a) Effects of Discharges: All drilling muds and cuttings will be hauled to approved disposal sites or disposed of in existing wells, so there will be no surface discharge of drilling wastes. No drilling activities will occur in the marine environment under this IAP, so no drilling muds and cuttings will be discharged into the marine environment. There should be no effects on bowhead whales as a result of discharges.

(b) Effects of Noise and Disturbance: Concern has been expressed that manmade noise may affect bowheads by raising background-noise levels, which could interfere with detection of sounds from other bowheads or from important natural sources, or by causing disturbance reactions. Noise-producing activities, including aircraft traffic and marine-vessel traffic, are the activities most likely to affect bowhead whales. Seismic surveys, drilling, construction activities, and oil-spill-cleanup activities also are discussed but are not likely to affect bowhead whales. A detailed description of these activities and their potential effects on bowhead whales in the MMS Beaufort Sea OCS Planning Area can be found in Section IV.B.a.1 of the Beaufort Sea Sale 144 Final EIS (USDOI, MMS, 1996a). Activities associated with the proposed oil and gas sale in the planning area under this alternative and their potential effects on bowhead whales follows.

1) Effects from Seismic Activities: No marine seismic surveys will occur as a result of this IAP. It is likely that seismic surveys in the planning area will be conducted entirely during the winter months (early December to mid-April) using all-terrain ground vehicles and supported by light aircraft. There should be no effects on bowhead whales as a result of seismic surveys.

2) Effects from Aircraft Activities: Aircraft likely will be used to support oil and gas exploration activities in the planning area. Seismic surveys and drilling operations probably would be conducted during the winter months, so aircraft support of these activities also would occur primarily during the winter. Any aircraft flights over the marine environment during the open-water season as a result of oil and gas operations in the planning area are likely to be minimal, should any occur. Bowheads are not affected much by any aircraft overflights at altitudes above 328 yards (Richardson and Malme, 1993). In addition, any such flights likely would be very near shore, well away from the normal migration corridor. It is unlikely there will be any effects on bowhead whales as a result of aircraft flights.

3) Effects from Vessel Activities: There may be some transportation of equipment and supplies through the marine environment during the open-water season. Because of logistics problems associated with moving materials over the long distances from existing infrastructure, barges may be used to transport heavy equipment and supplies. Staging areas may be established along the coastline of the planning area and materials transported and stockpiled during the summer months (mid-July to early October) for operations at inland sites during the winter months.

Bowheads react to the approach of vessels at greater distances than they react to most other industrial activities. Most bowheads begin to swim rapidly away when vessels approach rapidly and directly. Avoidance usually begins when a rapidly approaching vessel is 0.62 to 2.5 mi away. A few whales may react at distances from 3 to 8 mi, and a few whales may not react until the vessel is <0.62 mi away. Received noise levels as low as 84 dB re 1 μPa or 6 dB above ambient noise may elicit strong avoidance of an approaching vessel at a distance of 2.5 mi (Richardson and Malme, 1993, as cited in USDOI, MMS, 1996a). Fleeing from a vessel generally stopped within minutes after the vessel passed, but scattering may persist for a longer period. In some instances, bowheads returned to their original locations. Bowhead whales may encounter a few vessels associated with oil and gas activities in the planning area during their fall migration through the Alaskan Beaufort Sea, although most of the vessel activity would be in shallow, nearshore waters, probably shoreward of the main fall whale-migration route. Vessel traffic generally would be limited to routes between staging areas near existing infrastructure (such as West Dock or Oliktok Point) and staging areas in the planning area, such as Camp Lonely. Although any effects on bowhead whales as a result of barge or other vessel traffic are likely to be minimal, some endangered whales may interact with marine vessel traffic, and some inadvertent conflicts or incidental "taking" situations may occur. These inadvertent conflicts with or incidental "taking" situations of some individual whales as a result of marine-vessel traffic would not constitute a threat of harm to the species.

4) Effects from Drilling Activities: Exploration-drilling activities will be conducted only onshore and only during the winter months; bowhead whales would not be affected by the activity. If a commercial discovery is made, drilling of production wells likely will proceed during the summer months. Table IV.A.1.b-5 provides information regarding the number of wells likely to be drilled and the timeframe for drilling, development, and production for the estimated range of resources (90-420 MMbbl) in the planning area. Because no leasing will occur in the northern portion of the planning area under this alternative, no drilling operations will be conducted in that area. There should be no effects on bowhead whales as a result of drilling operations.

5) Effects from Construction Activities: Onshore pipeline construction or other construction activities would occur during the winter. No pipeline construction or other construction activities are expected in the marine environment. There should be no effects on bowhead whales as a result of construction activities.

6) Effects from Spill Cleanup: No spills are expected to occur in the marine environment, because no leasing will occur in the northern portion of the planning area under this alternative. It is likely that any oil spill in the planning area will be contained onshore and will not be released into the marine environment. If oil is spilled, personnel, equipment, and aircraft will be present conducting onshore-cleanup operations. If any spilled oil does reach the marine environment, such as under the Colville River Oil Spill Scenario, oil-spill-cleanup activities would be likely to occur adjacent to the coast and should not affect the bowhead whale migration. There should be no effects on bowhead whales as a result of oil-spill-cleanup activities.

(c) Effects of Spills: The effects of an oil spill on bowhead whales are uncertain. Several researchers (Geraci and St. Aubin, 1982; St. Aubin, Stinson, and Geraci, 1984, as cited in USDOI, MMS, 1996a) concluded that exposure to spilled oil is unlikely to have serious direct effects on baleen whales.

Under this alternative, there would be no leasing in the northern portion of the planning area. No spills are expected to occur in the marine environment, and small onshore spills are unlikely to reach the marine environment. Under the Colville River Oil-Spill Scenario, a 325-bbl spill is assumed to reach the Colville River and approximately half of that may reach the marine environment. If any spilled oil did reach the marine environment, it is likely to be a very small amount and is very unlikely to have any effect on bowhead whales. There is no discussion of potential effects on bowheads as a result of oil spills in the planning area because no leasing will occur in the northern portion of the planning area, the likelihood of an oil spill reaching the marine environment is small, the likelihood of exposure of bowhead whales to spilled oil is small, and any exposure to spilled oil that may occur is unlikely to have serious direct effects on bowheads. It is assumed for the Preferred Alternative that a fuel-oil spill, associated with the barging of supplies, would occur in the marine environment during August or September. If a fuel-oil spill occurred in bowhead whale habitat while bowheads were present, some whales could experience one or more of the following: skin contact,

baleen fouling, respiratory distress caused by inhalation of hydrocarbon vapors, localized reduction in food resources, consumption of some contaminated prey items, and perhaps a temporary displacement from some feeding areas. The number of whales contacted would depend on the size, timing, and duration of the spill; the density of the whale population in the area of the spill; and the whales' ability or inclination to avoid contact with the spilled fuel-oil.

(2) Effects on the Spectacled and Steller's Eiders: The reaction of eiders to disturbance in the oil fields is not well understood. Anderson et al. (1992) reported a shift in distribution between 1989 and 1991 away from noisy facilities installed as part of the GHX-1 project. Anderson and Cooper (1994) reported that the mean distance from facilities to spectacled eider nests was greater than the mean distance of facilities to eider observations (mainly during the prenesting season), suggesting that eiders may be less tolerant of facilities during the nesting season. Telemetry studies in the Prudhoe Bay area provided information on responses to oil field facilities during the broodrearing period (TERA, 1995, 1996). In 1994, two of nine tracked broods crossed roads compared with three out of five in 1993. Some broods were located in areas away from facilities. In 1994, six out of nine broods spent at least some time within 200 m of facilities. Four broods frequented areas containing exceptionally high-noise facilities—two broods near the airport and two broods near gathering centers.

Spectacled and Steller's eiders may be adversely affected by activities other than oil and gas exploration and development in the planning area. These potential effects are discussed above. Deferral of the northern portion of the planning area from leasing will protect most of the spectacled eider breeding and nesting areas in the planning area from noise and disturbance associated with oil and gas activities.

(a) Effects of Discharges: All drilling muds and cuttings will be hauled to approved disposal sites or disposed of in existing wells, so there will be no surface discharge of drilling wastes. No drilling activities will occur in the marine environment under this IAP, so no drilling muds and cuttings will be discharged into the marine environment. There should be no effects on spectacled and Steller's eiders as a result of discharges.

(b) Effects of Noise and Disturbance: Human-caused noise and activities and human presence may result in disturbance of spectacled eiders in the planning area. Noise-producing activities, including aircraft traffic and marine-vessel traffic, are the activities most likely to affect spectacled eiders. Seismic surveys, drilling, construction activities including vehicle traffic, and oil-spill-cleanup activities also are discussed but are not likely to affect spectacled eiders. Noise-producing activities, including aircraft traffic, marine vessel traffic, drilling; construction activities, including vehicle traffic; and oil-spill-cleanup activities are the activities most likely to affect Steller's eiders. Activities associated with the oil and gas exploration and development in the planning area under this alternative and a discussion of their potential effects on spectacled and Steller's eiders follows.

1) Effects from Seismic Activities: No marine-seismic exploration will occur as a result of this IAP. It is likely that seismic surveys in the planning area will be conducted entirely during the winter months (early December to mid-April) using all-terrain ground vehicles and supported by light aircraft. Some 2-D seismic exploration will occur each winter and up to two 3-D operations will occur in alternate winter seasons. There should be no effects on spectacled or Steller's eiders as a result of seismic surveys since seismic activities are conducted during the winter.

2) Effects from Aircraft Activities: Aircraft likely will be used to support oil and gas exploration activities in the planning area. Mostly fixed-wing aircraft would be used for oil and gas exploration and development operations, with helicopters used only in emergencies. Seismic surveys and drilling operations probably will be conducted primarily during the winter months, so aircraft support of these activities also would occur during the winter. Any aircraft flights over the marine environment during the open-water season as a result of oil and gas operations in the planning area are likely to be minimal, if any occur. Because no leasing will occur in the northern portion of the planning area (most of the Spectacled Eider Breeding Range) under this alternative, there should be no aircraft flights associated with oil- and gas-related operations. However, the portion of the Spectacled Eider Breeding Range west of Teshekpuk Lake is available for leasing, so some eiders in this area may experience temporary, nonlethal effects as a result of aircraft traffic associated with oil and gas activities. It is unlikely that the primary Alaskan nesting area for Steller's eiders, located south and southeast of Barrow, would be overflown by aircraft associated with oil and gas activities, so significant disturbance of nesting or broodrearing Steller's eiders is not expected to occur.

In the event of a commercial discovery, drilling operations and other activities may continue through the summer months and would be supported by aircraft. Pipelines are likely to be constructed aboveground, and aircraft likely will be used to look for leaks in the pipeline. Balogh (1997) indicated that fixed-wing aircraft flown at an altitude of 150 ft often cause spectacled eiders to flush, although helicopters flown at similar altitudes around

Prudhoe Bay do not cause them to flush. As stated previously, reactions of eiders to aircraft are not well understood. There are indications that some individuals are tolerant of aircraft activities in the vicinity of nests. Summer aircraft flights over onshore areas of the planning area, especially north and east of Teshekpuk Lake, may affect nesting females and their broods. The highest densities of spectacled eiders in the planning area are found in this area; they may use some of these lakes and other habitat in the area for breeding, nesting, and rearing their young. Because the area to the north and east of Teshekpuk Lake is not available for leasing under this alternative, there should be no effects on spectacled eiders breeding, nesting, and rearing in the area as a result of aircraft flights related to oil and gas activities. Also, displacement of nesting eiders in the vicinity of pipeline corridors and near airstrips as a result of aircraft overflights is unlikely. Some disturbance to spectacled eiders could occur in the portion of the Spectacled Eider Breeding Range west of Teshekpuk Lake as a result of oil and gas activities, because that area is available for oil and gas leasing. Steller's eiders may use some of the lakes in the central portions of the planning area for breeding, nesting, and broodrearing, and summer aircraft flights over the central portion of the planning area may affect breeding activities and nesting females and their broods. Some displacement of nesting Steller's eiders in the vicinity of pipeline corridors and near airstrips could occur as a result of aircraft overflights. Nest sites are scattered at relatively low density over much of the planning area, so substantial disturbance of nesting or broodrearing eiders is not expected to occur. Some eiders may experience temporary, nonlethal effects, probably lasting less than an hour. Stipulations pertaining to ground-impacting activities and oil and gas activities, including waste prevention, handling, and disposal, spills, and aircraft restrictions (Section II.C.7.b) should provide protection to both spectacled and Steller's eiders.

Winter aircraft flights associated with oil and gas operations should have no effects on spectacled or Steller's eiders. It is likely there will be minimal effects on eiders as a result of any summer aircraft flights over the marine environment, should any occur. Spectacled or Steller's eiders staging or migrating in coastal or offshore waters during the relatively brief staging/migration periods (late June/early July, late August/September) are not expected to experience significant disruption of foraging because of the low probability that these areas would be overflown by support aircraft.

3) Effects from Vessel Activities:

There may be some transportation of equipment and supplies through the marine environment during the open-water season. Because of logistics problems associated with moving materials over the long distances from existing infrastructure, barges may be used to transport heavy equipment and supplies. Staging areas may be established along the coastline and materials transported and stockpiled during the summer months (mid-July to early October) for operations at inland sites during the winter months. Spectacled and Steller's eiders staging or migrating in coastal or offshore waters during the relatively brief staging/migration periods (late June/early July, late August/September) are not expected to experience significant disruption of foraging because of the low probability of disturbance by barging activities.

4) Effects from Drilling Activities:

Exploration-drilling activities will be conducted only onshore and only during the winter months, so spectacled eiders would not be affected by the activity. Table IV.A.1.b-5 provides information regarding the number of wells likely to be drilled and the timeframe for drilling, development, and production for the estimated range of resources (90-420 MMbbl) in the planning area. The area north and east of Teshekpuk Lake is not available for leasing under this alternative. The portion of the Spectacled Eider Breeding Range west of Teshekpuk Lake is available for leasing. There should be no effects on spectacled eiders as a result of drilling operations, because drilling activities will be conducted during the winter months. There should be no effects on Steller's eiders as a result of exploratory drilling operations in the remainder of the planning area, because drilling would be conducted during the winter.

If a commercial discovery is made, drilling of production wells likely will proceed during the summer months. Noise from drilling activities in the summer may affect some breeding and nesting spectacled and Steller's eiders, although such effects are unlikely and the number of birds affected likely would be very limited. Disturbance is likely to be limited to within a few kilometers from the activities; but some eiders may experience temporary, nonlethal effects, although effects could continue all summer. During the development/production phase, crew-support camps likely would be established. Improper containment or disposal of refuse could attract potential bird predators such as arctic foxes, grizzly bears, ravens, and glaucous gulls. It is likely that should an increase in predators occur, it would result in the loss of eggs, chicks, or even adult eiders.

5) Effects from Construction Activities:

No pipeline-construction or other construction activities are expected to occur in the marine environment, so no effects on spectacled or Steller's eiders are expected in the marine environment. Onshore-pipeline-construction activities likely will occur in the winter and would not be likely to affect eiders. There should be no effects on

spectacled or Steller's eiders as a result of onshore-pipeline-construction activities.

Vehicle traffic on road systems through the oil fields during the summer may affect spectacled and Steller's eiders. However, no leasing will occur in the area north and east of Teshekpuk Lake under this alternative, so spectacled eiders will not be affected by vehicle traffic in that portion of the Spectacled Eider Breeding Range. The portion of the breeding range west of Teshekpuk Lake is available for leasing, so some eiders in this area may experience disturbance from vehicular traffic if a discovery is made. No summer road access to the oil fields in the remainder of the planning area is planned, so Steller's eiders should not be affected by vehicle traffic. Initial access will be by ice roads during the winter. If a discovery is made and development and production proceed, roads likely would be limited to the area between drill pads. Gravel for roads and pads is likely to come from gravel pits outside the planning area, possibly from the gravel mine across the Colville River from Nuiqsut. This is an existing gravel mine located in an area where the densities of spectacled and Steller's eiders are low. Little, if any, disturbance of these birds is expected to occur as a result of gravel mining operations at this location. Placement of fill for roads and pads could result in destruction of some breeding habitat or actual take of spectacled and Steller's eiders or their nests. While the amount of habitat lost may not be a significant proportion of the total amount of habitat available, the FWS (USDOI, FWS, 1998) anticipates some adverse effects to spectacled eiders. Spectacled eiders tend to be more concentrated within the planning areas than Steller's eiders. In addition to vehicle traffic, there likely would be other activities occurring during the summer such as maintenance of roads and pads, construction of buildings, etc. Disturbance is likely to be limited to within a few kilometers from the activities. Because the density of Steller's eiders in the southern half of the planning area is very low, it is likely that the effects of vehicular traffic on Steller's eiders will be minimal, affecting at most a few nesting birds.

Some disturbance could occur in the marine environment, if new staging areas are created or if a discovery is made and a waterflood program using seawater is initiated. It is likely that existing staging areas will be used to the extent possible, and there would be no effects from construction activities on eiders. Disturbance to eiders in the marine environment from construction of a staging area or a waterflood program may cause a few individuals to be displaced from the nearshore coastal area in the vicinity of the project. However, the effects on eiders are likely to be negligible.

6) Effects from Spill Cleanup: No spills are expected to occur in the marine environment. It is likely that any oil spill in the planning area will be contained onshore and will not be released into the marine environment. If oil is spilled onshore, personnel, equipment, and aircraft will be present to conduct cleanup operations. If any spilled oil does reach the marine environment, such as under the Colville River Oil Spill Scenario, oil-spill-cleanup activities would be likely to occur adjacent to the coast and should not affect eiders. No oil-spill-cleanup activities would occur adjacent to the coast in the area of highest eider density, because no leasing will occur in the northern portion of the planning area under this alternative. Overall. the effects on spectacled eiders as a result of oil-spill-cleanup activities are likely to be minimal. If oil-spill-cleanup activities occurred adjacent to Steller's eider breeding, nesting, or rearing areas, limited disturbance and possible displacement of eiders from their normal activities could occur. Because of the relatively small size of spills, the limited area affected by a spill, and the limited likelihood for a spill to occur near an eider-nesting area, it is likely that only a few eiders may be displaced from favored habitats or otherwise be affected by these activities.

(c) Effects of Spills: Exposure of spectacled and Steller's eiders to oil is expected to result in the general effects (i.e., individuals are not expected to survive moderate to heavy contact) noted in Section IV.B.6.c of the Beaufort Sea Sale 144 Final EIS (USDOI, MMS, 1996a). If a discovery occurs and seawater is used for waterflooding during the production phase, it is possible that some seawater could be spilled on the tundra as a result of a pipeline leak. While mortality to eiders is unlikely, some habitat could be damaged or destroyed from the seawater.

Under this alternative there would be no leasing in the northern portion of the planning area. No spills are expected to occur in the marine environment, nor is it likely that any oil spilled onshore will be released into the marine environment. Therefore, eiders occupying marine habitats during summer/fall periods for staging/migrating should not be at risk. Onshore spills of oil or seawater would not occur in the northern portion of the planning area in primary eider habitat. There should be no effects on spectacled eiders in most of the Spectacled Eider Breeding Range as a result of oil spills. Due to the potential for oil and gas activities in proximity to Teshekpuk Lake under this alternative, there would be increased potential for an oil spill to contact Teshekpuk Lake. For the purpose of analysis, it is assumed that a 325-bbl spill reaches the lake in early June. As a continuous spill, it would cover approximately 61 acres as a very thin film after 30 days. It likely would move around the lake as individual spillets with the prevailing wind direction. By the end of summer, all of the oil that is not cleaned up will be trapped along the lake's vegetated margins either on the water's surface or on

the bottom. Some mortality of spectacled eiders may occur, if they are contacted by spilled oil. Spectacled eiders may be present in low densities in the lake during the breeding season, particularly in the southwestern portion of the lake. There are little data regarding the presence or abundance of eiders on the lake during the remainder of the year. If an oil spill occurred in the remainder of the planning area it is likely that few, if any, Steller's eiders would be contacted. Onshore spills generally are fairly small; consequently, the affected area would be fairly small. Sixty-five to 80 percent of the spills are likely to occur on the drilling pad, where they would be unlikely to affect eiders. Those spills that occur on or reach the surrounding environment generally cover a small area ($\leq$500 ft^2). It also is assumed for the Preferred Alternative that a fuel-oil spill, associated with the barging of supplies, would occur in the marine environment during August or September. If a fuel-oil spill occurred in marine waters while eiders were present, some mortality likely would occur as a result of hypothermia. Some eiders could ingest fuel oil from preening of oiled feathers and be prone to various pathological conditions such as endocrine dysfunction, liver-function impairment, weight loss, etc.

Summary: Bowhead whales are not expected to be affected by activities associated with the IAP or by discharges, drilling operations, construction activities, oil-spill-cleanup activities, or oil spills associated with oil and gas activities as a result of this alternative. If a fuel-oil spill occurred in bowhead whale habitat while bowheads were present, some whales could experience one or more of the following: skin contact, baleen fouling, respiratory distress caused by inhalation of hydrocarbon vapors, localized reduction in food resources, consumption of some contaminated prey items, and perhaps a temporary displacement from some feeding areas. The number of whales contacted would depend on the size, timing, and duration of the spill; the density of the whale population in the area of the spill; and the whales' ability or inclination to avoid contact with the spilled fuel oil. There is a limited potential for whales to be affected by aircraft flights, although few flights, if any, are anticipated over the marine environment. Bowheads are not affected much by any aircraft overflights at altitudes above 328 yards (Richardson and Malme, 1993). Vessel traffic, such as barges transporting equipment and supplies, has the greatest potential to affect whales. Some endangered whales may interact with marine vessel traffic, and some inadvertent conflicts or incidental "taking" situations may occur. These inadvertent conflicts with or incidental "taking" situations of some individual whales as a result of marine-vessel traffic would not constitute a threat of harm to the species. Bowheads may exhibit avoidance behavior if approached by vessels at a distance of 0.62 to 2.5 mi (Richardson and Malme, 1993). In general, bowheads do not seem to travel more than a few kilometers in response to a single disturbance incident; and behavioral changes are temporary, lasting only a few minutes in the case of vessels and aircraft.

Under the Preferred Alternative, spectacled and Steller's eiders are not expected to be affected by oil and gas activities such as discharges, seismic surveys, overland moves, winter drilling activities, construction activities, and seawater spills associated with oil and gas activities. Onshore oil spills generally are fairly small and are likely to occur primarily on the drilling pad, where they would be unlikely to affect eiders. Spills that occur on or reach the surrounding environment generally cover a small area ($\leq 500^2$). The FWS (USDOI, FWS, 1998) anticipates that only those individuals or nests that are within 200 m are likely to be affected by oil spills. Some mortality of spectacled eiders could occur if spilled oil managed to reach Teshekpuk Lake, although eiders appear to be present in low densities during the breeding season. Little information is available for the rest of the season. If a discovery occurs and seawater is used for waterflooding during the production phase, it is possible that some seawater could be spilled on the tundra as a result of a pipeline leak. While mortality to eiders is unlikely, some habitat could be damaged or destroyed from the seawater. If a fuel-oil spill occurred in marine waters while eiders were present, some mortality would likely occur as a result of hypothermia. Some eiders could ingest fuel oil from preening of oiled feathers and be prone to various pathological conditions such as endocrine dysfunction, liver-function impairment, weight loss, etc. Neither spectacled nor Steller's eiders staging or migrating in the marine environment along the Beaufort Sea coast are expected to experience adverse effects from noise or disturbance from marine-vessel traffic or aircraft traffic associated with activities under this alternative. However, some disturbance could occur in the marine environment if new staging areas are created or if a discovery is made and a waterflood program is initiated using seawater. It is likely that existing staging areas will be used to the extent possible and there would be no effects from construction activities on eiders. Disturbance to eiders in the marine environment from construction of a staging area or a waterflood program may cause a few individuals to be displaced from the nearshore coastal area in the vicinity of the project. However, the effects on eiders are likely to be negligible.

Noise and disturbance associated with oil and gas activities, such as aircraft traffic, drilling of development and production wells, vehicle traffic, and oil-spill-cleanup activities could affect spectacled eiders in the area west of Teshekpuk Lake (part of the Spectacled Eider Breeding Range). This area is available for drilling and has a relatively high density of spectacled eiders. Spectacled eiders breeding, nesting, or rearing young in the Spectacled

Eider Breeding Range west of Teshekpuk Lake and Steller's eiders breeding, nesting, or rearing young in the central portion of the planning area may be disturbed by support aircraft, noise from drilling or vehicular traffic during development/production activities in the summer, or affected by oil-spill-cleanup activities. These eiders may experience temporary, nonlethal effects, probably lasting less than an hour but possibly continuing all summer, in the case of aircraft and drilling associated with summer operations. Significant disturbance of nesting or broodrearing eiders is not expected to occur. Some eiders may be displaced to habitat that may not be optimal for successful reproduction and survival. Adverse effects from such displacement would likely be minimal considering the relatively low density of eiders in the planning area and the likelihood that historic population levels utilizing this habitat were much higher. Improper containment or disposal of refuse at support camps could attract potential bird predators. It is possible that an increase in predators could result in the loss of eggs, chicks, or even adult eiders.

Some eiders may be affected by activities other than oil and gas, such as hazardous- and solid-material removal and remediation and summertime aircraft flights over sensitive areas that may affect nesting females and their broods. Eiders breeding, nesting, or rearing young in coastal habitats north, west, and east of Teshekpuk Lake may be overflown by aircraft (both helicopters and fixed-wing) on a regular basis during the summer months and may experience temporary, nonlethal effects, probably lasting less than an hour. Substantial disturbance is not expected to occur and is likely to be temporary and limited to within a few kilometers of the activities.

Overall, substantial disturbance is not expected to occur and is likely to be limited to within a few kilometers of the activities. Therefore, the effects on eiders should be limited, with only a few eiders exposed to oil and gas activities. Stipulations should provide some protection to eiders during the conduct of some of these activities. Disturbance of some individuals over the life of the project is expected to be unavoidable. Due to the relatively low density of eiders in the area, substantial disturbance is not expected to occur; and any disturbance is likely to be temporary and limited to within a few kilometers of the activities. Such short-term and localized disturbances are not expected to cause significant population effects. Disturbance, depending on its nature and duration, could be considered a "take" under the ESA.

Conclusion—First Sale: Bowhead whales are not likely to be affected by activities associated with the management plan. Overall, bowhead whales exposed to noise-producing activities such as marine vessel traffic and possibly aircraft overflights most likely would experience temporary, nonlethal effects. Bowheads may exhibit temporary avoidance behavior in response to vessel and aircraft activities. In general, bowheads do not appear to travel more than a few kilometers in response to a single disturbance incident. Behavioral changes as a result of exposure to vessel or aircraft traffic likely will last only a few minutes after the disturbance has left the area or the whales have passed. Overall, the effects on spectacled and Steller's eiders exposed to noise-producing activities are expected to be minimal. Spectacled eiders breeding, nesting, or rearing young in the Spectacled Eider Breeding Range west of Teshekpuk Lake and Steller's eiders breeding, nesting, or rearing young in the central portion of the planning area may be disturbed by support aircraft, noise from drilling or vehicular traffic during development/ production activities in the summer, or affected by oil-spill-cleanup activities. These eiders may experience temporary, nonlethal effects, probably lasting less than an hour but possibly continuing all summer, in the case of aircraft and drilling associated with summer operations. Significant disturbance of nesting or broodrearing eiders is not expected to occur. Some mortality of spectacled eiders could occur if spilled oil managed to reach Teshekpuk Lake, although eiders appear to be present in low densities during the breeding season. Small onshore oil spills are not likely to significantly affect eiders. If a fuel-oil spill occurred in marine waters while eiders were present, some mortality would likely occur as a result of hypothermia. Some eiders could ingest fuel oil from preening of oiled feathers and be prone to various pathological conditions such as endocrine dysfunction, liver-function impairment, weight loss, etc. Improper containment or disposal of refuse at support camps could attract potential bird predators. It is possible that an increase in predators could result in the loss of eggs, chicks, or even adult eiders. Overall, spectacled and Steller's eiders are not expected to be exposed to most noise-producing activities from oil and gas operations. Any effects from exposure likely would be minimal.

Some eiders may be affected by activities other than oil and gas, such as hazardous- and solid-material removal and remediation and summer aircraft flights over sensitive areas. Nesting females and their broods may experience temporary, nonlethal effects as a result of these activities. Disturbance of some individuals over the life of the project is expected to be unavoidable. Due to the relatively low density of eiders in the planning area, substantial disturbance is not expected to occur and is likely to be temporary and limited to within a few kilometers of the activities. Such short-term and localized disturbances are not expected to cause significant population effects. Disturbance, depending on its nature and duration, could be considered a "take" under the ESA. Stipulations should provide some protection to eiders during the conduct of some of these activities.

Overall, the effects of the Preferred Alternative are expected to be essentially the same as Alternative D.

Multiple Sales: Under the multiple-sales approach, the resource estimate for the Preferred Alternative increases from a range of 90 to 420 MMbbl in one to two oil fields (Table IV.A.1.b-4) to a range of 130 to 600 MMbbl in one to three oil fields (Table IV.A.1.b-6). Resources at the low end of the resource range (130 MMbbl) are not economically viable as stand-alone fields. The number of exploration wells increase from a maximum of 7 to 21, delineation wells increase from a maximum of 10 to 17, and production wells increase from a maximum of 132 on 4 pads to 180 on 5 pads. Pipeline miles increase from 95 to 110 mi (Tables IV.A.1.b-5 and 7). Multiple sales would occur over a longer period of time and, depending on the frequency of sales and results from exploratory drilling operations, possibly increase the timeframe for oil and gas activities in the planning area by a couple of decades.

For the Preferred Alternative, it is estimated that the number of spills <1 bbl would increase from a range of 14 to 63 spills to a range of 19 to 90 spills, and the number of spills >1 bbl would increase from a range of 5 to 21 spills to a range of 7 to 29 spills over the assumed production life of the planning area (Tables IV.A.2-3a and IV.A.2-3b). The estimated number of crude-oil spills over the assumed production life of the planning area would increase from a range of 18 to 84 spills to a range of 26 to 119 spills (Tables IV.A 2-2a and IV.A.2-2b). Information pertaining to oil spills can be found in Section IV.A.2.

Conclusion—Multiple Sales: Effects of multiple sales are expected to be essentially as described above for the first sale. Bowhead whales exposed to noise-producing activities such as marine-vessel traffic and possibly aircraft overflights most likely would experience temporary, nonlethal effects. Spectacled and Steller's eiders are not expected to be exposed to most noise-producing activities from oil and gas operations, and any effects from exposure likely would be minimal. The assumptions that oil spills would be relatively small in size, that the majority of the spills would occur on pads, and that small areas would be affected where spills occur off the pads would remain the same as for the first sale. Therefore, the effects of multiple sales and increased potential for noise-producing activities and oil spills on endangered and threatened species at the resource ranges and activity levels described are expected to be essentially the same as described above for the single sale.

c. Effects of an Oil Spill on Listed and Proposed Listed Species along the Transportation Route: This section includes an analysis of the effects of oil spills along transportation routes on species discussed in Section III.B.6. A number of listed and proposed species were discussed in previous consultations, as described in the consultation information presented in the lead paragraphs under Alternative A. This discussion concerns only additional species not included in previous consultations. These species include seventeen salmonids identified by NMFS; the Snake River sockeye salmon; Snake River spring, summer, and fall chinook salmon; southern Oregon/northern California coast coho salmon; central California coast coho salmon; Sacramento River winter-run chinook salmon; Umpqua River cutthroat trout; and ten steelhead ESU's. One steelhead ESU that is listed as a candidate species also is included. Also included are numerous species of animals and plants under the jurisdiction of the FWS—the Pacific pocket mouse, least Bell's vireo, San Francisco garter snake, tidewater goby, Sacramento splittail, callippe silverspot butterfly, Antioch Dunes evening primrose, Contra Costa wallflower, Monterey gilia, San Francisco lessingia, Contra Costa goldfields, Marin dwarf-flax, Suisun thistle, coastal dunes milk vetch, Hickmann's potentilla, showy Indian clover, Sonoma alopecurus, San Bruno Mountain manzanita, pallid manzanita, La Graciosa thistle, and yellow larkspur. Other species along transportation routes were discussed in previous EIS's, and potential effects are summarized in Section IV.B.10. This EIS analyzes potential effects on species from a tanker oil spill along the transportation route from Valdez to ports along the U.S. West Coast. The average tanker spill is approximately 30,000 bbl, although most are smaller. The average spill size was increased as a result of the *Exxon Valdez* Oil Spill (EVOS). Based on Table IV.A.2-5a, the estimated mean number of spills under the Preferred Alternative ranges from 0.10 to 0.46. The most likely number of spills to occur resulting from NPR-A resources is zero spills under the Preferred Alternative over the assumed production life of the NPR-A. There is a 10- to 37-percent chance that one or more spills ≥1,000 bbl will occur under the Preferred Alternative over the assumed life of the IAP.

Under the multiple-sales approach, the estimated mean number of spills under the Preferred Alternative increases to a range of 0.14 to 0.66 (Table IV.A.2-5b). The most likely number of spills to occur resulting from NPR-A resources is zero spills under the Preferred Alternative over the assumed production life of the IAP. There is a 13- to 48-percent chance that one or more spills ≥1,000 bbl will occur under the Preferred Alternative over the assumed life of the IAP.

(1) Salmonids: Contact with sufficient concentrations of spilled oil may affect fish populations in several ways: (1) eggs and larvae may suffer increased mortality due to coating or direct toxic effects; (2) adults may fail to reach spawning grounds in critical, narrow, or shallow contaminated waterways; (3) fecundity or spawning behavior may change; (4) local food species of

the adults, juveniles, fry, or larvae may be adversely affected or eliminated; and (5) sublethal effects may reduce fitness and affect the ability to endure environmental perturbations. However, concentrations of petroleum hydrocarbons (PHC's) are toxic to fishes only a short distance from, and for a short time after, a spill event (Malins, 1977). Available information indicates that concentrations of PHC's found beneath an oil slick are <0.1 ppm. This is well below toxic levels for fish eggs and larvae (sublethal effects on eggs, larvae, and adults at 0.01-1.0 ppm; lethal effects on eggs and larvae at 0.1 to 1.0 ppm, and on adults at 1 to 100 ppm) (Malins, 1977; Meyer, 1990).

There is some evidence that pelagic fishes (salmon) are able to detect and avoid hydrocarbons in the water (Weber, et al., 1981), although some salmon may not completely avoid oiled areas and, if exposed to sublethal amounts of spilled oil, may become temporarily disoriented; but they would eventually return to their home stream (Martin, 1992). Adult salmon appear to be relatively unaffected by oil spills and are able to return to natal streams and hatcheries even under very large oil-spill conditions, as evidenced by pink and red salmon returning to Prince William Sound and red salmon returning to Cook Inlet after the EVOS. Eggs of pelagic fish that spawn upstream in rivers and streams, such as the salmonids referenced above, would be unaffected by an oil spill. Potential effects on outmigrating smolts are less clear. Based on Malins (1977), some smolts may experience sublethal effects if a large oil spill occurred in the mouth of the river, bay, or estuary during the time that outmigrating smolts reached that area. This probably is an unlikely scenario.

It also has been suggested that the EVOS caused a reduction in food available to pink salmon populations in Prince William Sound, and that this has caused reduced survival and subsequent failures in pink salmon runs. Studies examining growth, survival, and availability of prey for juvenile pink salmon have produced conflicting results. One study examined juvenile pink and chum salmon contaminated by ingesting EVOS crude in 1989 (Wertheimer et al., 1993). Oil was present in 1 percent and 3 percent of these salmon, respectively, that were collected at oiled sites in 1989; but there was no evidence of oil contamination in these same areas in 1990. Juvenile salmon were more abundant in unoiled areas, and this difference continued in 1990 after oil-exposure levels diminished. The observed difference was attributed to geographic differences in production and migration rather than oil exposure. The diet composition and feeding efficiency of these fish was unaffected by the oil spill. Juvenile pink salmon were smaller and slower growing in oiled areas in 1989 but not in 1990. There was no evidence of a reduction in available prey to pinks and chums in oiled areas in 1989 or 1990. The slower growth of pink salmon juveniles in 1989 was attributed to the metabolic cost of depurating the hydrocarbon burden. The slower growth may have caused an incremental reduction in survival to adulthood.

Overall, the potential for an oil spill to affect these species seems limited. Tanker routes usually pass well offshore of the coast, unless the tanker is approaching or entering a port. In the event that an oil spill occurred and coincided with the outmigration of smolt, some smolts could be exposed to spilled oil. If this occurred, an oil spill could cause slower growth for smolts, which could result in an incremental reduction in survival to adulthood but probably would not result in population-level effects.

(2) Tidewater Goby: No information is provided in 59 *FR* 5494 concerning the potential effects of an oil spill on tidewater gobies, in spite of the numerous oil tankers transporting oil along the coast of California. Coastal development projects that result in the loss of coastal saltmarsh habitat currently are considered the major factor adversely affecting the tidewater goby. This includes activities such as draining marsh habitat, dredging waterways, channelization, changes in salinity and temperature, discharge of agricultural and sewage effluents, etc. The potential for an oil spill to affect this species seems limited. Tanker routes usually pass well offshore of the coast unless the tanker is approaching or entering a port. The tidewater gobies are discontinuously distributed along the coast of California in tidal streams associated with coastal lagoons, and they are found at the upper end of those lagoons in low- salinity water. In the event of an oil spill occurring near one of these coastal lagoons, it may be possible to place booms across the openings of many of these lagoons and prevent oil from reaching the goby's habitat. If an oil spill did reach the upper portions of a lagoon, it could adversely affect these fish by causing further degradation of their habitat. Tidewater gobies could be adversely affected at the population level due to limited availability of suitable habitat, low population size, and their restricted ability to recolonize habitats from which they have been extirpated. In general, the potential for adverse effects on this species is considered low.

(3) Delta Smelt: No information is provided in 58 *FR* 12854 concerning the potential effects of an oil spill on the delta smelt, in spite of the numerous oil tankers transporting oil along the coast of California. A variety of factors affect the estuarine ecosystems that may have led to a decline of the delta smelt. The principal factor mentioned was large exports of freshwater for agricultural and urban use. The species also is threatened by other factors such as prolonged drought, introduced nonindigenous aquatic species, reduction in abundance of key food organisms, and agricultural and industrial chemicals. The potential for an

oil spill to affect this species appears limited. Tanker routes usually pass well offshore of the coast, unless the tanker is approaching or entering a port. The Delta smelt occurs primarily in the Sacramento River channel in the Delta. It is rare in Suisun Bay and virtually absent from Suisun Marsh. The potential for an oil spill to reach the Sacramento River channel is likely to be very low. In the event of an oil spill occurring near this area, it may be possible to place booms across the channel, preventing oil from reaching this species' habitat. If an oil spill did reach these areas, it could adversely affect this fish by causing further degradation of its habitat. The Delta smelt could be adversely affected at the population level due to limited availability of suitable habitat and low population size. In general, the potential for adverse effects on this species is considered low.

(4) Sacramento Splittail: No information is provided in 59 *FR* 862 concerning the potential effects of an oil spill on the Sacramento splittail in spite of the numerous oil tankers transporting oil along the coast of California. A variety of factors affect the estuarine ecosystems that have led to a decline of the Sacramento splittail. The principal factor mentioned was the altered hydraulics and reduced outflow of the delta caused by export of freshwater from the Sacramento and San Joaquin rivers. Threats to the species include reduced river outflow, loss of spawning and nursery habitat, urban and agricultural pollution, introduction of exotic species, etc. The potential for an oil spill to affect this species seems limited. Tanker routes usually pass well offshore of the coast, unless the tanker is approaching or entering a port. The Sacramento splittail occurs only in the Suisun Bay and the San Francisco Bay-Sacramento-San Joaquin river estuary. The potential for an oil spill to reach these areas is very low. In the event of an oil spill occurring near these areas, it may be possible to place booms across the openings of many of these lagoons, preventing oil from reaching the Sacramento splittail's habitat. If an oil spill did reach these areas, it could adversely affect these fish by causing further degradation of their habitat. The Sacramento splittail could be adversely affected at the population level due to limited availability of suitable habitat and low population size. In general, the potential for adverse effects on this species is considered low.

(5) Suisun Thistle: Information is provided in 59 *FR* 862 concerning factors that may affect the Suisun thistle. A variety of factors affect the estuarine ecosystems that have led to a decline of the Suisun thistle. Habitat has been severely reduced due to hydraulic mining, diking, and filling involved in agricultural land conversion and urbanization, waste disposal, port and industrial development, railroad construction, dredging, salt production, sedimentation, etc. The potential for an oil spill to affect this species seems limited. Tanker routes usually pass well offshore of the coast, unless the tanker is approaching or entering a port. The Suisun thistle occurs only in salt or brackish tidal marshes within the San Francisco Bay area. The potential for an oil spill to reach these areas is very low. In the event of an oil spill occurring near these areas, it may be possible to place booms across the openings of many of these lagoons, preventing oil from reaching the Suisun thistle's habitat. The plant would likely be vulnerable only on a high tide. If an oil spill did reach these areas, it could adversely affect this species by smothering the plants and causing further degradation of their habitat. The Suisun thistle could be adversely affected at the population level due to limited availability of suitable habitat and low population size. In general, the potential for adverse effects on this species is considered low.

(6) Other Coastal Species: Many listed, proposed, and candidate species occupy coastal habitats that are not expected to be exposed to the same risk of impact as estuarine or offshore habitats. In particular, riverine habitat, coastal dunes, and adjacent inland habitats inhabited by the Pacific pocket mouse, least Bell's vireo, San Francisco garter snake, callippe silverspot butterfly, Antioch Dunes evening primrose, Contra Costa wallflower, Monterey gilia, San Francisco lessingia, Contra Costa goldfields, Marin dwarf-flax, coastal dunes milk vetch, Hickmann's potentilla, showy Indian clover, Sonoma alopecurus, San Bruno Mountain manzanita, pallid manzanita, La Graciosa thistle, and yellow larkspur are unlikely to be contacted by an oil spill from a tanker transporting oil from the NPR-A under typical weather and oceanographic conditions. None of the Federal Register notices or recovery plans published by the FWS refer to a potential for adverse effects from oil spills on these species. Many of these species occur in inland habitats, some at substantial elevations above sea level, and would not be contacted by oil spilled from a tanker. For those species living in the coastal dune habitat, significant contact of coastal dune habitat by a tanker spill is unlikely. It is likely that any contact of the coastal dune habitat by spilled oil would require a combination of the tanker spill occurring in the immediate area, very high tides, and strong onshore winds that would have to persist for an extended period of time prior to or immediately after the spill. If this scenario were to occur, it is possible that small numbers of some species may be affected by spilled oil.

11. Economy:

a. Activities Other Than Oil and Gas Exploration and Development: The Preferred Alternative would generate recreation-field employment by 30, 1-week long float-trip parties per year (Table II.H.3.b), which is equal to one person working for 8 months each year.

b. Oil and Gas Exploration and Development Activities: Increased revenues and employment are the most significant economic effects that would be generated by the Preferred Alternative. Increased property-tax revenues and new employment would be created with the construction, operation, and servicing of facilities associated with oil and gas activities. These facilities are described in Table IV.A.1-1 and are summarized as follows. For exploration, 2 to 7 exploration and 2 to 10 delineation wells would be drilled between 2000 and 2006; for development 30 to 132 production and service wells would be drilled, 1 to 4 production pads constructed, and 20 to 95 mi of onshore pipeline installed between 2006 and 2017. The number of workers needed to operate the infrastructure is determined by the scale of the infrastructure and not by the amount of oil produced. A wide range of production volume can be handled by a given level of infrastructure. Once the infrastructure is in place, the number of workers needed to operate it does not depend on the amount of product flowing through it. Effects include employment generated by seismic surveys during exploration. State property-tax revenues are in proportion to the value of onshore facilities. State royalty income and State severance tax are in proportion to production. Peak yearly production is estimated at 9 to 42 MMbbl. (For complete descriptions of resources and associated activity, see Sec. IV.A.1.b)

(1) North Slope Borough Revenues and Expenditures: Exploration, development, and production are projected to generate increases in property taxes above the levels without the Preferred Alternative activities starting in 2000 and averaging about 1 to 2 percent each year through the production period, or about $2 to $4 million. For revenues shared by the State, see subpart (4) below.

(2) North Slope Borough Employment: The gains from the Preferred Alternative in direct employment would include jobs in petroleum exploration, development, and production and jobs in related activities (Table IV.G.11-1). Direct employment is anticipated to peak in the range of 1,300 to 1,600 jobs during the development phase and decline to a level in the range of 500 to 825 during production from 2018 to 2028.

Total NSB resident employment is anticipated to increase in the range of 42 to 44 jobs in the peak of development and level off to 17 to 27 during production after 2017 (Table IV.G.11-1). The peak increase in resident employment is about 2 to 3 percent greater with the Preferred Alternative than without during development and about 1 to 2 percent greater during production. The increase in employment opportunities may partially offset declines in other job opportunities and delay expected outmigration. Increases in resident population will correspond to increases in employment (Table IV.G.11-2).

No workers will be needed to clean up numerous small oil spills beyond those already employed in the workers' enclave.

(3) Effects of Subsistence Disruptions on the NSB Economy: Disruptions to the harvest of subsistence resources could affect the economic well-being of NSB residents primarily through the direct loss of subsistence resources. See Section IV.G.13 for effects on subsistence-harvest patterns.

(4) Local, State and Federal Revenues: Local, State, and federal revenues will increase as a result of the Preferred Alternative. Property-tax revenues to the State will be approximately 25 percent of the revenues to the NSB, or $0.5 to $1 million annually. The annual royalty will be $5 to $45 million for the Federal Government and $5 to $45 million for the State and the NSB. The average annual State severance tax is estimated to be $9 to $75 million.

(5) Southcentral Employment: Workers in the enclave centered at Prudhoe Bay probably would commute to permanent residences in Southcentral Alaska, Fairbanks, and outside the State. However, for the purpose of this analysis, it is assumed all of the enclave workers (Table IV.G.11-1) commute to Southcentral Alaska and have permanent residences there except during peak construction years.

Population in Southcentral generated directly and indirectly by enclave workers during production will be in the range of 7,500 to 12,000, or 2 to 3.2 percent of the Southcentral population. In the 7-year period of the exploration and development phases, the population directly and indirectly associated with the Preferred Alternative would rise to the level sustained during production.

Conclusion-First Sale: For activities other than oil and gas, the Preferred Alternative would generate approximately 50 jobs for 4½ months associated with seismic surveys and recreation-field employment, which is equal to one person working 8 months per year. Activities other than oil and gas would have no effect; production in the Preferred Alternative is projected to generate increases above the levels of Alternative B as follows: NSB property taxes, 1 percent ($1-$2 million); direct oil-industry employment, 200 to 500 during production (5 times this in additional jobs) residing in Southcentral Alaska; NSB resident employment, 1 percent; and annual revenues of $0.25 to $0.5 million property tax to the State, $1 to $8 million royalty to the Federal Government, $1 to $8 million royalty

Table IV.G.11-1
Summary of Employment Forecasts, Preferred Alternative

	IAP Employment in Enclave			NSB Resident Employment		
	Without IAP Activity	With IAP Activity		Without IAP Activity	*Increase* with IAP Activity	
Year		$18/bbl	$30/bbl		$18/bbl	$30/bbl
1999	0	0	0	1,865	0	0
2000	0	99	99	1,825	2	2
2001	0	179	259	1,794	8	9
2002	0	99	259	1,767	10	19
2003	0	39	359	1,746	8	25
2004	0	59	139	1,730	9	26
2005	0	269	349	1,716	9	20
2006	0	1,217	1,332	1,701	36	44
2007	0	670	844	1,685	40	42
2008	0	637	760	1,662	18	19
2009	0	625	1,578	1,614	14	32
2010	0	476	933	1,565	10	20
2011	0	476	889	1,513	14	24
2012	0	486	978	1,470	14	30
2013	0	495	956	1,431	15	30
2014	0	486	911	1,393	16	31
2015	0	486	911	1,357	17	31
2016	0	506	911	1,350	17	31
2017	0	506	911	1,330	17	31
2018	0	506	800	1,310	17	27
2019	0	500	800	1,290	17	27
2020	0	506	800	1,290	17	27
2021	0	506	800	1,310	17	27
2022	0	506	800	1,330	17	27
2023	0	506	800	1,350	17	27
2024	0	506	800	1,370	17	27
2025	0	506	800	1,390	17	27
2026	0	506	800	1,410	17	27
2027	0	506	800	1,430	17	27
2028	0	506	800	1,450	17	27

Sources: Resident employment 1999–2015, Rural Alaska Model, North Slope Borough, 1996; IAP employment and resident employment 2016–2028, Manpower Model and MMS.

Table IV.G.11-2
Summary of NSB Population Forecasts, Preferred Alternative

Year	Resident Population No IAP Activity	Increase in Resident Population		Year	Resident Population No IAP Activity	Increase in Resident Population	
		IAP Activity $18/bbl	IAP Activity $30/bbl			IAP Activity $18/bbl	IAP Activity $30/bbl
1999	6,067	0	0	2014	6,582	48	93
2000	6,134	6	6	2015	6,423	51	93
2001	6,213	24	27	2016	6,300	51	93
2002	6,301	30	57	2017	6,200	51	93
2003	6,391	24	75	2018	6,100	51	81
2004	6,488	27	78	2019	6,000	51	81
2005	6,684	27	60	2020	6,000	51	81
2006	6,695	108	132	2021	6,100	51	81
2007	6,820	120	126	2022	6,200	51	81
2008	6,918	54	57	2023	6,300	51	81
2009	7,011	42	96	2024	6,400	51	81
2010	7,050	30	60	2025	6,500	51	81
2011	7,004	54	72	2026	6,600	51	81
2012	6,891	42	90	2027	6,700	51	81
2013	6,743	45	90	2028	6,800	51	81

Sources: For years 1999–2015, Rural Alaska Model, North Slope Borough, 1996. For 2016–2028, MMS.

to the State and NSB, and $3 to $13 million severance tax to the State.

Multiple Sales: The effect of multiple sale for the Preferred Alternative is project to be approximately two times that of the first sale for the Preferred Alternative.

Conclusion—Multiple Sales: The effect of multiple sales for the Preferred Alternative is project to be approximately two times that of the first sale for the Preferred Alternative.

12. Cultural Resources: Cultural resources (the physical remains resulting from the activities of historic or prehistoric humans) are nonrenewable. Once they are adversely impacted and/or displaced from their natural context, the damage is irreparable. At the same time it is important to remember that cultural resources are not ubiquitous. Cultural resources, unlike habitat, wildlife, or visual resources are not found everywhere within the planning area or across the North Slope. On a percent-of-area basis most of the vast surface/subsurface area of the region is devoid of cultural resources and it is quite possible that much of the potential surface/subsurface disturbing activities associated with exploration, development, and production of hydrocarbons could occur with little impact to cultural resources. Although the probability of the occurrence of cultural resources in a given area or locale can be predicted to some degree (based on ethnohistory, geomorphology, and other natural factors), the bottom line remains that, cultural resources are where you find them, and that any area slated for surface disturbing activities must first be examined for the presence of cultural resources.

a. Activities Other than Oil and Gas Exploration And Development: Under the Preferred Alternative, the management-action impacts to cultural resources might occur as a result of overland moves, excavation and collection, and the establishment and operation of temporary field camps.

Overland moves normally occur between November and May when the ground is covered with snow and deeply frozen. In most cases at that time of year subsurface (buried) cultural material usually is safe from disturbance. In locations where cultural material is exposed on the surface of the ground beneath the snow, some minor impact may occur and some material may be slightly displaced from its context, if equipment traverses or operates directly over the cultural material. At somewhat greater risk is cultural material that lies on the ground's surface but is not covered by snow, such as on a wind-scoured ridge. At greatest risk are cultural resources that are composed of aboveground structures such as cabins, sod houses, caribou corrals, cairns, drying racks, kayak templates, etc. Aboveground structures receive little natural protection from snow or frozen ground and are often hidden from sight by snowfall, making them difficult for equipment operators to see.

Excavation and collection normally occurs during the summer and usually is the result of archaeological research, although the process is sometimes associated with geologic fieldwork. When an archaeological site is excavated, it is destroyed. Therefore, archaeological excavation and collection is the ultimate destructive impact on cultural resources, although the process is the most common mitigative technique when cultural resources are threatened and avoidance is not an option. Archaeological excavation usually is conducted as either a means of obtaining information for scientific purposes or for documenting the information in a site prior to its destruction by development activities or natural forces.

The temporary summer field camps commonly associated with scientific or resource assessment work generally impact only a relatively small area. Therefore, such camps and the activities that are associated with them, such as aircraft use, on-the-ground survey/reconnaissance, hazardous- and solid-material removal and site remediation, and recreation, are not expected to have a significant effect on cultural resources.

b. Oil and Gas Exploration and Development Activities: In general, the types of environmental conditions and the types of cultural resources that might be impacted by exploration activities would be similar to those described under activities other than oil and gas exploration and development.

(1) Effects of Disturbance from Exploration: In addition to yearly seismic data gathering activities (possible impacts were discussed previously under overland moves) the drilling of 17 exploration/delineation wells is anticipated under the Preferred Alternative. However, no more than three wells are expected to be drilled during a single winter season due to the limited number of drill rigs available. Drilling the 17 wells would probably occur over the span of several winter seasons using drill pads, camp pads, roads, and airstrips made of ice and snow. Because no permanent pads, roads, or airstrips would be constructed and therefore no significant disturbance of the ground surface would occur, buried cultural resources should not be measurably impacted. On the other hand, cultural resources on or incorporated in the ground's surface could be significantly impacted by ice- and snow-construction activities, while the integrity of aboveground cultural structures certainly would be compromised. The only significant surface/subsurface disturbance would occur as a result of the actual drilling itself.

(2) Effects of Exploration Spills: Sixty-five to eighty percent of all spills are confined to a pad. Spills not confined to a pad usually are confined to an area adjacent to the pad. Therefore, it is assumed that most spills would occur on an ice pad, ice road, or during winter conditions where cleanup is less invasive than that resulting in response to a summertime terrestrial spill. The actual spilling of hydrocarbons on a cultural resources site, in most cases, would have limited impact. Spill cleanup however could pose a serious threat to the integrity of a site, perhaps resulting in its destruction.

(3) Effects of Disturbance from Development: The construction of as many as four production pads (with road connections), an airstrip for each well complex, a pump station, and 95 mi of pipeline is anticipated under the Preferred Alternative. Surface disturbance resulting from this work could impact approximately 300 acres. Additional surface disturbance could occur, depending on the source of the material used to construct the pads; e.g., material borrow areas. Any cultural resources lying within the area to be impacted by pad, road, or airstrip construction or that is located within the material borrow areas, would be severely impacted or destroyed. It is anticipated that pipelines would not have associated all-weather roads or pads and would be constructed during the winter months from an ice road and pads. Therefore, aside from the previously mentioned impacts associated with ice-pad construction, the only significant surface impact resulting from aboveground pipeline construction will be associated with the placement of VSM's and check valves. Any cultural resources at the location of VSM's or check valves will be severely impacted or destroyed. If any or all of the pipeline(s) are to be buried (except under water bodies) the potential for impact to cultural resources greatly increases.

(4) Effects of Development Spills: Sixty-five to 80 percent of all spills are confined to a pad. Spills not confined to a pad usually are confined to an area adjacent to the pad or the pipeline. The actual spilling of hydrocarbons on a cultural resources site, in most cases, would have limited impact, especially if the spill occurs when the ground is snow-covered and frozen. However, spill cleanup may pose a serious threat to the integrity of the site, perhaps resulting in its destruction.

Conclusion—First Sale: Under the Preferred Alternative impacts to cultural resources from management activities other than oil and gas exploration and development would be minimal. Most of the potential impacts to cultural resources would result from oil and gas exploration and development activities which have already been discussed.

Multiple Sales: The potential impacts may increase by a much as a factor of four. The realization of the potential increase depends on a suite of variables, including shared infrastructure. As previously mentioned, the scattered nature of cultural locales and the fact that the location of many remain unknown, make it somewhat difficult to assess the likelihood and severity of potential impacts.

Conclusion—Multiple Sales: The types and nature of impacts to cultural resources resulting from multiple lease sales are the same as described for a single sale. The potential impacts to cultural resources from management activities other than oil and gas exploration and development would be similar in nature to what has been mentioned previously, however the probability of impacts occurring may increase with multiple sales. As a result of multiple sales the potential impacts to cultural resources from oil and gas exploration and development could increase severalfold.

13. Subsistence-Harvest Patterns: This section analyzes the impacts of ground-impacting-management actions and oil and gas leasing activity on the subsistence-harvest patterns of communities in or near the planning area. This analysis is organized by types of effects and discusses effects on subsistence-harvest patterns on each affected community as a result of disturbance and oil spills. Analytical descriptions of affected resources and species as well as indigenous Inupiat knowledge concerning effects are described in detail.

Under the Preferred Alternative, approximately two-thirds of the area of high oil and gas potential of the planning area would be available for oil and gas leasing while maintaining protection for high-value waterfowl and caribou calving habitats, important subsistence use areas, and areas of scenic and recreational significance. Teshekpuk Lake and the areas north and east of the lake would not be available for leasing (see Fig. II.C.1-6). Protective measures would forbid most types of surface use for oil and gas activities and would be imposed on (a) the northern part of the Teshekpuk Lake Special Area (all of the Goose Molting Habitat LUEA, important calving and insect relief areas of the Teshekpuk Lake Caribou Habitat LUEA, and all of Teshekpuk Lake) to protect waterfowl and caribou habitat and important subsistence use areas; (b) along Fish, Judy, and Kealok creeks and the Ikpikpuk and Miguakiak rivers to protect subsistence resources and uses; and (c) along the Colville, Kikiakrorak, and Kogosukruk rivers to address concerns for subsistence uses and raptor habitat. These areas would be available for leasing except for (a) above.

Setbacks from ½ to 3 mi on the Miguakiak, Colville, Kikiakrorak, Kogosukruk, Ikpikpuk rivers, and Fish, Judy, and Kealok creeks would prevent permanent oil and gas surface occupancy near these watercourses. No permanent

oil and gas occupancy would be allowed in the Deep Water Lakes/Fish Habitat LUEA, and no surface occupancy would be allowed within ¼ mi of fish-bearing lakes. Leasing would be allowed on lands subject to pending Kuukpik Corporation conveyances, but any lands selected before the sale would be deleted from the sale.

The Preferred Alternative includes its own set of stipulations that represent a revision of those presented in the draft IAP/EIS. Important stipulations include establishing procedures and advisory bodies to address subsistence resources and uses and research for inventorying and monitoring. Stipulation 61 describes a conflict avoidance procedure to address subsistence concerns and issues relating to oil and gas activities. Through this process, lessees would consult with the local communities, the NSB, and the Subsistence Advisory Panel (a special body created to address subsistence issues, concerns, and research). Also, representatives of Federal, State, and NSB agencies with biological expertise would comprise an Interagency Research and Monitoring Team. This team would coordinate research and monitoring projects related to the effectiveness of stipulations and impacts to surface resources and consult with the Subsistence Advisory Panel.

Proposed stipulations and particularly the work of the Subsistence Advisory Panel are designed to address local subsistence and cultural issues. The following list would implicitly include all local concerns within proposed stipulations or through review by the Subsistence Advisory Panel. Proposed subsistence stipulations by BLM under the Preferred Alternative that specifically address local concerns about subsistence resources and uses would require the lessee to:

1. Develop a monitoring plan, in consultation with the Interagency Research and Monitoring Team and the Subsistence Advisory Panel, for effects of exploration, development, and production on subsistence (No. 59).
2. Not unreasonably restrict subsistence access to development areas (No. 60).
3. Establish procedures for entrance to facilities, the use of roads, and firearms discharge in consultation with local communities, the NSB, and the Subsistence Advisory Panel (No.60).
4. Develop and distribute information about how to conduct subsistence activities in development areas safely to local communities (No. 60).
5. Operate in a manner that prevents oil activities from unreasonably conflicting with subsistence activities (No. 61).
6. Consult with local communities, the NSB, and the Subsistence Advisory Panel about siting, timing, methods of operation, and mitigation that could be implemented to assure that exploration, development, and production activities do not conflict with subsistence practices. To ensure this end, conflict resolution agreements are encouraged. Local communities, the NSB, and the Subsistence Advisory Panel all will concurrently review any exploration, development and production plans, and any interested party may request that BLM initiate a dispute resolution group (made up of local communities, the Subsistence Advisory Panel, the NSB, and the lessee), if no conflict resolution agreement is reached. This process would apply to all concerns expressed by subsistence users (for example, seismic operation conflicts with traditional land use sites) (No. 61).
7. Give special consideration in the consultation process described above to the following areas: a 2-mi zone around long-term cabin sites and campsites, a 2-mi zone from the east bank of the Ikpikpuk River, a 3-mi zone from each bank of the Miguakiak River, a 2-mi zone from each bank of Kealok Creek, a 3-mi zone from each bank of Fish Creek downstream from Sec.31 T.11N., R1E. and a 2-mi zone from each bank upstream of Sec.31 T.11N., R.1E., a 2-mi zone from each bank of Judy Creek, a 2-mi zone from each bluff downstream from T.2N., R.3W., Umiat Meridian of the Kogosukruk River, and a 2-mi zone from the west bluff and extending the length of the Colville River in the Colville River Raptor, Passerine, and Moose LUEA (No. 62).
8. Develop a orientation program for all oil and gas industry personnel that informs these workers of local environmental, social, and cultural concerns. The program will be designed to increase sensitivity and understanding of local community values, customs, and lifestyles and to provide information on avoiding conflicts with subsistence (No. 63).
9. Conduct an inventory of known traditional land use sites to develop a plan to avoid these sites and to mitigate any possible damage to them. The plan will indicate how access to the site by local subsistence users will be provided. This plan will also be provided to the Subsistence Advisory Panel (No. 64).

The planning area includes the eastern half of Barrow's terrestrial subsistence-harvest area, the western half of Nuiqsut's terrestrial subsistence-harvest area, and the eastern edge of Atqasuk's terrestrial subsistence-harvest area crosses over the western boundary of the planning area (the Ikpikpuk River) (Sec. III.C.3).

As noted in Sections III.C.2 and 3, onshore oil developments at Prudhoe Bay already have affected the subsistence-harvest system. Many of these effects are the indirect result of increased wage employment made available through projects and services funded by the NSB. Wage employment has led to an upgrading of hunting technology but, alternatively, has constricted the total time

available for hunting. Additionally, Prudhoe Bay development has restricted access to traditional hunting areas in the vicinity. Currently, diminished household incomes, reduced by the loss of high earnings from NSB CIP activity in the early to mid-1980's, tend to encourage subsistence activity and to foster an increase in harvest levels and an expansion of subsistence-harvest areas for many subsistence resources (Pedersen, 1997). Another effect to subsistence-harvest patterns has been the alteration of use areas due to Prudhoe Bay development. Pedersen (1998, pers. comm.) has indicated that Nuiqsut residents have altered their use patterns around Prudhoe Bay, and Nuiqsut residents confirm this. Another major change is increased access to Deadhorse, the haul road, and beyond provided by a winter ice road that has connected Nuiqsut and Prudhoe Bay for the last few years.

Access to subsistence resources, subsistence hunting, and the use of subsistence resources could be affected by reductions in subsistence resources and changes in subsistence-resource-distribution patterns. These changes could occur as a result of disturbance from seismic surveys, aircraft and vessel traffic, drilling activities, and construction activities that include pipeline construction; structure placement; and support-base, pump-station, and road construction. The following analysis examines the effects of these disturbance agents on the communities near the planning area, with specific information on the subsistence resources harvested by the Inupiat living in these communities. This analysis discusses impacts on the terrestrial resources harvested by the residents of Barrow, Atqasuk, and Nuiqsut.

The factors affecting the subsistence-harvest patterns of Barrow, Atqasuk, and Nuiqsut are summarized as follows:

- Heavy reliance on caribou in the annual average harvest for Barrow (22-58% of the total subsistence harvest), Atqasuk (57%), and Nuiqsut (30-37%) (see Table III.C.4-3; Stoker, 1983, as cited by ACI/Braund, 1984; S.R. Braund 1989b; State of Alaska, ADF&G 1995d; S.R. Braund and Assocs. and ISER, 1993b; Pedersen, 1995a, 1995b; S.R. Braund and Associates, 1996; Brower and Opie, 1997; Opie, Brower, and Bates, 1997).
- Heavy reliance on bowhead whales in the annual average harvest for Barrow (21-38%) and Nuiqsut (4-38%) (see Table III.C.2-4; Stoker, 1983, as cited by ACI/Braund, 1984; S.R. Braund and Assocs. 1989b; ADF&G, 1995d; NSB Planning Dept., 1993; Kaleak, 1996; Brower and Opie, 1997). Percentages have continued to rise, because IWC quotas have almost doubled in recent years.
- Reliance on fish in the annual average harvest for Barrow (6-7%), Atqasuk (37%), and Nuiqsut (44-33%), (see Table III.C.2-4; S.R. Braund and Assocs. 1989b; ADF&G 1995d; Brower and Opie, 1997; Opie, Brower, and Bates, 1997).
- Hunting ranges overlap for many species harvested by Barrow, Atqasuk, and Nuiqsut.
- Hunting and fishing are cultural values that are central to the Inupiat way of life and culture.
- In 1990, the population of Barrow was 3,469; Atqasuk, 216; and Nuiqsut, 354. In 1997, the ADOL estimates were 4,380 for Barrow, 233 for Atqasuk, and 435 for Nuiqsut (ADF&G, 1995d; State of Alaska DCRA, 1997).

Effects Agents: The agents associated with management actions and oil and gas leasing in the planning area that could affect subsistence resources and subsistence-harvest patterns are impacts from disturbance and oil spills from activities other than oil and gas exploration and development and from oil and gas exploration and development activities.

Effects Definitions and Effects Levels: The assessment of effects levels derives from a set of effects-level definitions that have been developed over many years by MMS anthropologists and socioeconomic specialists and that have withstood many professional and legal reviews. These definitions follow a two-tiered approach in that they account for effects to subsistence resources as well as effects to subsistence harvests. Disturbance to subsistence is measured by duration of effect to resources and harvests and by changes in availability, in desirability, and in population levels of resources. The definitions used in this analysis consider periodic (short-term) effects to resources that have no consequent effects to harvests as the lowest level of effect (very low effect). The next level of effect has resources being affected for a period up to 1 year (1 harvest season), but none of these resources would become unavailable, undesirable, or experience population reductions and, therefore, would not alter subsistence harvests (low effect). The third gradation of effect has resources becoming unavailable, undesirable for use, or experiencing population reductions for a period up to 1 year (1 harvest season), with subsistence harvests being affected for that period (moderate effect). The next level of effect is similar to the previous definition, except resources would become unavailable, undesirable for use, or experience population reductions for a period from 1 to 2 years (2 harvest seasons) with subsistence harvests affected for a longer period (high effect). The highest level of effect defined again follows the structure of the previous two effects levels with resources becoming unavailable, undesirable for use, or experiencing population reductions for a period from 2 to 5 years (5 harvest seasons) with subsistence harvests affected for a much longer period (very high effect).

Disturbance: The noise-producing exploration and construction activities of seismic surveys, aircraft traffic, vessel traffic (supply vessels), and construction activities are those most likely to produce disturbance effects to subsistence species that include bowhead whales, beluga whales, caribou, fish, seals, walrus, and birds. A more detailed narrative of the effects from these activities on important subsistence species can be found in Section IV.B.10 of the Beaufort Sea Sale 144 Final EIS (USDOI, MMS, 1996a) and is summarized and incorporated here by reference.

Disturbance effects would be associated with aircraft and vessel noise, construction activities, and oil spills; specifically: (1) seismic surveys that occur prior to an oil and gas lease sale; (2) aircraft support of exploration and development activities; (3) possible vessel supply and support of exploration and development activities; (4) drilling activities during the exploration and development and production phases; and (5) onshore construction, including pipeline, road, support-base, landfall, and pump-station construction. Noise and traffic disturbance would be a factor throughout the life of the IAP.

Disturbance from construction activities could cause some animals to avoid areas in which they normally are harvested or to become more wary and difficult to harvest. The latter could be a concern during the bowhead whale migration offshore, although possible supply-barge traffic to coastal staging areas likely would occur during the summer when whales are not present and tend to follow a nearshore route. Current Western scientific research indicates bowheads do not seem to travel more than a few kilometers out of their original swimming direction due to noise-disturbance events, and that these changes in swimming direction are temporary, lasting from a few minutes for aircraft and vessel noise to up to 1 hour in response to seismic activity. Traditional Inupiat observation and experience affirms that whales are affected by noise at greater distances and alter their swimming directions for longer periods. In some instances, as in the case of nesting birds, construction activities may decrease the biological productivity of an area. Restrictions may be placed on the use of firearms in areas surrounding new oil-related installations (such as roads, landfalls, and pipelines) to protect oil workers and valuable equipment from harm. Finally, structures such as pipelines may limit hunter access to certain active hunting sites.

a. Ground-Impacting-Management Actions:

(1) Activities Other than Oil and Gas Exploration and Development: Ground-impacting-management actions within the planning area that may affect subsistence resources and harvest patterns under the Preferred Alternative include aircraft use for point-to-point transport, wildlife and other aerial surveys, ground activities such as seismic surveys, resource inventories for paleontological and cultural excavations, research and recreational camps, and overland moves, as well as guided hunting and river float parties on the Colville River from the headwaters to below Umiat. Hazardous- and solid-waste removal and remediation would continue to occur at abandoned drill sites. Only potential oil spills from fuel storage at construction sites and camps could occur, but the size of such spills is likely to be small (a few barrels) and areal contamination small. Cleanup activity is not likely to cause great disturbance to normal subsistence-harvest activities or the surrounding environment. As these are normal occurrences under the existing BLM management regime, little net change is expected in disturbance effects to subsistence resources and harvest patterns of the communities nearby the planning area.

(2) Oil and Gas Exploration and Development Activities: Oil exploration activities—seismic activity and exploration drilling—would occur in winter (early December to mid-April). Transportation of construction materials (and gravel for pads), personnel, and fuel would be done over winter ice roads from existing infrastructure at Prudhoe Bay and Kuparuk. Large equipment would be barged to coastal staging areas in the summer, stockpiled, and moved inland the following winter. Seismic surveys would continue on the NPR-A if a leasing program occurs and typically would involve 1 to 2 crews of 60 persons each collecting approximately 5 to 10 line miles of seismic data per day. A typical operation would employ Vibroseis trucks, supply vehicles, and a supply train pulling a camp on skids that would provide living facilities for the crew. Under the Preferred Alternative, 1 to 2 fields with a resource range of 90 to 420 MMbbl of oil is estimated. Two to 7 exploration wells would be drilled. For development, 2 to 10 delineation and 30 to 132 production and service wells could be drilled, as well as 20 to 95 mi of pipeline constructed. At $18/barrel, the Preferred Alternative would not be an economically viable stand-alone field, although small fields located close enough to the Alpine field to share infrastructure could be commercial under these circumstances.

(a) Effects of Disturbance: During the exploration phase, facilities at Kuparuk and Prudhoe/Deadhorse, and a new coastal site at Kogru River would be used for air-support staging, where personnel and air freight would be transferred to aircraft. Two fixed-wing aircraft trips per week per drill unit are assumed for exploration. The existing facilities at Kuparuk and Prudhoe Bay are adequate to handle the projected needs during exploration. Air traffic through Barrow might increase, but no significant staging of equipment or personnel would occur from the community. During the development phase, facilities at Kuparuk and Prudhoe/

Deadhorse also would be used for air-support staging, and air traffic would increase. Seismic and drilling activities would occur in the winter, as would transportation of construction equipment; in this way, disturbance to subsistence resources would be kept to a minimum.

(b) Effects of Spills and Spill Cleanup: The analysis for North Slope onshore spills indicates a record of chronic small spills, 65 to 80 percent of which occur on the drill pad. Twenty to 35 percent of these spills may occur on or reach areas off pad. Thirty-two percent of the crude-oil spills between 1989 and 1996 were ≤2 gal. Ninety-nine percent of the crude-oil spills were <25 bbl and, during the same period, no spills >1,000 bbl occurred. Of the spills that move off pad, generally coverage is <500 ft^2; spills that occur in winter contact snow, which is cleaned up before the tundra is contaminated.

1 to 2 fields with a resource range of 90 to 420 MMbbl of oil is estimated. Two to 7 exploration wells would be drilled. For development, 2 to 10 delineation and 30 to 132 production and service wells could be drilled, as well as 20 to 95 mi of pipeline constructed. At $18/barrel, the Preferred Alternative would not be an economically viable stand-alone field, although small fields located close enough to the Alpine field to share infrastructure could be commercial under these circumstances.

Under the Preferred Alternative, one to two fields with a resource range of 90 to 420 MMbbl of oil is estimated. Oil-spill-occurrence estimates over the assumed production life of the IAP range from 18 to 84 crude-oil spills ≥1 gallon, with a volume range from 72 to 336 bbl (average spill size equals 4 bbl). For TAPS spills resulting from NPR-A production, the number of spills ranges from one to six, with a volume ranging from 1 to 7 bbl. The oil-spill-occurrence estimate for TAPS tanker spills resulting from NPR-A resources is a 90- to 63-percent chance of 0 spills (with an average spill size of 30,000 gal) occurring. One-hundred- sixteen to 510 refined-oil spills (diesel fuel, aviation fuel, engine lube, fuel oil, gasoline, grease, hydraulic oil, transformer oil, and transmission oil) with an estimated volume ranging from 42 to 195 bbl (average spill size equals 29 gal) are estimated. Historically, by volume, diesel fuels account for 75 percent of the refined-oil spills.

All NPR-A scenarios call for an onshore pipeline for oil delivery to TAPS, and there is the potential for a pipeline spill contaminating the Colville River. Adequate data are not available to estimate a chance of such an occurrence. Records indicate four pipeline leaks, with the largest discharge being 125 bbl. A spill entering the Colville River potentially could affect fish populations, disrupt subsistence-fishing activity, and curtail the subsistence hunt as resources well may be tainted or, even if available, the perception of tainting would affect substantially the subsistence harvest (Sec. IV.C.13, Subsistence).

Other industrial activities associated with oil development that could have an effect on subsistence-harvest patterns would be the result of cleanup if an oil spill did occur. In the event of a large spill contacting and extensively oiling habitats, the presence of hundreds of humans, boats, and aircraft would increase the displacement of subsistence species and alter or reduce access to subsistence species by subsistence hunters. Because oil spills estimated from NPR-A activities would be small, chronic events and normally be contained on the drill pad, effects from the spills themselves and potential disruption from cleanup activities would have little to no impact on subsistence resources and harvest patterns.

b. Effects on Subsistence Species:

(1) Terrestrial Mammals:

(a) Effects from Disturbance: The disturbance to caribou from scientific study was noted by Noah Itta in 1993 public testimony, where he related having to kill a caribou that was suffering from rubbing the hair and skin off its legs trying to get free of a radio collar (USDOC, NOAA, NMFS, 1993). Pipelines can create physical barriers to subsistence access, making subsistence hunters' pursuit of caribou more difficult (Kruse et al., 1983). Additional pipelines built as a result of oil and gas activities in the planning area could disrupt the Nuiqsut subsistence caribou hunt to the extent the constructed pipeline and roads displaced caribou from traditional subsistence-hunting areas. Effects from disturbance to the subsistence harvests of caribou and other terrestrial mammals in Nuiqsut, Barrow, and Atqasuk are expected to be short term, as their caribou harvests depend primarily on the Teshekpuk Lake Herd, which would be protected by no leasing in the northern part of the planning area. No leasing in this area would protect primary calving and migration areas and stipulations would protect subsistence uses.

(b) Effects of Spills: The potential for an oil spill occurring, contacting, and seriously contaminating areas used by Barrow, Atqasuk, and Nuiqsut subsistence-caribou hunters is very low, considering the data that indicate primarily chronic, small spills that most often are contained on pad. If a spill occurred off the pad, the impact would be very local and would tend to contaminate tundra in the immediate vicinity of the spill source.

(2) Fish:

(a) Effects from Disturbance: Complaints about reduced fish size and overall harvest size persist in

Nuiqsut although subsistence-fish resources still accounted for 33 percent in 1993 (Pedersen, 1996) and 25 percent in 1995 of the total subsistence harvest for the community (Brower and Opie, 1997) (Sec. IV.G.7). Overall effects on fish resources from seismic noise and construction disturbance are expected to be short term and have no measurable impact on the subsistence fisheries of Barrow and Nuiqsut; Atqasuk's subsistence fishery does not quite reach the western edge of the planning area. Subsistence mitigation that includes setbacks from primary subsistence creeks and rivers would further protect subsistence fisheries.

(b) Effects from Spills: Chronic crude-oil and fuel spills, a potential seawater pipeline spill, and spills in or reaching Teshekpuk Lake and the Colville River may adversely affect arctic fish in the immediate area but are not expected to have a measurable effect on arctic fish populations. The potential for an oil spill occurring, contacting, and seriously contaminating areas used by Barrow, Atqasuk, and Nuiqsut subsistence fisherman is very low, considering the data that indicate primarily chronic, small spills that most often are contained on pad.

(3) Birds:

(a) Effects from Disturbance: Overall effects on subsistence waterfowl from seismic noise and construction disturbance are expected to be short term, and have little measurable impact on the subsistence waterfowl harvests of Barrow, Atqasuk, and Nuiqsut. Stipulations specifically designed to protect wetlands and restrict air traffic, deferral of the entire Goose Molting Habitat LUEA from leasing under the Preferred Alternative, stipulations protecting subsistence habitats and uses would further protect subsistence waterfowl resources.

(b) Effects from Spills: Off-pad oil spills would put loons and waterfowl at greatest risk. Especially at risk would be the large numbers of molting geese that occupy open waterbodies. (Sec. IV.C.8). The potential for an oil spill occurring and contacting areas used by Barrow, Atqasuk, and Nuiqsut subsistence-waterfowl hunters is very low, considering the data that indicate primarily chronic, small spills that most often are contained on the pad. Small oil spills, a potential seawater pipeline spill, and a larger spill entering lakes such as Teshekpuk Lake could occur. Impacts on the subsistence waterfowl harvests of Barrow, Atqasuk, and Nuiqsut would not make any waterfowl resource unavailable, undesirable for use, or experience overall population reductions. Stipulations specifically designed to protect wetlands and restrict air traffic, deferral of the entire Goose Molting Habitat LUEA from leasing under the Preferred Alternative, stipulations protecting subsistence habitats and uses would further protect subsistence waterfowl resources.

(4) Bowhead Whales:

(a) Effects from Disturbance: Overall effects to bowhead whales exposed to noise from marine vessel traffic and possible aircraft overflights would be temporary and nonlethal and have no apparent effects on the subsistence bowhead whale hunt in Barrow and Nuiqsut.

(b) Effects from Spills: Oil spills are not likely to pose direct threats to bowhead whales, but, in the unlikely event that a spill occurred in the marine environment, whales could experience skin contact, baleen fouling, respiratory distress caused by inhalation of hydrocarbon vapors, localized reduction in food resources, consumption of some contaminated prey items, and perhaps a temporary displacement from some feeding areas. It is even more unlikely that this spill would contact whales in their normal migration path. Therefore, effects from oil spills are not expected to make bowhead whales unavailable, undesirable for use, or experience overall population reductions.

(5) Other Marine Mammals:

(a) Effects from Disturbance: Overall effects on seals and polar bears from noise and disturbance along the coast, primarily in the Colville River Delta-inner Harrison Bay area, are expected to be local and short term (generally <1 year) and the subsistence harvest for seals and polar bear is expected to be unaffected.

(b) Effects from Spills: A small number of seals and no more than a few polar bears might be adversely affected or killed by a 325-bbl crude oil spill contacting the Colville River, but these losses would not be significant to marine mammal populations. Small onshore spills are unlikely to reach the marine environment and affect seals and polar bears. In terms of the subsistence harvest, effects from oil spills are not expected to make seals or polar bears unavailable, undesirable for use, or experience overall population reductions.

c. Effects on Communities: Effects on Barrow, Atqasuk, and Nuiqsut from oil-industry-development disturbance are discussed in detail in Section IV.B.10 of the Beaufort Sea Sale 170 Final EIS (USDOI, MMS, 1998). See previous discussions in this section of effects on the primary subsistence species: caribou (and other terrestrial mammals), fish, birds, bowhead whales, and other marine mammals. Effects assessments from these sections are summarized below; also included is a synthesis of traditional knowledge (where available) that addresses the specific disturbance agents.

(1) Barrow—Effects from Disturbance and Spills: Overall, short-term, localized, nonlethal impacts from disturbance and oil spills are expected on the Teshekpuk Lake Caribou Herd, other terrestrial mammals, fish, birds, bowhead whales, and other marine mammals harvested by Barrow subsistence hunters and would have little effect on Barrow's subsistence harvest. Under the Preferred Alternative, it is expected that subsistence-hunter concerns about access to resources and resource contamination would be minimal. Impacts would be further minimized by not leasing in important caribou, waterfowl, and fishing areas under this alternative, and from proposed stipulations, particularly the work of the Subsistence Advisory Panel designed to address local subsistence and cultural issues.

Barrow resident Charles Brower stated in 1986 that subsistence access could be adversely affected if a pipeline were built; additional hunting restrictions would occur, requiring a permit (USDOI, MMS, Alaska OCS Region, 1986). And the fact remains that pipelines built in the past have created access problems. Taqulik Hepa, NSB, Dept. of Wildlife Management subsistence research specialist, has made it clear that an NPR-A IAP/EIS must identify stipulations to protect subsistence-hunting sites, traditional fish camps, and access routes from development impacts (USDOI, BLM, 1997a) (see Sec. II).

Oil-industry impacts were described by Barrow elder Jonah Leavitt testifying in court in a class-action suit filed against the U.S. Government in 1980 to gain allotments and protect traditional hunting and fishing areas from industry development within the NPR-A:

> My grandfather, William J.L. Inuguak, moved on to the land in the fall of 1844. At first he lived in someone else's sod house; then he built his own house. My grandfather lived there because the fishing was so good. Other people would stop at that place and fish when they were on their way to trap foxes up inland. The lake nearby had very good fishing up until 1961. Then a vehicle broke down the side bank of the lake and the water drained out. Now we cannot fish in the lake. Baxter Adams, a resident of Barrow, saw the tracks, and he told me that they were made by an LVT (Land Vehicle Transport) vehicle (The Arctic Coastal Zone Management Newsletter, Nov. 1980).

Noah Itta described past impacts from older seismic techniques, where fish disappeared for three years due to seismic disturbance. "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" (USDOI, BLM, 1997a). More recent seismic activity still has considerable effects to wildlife, even when conducted in winter. Harry Brower, Jr., whaling captain and subsistence analyst for the NSB Department of Wildlife Management, had this to say of his recent observations traveling NPR-A:

> 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 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 Piks 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. And there was no caribou in the area. Well you know, I'd seen that. I made these trips up to my cabin. It's up on the Ikpikpuk River and I've observed the displacement of the wildlife over the winter. I've been going back and forth since December to just last week and I've seen the different areas where they've been over the winter, and I just wanted to bring that out, of my personal observations...(USDOI, BLM, 1997a).

At the Barrow NPR-A Scoping Meeting, Johnny Aiken spoke about oil-development impacts on a variety of species:

> We go to Taqulik lake where we go fishing. Every now and then in that particular lake we hardly get any fish. It's a surprising time. Two years ago we hardly got any grayling from that spot, that's our main grayling fish getter and we hardly got any a couple of years ago; that was surprising. And then in our river Kuparuk...we hardly get any more fish there... and I want to say too that I grew up hunting ugrooks and...I don't hardly see those ugrooks out there no more. And those eiders, the colored ones, me and my papa used to hunt them. We don't see those no more, hardly ever see them...(USDOI, BLM, 1997a).

Both the establishment of a Subsistence Advisory Panel under the Preferred Alternative (and under Alternatives C-E) and the adoption of effective stipulations designed specifically to protect subsistence resources and

subsistence practices will serve to address local concerns about scientific survey impacts to caribou, pipelines as barriers to caribou migration, reduced fish size, fewer fish in lakes, pollution impacts from past NPR-A exploration, winter seismic effects to caribou and furbearers, and reduced populations of ugrooks and eiders. The panel was conceived specifically to address local subsistence issues, to assist in monitoring the effects of oil and gas activity on subsistence practices, and to help design solutions to ongoing subsistence conflicts with development.

(2) Atqasuk—Effects from Disturbance and Spills: Overall, short-term, localized, nonlethal impacts from disturbance and oil spills are expected on the Teshekpuk Lake Caribou Herd, other terrestrial mammals, fish, birds, bowhead whales, and other marine mammals harvested by Atqasuk subsistence hunters and would have little effect on Atqasuk's subsistence harvest. Under the Preferred Alternative, it is expected that subsistence-hunter concerns about access to resources and resource contamination would be minimal. Impacts would be further minimized by not leasing in important caribou, waterfowl, and fishing areas under this alternative, and from proposed stipulations, particularly the work of the Subsistence Advisory Panel designed to address local subsistence and cultural issues.

Luke Kagak, president of Atqasuk Search and Rescue, expressed concern for areas critical to calving caribou and nesting waterfowl, suggesting that special management zones be established for these populations. He believes oil development has affected animal migrations and duck populations near Prudhoe Bay. He contends that development should not occur any closer than 15 to 20 mi to these habitats. Kagak adds that the oil industry should be responsible for funding studies that survey these population effects that have already occurred to wildlife near Prudhoe Bay. It is up to industry to prove developments not Native subsistence hunters: "The question is, industry, oil and gas developers in particular, have made life rather difficult for us. We have had to go so far as to make accommodations and pay for scientists...to document what we've known so that we can continue a way of life that we've had for centuries or forever. Why not have industry themselves try to find out...what happened to those species whose populations we have seen decline over the years because of impacts that they have done?" (USDOI, BLM, 1997a; Adams, 1997:1, 2). Arnold Brower, Sr., interviewed in the early 1980's, remembers returning from World War II and noticing the extensive environmental damage left by the Navy. He believed that damage done by the Navy near Imagruaq Lake damaged the tundra to such an extent that a drainage ditch was created that lowered the lake's water level and ruined fishing there. After the War, Navy exploration continued and Thomas Brower, Sr., remembers having to negotiate with the Navy so their planes wouldn't buzz his reindeer herd (Arundale and Schneider, 1987).

After World War II, seismic exploration was a problem to the reindeer in other ways, and Brower remembers the seismic wire catching in the hooves of the reindeer and making them lame (Arundale and Schneider, 1987). Fifty years later, seismic activity still is a problem. Karen Burnell, NSB Planning Director, indicated at the March 1997 Atqasuk NPR-A Scoping Meeting that inspection of seismic crews is necessary to keep their activities in line with permitting guidelines: "We have found a couple of instances where spills had occurred, small spills, but we didn't think they were adequately cleaned up, so we required the company to go back an do a better job. Or there's been debris left behind; we've made them go back and pick it up and since we've started doing that they know that we're going to be following them around; they've changed drastically in the last couple of weeks" (USDOI, BLM, 1997a).

Access issues are viewed as critical in view of the areas near Prudhoe now off limits to subsistence. Arnold Brower, Jr., NSB NPR-A Coordinator, said that similar firearm restrictions at oil-development sites would create problematic detours for subsistence hunters. Atqasuk subsistence hunter Dave Summond added: "I have an allotment out there at Ikpikpuk. I have land there and it won't be right if I'm not able to take my guns with me for purposes of hunting" (USDOI, BLM, 1997a).

Past drilling activity in the NPR-A has left its mark. Thomas Brower, Jr., notes: "I have gone how many times to Inigok where there was some drilling that took place, and I have seen bones from birds that have been killed...after they drill a hole, the stuff they leave behind, the fluids. I don't want to see that kind of thing happening where we see our wildlife and waterfowl dying from contaminants being left after having conducted drilling activity. I don't want to see that kind of thing" (USDOI, BLM, 1997a).

Considering the overall impact of NPR-A oil development near Atqasuk, Luke Kagak explained: "We need to be thinking of our future and what we leave for our children as we go through this process" (USDOI, BLM, 1997a). Atqasuk elder Ella Sakeagak, interviewed in the early 1980's, summed up the local attitude (that is still current today) about oil development in the vicinity of the village: "We lived at Suqlak [just west of Teshekpuk Lake]; our little house is up there. It's standing. There's lots of fish, all kinds of animals, and I desperately wish that the people working for oil would not disturb that hunting area" (Arundale and Schneider, 1987).

Both the establishment of a Subsistence Advisory Panel under the Preferred Alternative (and under Alternatives C-E) and the adoption of effective stipulations designed specifically to protect subsistence resources and subsistence practices will serve to address Atqasuk's concerns about establishing special game-management zones, impacts to animal migrations, reduced duck populations (especially eiders), the need for industry to monitor development effects to subsistence resources and practices, past environmental damage and contamination from exploration, anticipated contamination from drilling, fuel spills and litter left by seismic crews, firearm restrictions around development sites, and general disturbance to animal populations.

(3) Nuiqsut—Effects from Disturbance and Spills: Overall, short-term, localized, nonlethal impacts from disturbance and oil spills are expected on the Teshekpuk Lake Caribou Herd, other terrestrial mammals, fish, birds, bowhead whales, and other marine mammals harvested by Nuiqsut subsistence hunters and would have little effect on Nuiqsut's subsistence harvest. Under the Preferred Alternative, it is expected that subsistence-hunter concerns about access to resources and resource contamination would be minimal. Impacts would be further minimized by not leasing in important caribou, waterfowl, and fishing areas under this alternative, and from proposed stipulations, particularly the work of the Subsistence Advisory Panel designed to address local subsistence and cultural issues.

Pipelines can create physical barriers to subsistence access, making subsistence hunters' pursuit of caribou more difficult (Kruse et al., 1983). Fourteen years later, this same concern was still being expressed by Nuiqsut officials Leonard Lampe and Thomas Napageak, who recounted how designed caribou crossings of pipelines did not seem to work (USDOI, BLM, 1997a).

Elder Bessie Ericklook from Nuiqsut maintained that since the oil fields have been established [at Prudhoe Bay], the foxes have been dirty and discolored in [the] area of Oliktok [Point] (USDOI, MMS, 1979a). Leonard Lampe, present Mayor of Nuiqsut, recently expressed further concern for air-pollution and habitat problems, asserting that Nuiqsut has been experiencing these effects for some time: "A lot of air pollution, asthma, bronchitis—a lot with young children. We see smog pollution that goes from Prudhoe Bay out to the ocean and sometimes to Barrow when the wind is blowing that way. Tundra damage around the village" (Lavrakas, 1996:1, 5). At the NPR-A Scoping Meetings in the village, Lampe reaffirmed his concern for air-quality degradation; Rosemary Ahtuangaruak noted that: "The atmosphere has eroded and the fear of ozone depletion is upon us. What will be done to combat this?" (USDOI, BLM, 1997a). A Nuiqsut hunter commented in a subsistence survey done in the community by the NSB Wildlife Management Department in 1995 that white fox couldn't be trapped at Prudhoe Bay anymore because of yellow skin (Brower and Opie, 1997). In this same survey, another hunter observed that gas from Deadhorse was poisoning the animals; he was very concerned about gasses from Prudhoe (Brower and Opie, 1997).

Noting problems with seismic activity, Lampe continued, "I swear they seismiced the entire North Slope. It's dangerous with snowmachines to run into deep seismic trails. There's wire cables all over the place" (Lavrakas, 1996:1, 5). At the Nuiqsut village scoping meeting for NPR-A, Lampe again related village conflicts with seismic activity, explaining that seismic work in the vicinity of the village threatened traditional sites and might somehow have affected the caribou food chain as well. He suggested that increased traffic on the Dalton Highway might be interfering with migrations by spooking the animals. "Caribou have always been our primary source of subsistence...this has got to be evaluated very carefully " (USDOI, BLM, 1997a; Adams, 1997:5, 9). At an NPR-A symposium held in Anchorage in April 1997 after the village scoping meeting, Thomas Napageak, elder, Nuiqsut Native Village President, and AEWC Chairman, noted recent problems with seismic activity:

> Down by the village two years ago, seismic exploration was moving rapidly right over two graveyards. Of course, the markers were driftwood and had fallen off. But the graveyards were still visible. However, you can't see everything from a Rolligon or exploration vehicle when the snow is drifting. The graveyards were being run over. When I die I would like to rest peacefully under the ground without any seismic activity running over me (USDOI, BLM and MMS, 1997).

Ruth Nukapigak recounted that seismic activity has repeatedly trespassed onto her allotment on the Itkillik River, and that she has been trying unsuccessfully to get compensation since 1974 (USDOI, BLM, 1997a). Oil-exploration crews have been a constant problem to villagers. A cultural plan (*Nuiqsut Paisanitch: A Cultural Plan*) drafted by the village in 1979 noted these objections to field crews by a Nuiqsut resident: "Those oil exploration crews wreck our camps. They tore up our ice cellars at Oliktok and left meat and fish around to rot. They must not know we use those camps" (City of Nuiqsut, 1995).

Nuiqsut fish harvesters have noted that the number of arctic cisco have been down, coinciding with the [operation of] the Endicott water-treatment plant (Dames and Moore, 1996b). A Nuiqsut subsistence fisherman wondered in a

subsistence survey done in the community by the NSB Wildlife Management Department in 1995 why whitefish were so small that year when they used to be big the year before (Brower and Opie, 1997). At the April 1997 NPR-A scoping meeting in Nuiqsut, Rosemary Ahtuangaruak elaborated on development impacts to fish and the associated impact to village life: "The oil companies made causeways for the benefit of oil development. It took the fish away. The people suffered immensely without this natural resource. The community could not meet the needs for survival and the atmosphere was black. We had an increase in all the bad things: domestic violence, suicide, family demise" (USDOI, BLM, 1997a).

In 1979, Nannie Woods, the late Nuiqsut elder, talked about fish and caribou being abundant at the Sagavanirktok River, but now the river isn't as abundant since the development at Prudhoe Bay. She explained that the tributaries off the river don't have as many fish either, and that there are fewer caribou than there used to be in the summer (USDOI, MMS, 1979a).

Concerns about access restrictions have been voiced by local residents. Sarah Kunaknana, talking about local subsistence hunters, observed that others have stated that they don't hunt near Prudhoe Bay anymore because of oil development (S. Kunaknana, in Shapiro, Metzner, and Toovak, 1979). Nuiqsut's present Vice Mayor Mark Ahmakak, when asked in 1982 if people had been turned back from hunting and fishing areas, answered: "Oh, yes. I have experienced that myself in going out towards Nuiktuk [?] over toward DEW Line station. We have been told by oil company officials that we can't hunt near development area" (Kruse et al., 1983). Access problems were expressed by Nelson Ahvakana from Nuiqsut. He was concerned that areas that are supposed to be left open for subsistence hunting effectively will be closed because of increased security associated with the new drill sites, and that access to subsistence resources will be restricted (USDOI, MMS, 1990d). This concern takes on even more substance as the Northstar Project and development at the Alpine field become realities. During the 1996 Northstar Project Nuiqsut community meeting, two Nuiqsut men described being denied access to fishing and hunting areas around Prudhoe operations, even though they have traditional rights to be there. They do not want to be restricted or denied access by new projects (Dames and Moore, 1996c). In recent NPR-A scoping meetings in the village, Thomas Napageak elaborated on the issue of lost access noting that oil development at Prudhoe Bay and Kuparuk had already cut off Nuiqsut residents from nearly one-third of their traditional subsistence harvest areas. At the same meeting, Leonard Lampe, Jr., recounted how he has not been able to hunt or fish in the Kuparuk/Prudhoe Bay area once visited by village elders and that he fears the same loss of critical subsistence access to important lands in the NPR-A to future generations (USDOI, BLM, 1997a).

A major issue with the recent initiative in the NPR-A is the velocity of the environmental assessment process and the way it has taxed the resources of the Native community. Nuiqsut residents believe it precludes a thorough compilation of the vast cultural knowledge the Inupiat have gained over millennia. Leonard Lampe, Jr., present Mayor of Nuiqsut and Kuukpik Village Corporation officer, commented that 11,000 years of cultural and traditional knowledge could not be compiled and communicated in 8 days (USDOI, BLM, 1997a; Adams, 1997:5, 9). At the same meeting, Rosemary Ahtuangaruak vocalized this problem more simply when she said: "What we have to say will be documented but not integrated. We are being pushed and pulled in all directions at the same time with all the various agencies affecting our ability to thoroughly evaluate and document all issues." Taqulik Hepa, NSB, Dept. of Wildlife Management subsistence research specialist, did not believe the schedule set by BLM would allow for sufficient time for the proper analysis of recent wildlife and subsistence harvest data (USDOI, BLM, 1997a).

Oil spills also are an identified threat. Thomas Napageak stated in his testimony at the Nuiqsut NPR-A scoping meeting that: "The oil industry still does not have adequate technology for oil spill clean up in the Arctic, particularly in rivers, lakes, and the Beaufort Sea. Adequate spill response must be part of any development" (USDOI, BLM, 1997a).

Thomas Napageak expresses the larger issue of oil development and its potential effect on the subsistence lifeway: "...improvements in our physical comforts and services should not blind us to the threats that oil development on the wrong terms poses to our very identity and culture. Our land and our subsistence practices are our history, our identity, and our future. If we lose the land or can no longer maintain our subsistence culture, we lose ourselves and the future of our children." Rosemary Ahtuangaruak further elaborated Inupiat cultural conflicts with oil development when she asserted: "We need to live as our ancestors have shown us. We have this passion to our families for their survival.... NPR-A has been set aside and should be left alone. It has given the sustenance for countless animals that migrate throughout the world. They come back to us every year unless development prevents it" (USDOI, BLM, 1997a).

Both the establishment of a Subsistence Advisory Panel under the Preferred Alternative (and under Alternatives C-E) and the adoption of effective stipulations designed specifically to protect subsistence resources and

subsistence practices will serve to address Nuiqsut's concerns.

(4) Other Communities—Effects from Disturbance and Spills: Other communities within or adjacent to the NPR-A are the Chukchi Sea villages of Point Lay and Wainwright to the west and the inland community of Anaktuvuk Pass to the south and east. Subsistence-harvest areas for these communities are not within or adjacent to the planning area, although recent research indicates that movement by the Teshekpuk Lake Caribou Herd does bring the herd into the traditional subsistence-harvest areas of the communities of Wainwright and Point Lay. Historically, Anaktuvuk Pass caribou hunters have ranged to the southerly boundary of the planning area, and movement by the Teshekpuk Lake Caribou Herd would bring it into the harvest area of Anaktuvuk Pass subsistence hunters as well, although they primarily hunt the Western Arctic Caribou Herd (and to a lesser extent the Central Arctic Herd). Short-term and localized impacts from disturbance and oil spills to the Teshekpuk Lake and Central Arctic herds would have little effect on the subsistence-caribou harvest of these three communities.

Impacts to subsistence users farther from the planning area, including those in the Yukon-Kuskokwim Delta, would not be significant. The populations of waterfowl used by subsistence users south of the Brooks Range are not expected to be significantly impacted, because key waterfowl habitat would not be leased.

Summary: Short-term and localized impacts from disturbance and oil spills to the Teshekpuk Lake Caribou Herd, other terrestrial mammals, fish, birds, bowhead whales, and other marine mammals harvested by Barrow, Atqasuk, and Nuiqsut subsistence hunters would have little effect on subsistence harvests in these communities. Under the Preferred Alternative, it is expected that subsistence-hunter concerns about access to resources and resource contamination would be minimal. Impacts would be further minimized by not leasing in important caribou, waterfowl, and fishing areas under this alternative, and from proposed stipulations, particularly the work of the Subsistence Advisory Panel designed to address local subsistence and cultural issues.

Conclusion—First Sale: Overall effects associated with the Preferred Alternative on subsistence-harvest patterns in the communities of Barrow, Atqasuk, and Nuiqsut, and other nearby communities from oil and gas activities in the planning area as a result of impacts from disturbance and oil spills are expected to periodically impact subsistence resources, but no resource would become unavailable, undesirable for use, or experience overall population reductions. The effects of the Preferred Alternative are expected to be the same as Alternative C.

Multiple Sales: Under the multiple-sales approach, the resource estimate for the Preferred Alternative increases from a range of 90 to 420 MMbbl and one to two oil fields to a range of 130 to 600 MMbbl in one to three oil fields. The number of exploration wells increases from a maximum of 7 to 21, delineation wells increase from a maximum of 10 to 17, and production wells increase from 132 to 180. Pipeline miles increase to 110 mi. Multiple sales would occur over a longer period of time and, depending on the frequency of sales, the time frame for oil and gas activities in the planning area would extend to at least two decades.

For the Preferred Alternative, it is estimated that the number of spills ≤1 bbl would increase from a range of 14 to 63 spills to a range of 19 to 90 spills, and the number of spills >1 bbl would increase from a range of 5 to 21 spills to a range of 7 to 29 spills over the assumed production life of the planning area. The estimated number of crude-oil spills over the the assumed life of the planning area would increase from a range of 18 to 84 spills to a range of 26 to 119 spills (Sec. IV.A.2).

If several lease sales occur under the Preferred Alternative, considerably more exploration activity is expected to occur in the southern half of the planning area, and the levels of effects due to noise, disturbance, and habitat alteration is expected to increase. Surface, air, and foot traffic near facilities is expected to increase and to displace some caribou, moose, muskoxen, grizzly bears, wolves, and wolverines but not significantly affect Arctic Slope populations. The number of small, chronic crude-oil and fuel spills is expected to increase and result in the loss of small numbers of terrestrial mammals, with recovery expected within about 1 year. For arctic fish populations, additional disturbance effects could occur from additional gravel pads, gravel extraction, and fuel and oil spills. Insufficient recovery time between sales and greater oil activity levels would likely result in greater spill- related effects on arctic fish.

An increase in effects to bird populations from increased noise disturbance could be expected with multiple sales. Any nesting and postnesting birds exposed to routine aircraft disturbance could be displaced from local habitats and subject to increased energetic demands. Some consequent effects to reproductive success and survival of young is anticipated with populations not requiring >1 year to recover. Some localized displacement of nesting birds in the vicinity of drill sites may occur, but significant effects on reproductive success are not expected. Construction disturbance is expected to cause temporary behavioral changes and displacement of winter resident species within

100 yards to 0.6 mi of the sites. Recovery in these instances is expected to require no more than 1 year. Disturbance from more intense activity such as routine flights over goose molting lakes and increased river traffic would require several breeding seasons for recovery. Off-pad oil spills would put loons and waterfowl at greatest risk. Especially at risk would be the large numbers of molting geese that occupy open waterbodies. Spills entering these larger lakes with larger numbers of molting or broodrearing geese and other species may result in losses in the hundreds, requiring several breeding seasons for recovery.

Effects of multiple sales on bowhead whales are expected to be essentially the same as described for the first sale Bowhead whales exposed to noise-producing activities such as marine vessel traffic and possibly aircraft overflights most likely would experience temporary, nonlethal effects. Small onshore spills are unlikely to reach the marine environment. If spilled oil did reach the marine environment, it likely would be a very small amount, and any exposure to spilled oil likely would not pose serious direct effects to bowhead whales. For marine mammals, multiple sales under the Preferred Alternative B are expected to have similar effects to those for a single, i.e., local and short term, with no significant adverse effects to marine mammal populations as a whole, but the duration of activities and potential disturbance would extend over a longer period.

Conclusion—Multiple Sales: Effects from multiple sales to terrestrial mammals are expected to increase, but no significant impacts to populations are anticipated. Small numbers of terrestrial mammals would be lost due to the increase of small, chronic crude-oil and fuel spills, but populations are expected to recover within 1 year. Arctic fish populations would experience slightly increased effects but high-density fish areas would be deferred. Increased disturbance and displacement effects and increased oil-spills risks are expected for birds, but timing of the sales again is critical to recovery and prime goose molting habitat is deferred. With extended intervals between sales, impacted bird populations are expected to recover from noise and disturbance effects in 1 year. Bowhead whales are expected to experience short-term, nonlethal effects. Effects to seals and polar bear would be short term and local with no adverse effects to populations.

Given that resource estimates and development scenarios project an increase in resources and an increase in the number of drill pads and pipeline miles, logic would assume increased effects to potentially affected resources, except for the fact that these effects would be spread over 2 decades. The biological analyses expect slight increases in effects with little overall effects to resource populations; therefore, effects associated with multiple sales on subsistence-harvest patterns in the communities of Barrow, Atqasuk, and (especially) Nuiqsut as a result of impacts from disturbance and oil spills are expected to make no subsistence resource unavailable, undesirable for use, or experience overall population reductions.

14. Sociocultural Systems: This discussion is concerned with those communities that could be impacted by ground-impacting-management actions and oil and gas leasing in the planning area—Barrow, Atqasuk, and Nuiqsut. Under the Preferred Alternative, approximately two-thirds of the area of high oil and gas potential of the planning area would be available for oil and gas leasing while maintaining protection for high-value waterfowl and caribou calving habitats, important subsistence use areas, and areas of scenic and recreational significance. Teshekpuk Lake and the areas north and east of the lake would not be available for leasing (see Fig. II.C.1-6). Protective measures would forbid most types of surface use for oil and gas activities and would be imposed on (a) the northern part of the Teshekpuk Lake Special Area (all of the Goose Molting Habitat LUEA, important calving and insect-relief areas of the Teshekpuk Lake Caribou Habitat LUEA, and all of Teshekpuk Lake) to protect waterfowl and caribou habitat and important subsistence use areas; (b) along Fish, Judy, and Kealok creeks and the Ikpikpuk and Miguakiak rivers to protect subsistence resources and uses; and (c) along the Colville, Kikiakrorak, and Kogosukruk rivers to address concerns for subsistence uses and raptor habitat. These areas would be available for leasing except for (a) above.

Setbacks from ½ to 3 mi on the Miguakiak, Colville, Kikiakrorak, Kogosukruk, Ikpikpuk rivers, and Fish, Judy, and Kealok creeks would prevent permanent oil and gas surface occupancy near these watercourses. No permanent oil and gas occupancy would be allowed in the Deep Water Lakes/Fish Habitat LUEA, and no surface occupancy would be allowed within ¼ mi of fish-bearing lakes. Leasing would be allowed on lands subject to pending Kuukpik Corporation conveyances, but any lands selected before the sale would be deleted from the sale.

The Preferred Alternative includes its own set of stipulations that represent a revision of those presented in the draft IAP/EIS. Important stipulations include establishing procedures and advisory bodies to address subsistence resources and uses and research for inventorying and monitoring. Stipulation 61 describes a conflict avoidance procedure to address subsistence concerns and issues relating to oil and gas activities. Through this process, lessees would consult with the local communities, the NSB, and the Subsistence Advisory Panel (a special body created to address subsistence issues, concerns, and research). Also, representatives of Federal, State, and NSB agencies with biological expertise would

comprise an Interagency Research and Monitoring Team. This team would coordinate research and monitoring projects related to the effectiveness of stipulations and impacts to surface resources, and consult with the Subsistence Advisory Panel. Proposed stipulations and particularly the work of the Subsistence Advisory Panel are designed to address local subsistence and cultural issues. See Section IV.G.13 for a list of local concerns and stipulations that address those concerns.

The primary aspects of the sociocultural systems covered in this analysis are (1) social organization, (2) cultural values, and (2) social health, as described in Section III.C.3. For the purpose of effects assessment, it is assumed that effects on social organization and cultural values could be brought about at the community level, predominantly by industrial activities, increased population, increased employment, and effects on subsistence-harvest patterns associated with a proposed oil and gas lease sale. Potential effects are evaluated relative to the tendency of introduced social forces to support or disrupt existing systems of organization and relative to how rapidly they occur and their duration (Langdon, 1996).

North Slope Inupiat continue to express concern about the differences in how they and the dominant culture relate to the land and waters. Rex Okakok from Barrow expressed the problem when he said "Our land and sea are still considered and thought by outsiders to be the source of wealth, a military arena, a scientific laboratory, or a source of wilderness to be preserved, rather than as a homeland of our Inupiat" (USDOI, MMS, 1987c). Considering such use of Inupiat territory, Robert Edwardson from Barrow said that he would like to see revenues paid to the Inupiat for mineral rights (USDOI, MMS, 1995; see Sec. IV.C. 13., Subsistence).

a. Parameters of this Analysis: An analysis of the social organization of a society involves examining how people are divided into social groups and networks. Activities such as the sharing of subsistence foods are profoundly important to the maintenance of family ties, kinship networks, and a sense of community well-being. In rural Alaskan Native communities, task groups associated with subsistence harvests are important in defining social roles and kinship relations: the individuals one cooperates with help define kin ties, and the distribution of specific tasks reflects and reinforces the roles of husbands, wives, grandparents, children, friends, and others (Sec. III.C.3). Social groups generally are based on kinship and marriage systems, as well as on nonbiological alliance groups formed by such characteristics as age, sex, ethnicity, community, and trade. Kinship relations and nonbiological alliances serve to extend and ensure cooperation within the society.

An analysis of cultural values looks at those values shared by most members of a social group. Generally, these values are shared conceptions concerning what is desirable. They are ideals that members of a social group accept explicitly or implicitly. Forces powerful enough to change the basic values of an entire society would include a seriously disturbing change in the physical conditions of life: a fundamental cultural change imposed or induced by external forces, such as when an incoming group induces acculturation of the residing group, or when a series of fundamental technological inventions change existing physical and social conditions. Such changes in cultural values can occur slowly and imperceptibly or suddenly and dramatically (Lantis, 1959). For the system of sharing to operate properly, some households must be able to produce, rather consistently, a surplus of subsistence goods, and it is obviously more difficult for a household to produce a surplus than to simply satisfy its own needs. For this reason, sharing, and the supply of subsistence foods in the sharing network, could be more sensitive to harvest disruptions than the actual harvest and consumption of these foods by active producers.

Social organization could be affected by an influx of new population that causes growth in the community and/or change in the organization of social groups and networks. Disruption of subsistence-harvest task groups would damage the social bonds that hold the community together. Disruption of the subsistence cycle also could change the way these groups are organized. A serious disruption of subsistence-harvest patterns could alter these cultural values and could trigger an array of negative emotions: fear, anger, and frustration, as well as a sense of loss and helplessness. Because of the psychological importance of subsistence in these sharing networks, perceived threats to subsistence activities are a major cause for anxieties about oil development.

An Alaska Department of Fish and Game social-effects survey administered by the Division of Subsistence in 1994 in Nuiqsut included questions on effects from Outer Continental Shelf development. The majority of Nuiqsut residents believed that development would negatively impact fish, marine mammal, and bird resources. Most were not in favor of further oil development because of its perceived adverse impact on subsistence and the belief that small and large oil spills could not be effectively contained or cleaned up. The overall study on 21 Alaskan communities concluded that impacts persist from the *Exxon Valdez* Oil Spill on subsistence use and the social and cultural system that subsistence activities support (Fall and Utermohle, 1995).

A study conducted by Picou et al. (1992) on the disruption to the community of Cordova by the *Exxon Valdez* Oil Spill demonstrated empirically that 18 months following the

spill, residents of Cordova had experienced long-term negative social impacts that took the form of disruption to work roles and increased personal stress. Additionally, they observed that "...work disruption was correlated with intrusive stress...and fishermen experienced more work disruption than...other occupations. It may be possible that other natural resource community activities such as participation in subsistence harvests...may identify subpopulations more vulnerable to long-term negative social impacts" (Picou et al., 1992).

In the Social Indicators Study of Alaskan Coastal Villages, Volume VI. Analysis of the *Exxon Valdez* Spill Area, 1988-1992, the summary of findings section affirmed that immediately after the spill and continuing into early 1990, Natives decreased their harvests of wild resources and relied on preserved foods harvested before the spill. By the winter of 1991, Native harvesting activities had begun to resume to normal, but the proportions of wild foods in their diets remained below 1989 proportions. The study also demonstrated in its analysis that non-Natives and Natives "define the environment and resources within the environment very differently. Commodity valuation takes precedence" for non-Natives and "instrumental use and cultural and spiritual valuation take precedence" for Natives (Human Relations Area Files, Inc., 1994). The ADF&G and Picou et al. surveys and the Social Indicators Study demonstrate the impacts to social and cultural institutions and indicate the underlying fears that linger from such a catastrophic environmental event, even in communities not directly impacted by such an event.

Effects Agents: The agents associated with management actions and oil and gas leasing in the planning area that could affect the sociocultural institutions and systems in communities in the sale area (described in Sec. III.C.3) are disturbance and oil spills (and cleanup) from activities other than oil and gas exploration, and oil and gas exploration and development activities that would include changes in population and employment, and effects on subsistence-harvest patterns.

b. Ground-Impacting-Management Actions:

(1) Activities Other than Oil and Gas Exploration and Development: Even though use levels by researchers, recreationists, and seismic surveyors would increase under this alternative, because these are normal activities under the existing BLM management regime, little net change in effects is expected from disturbance from ground-impacting-management actions to subsistence resources and the communities nearby the planning area. For a more in-depth discussion of activities other than oil and gas exploration and development, see impacts discussion for sociocultural systems under Alternative A.

(2) Oil and Gas Exploration and Development Activities: Exploration activities—seismic activity and exploration drilling—would occur in winter (early December to mid-April). Transportation of construction materials (and gravel for pads), personnel, and fuel would be done over winter ice roads from existing infrastructure at Prudhoe Bay and Kuparuk. Under the Preferred Alternative, one to two fields with a resource range of 90 to 420 MMbbl of oil is estimated. Two to seven exploration wells would be drilled. For development, 2 to 10 delineation and 30 to 132 production and service wells could be drilled, as well as 20 to 95 mi of pipeline constructed.

(a) Effects of Disturbance: During the exploration phase, facilities at Kuparuk and Prudhoe/Deadhorse, and a new coastal site at Kogru River would be used for air-support staging, where personnel and air freight would be transferred to aircraft. Two fixed-wing aircraft trips per week per drill unit are assumed for exploration. The existing facilities at Kuparuk and Prudhoe Bay are adequate to handle the projected needs during exploration. With the use and upgrading of existing infrastructure for the staging of air support, contact with non-Native construction personnel in the villages of Atqasuk and Nuiqsut would not be expected to occur except under exceptional circumstances. Air traffic through Barrow might increase, but no significant staging of equipment or personnel would occur from the community. During the development phase, facilities at Kuparuk and Prudhoe/Deadhorse also would be used for air-support staging, and air traffic would increase.

(b) Spills and Spill Cleanup: See Section IV.C.13, Subsistence for a discussion of North Slope onshore spills.

All planning-area scenarios call for an onshore pipeline for oil delivery to TAPS, and there is the potential for a pipeline spill contaminating the Colville River. A spill entering the Colville River potentially could affect fish populations, disrupt subsistence-fishing activity, and curtail the subsistence hunt as resources well may be tainted or, even if available, the perception of tainting would substantially affect the subsistence harvest (Sec. IV.C.13, Subsistence).

Other industrial activities associated with oil development that could have an effect on sociocultural systems would be the result of cleanup if an oil spill did occur. In the event of a large spill contacting and extensively oiling habitats, the presence of hundreds of humans, boats, and aircraft would increase the displacement of subsistence species and alter or reduce access to subsistence species by subsistence hunters (Sec. IV.C.3, Water Quality). Because oil spills estimated from NPR-A activities would be small, chronic

events and normally be contained on the drill pad, effects from the spills themselves and potential disruption from cleanup activities are not likely to cause great disturbance to sociocultural systems or the surrounding environment, and impacts would be negligible.

Nuiqsut residents reiterated at a recent town meeting for the Northstar Project that they believe it is a matter of *when* a spill will occur, not *if* it will occur. They want assurance against disaster and impact funds set aside for them in the event of such a disaster (Dames and Moore, 1996b). Earlier village comments expressed the same attitude. In 1979, Gordon Rankin from Kaktovik suggested that a compensation fund be set aside for villages in case there is a devastating oil spill (USDOI, MMS, 1979a; see Sec. IV.C. 13, Subsistence).

c. Population and Employment: Under The Preferred Alternative, oil and gas leasing in the planning area is projected to affect the population of the NSB through two types of effects on regional employment: (1) more petroleum-industry-related jobs as a consequence of NPR-A exploration and development and production activities and (2) more NSB-funded jobs as a result of higher NSB operating revenues and expenditures (see Sec. IV.B.11). Employment projections as a consequence of planning-area activities are provided in Section IV.C.11.

With this alternative, total petroleum-related employment would range from a low of 99 jobs with exploration in the year 2000 to 1,578 jobs with development in 2009 to 800 jobs during production. Resident employment as a result of NPR-A activities would peak at 44 jobs in the year 2006. Most workers are expected to permanently reside outside of the North Slope. The NPR-A oil and gas activities are projected to increase resident employment 2 to 3 percent during the development phase and about 1 to 2 percent during the production phase above the declining existing-condition projections between 2000 and 2016 (Tables IV.G.11-1 and IV.G.11-2).

The NPR-A development under the Preferred Alternative is projected to increase the NSB population above the existing-condition level if oil prices are high enough to allow for maximum development (420 MMbbl). The Native proportion of the population is not expected to change much—approximately 70 to 77 percent Native. There may be some degree of sale-induced employment, but these changes, particularly as they translate into Native employment, historically have been and are expected to continue to be only 1 percent of total oil-industry jobs in the region. Even though Native employment in oil-related jobs on the North Slope is low, Native leaders continue to push for programs and processes with industry that would encourage more Native hire.

d. Subsistence-Harvest Patterns: Subsistence is important to the Inupiat sociocultural system through sharing subsistence foods, creating community task groups and crew structures, and through the strengthening of social bonds (see Sec. III.C.3 for a detailed description). Effects could be expected on subsistence-harvest patterns in the planning area as a result of disturbance to Barrow, Atqasuk, and Nuiqsut's subsistence harvests due to seismic disturbance, aircraft noise, supply vessel traffic, offshore exploration, onshore-construction, gravel extraction, pipeline trenching, and oil spills (see discussion for Alternative B, Sec. IV.C.13).

e. Effects on Barrow, Atqasuk, and Nuiqsut: The relatively homogenous nature of the communities of Atqasuk and Nuiqsut—both are predominantly Inupiat—whose sociocultural systems may be affected by oil and gas activities in the planning area indicates that changes in the communities would be similar. Barrow, which is larger, has a larger percentage of non-Natives and already has experienced more change than the other two smaller Native communities. This section analyzes effects of industrial activities, population and employment changes, and subsistence-harvest-pattern impacts on North Slope social organization, cultural values, and other issues. This discussion focuses on the North Slope as a whole, with a discussion of each community where necessary.

(1) Social Organization: The social organization of communities that might be affected by oil and gas activities in the planning area includes typical features of Inupiat culture: kinship networks that organize much of a community's subsistence-harvest, consumption, and sharing activities; informally derived systems of respect and authority; strong extended families (although not always living in the same household); stratification between families focused on success in the subsistence harvest; and access to subsistence technology (Sec. III.C.2). These non-Western elements of social organization could potentially be altered to become less oriented toward the family, and changes could be seen in a breakdown of kinship networks as a result of social conditions induced by oil and gas activities in the planning area. Increased air traffic and winter ice-road traffic during exploration is unlikely to have a large effect on these communities, except possibly increases in noise disturbance to the community of Nuiqsut. Recent increases in non-Native workers in the community from the development of the Alpine field resembles the situation present in North Slope communities during the peak of the CIP construction in the 1980's. Other industrial activities (pipeline construction) would occur nearest to the community of Nuiqsut but not within the actual community itself. Changes in population and employment would not be greater than those already experienced in the past by these communities. Social institutions in all three

communities would experience little direct disturbance from the staging of personnel and air freight expected for oil and gas activities in the planning area; negligible effects would be expected to sociocultural systems, and no displacement of existing institutions would occur. The scenario for oil and gas activities in the planning area stresses that staging will occur primarily from existing or enhanced facilities at the Prudhoe Bay/Deadhorse, Kuparuk, and a new coastal site at Kogru River, a situation that significantly would reduce disruption to nearby Native communities.

No disruptions are expected to the three communities' social institutions as a result of increases in temporary or permanent population growth, but the construction of winter ice roads near and a new hotel within Nuiqsut could cause some disruptions to Nuiqsut social organization because of an increase of social interaction between residents and oil-industry workers. Traffic restrictions near exploration infrastructure along the Nuiqsut/Prudhoe Bay ice road already has created some friction in Nuiqsut, where considerable dependence has developed within the village on this arterial for winter access to Prudhoe Bay and south to Fairbanks. Locally, Nuiqsut residents have articulated these conflicts, as seismic and drilling activity have increased dramatically recently for offshore projects such as the Northstar and Liberty developments, seismic and drilling activities from the onshore Alpine field, and potential NPR-A development.

Other instances of increased interaction would occur if many local residents were employed in oil-industry jobs, but, historically, the number of local Native hires is quite small. Some of the interactions of oil workers with the local Inupiat population are likely to be unpleasant and could lead to a growth in racial tension. Nuiqsut already has been exposed to oil workers due to its proximity to Prudhoe Bay, from village travel to Prudhoe on the winter ice road that is maintained between the two communities, increased seismic activity in the vicinity of the village, and a recent influx of personnel working on development of the Alpine field. It appears that the number of oil workers associating with local residents has increased. Social interaction of oil-industry workers with Nuiqsut residents could be long term, but there is not expected to be a tendency toward displacement of their social institutions. Changes in population and employment are unlikely to cause some disruption to sociocultural systems but would not displace existing institutions.

Subsistence is a cyclical activity, and harvests vary from year to year, sometimes substantially. Numerous species are hunted to compensate for a reduced harvest of a particular resource in any one year, but there is no satisfactory replacement for bowhead whales or caribou. Multiyear disruptions to even one resource, particularly one as important as the caribou or the bowhead whale, could disrupt sharing networks and subsistence-task groups. Other tensions perceived as a threat to subsistence resources could be caused by NPR-A oil and gas activities, especially if oil-industry activities are visibly evident, and North Slope residents in the Northeast planning area do not perceive development as a benefit to the Inupiat people.

Speaking at a 1983 hearing for an MMS sand and gravel lease sale, Nuiqsut resident Mark Ahmakak stated: "I think that if you are going to go ahead with this sale that you should utilize Natives in...the areas affected by this lease sale; then utilize some of these Natives as monitors on some of your projects" (USDOI, MMS, 1983). The general consensus is the desire for some benefit or employment opportunity to the community from nearby oil activities. Nuiqsut resident Joseph Ericklook expressed the community desire to see employment opportunities for local people result from development (USDOI, MMS, 1990d). Arnold Brower, Jr. noted that he would like to see residual rights to old abandoned wells in the NPR-A pass to the local communities because the local communities could benefit from local oil and gas resource development even when they were not economic for industry to develop (USDOI, BLM, 1997a; Sec. IV.C.13., Subsistence).

(2) Cultural Values: Cultural values and orientations (as described in Sec. III.C.2) can be affected by changes in the population, social organization and demographic conditions, economy, and alterations of the subsistence cycle. Of these, the only changes that could be expected to occur would be in Nuiqsut's social organization (see discussion above) and the subsistence cycle in Barrow, Atqasuk and Nuiqsut (see Sec. IV.C.14 and discussion above).

A trend toward displacement of community social institutions could lead to a short-term and decreased emphasis on the importance of the family, cooperation, sharing, and subsistence as a livelihood. Increasing oil-development activity could increase access to urban communities and cause more interaction with oil-industry workers, resulting in the introduction of new values and ideas as well as increased racial tensions and an increased availability of drugs and alcohol. Tensions would be created and could result in increased incidents of socially maladaptive behavior and family stress, potentially straining traditional Inupiat institutions' abilities to maintain social stability and cultural continuity. Cultural values and orientations can change slowly or suddenly (Lantis, 1959).

Long-term change depends on the relative weakening of traditional stabilizing institutions through prolonged stress and disruptive effects that could be exacerbated by activities accompanying the Northeastern NPR-A IAP.

These changes already are occurring to some degree on the North Slope as a result of onshore oil and gas development, more dependence on a wage economy, higher levels of education, improved technology, improved housing and community facilities, improved infrastructures, increased presence of non-Natives, increased travel outside of the North Slope, and the introduction of television and the Internet. To mitigate this onslaught, NSB institutions, such as the school district that promotes teaching Inupiat language and culture, the AEWC that negotiates with industry to protect Inupiat subsistence whaling interests, the Borough's Department of Wildlife Management, and other regional and village Native corporations and organizations, all work vigorously and quite successfully at preventing any weakening of traditional cultural institutions and practices.

Subsistence is considered the core value and central feature of Inupiat cultural values (see Sec. III.C.2 and IV.G.13). While a year-long disruption to only one subsistence resource likely would not cause long-term, chronic disruption or displacement of the sociocultural system, multiyear disruptions throughout the 35-year life of the project could begin affecting cultural values, with the potential for long-term sociocultural change and the displacement of existing institutions. When a group's identity is formed around being able to hunt, particularly caribou and bowhead whales, and this hunt is not possible or not successful due to oil-industry activity, a considerable amount of social stress, tension, and anxiety are likely to occur (see the *Exxon Valdez* Oil Spill discussion above).

Short-term and localized impacts from disturbance and oil spills to the Teshekpuk Lake Caribou Herd, other terrestrial mammals, fish, birds, bowhead whales, and other marine mammals harvested by Barrow, Atqasuk, and Nuiqsut subsistence hunters would have little effect on subsistence harvests in these communities. Under the Preferred Alternative, it is expected that subsistence-hunter concerns about access to resources and resource contamination would be minimal. Impacts would be further minimized by not leasing in important caribou, waterfowl, and fishing areas under this alternative, and from proposed stipulations, particularly the work of the Subsistence Advisory Panel designed to address local subsistence and cultural issues.

Overall effects associated with the Preferred Alternative on subsistence-harvest patterns in the communities of Barrow, Atqasuk, and Nuiqsut, and other nearby communities from oil and gas activities in the planning area as a result of impacts from disturbance and oil spills are expected to periodically impact subsistence resources with no apparent effect on subsistence harvests. Short-term disruptions of subsistence-harvest activities would cause periodic disruption to institutions and sociocultural systems but likely would not displace existing institutions.

Native testimony at hearings for North Slope development actions has suggested ways to mitigate such impacts. At MMS hearings in 1982, Mark Ahmakak from Nuiqsut stated that there should be economic benefits to Nuiqsut, such as cheaper diesel (USDOI, MMS, 1982b). Barrow resident Charles Okakok said that subsistence users should be compensated by the oil industry in case of an oil spill (USDOI, MMS, 1995), and this sentiment has been repeated often by Native residents of the North Slope. There are concerns about protecting traditional sites from development. Nannie Woods expressed her opposition to leasing in the Colville River Delta because of her concern for her husband's burial site that might be disturbed by development (USDOI, MMS, 1982b). Recently, a Nuiqsut elder had her "home place" at Prudhoe Bay desecrated by an oil company. Her house was looted and built over. She emphasized that graves of family members are in the area, and that she has been denied access there (Dames and Moore, 1996e). Susie Akootchook, former NSB Village Coordinator for Kaktovik, commented during MMS scoping meetings for Sale 170 in Nov. 1996, that traditional fishing and hunting sites need protection, and that a contingency plan needs to be developed to protect them (USDOI, MMS, 1996c). The need for impact assistance often is articulated at hearings held in local communities (USDOI, BLM and MMS, 1997).

(3) Social Health: Effects on sociocultural systems often are seen in rising rates of mental illness, substance abuse, and violence. This has proven true for Alaskan Natives who have been faced since the 1950's with increasing acculturative pressures. The rates of these occurrences far exceed those of other American populations such as Alaskan non-Natives, American Natives, and other American minority groups. For the period 1980 through 1989, the rate for Alaskan Native deaths from suicides and homicides was 77.9 per 100,000 compared to the rate of 25.8 per 100,000 for non-Natives; half of the Alaskan Native suicides are committed by 15- to 24-year olds. The alcohol mortality rate for Alaskan Natives is three- and- one-half times higher than the rate for non-Natives (4.1/10,000 for Natives; 1.2/10,000 for non-Natives). The reports of harm from physical abuse, neglect, and sexual abuse translate into a rate of 94 alleged victims per 1,000 Native children as compared to 55 per 1,000 children in non-Native communities. Although the Native population of Alaska represents 16 percent of the total Alaskan population, a 1991 study reported that for persons under the age of 18 arrested in Alaska, of those arrested for rape, 50 percent were Native; for aggravated assault, 30.7 percent were Native; for burglary, 37.1 percent were Native; for arson, 37.5 percent were Native; and for alcohol-related offenses, 39.8 percent were Native

(Alaska Natives Commission, 1994; Middaugh et al., 1991; Kraus and Buffler, 1979). Also, rates of mental illness are higher "...in larger rural Native towns than in the more traditional Native villages" (Foulks and Katz, 1973; Kraus and Buffler, 1979). While such behaviors are individual acts, the rates at which they occur vary among different groups and through time. These changing rates are recognized as the results of a complex interaction of interpersonal, social, and cultural factors (Kraus and Buffler, 1979; see also Kiev, 1964; Murphy, 1965; Inkeles, 1973). Traditionally, Native communities have helped buffer the individual by providing a sense of continuity and control.

Increases in social problems—rising rates of alcoholism, drug and alcohol abuse, domestic violence, wife and child abuse, rape, homicide, and suicide—also are issues of direct concern in this analysis of sociocultural systems (see Sec. III.C.3). Local Prince William Sound residents participating in the cleanup of the *Exxon Valdez* Oil Spill in Prince William Sound in 1989 tended to: (1) not participate in subsistence activities, (2) have a surplus of cash to spend on material goods as well as drugs and alcohol, and (3) not seek or continue employment in other jobs in the community (because oil-spill-cleanup wages typically were higher than those earned in the community). Studies indicate that the sudden, dramatic increase in income as a result of working on the oil-spill cleanup, as well as being unable or unwilling to pursue subsistence harvests because of the spill, caused considerable social dislocation—particularly seen in increases in depression, violence, and substance abuse (Fall and Utermohle, 1995; Cohen, 1993; Picou and Gill, 1993; Picou et al., 1992; Fall, 1992; Impact Assessment, Inc., 1990e).

Although the oil industry strictly forbids the consumption of alcohol and drugs by camp workers, such events frequently occur in Prudhoe Bay and Kuparuk. In Prudhoe Bay, it is often the service industries that have not complied with enforcing the ban on alcohol. The increased availability of drugs and alcohol in local communities as a result of increased traffic through their airports, visitors in town, and oil-industry workers associating with local residents could be disruptive to the social well-being of these communities. These problems already have occurred in Nuiqsut, which is within 35 mi of Kuparuk and 65 mi of Prudhoe Bay. Although not accessible by road year-round, Nuiqsut is connected to the Prudhoe Bay/Kuparuk industrial complex by a winter road and by air. An increase in social problems (consumption of alcohol and drugs, sexual abuse, domestic violence) in Nuiqsut at a rate slightly higher than in other North Slope communities has been observed possibly because of Nuiqsut's road accessibility (Armstrong, 1985).

Although there may be additional reasons for differences in social problems in local communities, it is clear that accessibility to cities and larger communities enables residents easier access to drugs and alcohol, thereby affecting the social health of the community—a situation that could intensify in Nuiqsut as a result of NPR-A oil and gas activity. Any effects on social health would have ramifications in the social organization, but NSB Native communities have, in fact, proven quite resilient to such effects by local voter insistence on these communities being "dry," and by the NSB's continued support of Inupiat cultural values and its strong commitment to health, social service, and other assistance programs.

Several salient points in the evaluation of possible sociocultural effects from oil-related developments due to oil and gas activities in the planning area should be made:

1. Change itself, even though induced primarily by forces outside the communities, does not necessarily cause the levels of psychic stress that lead to pathology, but technological disasters, as opposed to natural disasters, have been shown to produce more long-term stresses on affected communities (Picou et al., 1992; Inkeles, 1973).
2. Related to the first point is the fact that not all sociocultural change (directly or indirectly related to oil development) may be negative. Higher levels of employment, better health programs, and improved public services must be viewed as possible positive sociocultural effects from oil development on the North Slope. Additionally, income from oil-industry revenue and employment could improve living conditions, although major dependence on a nonrenewable-resource-based economy could cause long-term social disruption at the time of resource depletion.
3. What drives the disruption of sociological change "...is the manner in which changes occur" (Murphy, 1965).
4. The conditions that make sociocultural change stressful must be viewed as ongoing. If the stressful conditions alter, the society can make successful adjustments to the changes that have occurred; and the rates of violence, suicide, and substance abuse will drop.

Nuiqsut is the most likely community in the region to experience additional sale-related effects in social health and well-being above those effects already experienced as a result of NSB CIP employment and the indirect effects from current oil development. These effects on social health could have direct consequences on the sociocultural system but would not have a tendency toward displacement of existing institutions above the displacement that already has occurred with the current level of development. Effects on the institutions and sociocultural systems in

Barrow and Atqasuk would be periodic but not displace existing institutions.

Impacts from approaching oil and gas development now practically encircling the community of Nuiqsut are addressed by local residents more and more. In a 1996 public meeting for the Northstar project, a Nuiqsut elder stated that she wanted potential human-health issues that could result from the project looked into beforehand. She specifically expressed concern about cancers, health problems related to air pollution, and shortened lifespans (Dames and Moore, 1996e; see Sec. IV.C. 13., Subsistence).

Summary: Impacts on the sociocultural systems of communities in and near the planning area could occur as a result of disturbance from industrial activities (seismic activity, aircraft noise, supply-vessel traffic, offshore exploration, construction, and oil spills); changes in population and employment; and effects on subsistence-harvest patterns. These effect agents could affect the social organization, cultural values, and social health of the communities.

Social institutions in all three communities would experience little direct disturbance from the staging of personnel and air freight expected for oil and gas activities in the planning-area from exploration, development, and production; negligible effects would be expected to sociocultural systems, and no displacement of existing institutions would occur.

Social interaction of oil-industry workers with Nuiqsut residents could be long term, but there would not be a tendency toward displacement of their social institutions. Changes in population and employment are unlikely to cause disruption to sociocultural systems but would not displace existing institutions. Oil-spill employment is not likely to disrupt subsistence-harvest activities for an entire season (1 year) or create disruption to institutions and sociocultural systems, and would not displace existing institutions.

Under the Preferred Alternative, disturbance disruptions on Nuiqsut's subsistence resources are not likely to render important subsistence resources unavailable, undesirable for use, or available in reduced numbers or their pursuit more difficult for an entire season. The same would be true in Barrow and Atqasuk. There would be no expected disruption to institutions and sociocultural systems in these communities.

Any effects on social health would have ramifications in the social organization, but NSB Native communities have, in fact, proven quite resilient to such effects with the NSB's continued support of Inupiat cultural values and its strong commitment to health, social service, and other assistance programs. Health and social-services programs have attempted to meet the needs of alcohol and drug-related problems with treatment programs and shelters for wives and families of abusive spouses and with greater emphasis on recreational programs and services, yet a lack of adequate financing for individual NSB city governments has hampered the development of these programs, and declining revenues from the State of Alaska have seriously impaired the overall function of NSB city governments. Partnering together, Tribal governments, city governments and the NSB government may be able to provide programs, services, and benefits to residents. For several years, all communities in the NSB have banned the sale of alcohol although alcohol possession is not banned in Barrow and many communities are continually under pressure to bring the issue up for a local referendum vote (NSB, 1998).

Nuiqsut is the most likely community in the region to experience additional sale-related effects in social health and well-being above those effects already experienced as a result of NSB CIP employment and the indirect effects from current oil development. These effects on social health could have direct consequences on the sociocultural system but would not have a tendency toward the displacement of existing institutions above the displacement that has already occurred with the current level of development. Effects on the institutions and sociocultural systems in Barrow and Atqasuk would be periodic with no tendency toward displacing existing institutions. There is a likelihood for disproportionately adverse effects on Alaskan Natives as a result of the proposed action. Effects are expected to be focused on the Inupiat communities of Barrow, Atqasuk, and Nuiqsut within the North Slope Borough, and the sociocultural and subsistence activities of these Native communities could be affected by routine development.

Conclusion—First Sale: Effects from management actions and oil and gas activities in the planning area under the Preferred Alternative are unlikely to disrupt sociocultural systems. Periodic, short-term disturbance effects would be expected on the sociocultural systems of Barrow, Atqasuk, and Nuiqsut but these disturbances are not expected to disrupt or displace institutions and sociocultural systems; community activities; and traditional practices for harvesting, sharing, and processing subsistence resources. The effects of the Preferred Alternative are expected to be the same as Alternative C.

Multiple Sales: Under the multiple-sales approach, the resource estimate for the Preferred Alternative increases from a range of 90 to 420 MMbbl and one to two oil fields to a range of 130 to 600 MMbbl in one to three oil fields. The number of exploration wells increases from a maximum of 7 to 21, delineation wells increase from a

maximum of 10 to 17, and production wells increase from 132 to 180. Pipeline miles increase to 110 mi. Multiple sales would occur over a longer period of time and, depending on the frequency of sales, the time frame for oil and gas activities in the planning area would extend to at least two decades.

For the Preferred Alternative, it is estimated that the number of spills ≤1 bbl would increase from a range of 14 to 63 spills to a range of 19 to 90 spills, and the number of spills >1 bbl would increase from a range of 5 to 21 spills to a range of 7 to 29 spills over the assumed production life of the planning area. The estimated number of crude-oil spills over the the assumed life of the planning area would increase from a range of 18 to 84 spills to a range of 26 to 119 spills (Sec. IV.A.2).

If several lease sales occur under the Preferred Alternative, considerably more exploration activity is expected to occur in the southern half of the planning area, and the levels of effects due to noise, disturbance, and habitat alteration are expected to increase. Given that resource estimates and development scenarios project an increase in resources and an increase in the number of drill pads and pipeline miles, logic would assume an increase in the effects to potentially affected subsistence resources, except for the fact that these effects would be spread over 2 decades. The critical factor would be the timing between sales—a longer interval would allow more recovery to subsistence resources from aircraft, vehicular, and construction disturbance and to subsistence practices from increased access conflicts; less of an interval might not allow for sufficient recovery. In any case, the cumulative effect would clearly be an increased development "footprint" and consequent increased habitat loss to resources and use area loss to hunters. The biological analyses expect slight increases in effects with little overall effects to subsistence resource populations, and effects associated with multiple sales on subsistence-harvest patterns would make no subsistence resource unavailable, undesirable for use, or experience overall population reductions. Impacts would be further minimized by not leasing in important caribou, waterfowl, and fishing areas under this alternative, and from proposed stipulations, particularly the work of the Subsistence Advisory Panel designed to address local subsistence and cultural issues throughout the life of the plan.

Conclusion—Multiple Sales: Effects from management actions and oil and gas activities in the planning area for multiple sales under the Preferred Alternative could disrupt sociocultural systems for periods of <1 year, but impacts would not be expected to displace institutions and sociocultural systems, community activities, or traditional practices for harvesting, sharing, and processing subsistence resources.

15. Coastal Zone Management: Under the Preferred Alternative, 87 percent of the planning area (approximately 67% of the area of high oil and gas potential) would be available for oil and gas leasing while maintaining protection for high-value waterfowl and caribou-calving habitats, important subsistence-use areas, and areas of scenic and recreational significance. Most of Teshekpuk Lake and the areas north and east of the lake (589,000 acres) would not be available for leasing (see Fig. II.C.1-6). Nearly the entire Beaufort Sea coastal area, except for a small area south of Atigaru Point (T.13N, R.1E) would be excluded from possible leasing. In addition, oil and gas leasing would be allowed in a 5- to 6-mi band at the southern and western edge of the coastline (around Kogru Inlet), but surface activity is prohibited in this area. Rights to the subsurface resources under leases in this area would not include the uppermost 500 ft.

Protective measures would severely restrict most types of surface-use occupancy for oil and gas activities and would be imposed on (a) the northern part of the Teshekpuk Lake Special Area (all of the Goose Molting Habitat LUEA, important calving and insect relief areas of the Teshekpuk Lake Caribou Habitat LUEA, and all of Teshekpuk Lake) to protect waterfowl and caribou habitat and important subsistence use areas (called the Teshekpuk Lake Surface Protection Area); (b) along Fish, Judy, and Kealok creeks and the Ikpikpuk and Miguakiak rivers to protect subsistence resources and uses; and (c) along the Colville, Kikiakrorak, and Kogosukruk rivers to address concerns for subsistence uses and raptor habitat. These areas would be available for leasing except for (a) above. The Preferred Alternative would prohibit construction of roads (other than temporary ice roads) connecting the planning area with the existing road network outside the planning area.

Setbacks from ½ to 3 mi on the Miguakiak, Colville, Kikiakrorak, Kogosukruk, and Ikpikpuk rivers and Fish, Judy, and Kealok creeks would prevent permanent oil and gas surface occupancy near these watercourses. No permanent oil and gas occupancy would be allowed in the Deep Water Lakes/Fish Habitat LUEA, and no surface occupancy would be allowed within ¼ mi of fish-bearing lakes. Leasing would be allowed on lands subject to pending Kuukpik Corporation conveyances, but any lands selected before the sale would be deleted from the sale.

The Preferred Alternative includes its own set of stipulations (Sec. II.C.7.a) that represent a revision of those presented in the draft IAP/EIS. These stipulations are considered in place as a part of the preferred alternative. The Preferred Alternative also establishes procedures and advisory bodies to address subsistence and research (inventory and monitoring) concerns through conflict avoidance procedures among the lessee(s) and the NSB,

affected communities, and the Subsistence Advisory Panel, a special body created to represent subsistence issues..

Under the Preferred Alternative, one to two fields with a resource range of 90 to 420 MMbbl of oil is estimated. Oil-spill-occurrence estimates over the assumed production life of the IAP range from 18 to 84 crude-oil spills >1 gal, with a volume range from 72 to 336 bbl (average spill size equals 4 bbl). For TAPS spills resulting from NPR-A production, the number of spills ranges from 1 to 6, with a volume ranging from 1 to 7 bbl. The oil-spill-occurrence estimate for TAPS tanker spills resulting from NPR-A resources is a 90- to 63-percent chance of 0 spills (with an average spill size of 30,000 gal) occurring. An estimated 116 to 510 refined-oil spills (diesel fuel, aviation fuel, engine lube, fuel oil, gasoline, grease, hydraulic oil, transformer oil, and transmission oil) could occur, with an estimated volume ranging from 42 to 195 bbl (average spill size equals 29 gal). Historically, by volume, diesel fuels account for 75 percent of the refined-oil spills.

Federal lands within the NPR-A are excluded from the coastal zone; however, all uses and activities on Federal lands either occurring within the coastal zone or that may reasonably be expected to affect the coastal area and its resources must be consistent to the maximum extent practicable with enforceable standards of the ACMP, including State standards in 6 AAC 80 and enforceable policies of the NSB CMP. The primary goal of the NSB's Comprehensive Plan is to protect the subsistence lifestyle of the Borough's largely Inupiat population while also encouraging and managing economic development.

Major land uses on the North Slope are divided between traditional subsistence uses and hydrocarbon-development operations. Subsistence uses of the coastal resources in the NPR-A have been and will continue to be of the highest priority of the NSB Inupiat, given cultural and historic patterns of existence within NPR-A lands. Standards for development prohibit severe harm to subsistence resources or activities or disturbance of cultural and historic sites. Requirements address reasonable use of vehicles, vessels, and aircraft; engineering criteria for structures; drilling plans; oil-spill-control and -cleanup plans; pipelines; causeways, residential development associated with resource development; air and water quality; and solid-waste disposal.

a. Activities Other than Oil and Gas Exploration and Development: Ground-impacting-management actions associated with the Preferred Alternative include aircraft use for point-to-point transport, wildlife and other aerial surveys, ground activities such as seismic surveys, resource inventories for paleontological and cultural excavations, research and recreational camps, and overland moves, as well as guided hunting and river float parties on the Colville River from the headwaters to below Umiat. Hazardous- and solid-waste removal and remediation would continue to occur at abandoned drill sites. Only potential oil spills from fuel storage at construction sites and camps could occur, but the size of such spills is likely to be small (a few barrels) and areal contamination small. Cleanup activity is not likely to cause great disturbance to subsistence harvest activities or to the surrounding environment.

b. Oil and Gas Exploration and Development Activities: The Preferred Alternative involves several ground-impacting-management actions associated with oil and gas development. Oil exploration activities—seismic activity and exploration drilling—would occur in winter (early December to mid-April). Transportation of construction materials (and gravel for pads), personnel, and fuel would be done over winter ice roads from existing infrastructure at Prudhoe Bay and Kuparuk. Large equipment would be barged to coastal staging areas in the summer, stockpiled, and moved inland the following winter. Seismic surveys would continue on the NPR-A if a leasing program occurs and typically would involve 1 to 2 crews of 60 persons each collecting approximately 5 to 10 line miles of seismic data per day. A typical operation would use Vibroseis trucks, supply vehicles, and a supply train pulling a camp on skids that would provide living facilities for the crew. Under the Preferred Alternative, 1 to 2 fields with a resource range of 90 to 420 MMbbl of oil is estimated. Two to seven exploration wells would be drilled. For development, 2 to 10 delineation and 30 to 132 production and service wells could be drilled and 20 to 95 mi of pipeline constructed. At $18/barrel, the Preferred Alternative would not be an economically viable stand-alone field, although small fields located close enough to the Alpine field to share infrastructure could be commercial under these circumstances.

As previously indicated, the NPR-A is excluded Federal land and, while Federal lands are defined as being outside of the coastal zone, Federal activities and federally permitted activities must be reviewed for consistency with coastal management programs. Therefore, onshore activities within the NPR-A and some offshore activities identified under the Preferred Alternative should be assessed against the ACMP, which includes the NSB CMP (Sec. III.C.5(b).

While the NPR-A technically is outside the coastal zone, it is within the NSB. The NSB Comprehensive Plan are applied to all developments occurring on private, Federal, and State lands. Activities could include portions of road/pipeline corridors, including the offshore portions (such as inlets and bays) within the NSB boundary. Development activities that occur adjacent to the Colville and Ikpikpuk rivers that could affect coastal resources or

uses, including activities described in Exploration Plans and Development and Production Plans, could be subject to the Statewide standards and NSB district policies of the ACMP. All policies of the ACMP are examined herein for potential conflicts with effects from oil and gas exploration or development activities identified in Sections IV.G.1-14 and 16.

Effects of Exploration and Development on the Alaska Coastal Management Program: Section 307(c)(3)(B) of the Federal Coastal Zone Management Act (CZMA) requires applicants to certify that each activity that is described in detail in an exploration or development and production plan that affects any land use or water use in the coastal zone complies with, and will be implemented consistent with, the State's coastal program. The State would concur with or object to an applicant's certification. The State reviews exploration and development and production plans to determine if activities that could affect the coastal zone are consistent with the ACMP.

In the following discussion, ACMP uses and activities standards related to the Preferred Alternative and to potential effects identified in other resource sections of this EIS (Secs. IV.G.1-14 and 16). Policies of the NSB CMP are assessed in conjunction with the most closely associated Statewide standard.

This analysis is not a consistency determination pursuant to the Coastal Zone Management Act of 1972, as amended, nor should it be used as a local planning document. It is highly unlikely that the activities or events that are hypothesized will occur as assumed in this EIS. It is unknown at this time which of the alternatives, or any combination thereof, may be selected in BLM's record of decision. If one or more lease sales occur, the projected exploration and development activities in this EIS may be changed by lessees as they explore, develop, and produce petroleum products from leases offered for sale, and could affect the accuracy of this assessment.

(1) Coastal Development (6 AAC 80.040): Water dependency is a prime criterion for development along the shoreline (6 AAC 80.040 [a]). The intent of this policy is to ensure that onshore developments and activities that can be placed inland do not displace activities that depend on shoreline locations, including marine, lakes, and river waterfronts. Only activities around Kogru Inlet south of Atigaru Point would require a shoreline location, since almost the entire Beaufort Sea coast within the Northeast NPR-A Planning Area is excluded from leasing under the Preferred Alternative. Protective measures would forbid most types of surface use for oil and gas activities and would be imposed on (a) the northern part of the Teshekpuk Lake Special Area (all of the Goose Molting Habitat LUEA, important calving and insect-relief areas of the Teshekpuk Lake Caribou Habitat LUEA, and all of Teshekpuk Lake) to protect waterfowl and caribou habitat and important subsistence use areas; (b) along Fish, Judy, and Kealok creeks and the Ikpikpuk and Miguakiak rivers to protect subsistence resources and uses; and (c) along the Colville, Kikiakrorak, and Kogosukruk rivers to address concerns for subsistence uses and raptor habitat. Setbacks from ½ to 3 mi on the Miguakiak, Colville, Kikiakrorak, Kogosukruk, Ikpikpuk rivers, and Fish, Judy, and Kealok creeks would prevent permanent oil and gas surface occupancy near these watercourses. No permanent oil and gas occupancy would be allowed in the Deep Water Lakes/Fish Habitat LUEA, and no surface occupancy would be allowed within ¼ mi of fish-bearing lakes. Leasing would be allowed on lands subject to pending Kuukpik Corporation conveyances, but any lands selected before the sale would be deleted from the sale. Stipulations in place under the Preferred Alternative (see Sec. II.C.7.a) further reduce any potential for conflict with this policy around lakes and rivers, specifically, stipulations related to waste-prevention, handling, and disposal and spills (1-17); ice roads and water use (18-22); facility design and construction (29-48); abandonment (58), and protections for subsistence and traditional use sites (59-68), and other activities restrictions will reduce conflicts and the Preferred Alternative will be consistent with this standard. Although large equipment could be barged outside the NPR-A to coastal staging areas in the summer and stockpiled until winter, no development activity would conflict with this policy.

(2) Geophysical Hazard Areas (6 AAC 80.050): This Statewide standard requires coastal districts and State agencies to identify areas in which geophysical hazards are known and in which there is a substantial probability that geophysical hazards may occur. Development in these areas is prohibited until siting, design, and construction measures for minimizing property damage and protecting against the loss of life have been provided.

Permafrost, faults and earthquakes, hydrates and shallow gases, and factors affecting the geotechnical characteristics of the planning area must be considered. Onshore development would be sited in areas of permafrost. Development in these areas must "maintain the natural permafrost insulation quality of existing soils and vegetation" (NSB CMP 2.4.6[c] and NSBMC 19.70.050.L.3). Stipulations in place under the Preferred Alternative (Sec. II.C.7.a) will reduce conflicts and this alternative will be consistent with this standard.

(3) Recreation (6 AAC 80.060: This Statewide standard requires coastal districts to designate areas for recreational use if (1) the area receives significant use by persons engaging in recreational pursuits or is a major tourist destination, or (2) the area has potential for high-

quality recreational use because of physical, biological or cultural features. High priority is given to maintaining or increasing public access to coastal waters. The NSB has identified many areas within the NPR-A as high-recreational use areas. Stipulations in place under the Preferred Alternative (Sec. II.C.7.a) will reduce conflicts, and this alternative will be consistent with this standard.

(4) Energy Facilities (6 AAC 80.070): The ACMP requires that decisions on the siting and approval of energy-related facilities be based, to the extent feasible and prudent, on 16 criteria within the energy facilities standard. Stipulations in place under the Preferred Alternative will reduce conflicts, and this alternative will be consistent with this standard.

Other criteria within this standard require that facilities be consolidated and sited in areas of least biological productivity, diversity, and vulnerability (6 AAC 80.070 [3]). The NSB CMP also requires that "transportation facilities and utilities must be consolidated to the maximum extent possible" (NSB CMP 2.4.5.2[f] and NSBMC 19.70.050. K.6).

Construction associated with energy-related facilities under the Preferred Alternative also must comply with siting standards that apply to all types of development. These more general standards are discussed later under Habitats and Air, Land, and Water Quality.

(5) Transportation and Utilities (6 AAC 80.080): This Statewide standard requires that routes for transportation and utilities be compatible with district programs and sited inland from shorelines and beaches.

The NSB CMP contains several additional policies related to transportation that may be relevant to this analysis. All but one of the policies are "best-effort policies" and subject to some flexibility if (1) there is a significant public need for the proposed use and activity, (2) all feasible and prudent alternatives have been rigorously explored and objectively evaluated, and (3) all feasible and prudent steps have been taken to avoid the adverse effects the policy was intended to prevent. "Transportation development, including pipelines, which significantly obstructs wildlife migration" is subject to the three conditions listed above (NSB CMP 2.4.5.1[g] and NSBMC 19.70.050.J.7). Section IV.G.9 indicates that interference with caribou movements would be temporary and brief; caribou migrations and overall distribution are not expected to be affected. Stipulations related to the Teshekpuk Lake Caribou Habitat LUEA, including restrictions on overland moves and seismic work, oil and gas exploratory drilling, facility design and construction, ice roads and water use, ground transportation, and abandonment in place under the Preferred Alternative will further reduce conflicts, and the Preferred Alternative will be consistent with this standard.

As noted in the previous standard for energy facilities, transportation facilities are expected to be consolidated to the maximum extent practicable. Therefore, there should be no conflict with either NSB CMP 2.4.5.1(i) (NSBMC 19.70.050.J.9), which discourages duplicative transportation corridors from resource-extraction sites, or NSB CMP 2.4.5.2(f) (NSBMC 19.70.050.K.6), which requires that transportation facilities and utilities be consolidated to the maximum extent practical. The above stipulations required under the Preferred Alternative further reduce conflicts, and this alternative will be consistent with this standard.

The NSB CMP 2.4.6(b) (NSBMC 19.70.050.L.2), under the category of "Minimization of Negative Impacts," requires that alterations to shorelines, watercourses, wetlands, and tidal marshes and significant disturbance to important habitat associated with transportation and utilities be minimized. In the discussion of habitats in Sections IV.C.6-9, it is recognized that alterations to wetland habitat and ponds and lakes will occur and birds could be disturbed during construction. This policy also requires that periods critical for fish migration be avoided. These requirements identify constraints for the siting, design, construction, and maintenance of transportation and utility facilities. The above stipulations identified provide protections to resources and habitats. Therefore, stipulations in place under the Preferred Alternative will reduce conflicts, and the Preferred Alternative will be consistent with this standard.

(6) Mining and Mineral Processing (6 AAC 80.110): Extraction of sand and gravel is a major concern on the North Slope. Gravel resources are needed for construction of pads, roadbeds, berms or causeways, and docks to protect the tundra. The ACMP Statewide standards require that mining and mineral processing be compatible with the other standards, adjacent uses, and activities; State and national needs; and district programs (6 AAC 80.110 [a]). Sand and gravel may be extracted from coastal waters, intertidal areas, barrier islands, and spits when no feasible and prudent noncoastal alternative is available to meet the public need (6 AAC 80.110 [b]). Substantial alteration of shoreline dynamics is prohibited (NSB CMP 2.4.5.1[j] and NSBMC 19.70.050.J.10). Constraints may be placed on extraction activities to lessen environmental degradation of coastal lands and waters, if gravel is not obtained from inland sites, and to ensure floodplain integrity (NSB CMP 2.4.5.2[a] and [d] and NSBMC 19.70.050.K.1 and 4). Given the extraction required to support oil and gas development anticipated under the Preferred Alternative in conjunction with the stipulations in place (32 and 40) will reduce conflicts, the

Preferred Alternative will be consistent with this standard and the NSB policies.

(7) Subsistence (6 AAC 80.120): The Statewide standard for subsistence guarantees opportunities for subsistence use of coastal areas and resources. Subsistence uses of coastal resources and maintenance of the subsistence way of life are primary concerns of the residents of the NSB. Under this alternative, nearly the entire Beaufort Sea coast, except for the area around Kogru Inlet, within the planning area is excluded from leasing, significantly reducing potential disturbance to bowhead whales and other marine mammals. Teshekpuk Lake and the areas north and east of the lake are not be available for leasing. However, access to subsistence resources, subsistence hunting and resource use could be affected by reductions in subsistence resources and changes in subsistence-resource-distribution patterns. These changes could occur as a result of disturbance from seismic surveys, aircraft and vessel traffic, drilling activities, and construction activities that include pipeline construction; structure placement; and support-base, pump-station, and road construction. Short-term and localized impacts from disturbance and oil spills to the Teshekpuk Lake Caribou Herd, other terrestrial mammals, fish, birds, bowhead whales, and other marine mammals would have no apparent effect on subsistence harvests for Barrow, Atqasuk and Nuiqsut hunters. Subsistence-hunter concerns about access to resources and resource contamination would be minimal. Impacts would be further minimized by not leasing in important caribou, waterfowl, and fishing areas under this preferred alternative, and from protections afforded by stipulations identified in Section II to protect marine and terrestrial mammals, waterfowl, and fishing resources. Surface, air, and foot traffic near the oil fields is expected to increase under the preferred alternative and to displace some caribou, moose, muskoxen, grizzly bears, wolves, and wolverines but not significantly affect Arctic Slope populations. This conclusion is based partially on the established policy that roads and pipelines are constructed to provide for unimpeded wildlife crossings. Based on the analysis of disturbance effects of activities on caribou described in Section IV.G.9 and subsistence described in Section IV.G.13, and stipulations identified in Section II.C.7.a, potential conflict with the subsistence policies under the Preferred Alternative is reduced and makes the Preferred Alternative consistent with this standard.

Policy 2.4.3(d) (NSBMC 19.70.050.D) requires that development not preclude reasonable subsistence-user access to a subsistence resource. Onshore pipelines and construction activities could cause disruptions to subsistence caribou harvests from access and movement conflicts, but effects are expected to be short term. Where access is reduced or restricted, development can occur only if no feasible or prudent alternative is available, and then it is subject to the conditions of best-effort policies. Conflict with these standards and policies also will be minimized under the Preferred Alternative by the exclusion of the Teshekpuk Lake Caribou Habitat LUEA from leasing.

Several important NSB CMP policies relate to adverse effects on subsistence resources. The NSB CMP policy 2.4.3(a) (NSBMC 19.70.050.A) relates to "extensive adverse impacts to a subsistence resource" that "are likely and cannot be avoided or mitigated." In such an instance, "development shall not deplete subsistence resources below the subsistence needs of local residents of the Borough." Policy 2.4.5.1(a) (NSBMC 19.70.050.J.1) addresses "development that will likely result in significantly decreased productivity of subsistence resources or their ecosystems." Temporary reductions in subsistence resources and changes in subsistence resource-distribution patterns could occur as a result of disturbance from seismic surveys, aircraft and vessel traffic, drilling activities, and construction activities including offshore dredging, pipeline construction, structure placement and onshore pipelines, and support-base, pump-station, and road construction.

The development scenario calls for an onshore pipeline for oil delivery to the TAPS and potential for a pipeline spill contaminating the Colville River. A spill entering the Colville potentially could affect fish populations, disrupt subsistence-fishing activity, and curtail the subsistence hunt as resources well may be tainted or, even if available, the perception of tainting could substantially affect the subsistence harvest (Sec. IV.G.13). However, given that the number and size of oil spills estimated for the Preferred Alternative would be small, and that chronic spills can normally be contained on the drill pad, it is anticipated that the effects from spills and potential disruption from cleanup activities would have little to no impact on subsistence resources and harvest patterns.

Conflict with these policies is possible during the exploration, development, and production phases but is more likely during development and production increases in the unlikely event of an oil spill and associated oil-spill-cleanup activities. Special stipulations in place under the Preferred Alternative (Sec. II.C.7.a) to protect subsistence, especially the stipulation that establishes procedures and advisory bodies to address subsistence resources and uses and research for inventorying and monitoring, and which requires that lessees not unreasonably restrict access in development areas to subsistence users (Stipulations 59 and 60); Stipulation 61 describes a conflict avoidance procedure to address subsistence concerns with oil and gas exploration and development activities. Through it, lessees would consult with the NSB, affected communities, and the Subsistence Advisory Panel, a special body created to

represent subsistence issues (see Sec. II.F.6). Under the Preferred Alternative, representatives of Federal, State, and NSB agencies with biological expertise would participate on an Interagency Research and Monitoring Team. The team would coordinate research and monitoring projects related to effectiveness of stipulations and surface resource impacts, and would seek advice from the Subsistence Advisory Panel (see Sec. II.F.7). In addition, Stipulation 62, which provides special considerations for subsistence, wildlife habitat, and traditional/cultural land use areas of significant concern to local communities, will be given special consideration during the consultation process outlined for Stipulation 61 and for special areas along rivers and creeks identified in the stipulation; Stipulation 63, which requires lessees to develop an orientation program to increase sensitivity and understanding of local community values, customs, and lifestyles and how to avoid conflicts with subsistence will reduce conflicts; and the Preferred Alternative will be consistent with this standard.

(8) Habitats (6 AAC 80.130): The Statewide standard for habitats contains an overall standard policy plus policies specific to eight habitat areas: offshore areas; estuaries; wetlands and tideflats; rocky islands and seacliffs; barrier islands and lagoons; exposed high-energy coasts; rivers, streams, and lakes; and important upland habitat (6 AAC 80.130 [a], [b], and [c]). Activities and uses that do not conform to the standards may be permitted if there is significant public need and no feasible prudent alternatives to meet that need, and all feasible and prudent measures are incorporated to maximize conformance (6 AAC 80.030 [d]). The NSB CMP contains a district policy that reiterates the applicability of the Statewide standard (NSB CMP 2.4.5.2[g] and NSBMC 19.70.050.K.7), plus several others that augment the overall policy or can be related to activities within a specific habitat. Under the Preferred Alternative, areas excluded from leasing include Teshekpuk Lake and the areas north and east of the lake, and nearly the entire Beaufort Sea coastal area, except for Kogru Inlet. Also, protective measures would forbid most types of surface use for oil and gas activities and would be imposed on (a) the northern part of the Teshekpuk Lake Special Area (all of the Goose Molting Habitat LUEA, important calving and insect-relief areas of the Teshekpuk Lake Caribou Habitat LUEA, and all of Teshekpuk Lake) to protect waterfowl and caribou habitat and important subsistence use areas; along Fish, Judy, and Kealok creeks and the Ikpikpuk and Miguakiak rivers to protect subsistence resources and uses; and along the Colville, Kikiakrorak, and Kogosukruk rivers to address concerns for subsistence uses and raptor habitat. The special stipulations developed for the preferred alternative provide protection for birds, terrestrial mammals, fish and habitats (Sec. II.C.7.a, Stipulations 1-80). Therefore, conflicts with the ACMP standards would be reduced and would provide for activities under the Preferred Alternative to be consistent.

The ACMP Statewide standard for habitats in the coastal zone requires that habitats "be managed so as to maintain or enhance the biological, physical, and chemical characteristics of the habitat which contribute to its capacity to support living resources" (6 AAC 80.130 [b]). This overall policy is supported by an NSB CMP policy requiring that development "be located, designed, and maintained in a manner that prevents significant adverse impacts on fish and wildlife and their habitat, including water circulation and drainage patterns and coastal processes" (NSB CMP 2.4.5.2[b] and NSBMC 19.70.050.K.2). In addition, "vehicles, vessels, and aircraft that are likely to cause significant disturbance must avoid areas where species that are sensitive to noise or movement are concentrated at times when such species are concentrated" (NSB CMP 2.4.4 [a] and NSBMC 19.70.050.I.1). Some disturbances associated with exploration and development would be mitigated by stipulations placed on permits. The analyses in Sections IV.G.6 through 14 indicate that resources would not be subject to significant disturbance from these activities. Although there are no conflicts with the reasonably foreseeable activities under this proposal at this point, some activities that may appear as specific proposals are brought forward at the time of development. Special stipulations in place under the preferred alternative (Sec. II.C.7.a) will reduce potential conflicts, and the activities will be consistent with this standard.

Activities may affect several of the habitats identified in the Statewide standard, including lagoons, wetlands, rivers, lakes, and streams. Much of the uplands in the NSB are considered wetlands. Therefore, onshore-development activities would need to be designed and constructed to avoid (1) adverse effects to the natural drainage patterns, (2) destruction of important habitat, and (3) the discharge of toxic substances (6 AAC 80.130 [c][3]). Water impoundments created by a pipeline/road corridor would have both positive and negative effects. In localized areas near the pipeline-road complex (Sec. IV.G.8), impoundments would benefit some waterfowl by creating additional habitat but displace other nesting shorebirds.

Caribou of the CAH and TLH are expected to be disturbed and their movements delayed along the pipeline during periods of air overflights (i.e. pipeline inspections), but disturbances are not expected to affect migrations and overall distribution (Sec. IV.G.9). Surface, air, and foot traffic near the oil fields is expected to increase under the Preferred Alternative and to displace some caribou, moose, muskoxen, grizzly bears, wolves, and wolverines but not significantly affect Arctic Slope populations. This conclusion is based partially on the established policy that

roads and pipelines are constructed to provide for unimpeded wildlife crossings. The NSB CMP policy 2.4.6(e) (NSBMC 19.70.050.L.5) emphasizes this practice and provides a set of guidelines and an intent statement specifically to implement the policy. There is no inherent conflict between the crossing requirements and the assumed activities. If a spill occurred as a result of activities under the Preferred Alternative, it is expected to result in the loss of no more than small numbers of terrestrial mammals, with recovery expected within about a year (Sec. IV.G.9).

Rivers, lakes, and streams are managed to protect natural vegetation, water quality, important fish or wildlife habitat, and natural waterflow (6 AAC 80.130 [c][7]). Pipeline and road construction, including gravel extraction, could affect these waterways and would need to be conducted in a manner that ensures the protection of riverine habitat and fish resources. Gravel extraction also is regulated under policies that are described in the section on mining. The special stipulations in place under the Preferred Alternative will reduce conflicts, and the Preferred Alternative will be consistent with this standard.

(9) Air, Land, and Water Quality (6 AAC 80.140): The air, land, and water quality standard of the ACMP incorporates by reference all the statutes pertaining to, and regulations and procedures of, the ADEC. The NSB reiterates this standard in its district policies and emphasizes the need to comply with specific water and air quality regulations in several additional policies.

Water quality can be affected by oil spills, deliberate discharges and emissions, and gravel operations. As a precaution against accidental spills, the NSB CMP requires the use of impermeable lining and diking for fuel-storage units with a capacity >660 gal (NSB CMP 2.4.4[k] and NSBMC 19.70.050.I.11). In addition, development within 1,500 ft of a coast, lake, or river shoreline "that has the potential of adversely impacting water quality (e.g., landfills, or hazardous-materials storage areas, dumps, etc.)" must comply with the conditions of the best-effort policies (NSB CMP 2.4.5.1[e] and NSBMC 19.70.050.J.4). These conditions are: (1) there must be a significant public need, (2) the developer has rigorously explored and objectively evaluated all feasible and prudent alternatives and cannot comply with the policy, and (3) all feasible and prudent steps have been taken to avoid the adverse effects the policy was intended to prevent. There may be some short-term conflict with water quality due to potential oil spills between this policy and activities assumed under this alternative. However, the stipulations in place under this alternative will reduce conflicts, and the Preferred Alternative will be consistent with this standard.

Some discharges and emissions would occur during exploration and development, and the NSB CMP policy 2.4.4(c) (NSBMC 19.70.050.I.3) requires that "development resulting in water or airborne emissions...comply with all state and federal regulations." This is consistent with the Statewide standard.

Discharges of muds, cuttings, and drilling fluids are regulated closely. Formation waters produced from the wells along with the oil is regulated by the USEPA. Underground Injection Control program. The Alaska Oil and Gas Conservation Commission has primacy for this program for Class II wells in the State of Alaska. Produced waters and drilling wastes fall within the Class II category. Some wastes are disposed through the annulus of producing wells. This activity is exempt from the Underground Injection Control program, however, the AOGCC also regulates this practice for the State of Alaska. Surface disposal of drilling wastes would require a solid waste permit from ADEC.

Because discharges are carefully regulated, no conflict is anticipated with the Statewide standard or NSB CMP policy 2.4.4(d) (NSBMC 19.70.050.I.4), which requires that "industrial and commercial development...be served by solid waste disposal facilities which meet state and federal regulations." Any onshore development under the preferred alternative must meet the Statewide standard and the district policy related to solid-waste disposal. Assuming the regulations are implemented properly, including Stipulation 13 related to solid- and liquid-waste handling and hazardous-material disposal and cleanup, there is no inherent conflict between the proposed activities and the ACMP water-quality provisions.

Air quality also must conform with Federal and State standards (6 AAC 80.140, NSB CMP 2.4.3[i] and 2.4.4[c], and NSBMC 19.70.050.H and I.3). The analysis of air-quality effects under the Preferred Alternative in Section IV.G.5 indicates that conformance is anticipated, and no conflict between air quality and coastal policies should occur.

(10) Statewide Historic, Prehistoric, and Archaeological Resources (6 AAC 80.150): The ACMP Statewide standard requires that coastal districts and appropriate State agencies identify areas of the coast that are important to the study, understanding, or illustration of national, State, or local history or prehistory.

The NSB developed additional policies to ensure protection of its heritage. The NSB CMP 2.4.3(e) (NSBMC 19.70.050.E) requires that development that is "likely to disturb cultural or historic sites listed on the National Register of Historic Places; sites eligible for inclusion in the National Register; or sites identified as

important to the study, understanding, or illustration of national, state, or local history or prehistory shall (1) be required to avoid the sites; or (2) be required to consult with appropriate local, state and federal agencies and survey and excavate the site prior to disturbance." The NSB CMP 2.4.3(g) (NSBMC 19.70.050.G) goes on to require that "development shall not cause surface disturbance of newly discovered historic or cultural sites prior to archaeological investigation." These NSB CMP policies establish clearly what is required. Although the NPR-A technically is excluded from the coastal area, given the number of existing sites, it is likely that new cultural and paleontological sites may be discovered under the Preferred Alternative. However, we do not anticipate conflicts with these policies, since stipulations in place under the preferred alternative (Stipulation 66, which requires an inventory of traditional use sites prior to conducting any activities) will reduce conflicts and the Preferred Alternative will be consistent with this standard.

Traditional activities at cultural or historic sites also are protected under the NSB CMP 2.4.3(f) (NSBMC 19.70.050.F) and 2.4.5.2(h) (NSBMC 19.70.050.K.8). As noted in the discussion of policies related to subsistence, the latter is a best-effort policy that requires protection for transportation to subsistence-use areas as well as cultural-use sites. There is no inherent reason to assume conflict with these policies.

Summary: The Preferred Alternative, short-term and localized impacts from disturbance and oil spills to the Teshekpuk Lake Caribou Herd, other terrestrial mammals, fish, birds, bowhead whales, and other marine mammals are expected, but subsistence-hunter concerns about access to resources and resource contamination would be minimal under this alternative (Sec. IV.G.13). Impacts would be further minimized by not leasing in important caribou, waterfowl, and fishing areas under this alternative and from the stipulations in place under the preferred alternative, and potential conflicts from activities under the preferred alternative with coastal management policies and standards of the ACMP and NSB CMP would be consistent.

Potential conflict between the proposed activities under the preferred alternative and Statewide standards and NSB district policies may arise, but are not expected, in conjunction with the NSB CMP 2.4.5.2(h) (NSBMC 19.70.050.K.8) that relates to both subsistence and cultural resource areas. This policy requires that development be located, designed, and maintained so as not to interfere with the use of a site that is important for significant cultural uses or essential for transportation to subsistence-use areas. Also, conflict with district policies may arise in the potential for adverse effects to subsistence resources. The NSB CMP policy 2.4.3(a)(NSBMC 19.70.050.A) relates to "extensive adverse impacts to a subsistence resource" that "are likely and cannot be avoided or mitigated." In such an instance, "development shall not deplete subsistence resources below the subsistence needs of local residents of the Borough." Policy 2.4.5.1(a) (NSBMC 19.70.050.J.1) relates to "development that will likely result in significantly decreased productivity of subsistence resources or their ecosystems." Potential conflicts with these standards will be reduced by stipulations in place under the Preferred Alternative (Sec. II.C.7.a), and the preferred alternative will be consistent with the ACMP standards and local district policies.

Conclusion—First Sale: Under the Preferred Alternative, conflicts could occur with specific Statewide standards and NSB CMP policies related to potential user conflicts between development activities and access to subsistence resources. Conflicts are possible with the NSB CMP policy related to adverse effects on subsistence resources resulting from periodic disturbance and oil spills, but no resource would become unavailable, undesirable for use, or experience overall population reductions. These effects would occur in the unlikely event of spilled oil contacting subsistence resources and habitats and the activities associated with oil-spill cleanup. However, the stipulations in place under the preferred alternative will reduce conflicts and the preferred alternative will be consistent with ACMP standards.

Multiple Sales: Under a multiple-sales approach, the resource estimate for the Preferred Alternative increases from a range of 90 to 420 MMbbl and one to two oil fields to a range of 130 to 600 MMbbl in one to three oil fields. The number of exploration wells increases from a maximum of 7 to 21, delineation wells increase from a maximum of 10 to 17, and production wells increase from 132 to 180. Pipeline miles increase to 110 mi. Multiple sales would occur over a longer period of time and, depending upon the frequency of sales, the time frame for oil and gas activities in the planning area would extend to at least 20 years.

For the Preferred Alternative, it is estimated that the number of spills ≤ 1 bbl would increase from a range of 14 to 63 spills to a range of 19 to 90 spills, and the number of spills >1 bbl would increase from a range of 5 to 21 spills to a range of 7 to 29 spills over the assumed production life of the planning area. The estimated number of crude-oil spills over the the assumed life of the planning area would increase from a range of 18 to 84 spills to a range of 26 to 119 spills (Sec. IV.A.2).

If several lease sales occur under the Preferred Alternative, considerably more exploration activity is expected to occur in the southern half of the planning area, and the levels of effects due to noise, disturbance, and habitat alteration is expected to increase. Surface, air, and foot traffic near

facilities is expected to increase and to displace some caribou, moose, muskoxen, grizzly bears, wolves, and wolverines but not significantly affect Arctic Slope populations. The number of small, chronic crude-oil and fuel spills is expected to increase and result in the loss of small numbers of terrestrial mammals, with recovery expected within about 1 year (Sec. IV.G.9). For arctic fish populations, additional disturbance effects could occur from additional gravel pads, gravel extraction, and fuel and oil spills. Insufficient recovery time between sales and greater oil activity levels would likely result in greater spill-related effects on arctic fish. An increase in effects to bird populations from increased noise disturbance could be expected with multiple sales. Any nesting and postnesting birds exposed to routine aircraft disturbance could be displaced from local habitats and subject to increased energetic demands. Some consequent effects to reproductive success and survival of young is anticipated with populations not requiring >1 year to recover. Some localized displacement of nesting birds in the vicinity of drill sites may occur, but significant effects on reproductive success are not expected. Construction disturbance is expected to cause temporary behavioral changes and displacement of winter resident species within 100 yards to 0.6 mi of the sites. Recovery in these instances is expected to require no more than 1 year. Disturbance from more intense activity such as routine flights over goose molting lakes and increased river traffic would require several breeding seasons for recovery. Off-pad oil spills would put loons and waterfowl at greatest risk. Especially at risk would be the large numbers of molting geese that occupy open waterbodies. Spills entering these larger lakes with larger numbers of molting or broodrearing geese and other species may result in losses in the hundreds, requiring several breeding seasons for recovery. Effects of multiple sales on bowhead whales are expected to be essentially the same as described for the first sale. Bowhead whales exposed to noise-producing activities such as marine vessel traffic and possibly aircraft overflights most likely would experience temporary, nonlethal effects. Small onshore spills are unlikely to reach the marine environment. If spilled oil did reach the marine environment, it likely would be a very small amount, and any exposure to spilled oil likely would not pose serious direct effects to bowhead whales. For marine mammals, multiple sales under the Preferred Alternative are expected to have similar effects to those for a single sale, i.e., local and short term, with no significant adverse effects to marine mammal populations as a whole, but the duration of activities and potential disturbance would extend over a longer period. Multiple sales may cause potential conflicts with the subsistence, habitat, air- and water-quality, and transportation standards of the ACMP; however, the stipulations in place for the preferred alternative will reduce conflicts. Further, each oil and gas lease operating plan will be reviewed for consistency on a case-by-case basis.

Conclusion—Multiple Sales: Effects from multiple sales to terrestrial mammals are expected to increase, but no significant impacts to populations are anticipated. Small numbers of terrestrial mammals would be lost due to the increase of small, chronic crude-oil and fuel spills, but populations are expected to recover within 1 year (Sec. IV.G.9). Arctic fish populations would experience slightly increased effects but high-density fish areas would be deferred. Increased disturbance and displacement effects and increased oil-spills risks are expected for birds, but timing of the sales again is critical to recovery and prime goose molting habitat is deferred. With extended intervals between sales, impacted bird populations are expected to recover from noise and disturbance effects in 1 year. Bowhead whales are expected to experience short-term, nonlethal effects. Effects to seals and polar bear would be short term and local with no adverse effects to populations.

Given that resource estimates and development scenarios project an increase in resources and an increase in the number of drill pads and pipeline miles, logic would assume increased effects to potentially affected resources, except for the fact that these effects would be spread over two decades. The biological analyses expect slight increases in effects with little overall effects to resource populations; therefore, effects associated with multiple sales on subsistence-harvest patterns in the communities of Barrow, Atqasuk, and (especially) Nuiqsut as a result of impacts from disturbance and oil spills are expected to make no subsistence resource unavailable, undesirable for use, or experience overall population reductions.

16. Recreation and Visual Resources:

a. Activities Other than oil and Gas Exploration and Development: Under the Preferred Alternative, some impacts to recreation and visual resources would result from on-the-ground management activities such as archeological collection efforts, field camps, survey work, and overland moves. Between June and September, three to four camps, survey, or collection efforts are anticipated at any one time. In winter months, several overland moves may occur during a single season.

Temporary structures (e.g., sleds, tents), vehicles (e.g., rolligons, tractors), noise from generators, aircraft, human presence, and associated activity all would have some minimal short-term impact on scenic quality, solitude, naturalness, or primitive/unconfined recreation. These adverse, short-term impacts would be confined primarily to the activity site viewshed (i.e., approximately ½ mi in any direction or 500 acres) and are expected to affect no more than a total of approximately 2,000 acres at a time (500 acres x 4 camps).

A longer lasting impact would be "green trails" resulting from overland moves. "Green trails" are created by vehicles compacting snow and dead vegetative matter that in turn results in the greater availability of moisture and nutrients for underlying vegetation the following growing season. These trails do not necessarily develop over the entire route of an overland move, but when they do they can be very detectable from the air for 2 to 5 years. They usually are difficult to recognize from the ground. Another impact along these trails that has occurred in the past is vegetation actually being damaged or broken or the tops of tussocks being scraped off. Current operating procedures make this an infrequent problem but one that can occur in conjunction with green trails. Because overland moves are a relative constant year to year and generally follow the same route(s), approximately 100 mi of intermittent green trail in some phase of recovery (attributable to overland moves) will be visible from the air during any one summer season.

b. Oil and Gas Exploration and Development Activities:

(1) Exploration: Although no oil and gas development could occur in about 20 percent of the planning area under the preferred alternative, seismic-survey work could continue throughout the area. This work would occur in winter using all-terrain ground vehicles supported by light aircraft. Seismic crews are housed in mobile camps consisting of a train of trailer sleds pulled by tractors. These moving camps, associated noise (e.g., vehicles, aircraft), and activities would result in a short-term, adverse impact on scenic quality and a loss of solitude and naturalness. These impacts would be confined primarily to the activity site viewshed, or approximately ½ mi in any direction. As many as four seismic operations could take place in a season, temporarily affecting approximately 2,000 acres.

A longer lasting impact would be green trails resulting from seismic survey operations. Unlike overland moves, seismic operations do not follow the same routes every year and the number of miles of survey line run can vary greatly from year to year. In some years no surveys would occur. As with green trails created by overland moves, these trails do not necessarily develop over the entire survey route and are visible for about 2 - 5 years. Because of the many variables involved, it is difficult to make a reliable estimate as to the number of miles of green trail that would be visible during any one summer season as a result of seismic operations. Assuming several operations per season for the first 5 to 10 years of the lease, the number of miles of intermittent green trails visible from the air during any one summer season (from seismic operations) likely will peak at many hundred miles. The number of miles of trail visible will begin to decline as this phase of exploration slows.

A total of 17 exploration/delineation wells are anticipated under the Preferred Alternative. However, due to the limited number of drill rigs available, no more than three wells are anticipated to be drilled at any one time. Drilling would occur over several winter seasons using ice pads, roads, and airstrips. Temporary on site location of structures (e.g., drill rigs); noise from generators, vehicles, aircraft, etc.; human presence; and associated activity all would have adverse, short-term impacts on scenic quality, solitude, naturalness, or primitive/unconfined recreation during the winter season. These impacts are expected to be greatest within a 2-mi radius of the drill site, which is an area of approximately 8,000 acres per well site. Accordingly, under this alternative, there would be a temporary loss of scenic quality, solitude, naturalness, or primitive/unconfined recreation around over an area of approximately 24,000 acres.

In addition to the short-term impacts that result from ongoing exploratory drilling operations, an accumulating summer-season visual concern exists as a result of the greening of vegetation under vacated ice pads, airstrips, and roads. This direct impact to the area's naturalness would be a result of the same conditions that create green trails—the greater availability of moisture and nutrients as ice or compacted snow melts. This greening of the vegetation does not necessarily develop wherever ice pads are constructed or snow is compacted but when it does, it can be very detectable from the air for 2 to 5 years. Another impact at these sites would be vegetation actually being damaged or broken especially along the perimeter of a pad or edge of a road. Assuming approximately 50 acres of ice pads, airstrips, and roads per drill site, as many as 850 acres (17 vacated sites x 50 acres/site) will be in various states of recovery from these impacts.

Exploration wells also will leave behind a marker pipe expected to be no larger than a square foot on the surface and 6 ft tall. This is essentially a permanent impact, but almost unnoticeable from several hundred feet.

(2) Development: As many as four production pads, 95 mi of pipeline, and one pump station are anticipated under the preferred alternative. While the intensity of impacts would be greatest during actual construction and development of these facilities, remaining structures, human presence, and associated activity and noise all would have adverse impacts on scenic quality, solitude, naturalness, or primitive/unconfined recreation during the life of the field. Because production could occur for 30 years, impacts would be long term. These long-term, adverse impacts are expected to be greatest within 2 mi of a pad site (or an area of about 8,000 acres).

Pipelines also will impact recreation values. Pipelines will be elevated about 5 ft.

There will little if any associated on-the-ground activity, except during construction and repair. Long-term impacts to recreation values from pipelines are expected to be minimal beyond about ½ mi. This equates to about 640 acres per mile of pipeline. Adverse impacts to recreation values from a pump station would be similar to those resulting from a production pad and its facilities, or about 8,000 acres impacted per station. Accordingly under this alternative, there would be a long-term loss of scenic quality, solitude, naturalness, or primitive/unconfined recreation over an area of approximately 101,000 acres (i.e., [8,000 acres/pad x 4 pads] + [8,000 acres/pump station x 1 pump station]+ [640 acres/mi x 95 mi of pipeline]). Short-term, routine/daily inspection flights also will impact solitude and naturalness along the length of all pipelines as long as they are in use.

Effects of Spills: Most spills (65-80%) will be confined to a pad. Spills not confined to a pad usually are confined to the area immediately around the pad or pipeline. Therefore, impacts on scenic quality, solitude, naturalness, or primitive/unconfined recreation resulting from spills likely would be confined to the same area described above under (2) Development.

A large spill that reaches a river, especially the Colville, and moves rapidly downstream would have disastrous short-term (and possibly long-term) impacts on recreation values.

Impacts to Wild and Scenic River Values: Under the Preferred Alternative outstandingly remarkable river values along the Colville will not receive any special protection under the WSRA. However, the Colville River upstream from about Ocean Point would be designated either Visual Management Class I or II under this alternative. As such, only very limited management activity with possible exceptions for subsistence structures or essential pipeline crossings would be allowed. These management standards should prevent any significant impacts to visual/recreation values in this scenic and important recreation area.

Summary: Under this alternative, impacts to recreation and visual resources from management activities other than oil and gas exploration and development would impact about 2,000 acres. These impacts will be minimal and temporary.

Also under this alternative, impacts to recreation and visual resources would result from oil and gas exploration and development activities. At any one time, exploratory/delineation drilling and seismic operations could result in short-term impacts to scenic quality, solitude, naturalness, or primitive/unconfined recreation over an area of approximately 26,000 acres. More lasting impacts (2-3 years) would result from a vegetative greening phenomenon caused by compacted snow and dead vegetative matter. This may mean as many as 850 acres of "green pads" and many hundred miles of intermittent green trails visible from the air at any one time. Actual development, production pads, and connecting pipelines would result in long-term loss of scenic quality, solitude, naturalness, or primitive/unconfined recreation over an area as large as 101,000 acres (or 2.2% of the planning area). No scenic Class A or B areas would be impacted as a result of this alternative.

Conclusion—First Sale: There would be approximately 2,000 acres in adverse, temporary impacts to recreation values from activities other than oil and gas exploration and development. Short-term (temporary) impacts from ongoing oil and gas exploration activities would impact approximately 26,000 acres. The greening of vegetation resulting from ice pads, roads, airstrips, and compacted snow would impact about 850 acres. Seismic operations would result in many hundreds of miles of green trails.

Oil and gas development would result in the long-term loss of scenic quality, solitude, naturalness, or primitive/unconfined recreation over an area of approximately 101,000 acres (or 2.2% of the planning area) for the life of production fields and pipelines.

Effects of Multiple Sales: The types of impacts resulting from additional lease sales will be the same as described above for a single sale. Short-term impacts such as green trails and pads, disturbance from noise, aircraft and other on-going activities will not accumulate. Impacts from long term or permanent facilities such as roads, pipelines, gravel pads and pits will accumulate to the extent such facilities are necessary to support additional exploration and production. It is anticipated that such facilities will increase about 18 percent over those of a single sale and would affect a total of approximately 119,000 acres.

Conclusion—Multiple Sales: Long-term impacts will increase about 18 percent over those of the single sale, ultimately affecting about 119,000 acres or 2.6 percent of the planning area.

H. EFFECTS OF THE CUMULATIVE CASE:

The cumulative case is based on the analysis of the potential effects of each of the alternatives described in this EIS, Sections IV.B through G, and other major North Slope oil and gas activities listed in Section IV.A.5, Table IV.A.5-1. These activities include 18 producing oil and gas fields, 5 fields that are being developed and/or planned (including activities associated with obtaining the required permits), 12 fields that are hypothesized to be developed within the life of this plan (10-15 years), and 10 other discoveries/fields that are hypothesized to be developed after 10 or 15 years. The 1996 production rate and reserves for the producing fields are shown in Table IV.A.5-2. The infrastructure and facilities for the producing fields are shown in Table IV.A.5-3. Estimated reserves and proposed infrastructure and facilities are shown in Tables IV.A.5-4 and 5, respectively, for the fields being developed or planned. Table IV.A.5-6 shows those fields that might be developed within 10 to 15 years and their resources estimates—if this information is available to the public. Table IV.A.5-7 shows the reserve and resource estimates of the North Slope onshore and offshore oil and gas fields used in the cumulative case analysis

Development within the planning area may make development in nearby areas more economical by bringing transportation and processing infrastructure closer. This is especially the case regarding the potential for development offshore to the north of the planning area or in the NPR-A west of the planning area. Consequently, the likelihood of some of the developments postulated in the cumulative case actually occurring and the resultant cumulative effect varies among the alternatives analyzed in this plan. For purposes of analysis, however, we have assumed that elements of the cumulative case, other than the alternatives analyzed in this plan, would occur under all alternatives.

For a variety of reasons some discoveries may not be economic to develop within the next 10 to 15 years; Section IV.A.1.b. These reasons may include any or all of the following (1) an estimated amount of oil that is too small to be economically developed, (2) distance from existing infrastructure, or (3) lack of appropriate technology.

Hypothesizing when these discoveries might be developed is speculative. Industry interest in developing these fields appears to be low and there is no publicly available information about planning efforts. Any potential effects that might be associated with developing these discoveries/fields would be based on current information and knowledge. Industry has been developing strategies to reduce the impacts associated with development and it seems reasonable to expect this trend to continue. Thus future impacts might be less than are estimated in the cumulative case analysis of this EIS.

The cumulative case also includes an analysis of an existing pipeline facility, TAPS, and three proposed natural gas facilities; the TAGS, ANGTS, and a natural gas to liquids conversion facility (Table IV.A.5-1b). The effects of potential gas development and production on the environment of the planning and adjacent areas that would be additional to the effects associated with oil development and production are described in Section IV.L

The potential effects of future oil and gas lease sales are also considered in the cumulative case (Table IV.A.5-1c). These include: Federal oil and gas lease sales in the Beaufort Sea (OCS Sales 170 and 176) and in Western NPR-A; State of Alaska areawide sales in the North Slope, Beaufort Sea, and North Slope Foothills; and Sales on Native lands.

The level of activity associated with any future oil and gas lease sales is very speculative. Until exploration wells are drilled and evaluated there is no way of knowing what, if any, resources might be in any of the areas that could be leased (Sec. IV.a.1.b(1)(a)). However, some hypothetical scenarios have been developed to analyze the potential effects of developing three oil fields; one located offshore of the Northeast NPR-A Planning Area, one in an area west of the planning area, and on Native lands near Nuiqsut; Section IV.A.5. The potential effects from a variety of activities and facilities are included in the analysis of these scenarios. These include a pipeline across the northern part of the Northeast NPR-A Planning Area north of Teshekpuk Lake and another pipeline south of the lake, onshore staging for offshore development, construction and supply activities, oil spills and, except for the Preferred Alternative, a gravel road connecting possible NPR-A development with the Prudhoe Bay/Kuparuk road system.

In analyzing the cumulative case for the Northeast NPR-A Planning Area, consideration is given to the potential effects on (1) the physical and biological resources, sociocultural systems, and various programs from activities associated with petroleum exploration, development and production, and transportation in the planning area and the major projects discussed in Section IV.A.5 and (2) migratory species from activities over their range, including the transportation of oil from Valdez, Alaska, to the U.S. West Coast. Migratory species includes those species or species groups that migrate to and from Alaska as well as other species in other areas that might be affected by the transportation of Alaska North Slope crude oil—especially oil spilled along pipeline and marine tanker-transportation routes. (Alaska North Slope crude oil includes oil produced from both onshore and offshore fields north of the Brooks Range and would include any oil that might be produced in the planning area.)

Oil exploitation in the planning area would increase the level or activities affecting the environment and it resources. Under Alternative E, 500 to 2,200 MMbbl (Table IV.A.1.b-6) may be explored and developed as the result of multiple oil and gas lease sales in the planning area over a period of time that might be measured in decades. The level of activities associated with such development are shown in Table IV.A.1.b-7. Oil resource estimates for western NPR-A range from 0.13 to 1.2 Bbbl (Table IV.A.5-7). The total amount of oil produced from onshore fields north of the Brooks Range and offshore fields in the Beaufort Sea is estimated to be about 18.52 Bbbl (Table IV.A.5-7); about one-third of this estimate is from undiscovered fields—speculative future production. Potential oil production from the planning area, multiple sales, represents about 1 to 3 percent of the total estimated Alaska North Slope crude-oil production.

As noted in Section IV.A, any economically recoverable oil that might be discovered in the planning area would be transported through pipeline(s) to existing infrastructure associated with North Slope petroleum development, mixed with crude oil from other sources, and transported overland via the TAPS to Valdez for transshipment via tankers mainly to the U.S. West Coast refineries; a fraction of Alaska North Slope crude oil also is shipped to a refinery at Nikiski, Alaska, and to refineries located in the Far East.

The largest area that would be available for leasing with the Northeast NPR-A Planning Area would be under Alternative E; therefore it is most likely to have the highest estimated level of planned activities and potential effects compared to the other alternatives. Thus, the cumulative case is based on the summation of effects of Alternative E and the major North Slope oil and gas activities listed in Table IV.A.5-1 and a comparison of the effects of each of the other alternatives plus the effects of these North Slope activities with Alternative E.

HYPOTHETICAL DEVELOPMENT SCENARIOS: The following hypothetical scenarios have been developed to analyze the potential effects of oil and gas exploration and development in areas adjacent to the Northeast NPR-A Planning Area. These scenarios assume leases have been issued to conduct the activities; in the case of operations on State of Alaska and Federal lands, it also assumes oil and gas lease sales have been held. In addition, the scenarios assume pipeline rights-of-way have been approved and facilities associated with these projects have the required permits. The hypothetical scenarios are for oil and gas exploration and development of (1) an offshore oil field north or northwest of the Northeast NPR-A Planning Area, (2) an oil field west of the Northeast NPR-A Planning Area, and (3) an oil field on Kuukpik Lands near Nuiqsut. Also, a hypothetical scenario has been developed for a permanent road that would connect the central part of NPR-A, west of the Northeast NPR-A Planning Area, with the Prudhoe Bay/Kuparuk road system; this scenario would only be for Alternatives A through E.

Offshore Field North or Northwest of the Northeast NPR-A Planning Area: Crude oil is hypothesized to be produced as the result of exploration and development activities in Federal or State of Alaska waters north or northwest of NPR-A of the Northeast NPR-A Planning Area. For this hypothetical scenario, it is assumed exploration drilling would be conducted from a mobile, bottom-founded drilling unit in waters <80 ft deep. Drilling operations from such a drilling unit would be conducted during the winter and could be conducted year-round depending on the location. Mobile bottom-founded drilling units have been used to drill seven wells in Federal waters; the drilling sites were located in waters 49 to 60 ft. In shallow water, drilling also might be conducted from an island constructed from ice; the ice island would be constructed during the early part of winter and drilling would done through April. Ice islands have been used to drill two wells in Federal waters, which were 21 to 25 ft deep.

The facilities associated with production would be mounted on a bottom-founded gravity production platform. The produced oil would be transported through a pipeline that connects with Alpine/Kuparuk Pipeline to TAPS. Under Alternatives A through E, the offshore segment of the pipeline would connect with an onshore pipeline that crosses the Northeast NPR-A Planning Area north of Teshekpuk Lake. The pipeline would be constructed in the winter as described in Section IV.A.1.b (6)(d); it is assumed there would be no parallel gravel road. Under the Preferred Alternative, the oil would flow through an offshore pipeline that connects with the existing Kuparuk/Prudhoe Bay pipeline system east of the NPR-A. Construction of the offshore segment of the pipelines would be in the winter from the landfast ice zone. In the summer, leak inspections of both onshore and offshore pipelines would be conducted periodically from aircraft. In the winter, inspections may be conducted by vehicles which exert low ground pressure and would travel only over snow-covered ground frozen to a sufficient depth to minimize soil and vegetation impacts.

Staging for exploration, development, and pipeline construction activities likely would be from established Prudhoe Bay/Kuparuk facilities; marine mobilization for offshore exploration and development activities would be from Prudhoe Bay. In the summer, barges from the Prudhoe Bay could be used to supply exploration and development operations. Heliocopters transporting personnel and supplies also would originate from the Prudhoe Bay/Kuparuk area. In the winter, overland

transport or ice roads could be used to transport exploration and development equipment and supplies to a temporary storage staging area along the coast. Vehicles used in overland moves exert low ground pressure and are permitted to travel only over snow-covered ground frozen to a sufficient depth to minimize soil and vegetation impacts (Sec. IV.A.1.a(5)). Ice roads also will be used to haul equipment and supplies to exploration and/or production sites, if they are located within the landfast ice zone (Sec. III.A.1.a (4)). In the winter, overland transport or ice roads could be used to transport equipment and supplies for constructing and maintaining the pipeline. Under Alternatives A through E, Camp Lonely, at Pitt Point, would be available as a staging location and could be used for supplying offshore exploration and production operations or pipeline construction.

Offshore exploration and production facilities will have equipment and supplies to make the initial response to an oil spill. If the response requires additional personnel, equipment, and supplies, mobilization would be from the Prudhoe Bay/Kuparuk area. A staging area used for oil-spill response would involve the use of only temporary facilities; as a staging area for oil-spill response, Camp Lonely would be available under Alternatives A through E and the Preferred Alternative.

Field in the Central Part of the NPR-A West of the Northeast NPR-A Planning Area: For this hypothetical scenario, it is assumed crude oil would be produced from an isolated field located somewhere in the central part of the NPR-A west of the Northeast NPR-A Planning Area. Exploration drilling operations would be conducted in the winter. Mobilization for exploration activities would be from the Prudhoe Bay/Kuparuk area using aircraft and winter overland vehicles for transport of equipment, supplies, and personnel. The drilling pad and airstrip would be constructed out of ice.

Development of the hypothetical field would require transportation and construction strategies based on an isolated location, one not connected to any other oil and gas facilities by a gravel road.

It is assumed the production pad, airstrip, and connecting road would be constructed from gravel and a nearby source of the material could be located. Mobilization for development activities would be from the Prudhoe Bay/Kuparuk area using aircraft and winter overland vehicles for transport of equipment, supplies, and personnel.

The produced oil would be transported through a pipeline that connects with the Alpine/Kuparuk Pipeline to the TAPS. The pipeline would be constructed in the winter as described in Section IV.A.1.b (6)(d); it is assumed there would be no parallel gravel road. The pipeline is assumed to cross the planning area south of Teshekkpuk Lake. Under Alternatives A through E, the pipeline would have to be at least ½ mile from the lake. Under the Preferred Alternative, there would be a ½-mi setback from the lake or no surface occupancy area, whichever is greater. In the summer, leak inspections of the pipeline would be conducted periodically from aircraft. In the winter, inspections may be conducted by aircraft or by winter overland vehicles.

Staging for exploration, development, and pipeline construction activities likely would be from established Prudhoe Bay/Kuparuk facilities. Aircraft transport of personnel and supplies also would originate from the Prudhoe Bay/Kuparuk area.

Development of a Field on Kuukpik Lands near Nuiqsut: Oil and gas exploration and development activities on Kuukpik lands would depend on lease arrangements between the owners of the surface and subsurface rights and the petroleum company or companies wishing to exploit any potential oil and gas resources. The exploration and development of the field would be similar to that described in Section IV.A.1.b. Exploration most likely would be conducted in the winter from an ice pad. It is assumed the production pad, airstrip, and connecting road would be constructed from gravel from a nearby source. Mobilization for development activities would be from the Prudhoe Bay/Kuparuk area using aircraft, ice roads, and winter overland vehicles for transport of equipment, supplies, and personnel.

The produced oil would be transported through a pipeline that connects with Alpine/Kuparuk Pipeline to the TAPS. The pipeline would be constructed in the winter as described in Section IV.A.1.b (6)(d); there may be a gravel road connecting the field to Nuiqsut.

Interconnecting Road: For the purpose of analysis, it is assumed that for Alternatives A through E, a gravel road would be constructed that connects the central part of the NPR-A west of the Northeast NPR-A Planning Area with the Prudhoe Bay/Kuparuk road system. The Preferred Alternative precludes such a road. The road would cross the planning area south of Teshekpuk Lake. The road would have to be at least ½ mi from the lake. Construction could occur in the winter and/or summer. In the planning area, the road could parallel the pipeline described in the scenario describing a field in the central part of NPR-A west of the Northeast NPR-A Planning Area. The economics of the oil fields likely to be discovered in the central part of the NPR-A seem to make it unlikely that such a road will be built. However, it is assumed such a road will be constructed for the purposes of impact analysis.

The summaries of the cumulative-case analysis for each of the alternatives is presented in a comparative format in Table IV.H.1.

1. Soils: In addition to the alternatives presented in this document, other activities associated with the cumulative case that may impact soils include Federal and State offshore oil development (by supporting infrastructure onshore), State and private onshore oil development, oil transportation, and global climate change. All but the last would impact soils through the development of infrastructure.

Of the five factors of soil formation, climate is the most dominant. It has a strong influence on biological activity, which is another active factor of soil formation. Global climate change may impact soils in many ways, some direct and some indirect. For example, if the climate changes so "earth warming" increases, more ice-rich soils will deteriorate, lose water and volume, erosion will form gullies, and sediment will be transported to other areas. Another example is that increased warming may trigger a "snowball effect" of increased soil microbial activity with increased consumption of soil organic matter and increased emission of methane and carbon dioxide, which will contribute to the "greenhouse effect," which will increase global warming and so on, until the soil organic matter is depleted. Indirectly, global warming may include such effects as additional organic matter added to the surface soils from increased vegetative growth due to the longer growing seasons. Due to the impreciseness of predicting global climate change, it is difficult to be specific about the cumulative effect of global climate change and the proposed action on the planning area soils. It, however, is quite possible that before global climate changes become noticable on the North Slope, any oil production resulting from lease sales based on this plan will have been completed, the development facilities appropriately reclaimed and cleaned up, and the area abandoned by the lessee.

Impacts on soils usually are closely related to surface activities and disturbance of the vegetative cover. The more extent and severity of disturbance to vegetation, the more serious will be the impacts on soils. Therefore, for each of these considerations, please refer to the analysis for vegetation. The recovery of soils is slower than that of vegetatation; it may take from several years to many decades for soils to recover.

Mitigation requires that there always be full stipulation (Stipulation 71) compliance throughout all phases of developments: exploration, design, construction, operations and maintenance, termination, restoration, and abandonment.

2. Paleontological Resources: In general, cumulative impacts to paleontological resources would result from development and production activities rather than exploration activities. However, paleontological resources are not ubiquitous, as is the case with wildlife, habitat, or scenic value, and it is possible that paleontological resources might not be impacted by petroleum-related activities. If they occur, it is probable that significant cumulative impacts would be greatest in areas of high oil and gas potential.

3. Water Resources: The cumulative effects of oil and gas exploration and development would result from disturbance of stream banks or shorelines and subsequent melting of permafrost (thermokarst), blockages of natural channels and floodways that disrupt drainage patterns, increased erosion and sedimentation, and removal of gravel from riverine pools and lakes, as noted in Section IV.C.3. The cumulative case assumes exploration and development of all the planning noted for the planning area (maximum) in Table IV.A.5. Thus, the effects of oil and gas exploration and development in the planning area are likely to be greater than those estimated for Alternative E. Also, the cumulative case considers the other projects listed in Section IV.A.5 and the three hypothesized scenarios. Thus, the effects on water resources may be several times greater than estimated for Alternative E.

The long-term effect of thermokarst on water resources in the planning area would be subsidence of the ice-rich permafrost along the stream banks and lakeshores, 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 changes to stream channel and bed morphology.

Natural drainage patterns can be disrupted when activities or structures divert, impede, or block flow in stream channels, lake currents, or shallow-water tracks. Blockages or diversions to areas with insufficient flow capacity can result in seasonal or permanent impoundments. Diverting stream flow or lake currents also can result in increased bank or shoreline erosion and sedimentation as well as potential thermokarst.

Besides thermokarst and drainage alteration, erosion and sedimentation can be caused by construction activities or vehicular crossings, especially during periods of high stream flow or lake levels. Inadequate design or placement of structures, culverts, or bridges can alter natural sediment transport and deposition, creating scour holes or channel bars. Improper placement or sizing of gravel fill can result in erosion from pads or roadbeds adjacent to streams or lakes. Long-term effects are changes in channel

morphology and composition of lake and stream bottom materials.

Improper siting of gravel-removal operations can result in changes to stream channel or lake configuration, stream-flow hydraulics or lake dynamics, erosion and sedimentation, and ice damming and aufeis formation. This could result in long-term changes in stream-channel and lakeshore sand- and gravel-bar formation.

4. Water Quality: Discussed in this section are the additive effects of Alternative E (full leasing in the Northeast NPR-A Planning Area) and ongoing and future development on water quality. The cumulative effects of North Slope development projects on water quality, excluding northeastern NPR-A oil development, as contained in Section IV.H.1 of the Sale 144 Final EIS (USDOI, MMS, 1996a), are incorporated here by reference. A summary, supplemented by additional material, as cited, follows.

Spills ≥1,000 bbl are projected to temporarily contaminate Beaufort Sea waters several tens of square miles to levels above chronic criteria but below acute criteria. One to two such spills are anticipated (Sec.IV.A.1.b). Existing causeways have caused chronic degradation of salinity, water temperature, and turbidity over a larger area in coastal nearshore lagoons. Other causal agents (gravel-island removal, permitted drilling discharges, dredging, and offshore facilities construction) would have more localized and less significant impact.

Tankering of known Beaufort Sea and North Slope oil resources other than from the planning area from the southern end of the TAPS is projected to result in 6 to 13 spills ≥1,000 bbl spread along the tanker route (Sec. IV.A.1.b). These spills also individually would contaminate receiving water over several tens of square miles to levels above chronic criteria but below acute criteria.

The quality of freshwater within the sale area is not affected by any of the major projects considered in cumulative case.

Outside the planning area, in the Prudhoe Bay area, trace metal contamination has been raised as an concern (Woodward et al., 1988; Snyder-Conn et al. 1997). Based on very limited sampling, Snyder-Conn et al. suggested that elevated levels of nickel and mercury exist in snowpack near the ARCO (world's largest) gas handling facility and that elevated levels of mercury, antimony, cadmium, copper, and lead exist near the NSB solid-waste incinerator. Only a single total mercury sample was collected near each facility, and "additional sampling is needed before any conclusions [regarding mercury] are drawn." The total mercury concentration for this single snow sample near the gas-handling facility was 8.4 parts per trillion (ppt), a fewfold higher than the chronic water-quality standard of 1.2 ppt, but far below the acute (toxic) standard of 2,400 ppt.

There are two caveats that lessen concern over the single high mercury value near the gas plant. First, the USEPA has recommended that States treat USEPA-based metal standards as a dissolved metal—not total metal as reported by Snyder-Conn et al. (1997). The concentration of dissolved mercury may not exceed the criterion. Second, the USEPA-based standard is based on the assumption that all mercury present is methylmercury. The mercury in snow should be ionic and possibly metallic mercury, not methylmercury. A criterion based on ionic mercury rather than methylmercury would be much higher than the measured total mercury value.

Contribution of the Planning Area to the Cumulative Case: With a single lease sale, the IAP is projected to add 0 to 1 spills ≥1,000 bbl to the 6 to 13 TAPS tanker spills projected from the existing Beaufort Sea and North Slope oil resources. These additional spills also would individually contaminate receiving water over several tens of square miles to levels above chronic criteria but below acute criteria.

For freshwaters within the planning area, analyzed cumulative effects on water quality relate primarily to proposed oil and gas leasing within the planning area. Additional factors—fecal contamination from wildlife and areas with concentrations of cabins and shelters, point-source contamination at Department of Defense sites and NPR-A historical drill sites, and oil seeps—also affect water quality but are considered part of the description of existing water quality in Sec. III.3.A.2.b.

Water requirements during oil exploration in the planning area could require winter extraction of the unfrozen water from hundreds of acres of nearby lakes. During development, because of the continued need for ice roads, annual water use would be similar to that for exploration, requiring water from up to 310-acres' worth of intermediate-depth lakes. During the seasonal construction phase during development, annual water demand would be on the order of 37 acre-feet for each field, requiring water from an additional 12 acres of lake per field. After major construction is finished, annual water demand would decrease to about 15 acre-feet/year for each field, requiring up to 25 acres of lake for water supply for all fields. The areas affected by ice road construction would shift each year as the ice-roads are realigned and shifted to avoid continued compaction of vegetation.

Gravel construction can be anticipated to result in upslope water impoundment and thermokarst erosion equivalent to twice the area directly covered by gravel, or up to 1,000 acres for development. Unlike the situation for ice structures, the same locations would be affected each year over the life of the field(s).

Over the life of the field(s), spills could affect water quality of up to 18 ponds or small lakes, making their waters toxic to sensitive species for about 7 years.

For multiple sales, during peak exploration, annual ice-pad and -road construction (400-1,100-acre footprint each year), drilling, and domestic (crew) needs for water could require winter pumping of unfrozen water from 150 to 430 acres of nearby lakes. Most of this water use would be for ice roads. Pad construction, drilling, and crew needs together would require water use equivalent to 6 to 10 acres of lake.

Because of the continued need for ice roads, annual water use during development for ice-road construction would be similar to that for exploration, requiring extraction of water from 150 to 230 acres of intermediate-depth lakes. During the seasonal construction phase, annual water demand would be on the order of 37 acre-feet for each field, requiring water from an additional 12 acres of lake for each field. After major construction is finished, annual water demand would decrease to about 15 acre-feet/year for each field, requiring up to 10 to 40 acres of lake for water supply for all fields..

The primary water-quality effect from construction and placement of gravel structures during oil development is related to upslope impoundment and thermokarst erosion. Gravel construction of pads, within-field roads, and field airstrip would cover about a 100-acre footprint per field, or a 200 to 800 acres total. In flat thaw-lake plains on the North Slope, gravel construction can be anticipated to result in upslope water impoundment and thermokarst erosion equivalent to twice the area directly covered by gravel, or up to 1,200 acres. Unlike the situation for ice structures, the same locations would be affected by gravel structures each year over the life of the fields.

Over the life of development resulting from multiple sales, oil spills could degrade water quality of 8 to 36 ponds or small lakes, with resultant toxicity persisting and eliminating sensitive species in their waters for about 7 years. Multiple sales could add 0 to 2 oil spills ≥1,000 bbl to the 6 to 13 projected TAPS tanker spills. A salt water spill from a waterflood pipeline could affect water quality over up to 64 acres. If a deeper lake was contaminanted, elevated salinity above State water quality standards could persist for several years.

5. Air Quality: Current oil and gas development activities are required to meet the PSD criteria under the Clean Air Act. This places limits on the amount of pollutants that may be produced from existing facilities and those added from activity associated with the IAP. Arctic haze, which is discussed in Section III.A.3.b, is considered to be transported into the area from Europe and Asia. Current activity levels should not add to the existing haze levels. Future oil development in the planning area would add an incremental amount to the emissions inventory for the North Slope, but this incremental addition would be monitored and controlled by the State of Alaska through the PSD permitting process.

6. Vegetation: In addition to Alternative E multiple sales, presented in this document, other activities associated with the cumulative case that may affect the vegetation of Alaska's North Slope include oil development in the remainder of the NPR-A west of the planning area, Federal and State offshore oil development (through the construction of supporting infrastructure onshore), State onshore oil development, and oil transportation. All of these projects affect vegetation through the construction of infrastructure (direct effects of vegetation burial and indirect effects of vegetation change caused by snow drifting, dust, etc.) and through oil spills. In terms of acres affected, construction causes more than 99 percent of the impacts, with spills having a very minor role.

Most current onshore development on Alaska's North Slope is concentrated within the Arctic Coastal Plain physiographic province, which covers about 13 million acres. Most development that would result from Alternative E also would occur on the Arctic Coastal Plain and would impact vegetation on 720 to 3,800 acres. Potential development in the remainder of the NPR-A, for which there are lower resource and reserve estimates (Table IV.A.5), may impact 360 to 2,000 acres (assuming 1-5 s to recover 0.1-1.2 Bbbl). The current development in the Prudhoe Bay/Kuparuk areas impacts about 9,000 acres directly through gravel extraction and fill and a much larger acreage of vegetation (Walker et al., 1986, 1987), but the total impacted acreage remains a small proportion of the Arctic Coastal Plain.

No additions to the infrastructure outside the planning area for transport of NPR-A oil are expected to be required as a result of any oil development within the planning area. Therefore, all impacts to vegetation outside the planning area as a result of this plan would be from oil spills. Oil developed as a result of Alternative E would contribute 4 to 8 percent of future spills from the TAPS. Spills of oil from Alternative E that occur prior to reaching TAPS would contribute 7 to 17 percent of all onshore, non-TAPS spills

on Alaska's North Slope and 6 to 15 percent of TAPS pipeline spills.

In addition to these oil and gas development projects that would directly affect North Slope vegatation, global climate change could alter the species' composition. Increasing temperature would result in an increased presence of deciduous shrubs with a decrease in sedges and grasses. Eventually, continued temperature increase could result in the invasion of arctic tundra by taiga forests (Anderson and Weller, 1996).

7. Fish: This section considers other actions in addition to those associated with Alternative E that might affect arctic fish in the planning area. All are directly related to the oil and gas industry. The cumulative case also considers the effects of three hypothetical oil fields on arctic fish: one in the offshore area north of the planning area; one in the central portion of the NPR-A; and another on Kuukpik land near Nuiqsut. The activities associated with these actions that may affect arctic fish are the same as discussed for Alternative E (seismic surveys, construction, and oil spills). The individual effects of these activities and the agents associated with them already have been discussed (see Alternatives A-E). This analysis focuses on the additional amount of exposure arctic fish would have to these activities/agents for the cumulative case over that of Alternative E and estimates the cumulative effect of that exposure on arctic fish.

The cumulative case involves more seismic surveys and construction-related activities than Alternative E. However, most of these additional activities would be conducted outside of the planning area, and many would not involve land-based seismic surveys or construction. Hence, they are not expected to have a significant effect on arctic fish within the planning area. Marine seismic surveys conducted outside of the planning area are not expected to have a measurable effect on marine fish (USDOI, MMS, 1990). Projects that are likely to have additional seismic and construction-related effects primarily are those associated with additional lease sales and oil field development within the planning area. Assuming that Alternative E is implemented in the current lease sale, and assuming further that the future sales (which are part of Alternative E) implement result in similar levels of activity in similar fish habitats, their additional effect on arctic fish is likely to be proportional to the number of sales that actually occur. Based on these assumptions, if three additional sales occurred in the cumulative case, the probability of adverse effects on arctic fish would be roughly three times that of Alternative E for the first sale. Depending on the actual level and location of implementation, this could result in a corresponding increase in the overall effect of seismic and construction related activities on arctic fish in the cumulative case. Also, if there were insufficient time for recovery between sales, the affected fish populations would be expected to experience additional adverse effects and may require a longer period of time for full recovery.

The cumulative case also involves more oil spills than Alternative E. As indicated above, many of the cumulative-case projects (including the three hypothetical oil fields mentioned above) would be conducted outside of the planning area. The additional oil spills associated with some of these projects may adversely affect the migratory and marine fish that use the coastal areas of the NPR-A. Offshore oil spills, or those that occur in rivers and move into coastal waters are likely to increase oil-related adverse effects on arctic fish in the planning area over that of Alternative E, because oil spills associated with Alternative E are expected to be very small and would seldom enter fish habitat. Further, toxic hydrocarbon concentrations are not expected to make their way into the coastal environment, where the marine and migratory fish of the planning area concentrate during the summer (for additional discussion, see Alternative B). In contrast to this, oil spills associated with North Slope oil-development projects, former and future Federal and State oil and gas lease sales, the three offshore hypothetical oil fields mentioned above, and pipelines could spill comparatively large volumes of oil into the coastal environment. For example, Table IV.A.2-9 estimates that up to 21,000 bbl of oil could be spilled into offshore waters in the cumulative case, whereas no oil would be spilled in this area due to multiple sales in the planning area.

As indicated for Alternative A, lethal effects on fish from oil spills are seldom observed outside of the laboratory environment. For this reason, oil spills are expected to have mostly sublethal effects on the marine and migratory fish affected by them. Juvenile fish (e.g., arctic cod), which are common in the nearshore area during summer, or nearshore spawners (e.g., capelin) are among those most likely to receive lethal or sublethal effects. Because there is greater probability of an oil spill contacting the coastal waters of the NPR-A in the cumulative case, it is likely that cumulative case oil spills would adversely affect a greater percentage of arctic fish than estimated for Alternative E. However, assuming sufficient recovery time between spills, the estimated recovery from each spill is likely to be the same as Alternative E (3 years). Cumulative-case oil spills that do not enter coastal waters are expected to have no measurable effect on marine and migratory fish.

8. Birds: The cumulative-case discussion is limited to oil and gas activities and includes past, present and proposed Federal and State lease sales, development, infrastructure, and transportation. These projects and details of their development are shown on Tables IV.A.5-1a to 1c and IV.A.5-2 to 6, and discussed in the

accompanying text. In addition, future development in the NPR-A could include one or more of the following:

Offshore Scenario—Development of an offshore field north of the planning area with a pipeline across the Goose Molting Habitat LUEA to facilities described for Alternative E. Offshore spills (0-3) occurring or released when broodrearing or premigratory waterfowl and premigratory shorebirds are concentrated in coastal habitats for feeding could contact substantial numbers of individuals if the oil entered lagoons or heavily used habitats such as saltmarsh or tideflats. A pipeline in the Goose Molting Habitat would displace small numbers of breeding waterfowl, shorebirds, and passerines from the area covered by supporting gravel, and these species as well as molting waterfowl could be disturbed periodically by aerial pipeline inspections. Onshore staging at Camp Lonely and offshore vessel traffic is expected to cause minor disturbance in the immediate vicinity of the activity. Pipeline spills could contaminate tundra, wetland, and aquatic habitats. A release could contact hundreds of individuals if oil enters a lake occupied by large numbers of molting geese, but the small average spill size suggests that smaller losses would be more typical.

Central NPR-A Scenario—Development of a field west of the Northeast NPR-A Planning Area with a pipeline south of Teshekpuk Lake. Potential effects of onshore activities are discussed in Sections IV.B.8 and IV.C.8. Given their low density, disturbance of the three resident species by winter activities (exploration, construction of facilities) is expected to be insignificant. Most effects of disturbance and displacement of breeding birds through habitat loss are expected to be localized, temporary, and minor at the population level because of the relatively low density of most species (although yellow-billed loons and shorebirds have more high concentration areas west of the planning area), small areas likely to be involved in this development, and relatively insignificant productivity losses caused by displacing these small local populations. Losses from any elevated levels of predation would be additive to lost productivity associated with habitat alteration. Waterfowl losses caused by any oil spill entering aquatic habitats are expected to be minor because of the relatively low nesting density of most species.

Kuukpik/ASRC Lands Scenario—Development of a field on Kuukpik Lands near Nuiqsut with a pipeline connecting to Alpine/Kuparuk/TAPS pipelines. Potential effects of onshore activities are discussed in Sections IV.B.8 and IV.C.8, and would be essentially as described above although higher density areas for tundra swan and greater white-fronted goose do occur in this area. If development occurred near the Colville River, a spill entering the river would cause effects as described in Section IV.G.8.b.(3)(c)—small numbers of waterfowl oiled and possible secondary oiling of raptors.

Interconnecting Road—A road would connect development west of the Northeast NPR-A Planning Area to the Kuparuk/Prudhoe Bay system, crossing the area south of Teshekpuk Lake. Although no permanent surface transportation is proposed for possible field development to the west, an extensive road serving this area would cover an estimated minimum 420 acres (assuming straight line route) of tundra/wetland habitat and degrade substantial habitat at gravel mine sites (typically 20-50 acres each). Productivity of an unknown proportion of birds displaced by gravel structures and gravel mining could be lost for the season if they are unable to relocate in alternate habitat. The amount of nesting habitat removed in the area south of Teshekpuk Lake is not likely to increase competition for such habitat significantly in subsequent seasons. Bird use could increase or decrease seasonally in the immediate road vicinity (see Sec. IV.C.8.b.(2): dust fallout may cause availability of habitats earlier in the season, but also may reduce plant growth; birds may be attracted to ponds produced by the damming effect of a road, but altered hydrologic regime may make certain habitats marginal for breeding birds; disturbance may displace potentially nesting species; and thermokarst may influence forage plants but the net effect is uncertain.

Perhaps most importantly, the road would provide increased access to a large area of tundra and wetland habitats, potentially resulting in increased hunting pressure on waterfowl and ptarmigan. If this occurred within the foraging range of raptors nesting along the Colville River, decreased prey availability could adversely affect their reproductive success. Outside the nesting season, lack of prey could result in lower survival, especially of juvenile gyrfalcons; typically under such conditions that are a result of natural prey population fluctuations, gyrfalcons and other raptors will move south to areas where prey are more abundant. If the road enhanced access to the goose molting areas to the north, increased hunting of concentrated and flightless goose populations could result in significant takes of these species and effects far beyond the Arctic Slope (see Sec. III.B.4).

The potential effects on coastal birds from onshore activities which may be associated with any of the projects in Tables IV.A.5-1 to 6 are discussed in Sections IV.B.8, IV.C.8, and IV.G.8. Effects of offshore activities are summarized in the offshore scenario discussion above. The overall cumulative effects of the numerous ongoing and proposed projects on Arctic Slope bird populations, including an increased likelihood for additional oil spills (0-3, average 7,000 bbl), is expected to be substantially greater than those associated with the proposed IAP. Most of these projects have a strong coastal or offshore marine

component and so are expected principally to affect post-nesting birds that are concentrated along the coast for broodrearing, molting, premigratory staging, or migration. These may include large flocks of waterfowl foraging in lagoons or offshore, and shorebird concentrations foraging in coastal habitats; oil spill contact with either may result in substantial mortality that could result in significant population-level effects.

Infrastructure associated with these projects also could adversely affect species during the nesting period as discussed in the sections cited above. Offshore development probably would result in substantial expansion of facilities at Camp Lonely with corresponding increase in disturbance of waterfowl in that area. Air and vehicle traffic, personnel presence, construction activity, pipelines, and predator attraction are expected to increase significantly, pushing the disturbance and displacement zone adjoining roads, airstrips, and pads to include broader areas with substantially greater effects on populations as competition for favored habitats increases regionally.

More than 9,000 acres of various habitats has been altered or destroyed in Prudhoe Bay/Kuparuk region, and an additional 452 acres is expected to be affected by possible future projects (Table IV.G-1). This may include gravel mining along the Colville River for development in the Northeast NPR-A Planning Area and will include a mine east of Nuiqsut for the Alpine development. Gravel mining may disturb/destroy small amounts of gravel bar or mudflat habitat used by shorebirds and waterfowl, and riverine tall shrub habitat which is important for passerine nesting. These additional habitat losses could intensify competition for favored breeding habitat by displacing birds, but the extent of potential losses is uncertain because the location and extent of most mine sites is speculative at present. In most cases these losses represent a small proportion of the habitats available in NPR-A; however, information is lacking that would suggest at what level of habitat loss irreversible declines in Arctic Slope populations would occur. Likewise, the additive effect of habitat loss by construction of a Trans-Alaska Gas System is unknown. With the exception of effects on molting geese, and possibly king eider, the contribution of proposed oil and gas development in the Northeast NPR-A Planning Area to the cumulative effects on Arctic Slope bird populations is expected to be <5 percent.

Because few of these ongoing or proposed projects are likely to affect geese in the goose molting habitat area, and potentially would have a lesser effect on king eiders whose abundance is proportionately greater in the planning area than outside, oil and gas activities associated with the proposed IAP are expected to make the greatest contribution to molting goose and king eider disturbance effects, and goose mortality, under the cumulative case. Under Alternative E, with development allowed in the Goose Molting Habitat Area, the contribution of activities in the planning area to cumulative disturbance and oil spill effects on Arctic Slope goose populations (based on calculations using data for brant) is expected to be 75 to 90 percent. The most significant effect would be the displacement of geese away from this traditional and unique molting area. Under alternatives with the goose molting habitat unavailable for leasing, contribution is expected to be <15 percent. (Note: For comparative purposes, considering the entire brant population and all factors that may affect it throughout its range on an annual basis suggests that an estimated 15-25 percent of disturbance but <5 percent of mortality would be contributed by oil and gas activities in the northeastern NPR-A.)

9. Mammals:

a. Terrestrial Mammals: The additive effects on caribou and on other terrestrial mammals of other ongoing and planned projects on the Arctic Slope of Alaska and in the planning area are discussed here. Although the probability of all planned and ongoing projects reaching developmental stages generally is unknown, this analysis assumes that all plans and projects discussed in this section do reach developmental stages (Fig. IV.A.5-1). Motor-vehicle traffic along >310 mi (about 500 km) of existing pipeline roads and an additional several hundred miles of future pipelines and roads associated with these projects could disturb, impede movements, and displace caribou and other terrestrial mammals and alter or destroy some calving and summer range through facility construction.

Oil and gas activities associated with planning area activities and other onshore and offshore projects would subject TLH, WAH, and CAH caribou and their summer and calving ranges to oil-development projects (Fig. IV.A.5-1). Potential oil spills from offshore as well as onshore oil activities associated with Federal and State of Alaska leases are likely to have a small effect on the caribou herds and other terrestrial mammals in general, because comparatively low numbers of animals are expected to be contaminated or to ingest contaminated food sources and die as a result of oil spills (Sec. IV.C.9.a).

Future cumulative development in the NPR-A could include one or more of the following scenarios:

Offshore Scenario—Development of an oil field north of the planning area with a pipeline that landfalls in the Camp Lonely area and crosses TLH calving habitat north of Teshekpuk Lake and connects with oil facilities under Alternative E. This hypothetical scenario would expose TLH calving caribou to additional disturbance on their

calving and summer ranges and expose other terrestrial mammals (grizzly bears and arctic foxes) to these activities.

Central NPR-A Scenario—Development of a field west of the planning area. Under this scenario, oil development might occur within the WAH caribou calving range located west of the current planning area and expose this herd to similar disturbance as described under Alternative E for the TLH. If this scenario occurred, an interconnecting road from the oil field to the TAPS and the Dalton Highway may occur.

Kuukpik/ASRC Lands Scenario—Development of a field on Kuukpik Lands near Nuiqsut. Under this scenario, development along the Colville River would increase over that associated with the Alpine and Fjord projects. Caribou of the TLH and CAH and other terrestrial mammals such as moose and muskoxen would be exposed to further habitat alteration and disturbance associated with additional roads and vehicular and air traffic along the Colville.

(1) Cumulative Noise and Disturbance: Past seismic surveys and oil and gas exploration drilling in the planning area included approximately 4,000 mi of Federal and 12,000 line miles of industry-conducted seismic surveys and the discovery of three noncommercial fields at Umiat, Fish Creek, and Square Lake. These activities probably briefly disturbed and displaced TLH (and perhaps WAH and CAH) caribou near exploration drill sites (10-12 wells) and along ice roads and aircraft-transportation routes within the Teshekpuk Lake area. However, this effect would not have persisted after exploration was complete and probably had no consequential effect on the abundance or productivity of TLH, WAH, and CAH caribou. The primary sources of disturbance of caribou and muskoxen are ground-vehicle traffic, humans on foot, and aircraft traffic near cows with newborn calves. Aircraft disturbance of caribou and other terrestrial mammals associated with cumulative oil exploration and development and resource-inventory-survey activities (particularly by helicopter traffic) is expected to have short-term (few minutes to <1 hour) effects on some caribou and muskoxen (particularly cow/calf groups), with animals being briefly displaced within about 1 mi from feeding and resting areas when aircraft pass nearby.

During development, the greatest concern from surface-vehicle/road-traffic disturbance of calving caribou and interference with caribou movements is disturbance associated with roads adjacent to pipelines. Caribou are most hesitant to cross (1) under an elevated pipeline adjacent to a road and (2) when motor-vehicle traffic is present on the road. The success of crossing a pipeline-road complex in the presence of traffic depends on motivation. During the mosquito season, caribou are highly motivated to seek relief from insect harassment, and the frequency of crossing pipelines in the Prudhoe Bay-Kuparuk area increases (Curatolo, 1984), although increases in the percentage of disturbance reactions tend to reduce crossing frequency. However, caribou do successfully cross pipeline-road complexes and numerous highways in Alaska and Canada with no apparent effect on herd distribution, abundance, or integrity. Although some habituation of caribou to the road system on the s is evident, cow caribou avoid areas of intensive human activity before, during, and immediately after the calving season (Smith, Cameron, and Reed, 1994). Cumulative disturbance of caribou (outside of the calving area) from road traffic (perhaps several hundred vehicles/day during construction) associated with pipelines in the cumulative case is expected to cause very short-term (a few minutes to a few hours) displacement of caribou within about 1 mi of the road. Road traffic temporarily delays the successful crossing of pipelines and roads by caribou and may have significant energetic effects on some animals but has no measurable effect on herd abundance or overall distribution. The exception to this level of effect is when disturbance levels are very high or when development facilities (especially roads) on the calving grounds cause long-term (over the life of the field) displacement—local change in distribution of cows and calves from within 1.86 to 2.48 mi (3-4 km) of roads that cross concentrated calving areas (Dau and Cameron, 1986; Cameron et al., 1992; Nellemann and Cameron, 1996).

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 oil fields (Lawhead, 1997; Nellemann and Cameron, 1996). The cumulative displacement of CAH cow/calf groups from portions of the calving range with the development of additional oil fields in the Prudhoe Bay-Kuparuk area (Figs. III.B.5.a-1 and IV.A.5-1) and in the Teshekpuk Lake TLH calving area. Possible oil exploration and development within the WAH calving area could occur, if the rest of the NPR-A west of the current planning area is made available for oil and gas leasing in the future. This development could result in a long-term displacement and functional loss of habitat for TLH, WAH, and CAH caribou over the life of the s.

At present, oil development has affected a portion of the calving and summer ranges of the CAH. Future State oil-lease sales in the Kuparuk Uplands, Prudhoe Bay Uplands, and North Slope Foothills will increase the amount of oil leases on the CAH range.

If full-scenario oil development (under Alternative E, with multiple lease sales, as well as the leasing of all of the NPR-A for oil exploration and possible development) were to occur, a large number of the TLH calving caribou (or most of the population) and part of the WAH caribou

calving area could be exposed to development activities. Assuming calving-activity displacement (reduction in habitat use) persists beyond the construction period and lasts over the life of the s, this would represent a long-term (several-generation) effect on the distribution of the TLH and WAH caribou. However, these effects may be mitigated by consolidation of facilities (especially reducing the number of roads) and by restricting surface and air traffic, humans on foot, and other activities during the calving season (Sec. IV.F.9.a).

Under NPR-A oil development in the Teshekpuk Lake area, a pipeline corridor connecting hypothetical s is assumed would connect with the TAPS through the Kuparuk River and the Dalton Highway. This corridor would transect TLH and CAH movements to and from insect-relief areas along the coast of Harrison Bay east to the Kuparuk River and also would transect TLH seasonal movements east of Teshekpuk Lake. Road traffic within the -development areas would be the primary source of caribou disturbance. Surveillance-helicopter traffic along the pipeline could cause a very brief and probably inconsequential disturbance of caribou. The combined disturbance from motor-vehicle traffic and the visual presence of the pipeline (visual obstruction to the caribou's line of sight) could delay TLH movements across the s in the Teshekpuk Lake area and reduce calving-activity use of habitat within 1.86 to 2.48 mi (3-4 km) of the roads (Dau and Cameron, 1986; Cameron et al., 1992; Nellemann and Cameron, 1996). Existing State of Alaska oil and gas leasing offshore and adjacent to the CAH and TLH ranges, as well as Federal OCS leases in Harrison Bay west to Smith Bay, might include offshore pipelines that come ashore within the TLH range and connect with the above hypothetical s. Potential offshore oil development adjacent to the TLH and CAH ranges may increase surface-vehicle traffic disturbance of caribou along transportation corridors that would connect offshore oil discoveries with the above-discussed Teshekpuk Lake area hypothetical s and TAPS (Fig. IV.A.5-1). 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 motor-vehicle and air-traffic disturbance of caribou at insect-relief areas along the coast and perhaps reduce the seasonal use of range land near the coast by cows and calves.

The reduction in calving-habitat use within 1.86 to 2.48 mi (3-4 km) of oil-development facilities, in theory, eventually could limit the growth of the arctic caribou herds within their present ranges and may prevent the herds from reaching the maximum population size that they could achieve on their present ranges without the presence of development. Such an effect may not be apparent, because natural changes in the distribution and productivity of the herds are 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 calving on the s compared with CAH cow-caribou calving east of the s suggests that disturbance-displacement of cow caribou may be affecting CAH caribou productivity (Cameron, 1994; Nellemann and Cameron, 1996). On the other hand, differences in densities and movements between segments of the CAH on the oil fields and east of the fields may have contributed to the decline (Cronin et al., 1997).

(2) Cumulative Habitat Alteration and Destruction: Cumulative oil development in the Prudhoe Bay-Kuparuk area encompasses >500 mi^2, and hundreds of miles of gravel roads cross a large portion of the calving range of the CAH. More than 8,000 acres of habitat has been destroyed or altered where roads, gravel pads, gravel quarries, pipelines, pump stations, and other facilities are located on the Arctic Slope, and an additional 450 acres are expected to be affected by planned projects (Tables IV.A.5-3 and 5-5). However, the loss of additional range habitat from facility construction in future oil development, such as in the planning area, is expected to represent a smaller portion of the available grazing habitat of the TLH (and WAH) caribou covered by gravel pads and roads because of consolidation of facilities, such as fewer roads and gravel pads. This additional loss or alteration of habitat is expected to represent a minor effect on caribou. However, displacement of calving caribou caused by disturbance has resulted in a significant functional loss of habitat on the existing s. A comparable functional loss of calving habitat might occur in the Teshekpuk Lake area and might occur within the calving range of the WAH, if all of the NPR-A were available for oil and gas leasing.

The alteration of >8,000 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 apparently have increased in numbers near the oil fields. Muskoxen have continued to expand their range eastward across the North Slope from an introduced population the Arctic National Wildlife Refuge. There are no apparent effects on grizzly bears, wolves, and other terrestrial mammal populations associated with this development.

(3) Effects of Increased Access from Roads and Other Facilities: The development of more transportation corridors in support of oil development on the North Slope, particularly roads that eventually may be open to the public, would increase human access to the Arctic Slope caribou herds and other terrestrial mammals, which could result in increased hunting pressure and perhaps overharvest of some populations. Hunting caribou with firearms south of the s along the Dalton Highway is

not permitted within 5 mi of the highway; however, hunting by bow and arrow is permitted within that distance. Noise and disturbance associated with hunting of caribou and other terrestrial mammals is not expected to have any significant effect on the movements of these mammals across the Dalton Highway and other North Slope roads. Caribou have continued to cross roads and highways, even when subjected to heavy hunting pressure and to the increased noise and disturbance associated with hunting (Valkenburg and Davis, 1986).

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 will reduce the use of roads and adjacent habitat by these animals.

The increase in the number of development facilities on the Arctic Slope is expected to increase the number of adverse interactions between humans and grizzly bears, resulting in the loss of bears due to their attraction to human refuse. These interactions are expected eventually to result in a decline in grizzly bear abundance near development areas. Cumulative oil development on the Arctic Slope also is expected to result in an increase in abundance of arctic foxes near development areas, which adversely may affect tundra-nesting birds and may pose a health hazard to humans through the spread of rabies among the growing fox population.

(a) Effects of an NPR-A Interconnecting Road: The possible construction of a road across the NPR-A and connecting with the Prudhoe Bay road system and the Dalton Highway-TAPS greatly would increase human access to the Arctic slope of Alaska. Hunting, trapping, recreation, and tourism would increase and expand across the Arctic. Hunting harvests of caribou, moose, and muskoxen and hunting and trapping of wolves, grizzly bears, and other mammals would increase over present levels of harvest. Disturbance of terrestrial mammals and other wildlife by increases in vehicle and human traffic would occur and result in reductions in abundance and in distribution of mammals along the road corridor.

The TLH, WAH, and CAH caribou herds are subject to little development on their winter ranges within and south of the Brooks Mountain Range. The TLH caribou are relied on for subsistence hunting by several Native villages on the Arctic Slope. Current harvest rates on the TLH caribou and the other arctic herds have not adversely affected caribou populations; however, the construction on a road across the NPR-A would increase subsistence hunting and trapping and sport hunting access to terrestrial mammals on the NPR-A.

(4) Effects of Global Warming: An increase in abundance of deciduous shrubs, especially birch (less favorable caribou forage), and a decline in the abundance of grasses-sedges such as *Eriophorum vaginatum* (an especially important food of calving caribou) are predicted to occur if a significant increase in temperatures occurs 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).

b. Marine Mammals: Discussed in this section are the additive effects of Alternative E (full leasing in the Northeast NPR-A Planning Area) and ongoing and future development on marine mammals in the Alaskan Arctic, in winter ranges in the Bering Sea, and along oil-tanker routes in the Gulf of Alaska. Development could have actual or potential adverse effects on the distribution or abundance of ice seals (ringed, spotted, and bearded seals), walruses, belukha whales, and polar bears in the Alaskan Arctic (and subarctic Bering Sea), and harbor seals and sea otters in the Gulf of Alaska. 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 are commercial fishing and hunting/harvesting.

Future cumulative development in the NPR-A could include one or more of the three following scenarios:

Offshore Scenario—Development of an oil field north of the planning area with a pipeline that landfalls in the Camp Lonely area and crosses the Teshekpuk Lake Special Area north of the lake and connects with oil facilities under Alternative E. This hypothetical scenario would expose some seals, polar bears, and perhaps a small number of belukha whales to additional noise and disturbance from air and vessel traffic associated with oil production in Smith Bay and from the pipeline to shore in the Camp Lonely area.

Central NPR-A Scenario—Development of a field west of the planning area. Under this scenario, oil development might occur far inland from the coast and would not affect marine mammals

Kuukpik/ASRC Lands Scenario—Development of a field on Kuukpik lands near Nuiqsut. Under this scenario, development along the Colville River would increase over that associated with the Alpine and Fjord projects. Some spotted seals and a few polar bears would be exposed to increase noise and disturbance associated with vessel and air traffic along the Colville River.

(1) Effects of Spills:

(a) Arctic Region Planning Areas: Cumulative oil-spill risks to marine mammal habitats from Camden Bay west to Point Barrow could develop from activities associated with Federal OCS Sale 170; offshore development at Endicott, North Star, and Liberty; onshore development on the NPR-A and at Sourdough, Alpine, and Badami; and possible barging of fuel oil for oil exploration and development in the planning area.

An important habitat for marine mammals is the active-ice, or ice-flaw, zone. Seals, walruses, and belukha 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 obviously pose a higher risk to marine mammals than onshore spills, but along the coast of the planning area some aggregations of seals and walruses and a small number of polar bears could be contaminated by onshore spills that reach marine waters and could suffer lethal or sublethal effects.

Spills that occurred during the open-water season (summer) or that occurred during the winter and persisted in the Beaufort Sea area after meltout 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 are likely to be contaminated by spills that 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, nonbreeding ringed seals, bearded seals, and polar bears could be exposed to cumulative oil spills that 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 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 belukha whales. Losses from an estimated 1 to 3 oil spills ≥1,000 bbl (Table IV.A.2-8) could be <1,000 seal pups ands adults, <1,000 walrus calves and adults, and <30 polar bears out of a population of 1,300 to 2,500 bears. (Assuming the current growth rate of 2.4% probably would replace lost bears within <1 generation [or 3-5 years] given the potential biological removal rate of 48 bears/year and assuming equal sex ratio of removed bears and a subsistence harvest of 20-30 bears/year [USDOI, FWS, 1995]). These losses are likely to be replaced within one generation or less (about 5-7 years), with a generation time of about 5 years for ringed seals and at least 7 years for polar bears (Kelly, 1988; USDOI, FWS, 1995). Belukha whales are likely to suffer low mortality (< 10 whales), with population recovery expected within 1 year.

(b) Arctic Oil Transportation Through Prince William Sound and Gulf of Alaska: Potential future oil-spill effects from tanker transportation of arctic oil (including NPR-A oil) from the TAPS terminal at Valdez could have serious cumulative effects on marine mammals, especially sea otters, in Prince William Sound and the Gulf of Alaska. There also could be local effects on the survival of young harbor seals if the spill occurred during the pupping season, as did the 1989 *Exxon Valdez* spill (11 million gallons or 258,000 bbl of crude oil). Indications from scientific studies of the effects of the spill suggest that the local sea otter populations in Prince William Sound, Kenai Peninsula, and the Kodiak-Katmai Bay area were reduced substantially. The western Prince William Sound sea otter population may have been reduced by at least 2,650 otters out of an estimated 6,500 otters (Garrott, Eberhardt, and Burn, 1993). The Kenai Peninsula and Kodiak-Katmai Bay sea otter populations probably suffered smaller losses (a few hundred otters) due to weathering and dispersion of the spill. It is likely that local assemblages or populations of sea otters in heavily contaminated coastal areas of Prince William Sound will take more than one to two generations, or ≥5 years, to recover from the spill. The oil spill also adversely affected the survival of harbor seal pups at pupping areas contaminated by oil and was estimated to have killed about 300 harbor seals (Frost et al., 1993). Oil resources estimated for Alternative E represent 4 percent of total North Slope onshore and offshore oil resources. By 2009, projected NPR-A production (under Alternative E multiple sales) could constitute 8 to 14 percent of the oil transported through the TAPS (at $18/bbl) and in tankers through Prince William Sound. Assuming tanker spills occur, cumulative transportation of North Slope oil through Prince William Sound is expected to have a long-term (≥5 years) effect on seas otters and harbor seals.

(2) Effects of Noise and Disturbance: In the Beaufort Sea and on the Alaskan Arctic Slope, cumulative noise and disturbance effects on breeding ringed seals from on-ice seismic surveys and possible from overland hauls that sometimes occur on stable sea ice adjacent to the planning area are expected to have a short-term (≤1 year) effect on ringed seals, because only a small percentage of the population (perhaps 1-3%) is likely to be disturbed; and even fewer pups are likely to be lost due to adult abandonment of maternity lairs (USDOI, BLM and MMS, 1997). Cumulative noise and disturbance of belukha whales during spring migration from icebreaker and vessel traffic could have a local effect on the movement of some whales, if their migration was delayed or diverted due to frequent traffic in the ice-lead system. Other cumulative

noise and disturbance effects from many helicopter and vessel trips per month are expected to be short term (a few minutes to <1 hour), because the disturbance reactions of seals, polar bears, and belukha whales would be brief—with the affected animals returning to normal behavior patterns and distribution within a short period of time after the boat or aircraft has left the area—and no long-term effects are expected to occur. These disturbance reactions are not likely to be additive. Cumulative disturbance effects on polar bears are expected, if some coastal denning areas in the Beaufort Sea or along the Arctic coast are disturbed and some maternity dens on the sea ice or on the coast were abandoned because of noise and human presence near denning areas. However, existing requirements under the Marine Mammal Protection Act are expected to prevent excessive disturbance of the bears.

Some polar bears could be killed as a result of human-bear encounters near oil camps and other facilities associated with cumulative oil development. In the Northwest Territories, Canada, from 1976 to 1986, 15 percent (33 of 265) of polar bears killed as a result of conflicts with humans occurred near industrial sites (Stenhouse, Lee, and Poole, 1988). Some of these losses are unavoidable and represent a small source of mortality on the polar bear population that would be replaced by recruitment within 1 year. Four bears were unavoidably killed after being attracted to offshore platforms in the Canadian Beaufort Sea over a 5-year period of intensive oil exploration (Stirling, 1988). The incidental loss of polar bears caused by cumulative oil and gas development in the Arctic is unlikely to significantly increase the mortality rate of the polar bear population because of subsistence harvest and natural causes.

Migratory populations of belukha whales, walruses, and spotted, ringed, and bearded seals have been exposed to oil-exploration activities (seismic surveying, drilling, air and vessel traffic, dredging, and gravel-dumping operations) in the Beaufort Sea and exposed to some industrial activities in the Bering and Chukchi seas. The exposure of the marine mammal populations to the above activities and to other marine-vessel traffic (sealift-barge traffic to the Arctic Slope and increased icebreaker activity in support of offshore oil exploration) may increase in the future. These industrial activities are likely to have some short-term (<1 generation) effects on the distribution of migratory seals, walruses, and belukha whales during the seasonal drilling season. If and when oil development occurs, some local changes (within a few miles of the activity) in the distribution of their populations could occur. However, some habituation of seals, walruses, and belukha whales to noise and human presence is likely to occur. The displacement associated with cumulative industrial activities or coincidental to such activities is not expected to result in a significant reduction in the overall abundance, productivity, or distribution of these marine mammals adjacent to the planning area and in the Beaufort Sea.

Helicopters flying along the coast to and from Camp Lonely, Prudhoe Bay, and NPR-A exploration and production facilities in the planning area could disturb some polar bears and seals hauled out near the coast. However, 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 is expected to cause short-term displacement of individual animals (a few minutes to less than a few days) within about 1 mi of the air traffic route and to have no significant effects on their populations near the planning area.

(3) Effects of Habitat Alteration: About 40 exploration-drilling units have been installed or constructed in the Beaufort Sea as a result of past Federal, State, and Canadian oil and gas leases. Several million cubic yards of gravel and dredge-fill material have altered a few square miles of benthic habitat in the Beaufort Sea. The cumulative effects of habitat alterations associated with platform construction, dredging, pipeline burial, and causeways are expected to have local (within about 1 mi) effects on some benthic food organisms and some fish species and are likely to have a short-term (<1 year or season) and local (1-2 mi) effect on the availability of these marine mammal food sources.

Exploration-drilling units and future production platforms in the Beaufort Sea are expected to have some local effects on ice movements and fast-ice formation. These local changes are likely to have a short-term (<1 year) effect on seal distribution during platform installation and construction activities. However, natural variation in ice conditions and resulting changes in seal, polar bear, and belukha whale distribution are likely to reverse or overcome any local reduction in the distribution of these species.

(4) Effects of Other Activities:

(a) Effects from Commercial Fishing: In the Bering Sea, the actual and potential effects of commercial fishing on harbor seals, ice seals, walruses, and belukha whales include the following: (1) direct mortality from entanglement in fishing gear and from shooting of marine mammals raiding fishing nets; (2) competition for prey/commercial-fish species that could reduce the availability of prey for marine mammals; and (3) displacement of marine mammals caused by noise and disturbance from boats and aircraft associated with intense

fishing activities. In Bristol Bay, the entanglement of belukha whales in the salmon gillnet fishery is an additive source of mortality for some pods of belukhas. In the Bering Sea, migratory spotted seals are likely to experience some mortality through entanglement in nets used by herring-fishing operations along the coast. In the southern Bering Sea and Gulf of Alaska, entanglement of migratory fur seals in discarded fishing gear, as well as incidental catches of sea lions in bottom-fishing trawl operations, are likely to have been contributing factors in the decline of these populations.

Competition for fish (particularly pollock and perhaps pandalid shrimp in the western Gulf of Alaska) is known to occur between marine mammals and commercial fishing. The rapid increase in the bottomfish fishery in the Gulf of Alaska and in the southern Bering Sea and/or the crash in the shrimp and capelin populations in the western Gulf of Alaska might be contributing causes for the >80-percent decline of northern sea lions and harbor seals over the past 20 to 30 years (Loughlin, 1989; Hansen, 1996).

At present, migratory ice seals (spotted, ringed, and bearded seals) and belukha whales that summer in the Arctic and winter in the Bering Sea are believed to have experienced only low losses in numbers because of direct mortality or food competition from commercial fishing in the northern Bering Sea, where the fleet is small (hundreds of boats) compared to the fleet in the southern Bering Sea-Bristol Bay and Gulf of Alaska (thousands of boats). These arctic marine-mammal populations are not exposed to such intense fishing activities during the winter months when they migrate to the northern Bering Sea. However, the amount of commercial-fishing activity has increased greatly in the northern Bering Sea, and migratory marine mammals are exposed to an increasing number of vessels. It is likely that temporary displacement (minutes to hours to 2-3 days) of seals, walruses, and belukha whales occurs as a result of vessel and air traffic associated with commercial fishing in Bristol Bay and Norton Sound.

Longer displacement (several days to a few months) of some portions of migratory marine mammal populations probably is occurring in areas of intense commercial-fishing activity. Up to 33 percent of the walrus herd that seasonally hauls out on Round Island in Bristol Bay apparently has been displaced from the area as a result of the bottom-trawl-fishing operations occurring near the island in the summer (Lowry, 1989, pers. comm.). This seasonal displacement of about 6,000 walruses to other haulout sites is not likely to have had a significant adverse effect on the productivity and abundance of the walrus population, but could represent a long-term (several-year), seasonal effect on the distribution of a portion of the population if this reduction in habitat use persisted for several years.

To summarize, the overall effects of commercial fishing on seals, walruses, and belukha whales include direct mortality from entanglement in fishing gear and shooting, competition for prey/commercial-fish species, and disturbance/displacement from vessel traffic. In the Bering Sea and in the Arctic, some populations of spotted seals and walrus could experience long-term (several-generation) displacement caused by increased traffic and competition for prey species. Seals and belukha whales could experience an increase in direct mortality as a result of net entanglements and shootings. They also could experience a long-term (several-generation) decline in productivity and abundance as a result of increased competition for prey species. The intense commercial bottom-trawl fishery for pollock and other bottomfish may have had a long-term effect on regional northern sea lion and harbor seal populations in the southern Bering Sea and in the Gulf of Alaska.

(b) Effects from Hunting/Harvesting on the Pacific Walrus Population: The annual harvest of Pacific walruses more than doubled from the 1970's (3,000-4,000 animals) to the 1980's (6,000 to >10,000 animals), with a total combined catch by Soviet and American hunters at 10,000 to 15,000 per year, or 4 to 6 percent of the population (Fay, Kelly, and Sease, 1989). During this same time, herd productivity and calf survival declined sharply. Because the population had reached the carrying capacity of the environment, the increased harvest occurred at the same time that the population was experiencing a natural decline in productivity (Fay, Kelly, and Sease, 1989).

Harvest/exploitation rates of >10,000 walruses per year caused the population to decline by about 50 percent, according to Fay, Kelly, and Sease (1989), representing a long-term (several-year) effect on the walrus population. A cooperative reduction in harvest rates by Soviet and American hunters would prevent such a population decline. However, some decline might continue into the next decade before any reversal or recovery of the population would begin (Fay, Kelly, and Sease, 1989). Optimistically, the international hunting of Pacific walruses still would have a short-term (<1 generation) effect on the walrus population. International subsistence hunting of other pinnipeds and belukha whales is believed to have no more than a short-term effect on migratory seals and belukha whales.

10. Endangered and Threatened Species: The discussion of activities under the cumulative case is limited to oil and gas activities and includes both proposed and past Federal and State lease sales and infrastructure and transportation scenarios. A detailed discussion of the numbers of past and proposed Federal and State sales as well as information on infrastructure and transportation can be found in Section IV.A.5. Existing and proposed

projects considered include TAPS and proposed natural gas pipelines (Table IV.A.5-1b), infrastructure and facilities for existing producing fields (Table IV.A.5-3), and proposed infrastructure and facilities for developing/planning projects (Table IV.A.5-5). The cumulative also considers impacts associated with a road connecting hypothetical new fields west of the planning area with the existing road network from Kuparuk to Deadhorse and the Dalton Highway. Finally, three individual scenarios to address potential additional fields are considered. The BLM makes an assumption that all of the NPR-A west of the current planning area would be made available for oil and gas leasing within 10 years of completion of the current planning effort. Preliminary resource estimates for the NPR-A west of the planning area range from 130 to 1,240 MMbbl. It also is assumed that stipulations similar to those that apply to Alternative E would also be incorporated in future decisions to make additional NPR-A lands available for leasing. The BLM assumes that the resulting oil field infrastructure and associated surface disturbance would be similar to that forecast for the planning area under Alternative E. Should the area west of the current planning area be made available for oil and gas leasing, appropriate NEPA actions and endangered species consultations would be conducted.

For the cumulative case, there is an estimated 61- to 98-percent chance of one or more spills ≥1 gal occurring as a result of Federal and State offshore sales in the Beaufort Sea with the most likely number of spills being zero to three over the assumed production life of the planning area (Table IV.A.2-8). An estimated total of 1,383 to 1,948 onshore spills ≥1 gal could occur. An estimated 26 to 119 onshore spills ≥1 gal could occur from activities in the planning area (Table IV.A.2-8). From 26 to 129 spills ≥1 gal are estimated could occur from NPR-A activities west of the planning area (Table IV.A.2-8). For tanker spills, there is an estimated 13- to 50-percent chance of one or more spills ≥1 gal occurring as a result of activities in the planning area, with the most likely number of spills being zero over the assumed production life of the planning area (Table IV.A.2-8). The most likely number of tanker spills estimated for all North Slope/Beaufort Sea production is from 7 to 12 spills over the assumed production life of the planning area (Table IV.A.2-8). Information pertaining to oil spills can be found in Section IV.A.2.

a. Effects on the Bowhead Whale: Information regarding the potential effects on bowhead whales from offshore lease sales was discussed in detail in the Beaufort Sea Sale 170 Draft EIS (USDOI, MMS, 1997), which is incorporated here by reference and summarized. Under the cumulative case, there could be an increase in seismic surveys, aircraft and vessel traffic, drilling, and construction activity as a result of existing leases and future sales, although bowhead whales generally are less likely to encounter activities in State waters. Bowheads may exhibit avoidance behavior if closely approached by vessels or seismic-survey activity but are not affected much by any overflights, unless aircraft altitudes are below 328 yards. Whales also likely would try to avoid being closely approached by motorized hunting boats. Bowheads have been sighted near drillships, although some bowheads probably change their migration speed and swimming direction to avoid close approach to them. Whales appear to exhibit less avoidance behavior with stationary sources of relatively constant noise than with moving sound sources. Bowheads do not seem to travel more than a few kilometers in response to a single disturbance incident; and behavioral changes are temporary, lasting from minutes (in the case of vessels and aircraft) up to 30 to 60 minutes (in the case of seismic activity). Overall, exposure of bowhead whales to noise-producing activities from oil and gas exploration and development and production operations is not expected to result in lethal effects; but some individuals could experience temporary, nonlethal effects. Because more oil spills are assumed to occur under the cumulative case than over the life of the proposed action, the probability is greater that whales may be contacted by spilled oil; and oil-spill effects are likely to be greater. However, the probability of oil actually contacting whales would be considerably less than the probability of contact with bowhead habitat. Some individuals may be killed or injured as a result of prolonged exposure to freshly spilled oil; however, the number of individuals so affected is expected to be small. Overall, prolonged exposure of bowhead whales to spilled oil may result in lethal effects on a few individuals, with the population recovering within 1 to 3 years. Most individuals exposed to spilled oil are expected to experience temporary, nonlethal effects.

For the cumulative case, the only existing or proposed projects included in the tables above that have the potential to affect bowhead whales are the Endicott, Liberty, and Northstar projects. Neither the Endicott nor Liberty projects are likely to cause any adverse effect on bowhead whales. Both projects are inside the barrier islands in relatively shallow water and operations would occur from gravel structures, which would limit the distance that noise effects would travel. Northstar is not inside the barrier islands but is well shoreward of the main bowhead whale fall migration route. Bowhead whale sightings by LGL (1996) indicate that nearly all the whales in 1996 were found mainly between the 15-m and 40-m depth contours, approximately 10 to 50 km from shore. The potential for spilled oil from these projects to reach bowhead whale habitat and contact whales is minimal. For example, the Oil-Spill-Risk Assessment model for Liberty estimates combined probability of ≤2-percent chance that one or more spills ≥1,000 bbl would occur and contact bowhead whale habitat, areas where bowheads may be present during the fall migration, within 180 days over the assumed

production life of the Liberty project. Bowhead whales are not likely to be affected by the TAPS or the construction of the TAGS, ANGTS, or an LNG conversion project, or tankering of crude oil from Valdez.

The overall contribution of proposed activities in the planning area to the cumulative effects on bowhead whales is expected to be limited to temporary avoidance behavior in response to vessel and aircraft activities.

b. Effects on the Spectacled and Steller's Eiders: Information regarding the potential effects on spectacled and Steller's eiders from offshore lease sales was discussed in detail in the Beaufort Sea Sale 170 Draft EIS (USDOI, MMS, 1997), which is incorporated here by reference and summarized. Spectacled and Steller's eiders in marine waters of the Beaufort Sea are not expected to experience significant adverse effects from drilling discharges or noise-producing activities associated with offshore exploration and development/production. Disturbance of some individuals as a result of offshore operations is expected to be unavoidable over the long term. Some mortality could result from contact with spilled oil. The effects of various cumulative factors, including an increased likelihood for additional oil spills, on the Arctic Slope spectacled eider population is likely to be substantially greater than those associated with any the proposed Sale 170 action, whereas the effects on the Arctic Slope Steller's eider population is likely to remain about the same. Substantially greater spectacled eider mortality is expected if additional oil spills occur under the cumulative case. Recovery for either species from substantial overall cumulative effect is not expected to occur, if the population decline of recent decades persists.

Both spectacled and Steller's eiders may be affected by activities proposed for the NPR-A sale, as discussed under Alternatives A through E. The marine component for the NPR-A sale and subsequent effects on eiders is likely to be minor, limited to perhaps disturbance from marine- vessel traffic and possibly some aircraft traffic.

Existing and proposed onshore oil and gas development/ production/transportation activities that may affect spectacled eiders include Prudhoe Bay, Kuparuk River, Milne Point, Alpine, TAPS, and TAGS. If production from the Alpine prospect occurs, a pipeline will be constructed to carry oil to the existing pipelines in the Kuparuk field. Activities associated with Prudhoe Bay, Kuparuk, Milne Point, and Alpine may cause disturbance to some spectacled eiders. Spectacled eiders are present in these areas in relatively low densities. The effects on eiders as a result of activities in these areas are likely to be minimal. A few Steller's eiders may be affected by activities at Alpine and Kuparuk. In addition, there would be activities associated with future onshore State oil and gas lease sales that may affect eiders, although the potential effects of the future onshore sales on eiders is not clear. There likely would be additional disturbance as a result of aircraft and vehicle traffic, construction of drilling pads, pipeline, etc. as a result of new lease sales in the area. In general, few Steller's eiders are found east of the Colville River; and the majority of spectacled eiders are found west of the Colville River, although they are present throughout the Prudhoe Bay and Kuparuk fields. Eiders are not likely to be affected by TAPS, construction of the TAGS, or tankering of crude oil from Valdez. Tankering of oil produced in the planning area under Alternative E represents from 1.7 to 4.7 percent of all expected future production and expected future production plus possible future production, respectively, to be transported by tanker from Valdez.

Existing and proposed offshore oil and gas development/production activities that may affect spectacled and Steller's eiders include Endicott, Northstar, and Liberty. Noise from activities at these locations are not likely to cause adverse effects to eiders that may be present in the area. The probability of an oil spill from these activities is small. Some mortality of eiders would likely result if an oil spill occurred in marine waters while eiders were present in the area. Some eiders could ingest oil from preening of oiled feathers and be prone to various pathological conditions such as endocrine dysfunction, liver-function impairment, weight loss, etc.

As stated above, BLM makes an assumption that all of the NPR-A west of the current planning area would be made available for oil and gas leasing. It is assumed that stipulations similar to those that apply to Alternative E would also be incorporated in future decisions to make additional NPR-A lands available for leasing. No information is available regarding resource estimates or levels of oil and gas activities expected in the area. Also, no information is available regarding the levels of activities other than oil and gas activities. In general, densities of both spectacled and Steller's eiders are higher in the area west of the current planning area. It is likely that disturbance to eiders as a result of both oil and gas activities and other activities would be greater in the area west of the planning area than in the planning area itself.

Overall, the effects on spectacled and Steller's eiders as a result of various cumulative factors is likely to be substantially greater than for any single activity or any activities associated with any individual lease sale. Disturbance of some individuals as a result of both onshore and offshore oil and gas operations is expected to be unavoidable over the long term. Some mortality could result as a result of contact with spilled oil. Activities associated with the planning area could adversely affect some spectacled and Steller's eiders but are not likely to

jeopardize the species. Oil spills are likely to be small and primarily confined to drilling pads, although some eiders may be adversely affected by spills that reach the surrounding tundra. The FWS (USDOI, FWS, 1998) anticipates that spectacled eiders or nests within 200 m of a spill are likely to be affected. Some individuals also may be adversely affected by loss of habitat for drill pads and roads, although the amount of habitat lost is not a significant proportion of the total amount of habitat available. Steller's eiders are less likely to be affected by spilled oil. Improper containment or disposal of refuse at onshore support camps could attract potential bird predators. It is possible that an increase in predators could result in the loss of eggs, chicks, or even adult eiders. The overall contribution of proposed activities in the planning area to the cumulative effects on spectacled and Steller's eiders is expected to be limited primarily to occasional disturbance from aircraft activities resulting in temporary, nonlethal effects. Disturbance may last less than an hour but could continue all summer in the case of summer drilling operations. Some mortality could occur as a result of the proposed NPR-A activities, but any mortality is not likely to affect either species at the population level. The overall contribution to the cumulative effects on species along transportation routes from tankering oil produced in the planning area to ports along the U.S. West Coast is expected to be minimal.

Offshore Scenario—Development of an Offshore Field North or Northwest of the Northeast NPR-A Planning Area: A hypothetical development of an offshore field north or northwest of the planning area in OCS waters likely would result in some impact to bowhead whales. The scenario calls for a bottom-founded gravity production platform, use of barge transport, aircraft traffic, supply-vessel traffic, and drilling operations that would occur during the open-water season when bowheads may be migrating through the area during their fall migration. Bowheads may be affected by noise from vessel and aircraft traffic as described in Section IV.C.10. Bowheads also may be affected by noise from drilling operations and may avoid the area where drilling operations are occurring. A detailed description of offshore drilling operations and their potential effects on bowhead whales in the MMS Beaufort Sea OCS Planning Area can be found in Section IV.B.1.a of the Beaufort Sea Sale 144 Final EIS (USDOI, MMS, 1996a). Oil spills also could affect bowhead whales. A detailed description of potential effects of oil spills on bowhead whales in the MMS Beaufort Sea OCS Planning Area can be found in Section IV.B.a.2 of the Beaufort Sea Sale 144 Final EIS (USDOI, MMS, 1996a).

This scenario also could affect spectacled eiders, because the project would have a pipeline crossing the spectacled eider LUEA. Aircraft flights for pipeline inspection could cause disturbance to eiders in or adjacent to the pipeline corridor. Some habitat would be lost from pipeline construction. Eiders would not be affected by construction activities, because construction would occur during the winter. Some eiders may be adversely affected by an oil spill if there was a rupture in the pipeline. Steller's eiders are not likely to be affected much by this scenario. Some eiders in the marine environment may be disturbed by marine vessel and aircraft traffic. These potential effects are discussed in more detail in Sections IV.B.10.b.2 and IV.C.10.b.2.

Central NPR-A Scenario—Development of a Field West of the NPR-A: A scenario for a hypothetical development of a field west of the planning area calls for an isolated production facility using a winter road system and resupply by aircraft and a pipeline south of Teshekpuk Lake. This hypothetical scenario would not affect bowhead whales. The likely effects of this scenario on spectacled eiders is difficult to determine, because there is insufficient information regarding the location of the development. Spectacled eiders could be affected, because the project would have a pipeline crossing the Spectacled Eider LUEA. Aircraft flights for pipeline inspection could cause disturbance to eiders in or adjacent to the pipeline corridor. Some habitat would be lost from pipeline construction. Eiders would not be affected by construction activities, because construction would occur during the winter. Some eiders may be adversely affected by an oil spill if there was a rupture in the pipeline. Depending on the location, Steller's eiders also may be adversely affected in a similar manner. These potential effects are discussed in more detail in Sections IV.B.10.b.2 and IV.C.10.b.2.

Kuukpik/ASRC Lands Scenario—Development of a Field on Kuukpik Lands Near Nuiqsut: A scenario for a hypothetical development of a field on Native lands near the planning area calls for a production facility similar to Alpine but would use a gravel road system and a pipeline involving aerial inspection. Spectacled eiders may be affected some by the project. Aircraft flights for pipeline inspection could cause disturbance to eiders in or adjacent to the pipeline corridor. Some habitat would be lost from pipeline construction. Eiders would not be affected by construction activities, because construction would occur during the winter. Some eiders may be adversely affected by an oil spill if there was a rupture in the pipeline. Steller's eiders are not likely to be adversely affected. These potential effects are discussed in more detail in Sections IV.B.10.b.2 and IV.C.10.b.2.

Interconnecting Road: The cumulative effects associated with a road connecting hypothetical oil fields west of the planning area with the existing road network, which stretches from Kuparuk to Deadhorse and the Dalton Highway. The hypothetical road would cross the planning area south of Teshekpuk Lake. This hypothetical scenario

would not affect bowhead whales. The location of the theoretical road is in an area of low density for both spectacled and Steller's eiders. If such a road were to be constructed in the summer, some eider nests could be destroyed by construction activities and some nesting eiders or eiders with broods could be disrupted, possibly resulting in some mortality. Placement of fill could result in long-term destruction of some breeding habitat, resulting in adverse effects to some eiders. Improved access to the area also could result in increased mortality from hunting and collecting eggs. The Fish and Wildlife Service Biological Opinion for the Integrated Activity Plan for the Northeast Portion of the National Petroleum Reserve-Alaska (1998) states that neither spectacled or Steller's eiders appear to be target species for hunters in the planning area. The opinion also stated that current hunting pressure on these species in the planning area probably is minimal but could increase as a result of improved access. It is likely that improved access would not greatly increase eider mortality considering the relatively low densities for eiders in the area, and there probably would not be much effect on the populations.

c. Effects on Species along the Transportation Routes: Analysis of the oil-spill risk on species along transportation routes in the Gulf of Alaska/U.S. West Coast, particularly the southern sea otter and marbled murrelet, can be found in the Cook Inlet Sale 149 Final EIS (USDOI, MMS, Alaska OCS Region, 1996b), which is incorporated here by reference and summarized in Alternative A. Analysis of the potential effects of an oil spill on species along transportation routes to ports in the Far East can be found in the Beaufort Sea Sale 144 Final EIS (USDOI, MMS, 1996a), which also is incorporated by reference and summarized in Alternative A. It is anticipated that most oil produced as a result of an NPR-A sale would be shipped to southern ports rather than to Far East ports. The contribution to the cumulative case for oil spills from oil produced in the planning area is small, with the most likely number of tanker spills estimated at zero spills compared to an estimated 7 to 12 spills for all North Slope/Beaufort Sea production over the assumed production life of the planning area. Tankering of oil produced in the planning area under Alternative E represents from 1.7 percent of all expected future production from the North Slope/Beaufort Sea area to be transported by tanker from Valdez.

11. Economy:

a. Activities Other Than Oil and Gas Exploration and Development: For the cumulative case, there would be no economic effect.

b. Oil and Gas Exploration and Development Activities: Increased revenues and employment would be the most significant economic effects generated by the cumulative case. Effects on the economy in the cumulative case are assessed in terms of (1) current conditions, described in Section III.C.1; (2) effects from Alternative E, described in Section IV.F.11; (3) and effects from the projects of the cumulative case, described in Section IV.A.2 except for the TAGS. Analysis of effects on the economy takes into account that effects from increased revenues and employment would be the most significant economic effects generated by the existing and proposed projects in the cumulative case. Increased tax revenues and new employment would be created with the construction, operation, and servicing of facilities associated with IAP activities.

The cumulative-case effects described in this section are those anticipated to be occurring in approximately the years 2015 to 2020. This is the period when the Preferred Alternative would be expected to be in the production stage.

A substantial portion of the employment and revenues in the cumulative case will result from replacement of oil production and infrastructure that is occurring in 1998. That is, a substantial portion of the oil production described as "Expected and Future Production" in Table IV.A.5-7 will replace the oil production occurring today. A portion of that future production will use infrastructure existing in 1998. Some of the future production will generate construction and use of new infrastructure. Some of this new infrastructure will replace infrastructure existing in 1998. Jobs in the 2015 to 2020 period will be associated with older infrastructure and new infrastructure. Federal, State, and local tax revenues will be in part generated by oil production in the future, which replaces 1998 production. Property taxes to the State and NSB will, in part, be generated by replacement of infrastructure existing in 1998. Decline between 1998 and the 2015 to 2020 period is anticipated for all forecast variables, except Federal revenues, which is zero in 1998.

The forecast of "replacement" based on "Expected and Future Production" in Table IV.A.5-7 for the 2015-2020 period is as follows:

NSB Property Tax—$220 million (a)
Oil and Gas Industry Employment on the North Slope—2,500 jobs (a)
NSB Resident Employment—1,400 jobs (b)
State Oil and Gas Revenue from the North Slope—$610 million (c)
Federal Revenue from the OCS—$90 million (a)

Revenues are annual revenues. (a) MMS forecast. (b) MMS Rural Alaska Model. (c) State of Alaska, Department of Revenue, Oil and Gas Audit Division, 1997.

The total cumulative economic effect is the replacement effect noted above plus effects that are two times those of Alternative E, which are based on "Possible Future Production," "Future NPR-A Leasing," and "Speculative Future Production" in Table IV.A.5-7. Analysis below are effects that are forecast to be two times those of Alternative E.

(1) North Slope Borough Revenues and Expenditures: Potential revenues will be determined by several different factors; therefore, the revenue projections should be considered with the understanding that many uncertainties exist. Exploration, development, and production are projected to generate increases in property taxes above the levels without the cumulative case starting in 2000, averaging about 6 to 12 percent each year through the production period, or about $12 to $24 million. The increase would decline over the period of oil and gas activity due to depreciation of the infrastructure. In general, the property-tax increases associated with the cumulative case would be two times those associated with Alternative E. For revenues shared by the State see subpart (4) below.

(2) NSB Employment: The gains from the cumulative case in direct employment would include jobs in petroleum exploration, development, and production and jobs in related activities. Gains would be two times those for Alternative E (Table IV.F.11-1). For the cumulative case, direct employment is anticipated to peak in the range of 4,400 to 8,400 jobs during the development phase and decline to a level in the range of 1,400 to 2,800 during production from 2018 to 2028. All of these jobs would be filled by commuters who would be present at the existing enclave-support facilities in and near the Prudhoe Bay complex approximately half of the days in any year. Most workers would commute to permanent residences in the following three regions of Alaska: Southcentral, Fairbanks and, to a much smaller extent, the North Slope. Some workers would commute from these enclaves to permanent residences outside Alaska, especially during the exploration phase.

Because of the development of facilities or the continued use of facilities that are taxable by the NSB, the NSB would have additional revenues that most likely would be used for ongoing operations. This in turn results in NSB-government jobs.

For the cumulative case, increases in total NSB-resident employment would be two times those of Alternative E, or in the range of 128 to 236 jobs during the peak of development, leveling off to 46 to 120 during production after 2017 (Table IV.F.11-1). The peak increase in resident employment is about 8- to 16-percent greater with the cumulative case than without during development, and about 4- to 10-percent greater during production. The increase in employment opportunities partially may offset declines in other job opportunities and delay expected outmigration. Increases in resident population also would be two times those of Alternative E and would correspond to increases in employment.

It is assumed that NSB-resident Natives would hold approximately 1 percent of the oil-industry jobs, based on historical experience. No workers would be needed to clean up numerous small oil spills beyond those already employed in the workers' enclave.

(3) Effects of Subsistence Disruptions on the NSB Economy: Disruptions to the harvest of subsistence resources could affect the economic well-being of NSB residents primarily through the direct loss of subsistence resources. See Section IV.G.13 for effects on subsistence-harvest patterns.

(4) Local, State, and Federal Revenues: Local, State, and federal revenues would increase as a result of the cumulative case, the increases being about twice those of Alternative E. For the cumulative case, property-tax revenues to the State would be approximately 25 percent of the revenues to the NSB, or $3 to $6 million annually. The annual royalty will be $28 to $232 million for the Federal Government and $28 to $232 million for the State and NSB. The average annual State severance tax is estimated to be $48 to $392 million.

(5) Southcentral Employment: Workers in the enclave centered at Prudhoe Bay probably would commute to permanent residences in Southcentral Alaska, Fairbanks, and outside the State. However, for the purpose of this analysis, it is assumed all of the enclave workers commute to Southcentral Alaska and have permanent residences there except during peak construction years. For the cumulative case, the number of workers would be two times that Alternative E (Table IV.F.11-1). Every enclave worker generates approximately five additional jobs, and these are assumed to be located in Southcentral mostly in the trade, finance, and service sectors. This is a result of spending by enclave workers, who have higher than average wages, which has a multiplier effect on the economy and generates additional employment.

For the cumulative case, during production, the population in Southcentral Alaska generated directly and indirectly by enclave workers would be twice that generated under Alternative E, and would be in the range of 21,000 to 42,000, or 5.6 to 11.4 percent of the Southcentral population. In the 7-year period of the exploration and development phases, the population directly and indirectly associated with the cumulative case would rise to the level

sustained during production (for methodology, see Alternative E).

c. The Trans-Alaska Gas System: The Trans-Alaska Gas System (TAGS), described in Table IV.A.5-1a, will generate considerable employment and revenue. The TAGS during 5 years of construction will peak at 7,200 direct jobs and 3,300 indirect jobs. The TAGS during operations will generate 550 direct jobs and 1,250 indirect jobs. The TAGS during operations will generate annually $188 million in property tax (for all local jurisdictions and the State), $64 million State severance tax, and $125 million royalty revenue (USDOI, BLM, and USDOD, U.S. Army, COE, 1988).

12. Cultural Resources: In general, cumulative impacts to cultural resources would result from development and production activities rather than exploration activities. However, cultural resources are not ubiquitous as is the case with wildlife, habitat, or scenic value, and it is possible that cultural resources might not be impacted by petroleum-related activities. If they occur, it is probable that significant cumulative impacts would be greatest in areas of high oil and gas potential.

13. Subsistence-Harvest Patterns: Cumulative effects on subsistence-harvest patterns include effects of multiple lease sales in the Northeast NPR-A Planning Area, additional sales in the remainder of the NPR-A, and other ongoing or planned projects on the North Slope that would include Federal and State offshore lease sales and State and private activities expected to occur in the future, and the transportation of oil and gas by pipeline.

Access to subsistence resources, subsistence hunting, and the use of subsistence resources could be affected by reductions to subsistence resources and changes to subsistence-resource-distribution patterns. Major factors considered in the effects analysis of subsistence-harvest patterns of the communities of Barrow, Atqasuk, and Nuiqsut are: (1) heavy reliance on caribou, fish, birds, and bowhead whales in the annual average harvest; (2) the overlap of subsistence-hunting ranges for many species harvested by the three Native communities; and (3) subsistence hunting and fishing as central cultural values in the Inupiat lifeway. Effects on subsistence resources would have associated effects on subsistence harvests. Oil spills occurring during the winter season could affect sealing and polar bear hunting. In spring, whaling, sealing, and bird hunting could be affected. In the open-water season, whaling, sealing, walrus hunting, and bird hunting could be impacted.

Any perceived disruption of the bowhead whale harvest from oil spills and any tainting or perceived tainting anywhere during the bowhead inmigration, summer feeding, and outmigration could disrupt the bowhead hunt for an entire season, even though whales would not be rendered unavailable. Biological effects to subsistence resources might not necessarily affect species distributions or populations, but disturbance could extend the subsistence hunt, making more frequent and longer trips necessary to harvest enough resources in a given harvest season. Beluga whales, when hunted, can be taken in ice leads and open water, and hunting is possible at different times over a 6-month period. This seasonal flexibility could be possible mitigation against noise and disturbance effects. Even though noise and disturbance effects to marine and coastal birds would be short term and local, such disturbance could cause waterfowl to avoid one or more productive subsistence-hunting sites. Cumulative loss of habitat from development activities and population loss from oil spills could cause harvest disruptions that would be significant to subsistence hunters who regard the spring waterfowl hunt to be of primary importance.

The gradual and continual loss of habitat associated with oil and gas development on the North Slope has been documented in a number of studies (Walker et al., 1986; Walker, 1986; Walker et al., 1987; Walker, Cate, Brown, and Racine, 1987; Walker and Walker, 1991). Walker et al. (1987) in a geobotanical mapping study concluded that by 1986 the Prudhoe Bay oil field occupied about 500 km^2 between the Kuparuk and Sagavanirktok rivers, that included 359 km of roads, 21 km^2 of tundra covered by gravel, and 14 km^2 that had been flooded by road and gravel-pad construction. Growth since 1968 had proceeded at a constant rate, and it was noted that construction at the Kuparuk Field was proceeding at a similar rate, thus doubling the total rate of development. Walker et al. (1987) considered these to be major landscape impacts and recommended that the implications to wetland values, wildlife corridors, and caribou calving grounds be addressed. It was suggested that such studies, which are necessary for assessing cumulative impacts in the region, would be hampered by the lack of baseline information at Prudhoe Bay prior to development, but, nevertheless, methods needed to be developed to assess cumulative impacts so as to foster better comprehensive regional planning on Alaska's Arctic coastal plain. Although recent innovations in the oil industry have reduced the size of an oil field "footprint" (Robertson, 1989), habitat loss needs to continually be assessed and such information used to assess cumulative effects to wildlife populations, subsistence resources, and subsistence harvests (Secs. IV.C.9 and IV.G.9).

Cumulative effects from oil development have been and continue to be paramount concerns to North Slope residents. Kaktovik resident Michael Jeffrey, testifying at hearings for the first offshore oil and gas lease sale, perceived early on a social impact from government

actions, stating that there was a cumulative effect on the villagers from having to participate in hearings and meetings. People knew that the issues were important, so they had to take time off from working and hunting to attend. Jeffrey believed the documents to be too technical, and to facilitate villagers' familiarity with them, he suggested that timelines and schedules be extended in non-English speaking communities so that there was enough time to translate documents (USDOI, MMS, 1979b). Sam Taalak, Nuiqsut Mayor in 1982, saw the onslaught of cumulative activity on his village 14 to 15 years ago: "We presently live at Nuiqsut and for the moment we're hemmed in from all sides by major oil explorations, even from the coast front" (USDOI, MMS, 1983a). Leonard Lampe, present Nuiqsut mayor, suggested recently that the village has begun to consider the long-term impact of oil development to their culture: "It's time to look at things seriously and ask if it's worth it. That's what the town is asking itself" (Lavrakas, 1996).

Nuiqsut Village President and AEWC Chairman, Thomas Napageak, in a January 10, 1997, meeting with MMS in Anchorage over a possible Sale 170 Nuiqsut Deferral, explained that the people of Nuiqsut have begun to focus on the issue of cumulative effects; their concern is that when the Northstar project proceeds, it will be out there and impacting the community for 15 to 20 years. The immediate impact of such development (such as Northstar) is directly on Nuiqsut. Mr. Napageak wanted the Sale 170 stipulations to deal with cumulative effects from Sale 170, as well as other projects, and that MMS make it clear in the EIS about cumulative effects. He wanted to see protective language developed for leases in the Sale 170 area that would extend to and bind lessees with existing leases from past sales. He believed such language would cover Nuiqsut's concerns about cumulative effects from other projected development activities (Casey, 1997, pers. comm.) Such language was included in Stipulation 5, Subsistence Whaling and Other Subsistence Activities, instructing lessees to "include a discussion of multiple or simultaneous operations, such as ice management and seismic activities, that can be expected to occur during operations in order to more accurately assess the potential for cumulative effects" (Sale 170 Draft EIS, USDOI, MMS, 1997). Similar language would be needed in onshore subsistence stipulations for monitoring impacts on subsistence resources and access to those resources. For NPR-A IAP/EIS planning, an innovative Subsistence Advisory Panel made up of Federal and State representatives and members from the NSB and local communities has been proposed. This group would investigate conflicts between subsistence activities and oil exploration and development activities, verify the level of conflict, and propose an action to the lessee and BLM for resolution.

At the NPR-A Nuiqsut Scoping Meeting, Thomas Napageak noted again the importance of assessing cumulative impacts, especially the cumulative and indirect effects of existing and potential oil development on Nuiqsut. He remarked, "...federal leasing cannot be examined in isolation as though none of this other development and potential development were going on" (USDOI, BLM, 1997a). At a BLM symposium on NPR-A held later the same month, Thomas Napageak reaffirmed the importance of addressing cumulative impacts: "Accumulated impact effects that would hinder the community and the socioeconomics of the community, how it will be affected by Alpine and presumably by NPR-A; these..really need to be considered" (USDOI, MMS, 1997).

The BLM, in its 1990 Western Arctic Resource Management Plan: Management Plan Analysis, made this assertion about the cumulative impacts of development on the North Slope: "To the extent that the planning area bordering lands and seas remain 'open range' geography, subsistence and cultural patterns dependent thereon shall remain open to perpetuation. To the extent that the 'open range' is transected and truncated by developments and their support systems, the subsistence option will be diminished or, at the extreme, closed" (USDOI, BLM, 1990).

Without some mechanism to ensure subsistence hunters access to and through development areas and a protocol for defining "no-fire" zones around development sites, the overall ability to reach subsistence-harvest areas by local subsistence hunters would be restricted, especially in Nuiqsut. No monitoring efforts assessing subsistence-resource damage, resource displacement, changes in hunter access to resources, increased competition, contamination levels in subsistence resources, harvest reductions, increased hunter effort, increased hunter risk, and increased hunter costs have been done or are ongoing. Without a process in place for monitoring harvest patterns and the effectiveness of current mitigation measures, that would necessarily include serious attention to traditional Inupiat knowledge of subsistence resources and practices, no truly informed projection can be made about cumulative effects on subsistence on a systematic and regular basis. The need for an ongoing monitoring effort already has been demonstrated, as initial research has already shown that North Slope oil development has produced more regulation of local subsistence pursuits, reduced access to hunting and fishing areas, altered habitat, and intensified the competition by nonsubsistence hunters for fish and wildlife (Haynes and Pedersen, 1989).

Interconnecting Road: An interconnecting road could bring impacts from increased access to subsistence resources. More specifically, increased access could increased hunting pressure on subsistence resources from

both subsistence and nonsubsistence hunters. Increased harvest levels could potentially make game scarcer near the road proper. Reduced abundance and distribution to caribou and other terrestrial mammals is expected along the road corridor from hunting, trapping, recreation, and tourist traffic associated with an interconnecting road. Increase 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. On the other hand, access could be diminished for subsistence hunters if the same problems arise in unitized oil fields where subsistence access has been curtailed near development sites by enforced "no-fire" zones.

14. Sociocultural Systems: Cumulative effects on sociocultural systems include effects of multiple lease sales in the Northeast NPR-A Planning Area, additional sales in the remainder of NPR-A, and other ongoing or planned projects on the North Slope that would include Federal and State offshore lease sales and State and private activities expected to occur in the future, and the transportation of oil and gas by pipeline.

a. Social Organization: In the cumulative case, effects on social organization could result from industrial activities, changes in population and employment, and changes in subsistence-harvest patterns. These effects would be similar to those described for the IAP; however, the level of effects would be increased because of the intensity of activity in the cumulative case. Additional air traffic and growth in the number of non-Natives in the North Slope region could increase the interaction between Natives and non-Natives and could cause additional stress between these groups. In the past, non-Native workers have worked primarily in enclaves and, by so doing, have mitigated much of the expected increase in interaction; but recent Alpine Field activity has placed non-Native workers directly in the Native village of Nuiqsut, and this proximity is bound to add stresses to the community. Impacts that already have surfaced in the community are increased demands for power and health care by workers on the Alpine project.

Increases in population growth and employment would be long term in the cumulative case and could cause disruptions to (1) the kinship networks that organize the Inupiat communities' subsistence-production and -consumption levels, (2) extended families, and (3) informally derived systems of respect and authority (primarily respect of elders and other leaders in the community). Offsetting such effects are strong efforts by the NSB government, the AEWC, and local governments and village corporations to institutionally foster and protect Inupiat cultural traditions. Cumulative-case effects on subsistence-harvest patterns (which also would be long term in the cumulative case) would affect the 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 cause a breakdown in family ties and the communities' well-being as well as tensions and anxieties, leading to high levels of social discord. The NSB, the AEWC, and local whalers have set precedents for the negotiation of agreements with the oil industry to protect subsistence-whaling practices. For northeastern NPR-A IAP/EIS planning, an innovative Subsistence Advisory Panel made up of Federal and State representatives and members from the NSB and local communities has been proposed. This group would investigate conflicts between subsistence activities and oil exploration and development activities, verify the level of conflict, and propose an action to the lessee and BLM for resolution.

b. Cultural Values: In the cumulative case, effects on cultural values could result from industrial activities, changes in population and employment, and changes in subsistence-harvest patterns. These effects would be similar to those described for the IAP; however, the level of effects would be higher due to the intensity of activity in the cumulative case. Cumulative-case effects on the social organization could lead to a decreased emphasis on the importance of the family, cooperation, sharing, and subsistence as a livelihood, and to an increased emphasis on individualism, wage labor, and entrepreneurialism. In the cumulative case, long-term effects on subsistence-harvest patterns are expected. Chronic, long-term disruptions of subsistence-harvest patterns could affect subsistence-task groups and have a tendency to displace sharing networks, but there would be no tendency toward the displacement of subsistence as a cultural value. These cultural values would be afforded the same protection by NSB institutions, the AEWC, community whaling organizations, the oversight of the Subsistence Advisory Panel, and regional and village corporations.

c. Other Issues: Increases in social problems, such as rising rates of alcoholism and drug abuse, domestic violence, wife and child abuse, rape, homicide, and suicide also are issues of concern in the cumulative case. The NSB already is experiencing social problems in its communities, and additional development (including onshore and offshore oil development) on the North Slope would lead to further disruptions of social health and well-being. Historically, it is suggestive that abuse of alcohol and increased violence seem to be somewhat connected to the increased flow of income into North Slope communities. During the peak of commercial whaling and then again during the height of the fur trade, secondary sources have indicated the onset of socially dysfunctional behavior. During the economic declines following these periods,

drinking and violence seemed to ebb. Recent evidence of the effects of employment during and just after World War II loosely substantiate this generalization. Lacking clear, incontrovertible evidence, it still could be assumed that the significant social changes encouraged and abetted by the huge cash flows from onshore oil development to date have played at least some role in the expression of these problems. It also is likely that these social changes in the North Slope have contributed to the extremely high rate of suicide among the Inupiat (90.8 per 100,000 for the Inupiat vs. 35 per 100,000 among the Yup'ik [Travis, 1989]). Long-term effects in the cumulative case could cause a displacement of existing sociocultural institutions, but again, the NSB continues to vigilantly protect the rights and culture of the Inupiat.

Although not long term, activities associated with oil-spill cleanup could generate up to 300 jobs for cleanup workers. For local Native residents employed in cleanup work (based on the situation during the *Exxon Valdez* spill cleanup), there could be curtailed participation in subsistence activities, a large cash surplus to spend, and a tendency to not continue employment in other local, lower paying jobs in the community. This sudden and dramatic increase in income for local Native cleanup workers and the disruption or inability to pursue subsistence because of oil-spill disruption and oil-spill cleanup employment could cause tremendous social upheaval. Nevertheless, many village men have been trained in oil-spill cleanup procedures and have expressed a desire to be part of any oil-spill-cleanup response, and it is expected that the NSB would have a large part in the structure of any oil-spill response.

15. Coastal Zone Management: The probability of any or all of the ongoing and planned offshore and onshore projects reaching the development and production stage is unknown; however, the following discussion assumes that all of these projects would reach the development and production stage. As with the Preferred Alternative, the effects of the projects considered in the cumulative case would occur from oil spills; noise from seismic activities; air- and road-traffic disturbance; disturbance from construction activities associated with pipelines; oil facilities (construction, installation, and operation); roads and landfalls; supply efforts; and from the tankering of oil. Cumulative effects of multiple lease sales in the Northeast NPR-A Planning Area, additional sales in the remainder of the NPR-A, and other ongoing or planned projects on the North Slope that would include Federal and State onshore and offshore lease sales, and State and private activities expected to occur in the future, and transportation of oil and gas by pipeline likely will increase potential conflicts with coastal management policies of the ACMP and NSB CMP.

Cumulative effects may lead to changes in the level of effects or may involve policies that were not relevant to Alternatives E, the maximum resource scenario. These differences are the focus of this analysis. Many of the projects included in the cumulative case could occur on Federal and State onshore and offshore lands, as well as lands covered by the NSB Comprehensive Plan.

a. ACMP Standard for Energy Facilities (6 AAC 80.070) and Transportation and Utilities (6 AAC 80.080): The effects of pipelines, roads, and facilities installation and construction are magnified in the cumulative case. Cumulative loss of bird habitat, if all the potential projects are developed, could be substantial and have locally significant effects on nesting distribution or density of some bird species near roads and facilities. If an extensive network of pipelines and associated roads were to bisect important calving areas, effects would be greater. The cumulative case results in an increased potential for conflict with 6 AAC 80.070(b)(1)(2) and (13), Energy Facilities, and NSB CMP 2.4.5.1(g), Best Effort Policies, (NSBMC 19.70.050.J.7).

The State's ACMP Energy Facilities policy, AAC 80.070(b)(1) states that: "The siting and approval of major energy facilities by districts and state agencies must be based, to the extent feasible and prudent, on the following standards: (1) site facilities so as to minimize adverse environmental and social effects while satisfying industrial requirements; (2) site facilities so as to be compatible with existing and subsequent adjacent uses and projected community needs; and (13) site facilities in areas of least biological productivity, diversity, and vulnerability and where effluents and spills can be controlled or contained."

The NSB Best Effort Policy NSB CMP.2.4.5.1(g) states that development will be allowed only if the development category or type has met the criteria under 2.4.5, namely, that (1) significant public need for the proposed use and activity; and (2) the development has rigorously explored and objectively evaluated all feasible and prudent alternatives to the proposed use or activity and cannot comply with the best effort policy. NSB CMP 2.4.5..l, category (g), identifies development to accommodate large scale movement of crude oil or natural gas via marine tankers. Intent: The intent of this policy is to limit development to accommodate large-scale movement of crude oil or natural gas via marine tankers to instances where no feasible and prudent alternative exist, recognizing that development of marine tanker facilities is a use of State concern.

b. ACMP Subsistence standard (6 AAC 80.120): The increase in the range and number of activities associated with possible interference with subsistence activities and potential loss of access and

resources would accentuate potential conflicts with the Statewide standard that guarantees opportunities for subsistence use of coastal areas and resources and the NSB CMP policies that are addressed in Section IV.C.15. The duration of the potential user conflicts may cause subsequent developments to fall into a more restrictive policy. Cumulative effects on marine mammals from noise and disturbance of most subsistence species are expected to be limited to temporary avoidance behavior in response to vessel and aircraft activities, and are not expected to affect their overall abundance, productivity, or distribution. Cumulative effects from oil spills could oil and contaminate these species and/or their habitats, resulting in low to moderate mortality rates. Planning-area activities, including oil exploration and development, are expected to have short-term effects on Arctic marine mammals.

Cumulative effects on caribou are expected to be long term, particularly the cumulative effects on caribou calving distribution are likely to be long term over the life of the s, possibly affecting local subsistence harvests. Reduction in calving and summer habitat use by cows and calves of the CAH and TLH and possibly on WAH caribou from future NPR-A leasing, represents a functional loss of habitat that may result in a long-term effect on caribou herd productivity and abundance. The contribution of the planning-area oil exploration and development activities to the cumulative effects on the TLH (and on WAH caribou from NPR-A wide possible oil exploration and development activities) is estimated to be perhaps 80 to 90 percent and on the CAH, perhaps 10 percent. The cumulative effects to other terrestrial mammals, including grizzly bears, muskoxen, moose, wolves, and wolverines (other than global warming) are likely to be local within about 1 to 2 mi of oil exploration and development facilities and resource inventory-survey activities and generally short term, with no significant adverse effects on their populations.

Cumulative effects from potential oil spills and onshore disturbance to fishes are expected to be local and temporary. Cumulative-case oil spills that enter coastal waters are likely to cause lethal or sublethal effects to a greater percentage of arctic fish than estimated for oil spills associated with Alternative E. Assuming sufficient recovery time between spills, the recovery from each cumulative case spill affecting fish is expected within 3 years. Onshore cumulative-case oil spills are expected to have an effect on arctic fish similar to that discussed for Alternative E (Secs. IV.C.7 and IV.E.7). Effects on fish resources from seismic and construction disturbance would increase under the cumulative case with increased chronic, short-term impacts on the subsistence fisheries of Barrow, Nuiqsut, and Atqasuk

Cumulative effects to birds for the NPR-A sale and subsequent effects on bird populations is likely to be minor, limited to perhaps disturbance from marine vessel traffic, aircraft activity, and future development activities, resulting in temporary, nonlethal effects. Disturbance may last less than an hour but could extend to several months in the case of summer drilling operations (Secs. IV.C.8 and IV.G.8).

Cumulative effects from exposure of bowhead whales to noise-producing activities from both onshore and offshore oil and gas exploration and development and production operations are not expected to result in lethal effects; but some individuals could experience temporary, nonlethal effects. Prolonged exposure of bowhead whales to spilled oil may result in lethal effects on a few individuals, with the population recovering within 1 to 3 years. Most individuals exposed to spilled oil are expected to experience temporary, nonlethal effects. (Secs. IV.C.10 and IV.G.10).

In the Beaufort Sea, cumulative effects to other marine mammals (seals, walruses, polar bears, and belukha whales) from oil and gas development are expected to be relatively short term (within ≤1 generation, perhaps 1-7 years) on ice seals (ringed, spotted, and bearded seals), walruses, polar bears, and belukha whales. In Prince William Sound, the cumulative effects are expected to be longer- term (>5 years) on sea otters and harbor seals. The cumulative effects from other development projects (such as commercial fishing) are expected to be long term (>1 generation to perhaps several generations) on harbor seals, and short term (<1 generation) on other marine mammals.

Rather than considering subsistence access reduced or restricted (NSB CMP 2.4.5.1[b]) (NSBMC 19.70.050.J.2), it may be considered precluded and be subject to NSB CMP 2.4.3(d) (NSBMC 19.70.050.D) instead. It is possible that some subsistence resources could be depleted below the subsistence needs of local residents (NSB CMP 2.4.3[a] and NSBMC 19.70.050.A).

c. Habitats Standard (6 AAC 80.130): All habitats noted as at risk for Alternative E, the maximum resource scenario, are more likely to be adversely affected in the cumulative case. This could lead to conflict with the ACMP Statewide standard and the NSB CMP habitat policies identified in Section IV.C.15. One policy that likely will be implemented with greater scrutiny in all habitats is the policy that curtails vehicles, vessels, and aircraft activity when and where it may affect concentrations of sensitive populations (NSB CMP 2.4.4[a] and NSBMC 19.70.050.I.1). Potential effects resulting from noise and disturbance on birds, mammals, waterfowl, and caribou all increase in the cumulative case.

In the offshore habitat, increased effects relate to the increased number of oil spills and development of roads and facilities over the life of the fields. The NSB CMP policy 2.4.4(i) (NSBMC 19.70.050.I.9), identified previously under transportation, will receive greater attention with respect to the offshore habitat.

Development of State leases included in the cumulative case increases the likelihood that barrier islands and lagoons would be affected. Disruptive activities and requests for altering shores are probable, because this habitat is within the area leased by the State for oil and gas exploration and development.

The cumulative case analysis also considers effects to the tundra wetlands that would be subject to infilling. Adverse effects on tundra and wetland nesting, feeding, and staging areas, particularly in the Teshekpuk Lake waterfowl-concentration area, the NPR-A oil-exploration and -development area, and the Mackenzie River Delta oil development in Canada, are likely to represent a greater loss of tundra habitat on the North Slope for several species and may have a long-term, local effect on the nesting distribution and density of some species for more than one generation (or over the life of the s).

Pipeline and road crossings and gravel extraction would increase in riverine areas that are used extensively by anadromous fishes. Although this could lead to greater conflict with the riverine-habitat policy, development probably would be modified if conflict with this policy became evident.

d. ACMP Air, Land, and Water Quality Standard (6 AAC 80.140): Greater adverse effects for water quality are expected for the cumulative case; however, regional water quality in the Beaufort Sea would not be affected. Conflict with the ACMP Statewide standard and district policies could occur only if it were not consistent with Federal or State water-quality standards.

Air quality in the cumulative case would be the same, qualitatively, as that discussed in Alternative E. Effects on onshore air quality for cumulate-case emissions are expected to be low. These effects would not make the concentrations of criteria pollutants in the onshore ambient air approach the air-quality standards. Conflict with NSB CMP policies is not anticipated. The NSB CMP 2.4.3(h) (NSBMC 19.70.050.H) also requires that development comply with Federal and State air-quality standards. The NSB CMP 2.4.4(c) (NSBMC 19.70.050.I.3) identified airborne emissions specifically as needing to meet the standards. Acidification of tundra vegetation is not covered under air-quality standards but would be covered under several elements, either in the facility-siting standard or the wetland-habitat standard. Emissions estimated for the cumulative case are not expected to be sufficient to harm vegetation.

16. Recreation and Visual Resources:

Cumulative impacts would result from: (1) long-term impacts resulting from development pads and pipelines; (2) the "midterm" (2-5 years) impacts from green pads and green trails caused by overland moves, exploratory drilling, and seismic work; and (3) short-term impacting activities such as overflights, camps, and seismic trains. Cumulative impacts would be greatest in areas of high oil and gas potential. Short- and mid-term impacts result in a momentary relationship to the total of cumulative impacts.

Table IV.H-1

Comparisons of Impacts for the Cumulative Case (Alternatives A, B, C, D, and E, and the Preferred Alternative) for the National Petroleum Reserve — Alaska Planning Area Integrated Activity Plan/ Environmental Impact Statement

Soils
Paleontological Resources
Water Resources
Water Quality
Air Quality
Vegetation
Fish Resources
Birds
Mammals — Terrestrial
Mammals — Marine
Endangered and Threatened Species
Economy
Cultural Resources
Subsistence-Harvest Patterns
Sociocultural Systems
Coastal Zone Management
Recreational and Visual Resources

The summaries presented in this table are based on the comprehensive analysis in Section IV. H of an Integrated Activity Plan that includes potential oil and gas lease sales in the planning area

SOILS		
Alternative E	**Alternative A**	**Alternative B**
Current assumed potential developments would impact soil on about 40,000 acres. The impacts of Alternative E, multiple sales, on the soil of Alaska's North Slope, both from construction of infrastructure and from oil spills, are expected to represent a small (2-13%) but measurable proportion of the cumulative impacts to soil from oil development. The variation depends on which of the other hypothetical development scenarios becomes reality. These cumulative impacts are expected to affect much less than one percent of the soil of the Arctic Coastal Plain, which is the most heavily impacted of the three physiographic provinces of the North Slope.	Alternative A, Multiple Sales, which would not include any petroleum development in the planning area, would have a negligible impact on soil of the Arctic Coastal Plain. Instead of representing 2-13% of the impacts to soil on the North Slope as does Alternative E, Multiple Sales, it would effectively be zero. In addition, under Alternative A it is unlikely that petroleum development in NPR-A west of the planning area would ever be economically feasible. As a result the cumulative area of soil impacted would be about 35,00 acres	Alternative B, Multiple Sales, would impact 0 to 820 acres of soil in the planning area. This would represent 0-3% of the total impacts to soil on Alaska's North Slope. The variation depends on which of several hypothetical development scenarios for other portions of the North Slope becomes reality. This is less than the 2-13% of all impacts to North Slope soil that would result from implementation of Alternative E, Multiple Sales. The cumulative area of soil impacted would be 720 to 3,000 acres less than under Alternative E
PALEONTOLOGICAL RESOURCES		
Alternative E	**Alternative A**	**Alternative B**
Paleontological resources are at greatest risk through excavation of borrow areas. Approximately 1,500 acres on the North Slope east of the planning area have been impacted by borrow areas and future actions may create 420 to 650 acres of borrow area, for a cumulative impact of 1,920 to 2,150 acres of potential paleontological resources at risk.	Cumulative impacts and the risk of significant cumulative impacts under Alternative A are reduced from Alternative E because no lease sales would occur in the planning area. Borrow areas would place 1,880 to 1,950 acres of paleontological resources at risk.	Cumulative impacts and the risk of significant cumulative impacts under Alternative B are reduced from Alternative E because no lease sales would occur in the planning area. Borrow areas would place 1,880 to 1,990 acres of paleontological resources at risk.
WATER RESOURCES		
Alternative E	**Alternative A**	**Alternative B**
The cumulative effects of oil and gas exploration and development on water resources would include disturbance of stream banks or shorelines and subsequent melting of permafrost (thermokarst), blockages of natural channels and floodways that disrupt drainage patterns, increased erosion and sedimentation, and removal of gravel from riverine pools and lakes. These effects could cause long-term changes in stream-bank and lakeshore stability, diversions from natural drainage patterns, and variations in stream-channel and lakeshore sand- and gravel-bar formation. These effects could be reduced but not completely eliminated through application of stipulations. The cumulative effects of oil and gas exploration and development on water resources may be up to several times greater than those estimated for Alternative E.	The type of cumulative effects of oil and gas exploration and development under Alternative A would be similar to Alternative E. The impacting activities would probably be limited to roads, pipelines and facilities used to support activities outside the planning area. As such, the cumulative impacts to water resources would be significantly less than for Alternative E.	The type of cumulative effects of oil and gas exploration and development under Alternative B would be similar to Alternative E, except that most of the impacts would be outside the Teshekpuk and deep-water lake systems. Some development, probably limited to roads, pipelines and facilities used to support activities outside the planning area could traverse these closed areas. As such, the cumulative impacts to water resources would be significantly less than Alternative E, but more than for Alternative A.
WATER QUALITY		
Alternative E	**Alternative A**	**Alternative B**
Alternative E accounts for all of the cumulative impacts to water quality in the planning area, i.e. construction could impact long-term water quality on >4,000 acres and spills could make up to 36 ponds or small lakes toxic to sensitive species for about 7 years. Alternative E would add 0 to 1 spills to the projected 6 to 13 tanker spills ≥1,000 bbl.	Alternative A would impact a fraction of an acre; even less under the no-seismic option. It would not increase the projected 6 to 13 tanker spills ≥1,000 bbl.	Alternative B accounts for all of the cumulative impacts to water quality in the planning area, i.e. construction could impact long-term water quality on a few hundred acres and spills could make about 8 ponds or small lakes toxic to sensitive species for about 7 years. Alternative B would add negligibly to the potential for 1 more than the currently projected 6 to 13 tanker spills ≥1,000 bbl.
AIR QUALITY		
Alternative E	**Alternative A**	**Alternative B**
The current regulatory and permitting regime would result in negligible impacts	The current regulatory and permitting regime would result in negligible impacts	The current regulatory and permitting regime would result in negligible impacts

SOILS		
Alternative C	**Alternative D**	**Preferred Alternative**
Alternative C, Multiple Sales, would impact 360 to 1,180 acres of soil in the planning area. This would represent 1-4% of the total impacts to soil on Alaska's North Slope. The variation depends on which of several hypothetical development scenarios for other portions of the North Slope becomes reality. This is less than the 2-13% of all impacts to North Slope soil that would result from implementation of Alternative E, Multiple Sales. The cumulative area of soil impacted could be several hundred to 2,600 acres less than under Alternative E	Alternative D, Multiple Sales, would impact 720 to 2,620 acres of soil in the planning area. This would represent 2-9% of the total impacts to soil on Alaska's North Slope. The variation depends on which of several hypothetical development scenarios for other portions of the North Slope becomes reality. This is somewhat less than the 2-13% of all impacts to North Slope soil that would result from implementation of Alternative E, Multiple Sales. The cumulative area of soil impacted could be as much as 1,200 acres less than under Alternative E.	Preferred Alternative, Multiple Sales, would impact 360 to 1,180 acres of soil in the planning area. This would represent 1-4% of the total impacts to soil on Alaska's North Slope. The variation depends on which of several hypothetical development scenarios for other portions of the North Slope becomes reality. This is less than the 2-13% of all impacts to North Slope soil that would result from implementation of Alternative E, Multiple Sales. The cumulative area of soil impacted could be several hundred to 2,600 acres less than under Alternative E
PALEONTOLOGICAL RESOURCES		
Alternative C	**Alternative D**	**Preferred Alternative**
Cumulative impacts and the risk of significant cumulative impacts under Alternative C are reduced from Alternative E because no lease sales would occur in the planning area. Borrow areas would place 1,900 to 2,010 acres of paleontological resources at risk.	Cumulative impacts and the risk of significant cumulative impacts under Alternative D are reduced from Alternative E because no lease sales would occur in the planning area. Borrow areas would place 1,920 to 2,090 acres of paleontological resources at risk.	Cumulative impacts and the risk of significant cumulative impacts under the Preferred Alternative are reduced from Alternative E because no lease sales would occur in the planning area. Borrow areas would place 1,750 to 1,860 acres of paleontological resources at risk.
WATER RESOURCES		
Alternative C	**Alternative D**	**Preferred Alternative**
The type of cumulative effects of oil and gas exploration and development under Alternative C would be similar to Alternative E, except that most of the impacts would be outside the Teshekpuk Lake system. Some development, probably limited to roads, pipelines and facilities used to support activities outside the planning area, could traverse this closed area. As such, the cumulative impacts to water resources would be significantly less than for Alternative E, but more than for Alternatives A and B.	The type of cumulative effects of oil and gas exploration and development under Alternative D would be similar to Alternative E, except that a limited area north of the Teshekpuk Lake system would be closed. Some development, probably limited to roads, pipelines and facilities used to support activities outside the planning area could traverse this closed area. As such, the cumulative impacts to water resources would be slightly less than for Alternative E, but more than for Alternatives A, B, and C.	The cumulative effects of oil and gas exploration and development under the Preferred Alternative would be similar to Alternative E, except that most of the impacts would be outside the Teshekpuk and deep-water lake systems. Some development, probably limited to an off shore pipeline used to support activities outside the planning area, could be developed adjacent to the closed areas. As such, the cumulative impacts to water resources would be significantly less than for Alternatives D and E, slightly less than B and C, but more than for Alternative A.
WATER QUALITY		
Alternative C	**Alternative D**	**Preferred Alternative**
Alternative C accounts for all of the cumulative impacts to water quality in the planning area, i.e. construction could impact long-term water quality on a few hundred acres annually and spills could make about 9 ponds or small lakes toxic to sensitive species for about 7 years. Alternative C would add to the potential for 1 more than the currently projected 6 to 13 tanker spills ≥1,000 bbl.	Alternative D accounts for all of the cumulative impacts to water quality in the planning area, i.e. construction could impact long-term water quality on up to 2,000 acres annually and spills could make about 27 ponds or small lakes toxic to sensitive species for about 7 years. Alternative D would add to the potential for 1 more than the currently projected 6 to 13 tanker spills ≥1,000 bbl.	The Preferred Alternative accounts for all of the cumulative impacts to water quality in the planning area, i.e. construction could impact long-term water quality on a few hundred acres and spills could make up to 10 ponds or small lakes toxic to sensitive species for about 7 years. The Preferred Alternative would negligibly add to the potential for 1 more than the currently projected 6 to 13 tanker spills ≥1,000 bbl.
AIR QUALITY		
Alternative C	**Alternative D**	**Preferred Alternative**
The current regulatory and permitting regime would result in negligible impacts	The current regulatory and permitting regime would result in negligible impacts	The current regulatory and permitting regime would result in negligible impacts

VEGETATION		
Alternative E	**Alternative A**	**Alternative B**
Current assumed potential developments would impact vegetation on about 40,000 acres. The impacts of Alternative E, multiple sales, on the vegetation of Alaska's North Slope, both from construction of infrastructure and from oil spills, are expected to represent a small (2-13%) but measurable proportion of the cumulative impacts to vegetation from oil development. The variation depends on which of the other hypothetical development scenarios becomes reality. These cumulative impacts are expected to affect much less than one percent of the vegetation of the Arctic Coastal Plain, which is the most heavily impacted of the three physiographic provinces of the North Slope.	Alternative A, Multiple Sales, which would not include any petroleum development in the planning area, would have a negligible impact on vegetation of the Arctic Coastal Plain. Instead of representing 2-13% of the impacts to vegetation on the North Slope as does Alternative E, Multiple Sales, it would effectively be zero. In addition, under Alternative A it is unlikely that petroleum development in NPR-A west of the planning area would ever be economically feasible. As a result the cumulative area of vegetation impacted would be about 35,00 acres	Alternative B, Multiple Sales, would impact 0 to 820 acres of vegetation in the planning area. This would represent 0-3% of the total impacts to vegetation on Alaska's North Slope. The variation depends on which of several hypothetical development scenarios for other portions of the North Slope becomes reality. This is less than the 2-13% of all impacts to North Slope vegetation that would result from implementation of Alternative E, Multiple Sales. The cumulative area of vegetation impacted would be 720 to 3,000 acres less than under Alternative E
FISH RESOURCES		
Alternative E	**Alternative A**	**Alternative B**
The additional effect of seismic surveys and construction-related activities over that of Alternative E is expected to be proportional to the number of future activities. Their effect on arctic fish populations may be greater if there is insufficient time for full recovery between these activities. Offshore cumulative-case oil spills are expected to have mostly sublethal effects on arctic fish populations. Those that enter coastal waters are expected to affect a greater percentage of fish than estimated for Alternative E. Assuming sufficient recovery time between spills, the recovery from each cumulative case spill is expected within 3 years. Onshore cumulative-case oil spills are expected to have an effect on arctic fish populations similar to that discussed for Alternative E.	Because Alternative A does not expose fish bearing waters to oil and gas development, and Alternative E exposes 100%, the cumulative effect of Alternative A is expected to be less than Alternative E.	Because Alternative B exposes only 44% of the less productive fish bearing waters to oil and gas development, rather than the 100% exposed by Alternative E, the cumulative effect of Alternative B is expected to be less than Alternative E.

VEGETATION		
Alternative C	**Alternative D**	**Preferred Alternative**
Alternative C, Multiple Sales, would impact 360 to 1,180 acres of vegetation in the planning area. This would represent 1-4% of the total impacts to vegetation on Alaska's North Slope. The variation depends on which of several hypothetical development scenarios for other portions of the North Slope becomes reality. This is less than the 2-13% of all impacts to North Slope vegetation that would result from implementation of Alternative E, Multiple Sales. The cumulative area of vegetation impacted could be several hundred to 2,600 acres less than under Alternative E.	Alternative D, Multiple Sales, would impact 720 to 2,620 acres of vegetation in the planning area. This would represent 2-9% of the total impacts to vegetation on Alaska's North Slope. The variation depends on which of several hypothetical development scenarios for other portions of the North Slope becomes reality. This is somewhat less than the 2-13% of all impacts to North Slope vegetation that would result from implementation of Alternative E, Multiple Sales. The cumulative area of vegetation impacted could be as much as 1,200 acres less than under Alternative E.	Preferred Alternative, Multiple Sales, would impact 360 to 1,180 acres of vegetation in the planning area. This would represent 1-4% of the total impacts to vegetation on Alaska's North Slope. The variation depends on which of several hypothetical development scenarios for other portions of the North Slope becomes reality. This is less than the 2-13% of all impacts to North Slope vegetation that would result from implementation of Alternative E, Multiple Sales. The cumulative area of vegetation impacted could be several hundred to 2,600 acres less than under Alternative E.
FISH RESOURCES		
Alternative C	**Alternative D**	**Preferred Alternative**
Because Alternative C exposes only about 73% of the more productive fish bearing waters to oil and gas development, rather than the 100% exposed by Alternative E, the cumulative effect of these Alternatives is expected to be less than Alternative E.	Because Alternative D expose only 89% of the more productive fish bearing waters to oil and gas development, rather than the 100% exposed by Alternative E, the cumulative effect of Alternative D is expected to be less than Alternative E.	Because the Preferred Alternative exposes only about 65% of the more productive fish bearing waters to oil and gas development, rather than the 100% exposed by Alternative E, the cumulative effect of the Preferred Alternative is expected to be less than Alternative E.

BIRDS		
Alternative E	**Alternative A**	**Alternative B**
Cumulative effects of past, present, and proposed onshore and offshore oil and gas development on nonendangered arctic slope bird populations are expected to be substantial. Some long-term changes in bird distribution due to displacement of individuals and habitat alteration may occur as well as short-term declines in productivity of displaced individuals or those exposed to higher levels of predation. Mortality of broodrearing, premigratory, and migratory waterbirds caused by oil spills is likely to be the primary effect of offshore development, although construction of additional facilities/roads/pipelines would cause some displacement and loss of productivity. The primary effect of onshore oil and gas project development is expected to be lost productivity caused by disturbance (including raptors and passerines along rivers), displacement from altered habitats, and increased predation. Minor losses, mainly of waterfowl, from small oil spills may occur wherever these projects are located on the arctic slope. If the Teshepuk Lake Special Area is open to oil and gas development, mortality of molting geese in the 100's could occur, still representing a minor loss. More significant would be the potential for displacement of geese from this traditional and unique molting area. A road connecting western NPR-A development with Prudhoe Bay/Kuparuk would cause substantial bird displacement and lost productivity as well as enhance access to this area that could result in greater disturbance and mortality. Based on the assumed population vulnerability of those species most likely to be affected, more than two breeding seasons would be required for recovery. Some species with relatively high fecundity may not require this much time. However, species with low reproductive potential, such as loons or those that are experiencing poor reproductive success, may require a longer period. With the exception of brant and a few others, it is not possible now to accurately model recovery periods. Contribution of this alternative to cumulative disturbance and oil spill effects is expected to be 75-90 percent for goose populations. Alternative E would contribute 5 percent of cumulative effects on overall nonendangered North Slope bird populations.	Activities in the planning area other than the road across the planning area would have a negligible impact. Oil and gas development outside the planning area and a road across the planning area would have effects similar to those described for Alternative E.	Impacts outside the planning area would be similar to those described for Alternative E. Primary effects on birds in the planning area under this alternative are expected to be lost productivity caused by disturbance, displacement from altered habitats, and possible increased predation. Minor losses, mainly of waterfowl, from small oil spills may occur anywhere south approximately of the Teshekpuk Lake Watershed LUEA and outside buffers established along 6 selected watercourses in the planning area. Because the Goose Molting Habitat Area and other significant wildlife areas are not open to oil and gas development, cumulative disturbance and oil spill effects of this alternative are expected to be less than 5 percent above Alternative A.

BIRDS		
Alternative C	**Alternative D**	**Preferred Alternative**
Impacts outside the panning area would be similar to those described for Alternative E. Primary effects on birds in the planning area under this alternative are expected to be lost productivity caused by disturbance (including raptors and passerines along rivers), displacement from altered habitats, and possible increased predation. Minor losses, mainly of waterfowl, from small oil spills may occur anywhere south of the Teshekpuk Lake Caribou Habitat LUEA . Because the Goose Molting Habitat Area and other significant wildlife areas are not open to oil and gas development, but primary raptor and passerine habitats along rivers are relatively exposed to development activities, cumulative disturbance and oil spill effects of this alternative are expected to be less than 10 percent above Alternative A	Impacts outside the panning area would be similar to those described for Alternative E. Primary effects on birds in the planning area under this alternative are expected to be lost productivity caused by disturbance (including raptors and passerines along rivers), displacement from altered habitats, and possible increased predation. Minor losses, mainly of waterfowl, from small oil spills may occur anywhere south of the Goose Molting Habitat LUEA. Because the Goose Molting Habitat Area is not open to oil and gas development, but king eider concentration areas are relatively exposed to development activities, cumulative disturbance and oil spill effects of this alternative area expected to be less than 10-15 percent above Alternative A.	Impacts outside the panning area would be similar to those described for Alternative E. Primary effects on birds in the planning area under this alternative are expected to be lost productivity caused by disturbance (including raptors and passerines along rivers), displacement from altered habitats, and possible increased predation. Minor losses, mainly of waterfowl, from small oil spills may occur anywhere south of the Goose Molting Habitat LUEA, northeastern 2/3 of Teshekpuk Lake, and outside buffers established along 7 selected watercourses in the planning area. Because the Goose Molting Habitat Area and other significant wildlife areas are not open to oil and gas development no interconnecting road would be allowed across the planning area and some waterfowl concentration areas south and southwest of the lake are marginally protected, contribution of this alternative to cumulative disturbance and oil spill effects is expected to be less than 5-10 percent above Alternative A.

TERRESTRIAL MAMMALS		
Alternative E	**Alternative A**	**Alternative B**
Cumulative effects on caribou calving distribution are likely to be long term over the life of the oilfields, but probably local within 1.86 to 2.48 mi (3-4 km) of roads located within calving areas. This reduction in calving and summer habitat use by cows and calves of the CAH and TLH and possibly on WAH caribou from future NPR-A leasing, represents a functional loss of habitat that may result in a long-term effect on caribou herd productivity and abundance. However, this potential effect may not be measurable due to the great natural variability in caribou population productivity. Current and projected development east of the planning area has or would subject all of the CAH calving area to leasing, though only a fraction of the land would be developed. Future leasing may occur on WAH calving area in the western NPR-A, though development potential in the calving area is not considered highly likely. Cumulative oil development on the Arctic Slope also is likely to result in an increase in abundance of arctic foxes near development, which may present a rabies health hazard to people, and the attraction of grizzly bears to human refuse and food sources is expected to lead to the loss of bears due to interactions with humans and an eventual decline in bear abundance near development areas. The cumulative effects on muskoxen, moose, wolves, and other terrestrial, mammals (other than global warming) are likely to include: local disturbance within about 1 to 2 mi of oil exploration and development facilities and resource inventory-survey activities and generally short term, with no significant adverse effects on their populations.	The nature of impacts would be similar to those described for Alternative E. The impacts to the CAH and the WAH would be the same as for Alternative E. None of the TLCH's main calving area would be available for leasing. The contribution of the alternative to cumulative impacts would be short-term and represent a very small fraction of the combined effect on terrestrial mammals.	The nature of impacts would be similar to those described for Alternative E. The impacts to the CAH and the WAH would be the same as for Alternative E. None of the TLCH's main calving area would be available for leasing. The contribution of the alternative to cumulative impacts would be short-term and not affect terrestrial mammal populations.

MARINE MAMMALS		
Alternative E	**Alternative A**	**Alternative B**
Cumulative effects are generally expected to be relatively short term (within ≤1 generation) on ice seals (ringed, bearded, and spotted seals), walruses, polar bears, and belukha whales and longer term (>1 generation to perhaps several generations) on sea otters and harbor seals. Under Alternative E (with multiple sales and possible NPR-A-wide oil and gas exploration and development), oil resources are estimated to represent 8 percent of the total North Slope production, and production by 2009 could make up 8 to 14 percent (at $18/bbl) of oil carried in tankers in Prince William Sound. As a result, planning-area activities are projected to contribute about 8 percent of the risk of oil-spill mortality and other effects on ice seals, polar bears, walruses, and belukha whales; and 8 to 14 percent of the risk of mortality to sea otters and harbor seals.	Combined activities of onshore and offshore oil and gas development on the Arctic Slope and in the Beaufort Sea and resource inventory-surveys in the Northeast NPR-A planning area under Alternative A are likely to have some long-term and short-term effects on marine mammals (seals and polar bears) in the Alaskan arctic. The contribution of Alternative A resource inventory-survey and seismic activities to the overall cumulative effect would be short-term and represent a very small fraction of the combined effect on marine mammals.	Combined activities of onshore and offshore oil and gas development on the Arctic Slope and in the Beaufort Sea and resource inventory-surveys in the Northeast NPR-A planning area under Alternative B are likely to have some relatively short term effects (within ≤1 generation) on on marine mammals (seals and polar bears) in the Alaskan arctic. The contribution of Alternative B to the overall cumulative effect would be no more than about 1 percent of the combined effect on marine mammals based on oil resources estimated to represent 1 percent of the total North Slope production by 2009.

TERRESTRIAL MAMMALS		
Alternative C	**Alternative D**	**Preferred Alternative**
The nature of impacts would be similar to those described for Alternative E. The impacts to the CAH and the WAH would be the same as for Alternative E. None of the TLCH's main calving area would be available for leasing. The contribution of the alternative to cumulative impacts would be somewhat greater than for Alternative B but not significantly affect terrestrial mammal populations.	The nature of impacts would be similar to those described for Alternative E. The impacts to the CAH and the WAH would be the same as for Alternative E. Approximately 40% of the TLCH's main calving area would be available for leasing. The contribution of the alternative to cumulative impacts would be significantly greater than for Alternative B, particularly if an oil field is developed in the calving area south and southeast of Teshekpuk Lake.	The nature of impacts would be similar to those described for Alternative E. The impacts to the CAH and the WAH would be the same as for Alternative E. Approximately 40% of the TLCH's main calving area would be available for leasing, but only about 5% would be subject to oil and gas-related surface occupancy. The contribution of the alternative to cumulative impacts would be somewhat greater than for Alternative B but not significantly affect terrestrial mammal populations.

MARINE MAMMALS		
Alternative C	**Alternative D**	**Preferred Alternative**
Combined activities of onshore and offshore oil and gas development on the Arctic Slope and in the Beaufort Sea and resource inventory-surveys in the Northeast NPR-A planning area under Alternative C are likely to have some relatively short term (within ≤1 generation) on on marine mammals (seals and polar bears) in the Alaskan arctic. The contribution of Alternative C to the overall cumulative effect would be no more than about 2 percent of the combined effect on marine mammals based on oil resources estimated to represent 2 percent of the total North Slope production by 2009.	Combined activities of onshore and offshore oil and gas development on the Arctic Slope and in the Beaufort Sea and resource inventory-surveys in the Northeast NPR-A planning area under Alternative D are likely to have some relatively short term (within ≤1 generation) on on marine mammals (seals and polar bears) in the Alaskan arctic. The contribution of Alternative D to the overall cumulative effect would be no more than about 6 percent of the combined effect on marine mammals based on oil resources estimated to represent 6 percent of the total North Slope production by 2009.	Combined activities of onshore and offshore oil and gas development on the Arctic Slope and in the Beaufort Sea and resource inventory-surveys in the Northeast NPR-A planning area under the Preferred Alternative are likely to have some relatively short term (within ≤1 generation) on on marine mammals (seals and polar bears) in the Alaskan arctic. The contribution of this alternative to the overall cumulative effect would be no more than about 2 percent of the combined effect on marine mammals based on oil resources estimated to represent 2 percent of the total North Slope production by 2009.

ENDANGERED AND THREATENED SPECIES		
Alternative E	**Alternative A**	**Alternative B**
Exposure of bowhead whales to noise-producing activities from both onshore and offshore oil and gas exploration and development and production operations is not expected to result in lethal effects; but some individuals could experience temporary, nonlethal effects. Prolonged exposure of bowhead whales to spilled oil may result in lethal effects on a few individuals, with the population recovering within 1 to 3 years. Most individuals exposed to spilled oil are expected to experience temporary, nonlethal effects. The overall contribution of proposed activities in the planning area to the cumulative effects on bowhead whales is expected to be limited to temporary avoidance behavior in response to vessel and aircraft activities. Overall, the effects on spectacled and Steller's eiders as a result of various cumulative factors from both onshore and offshore oil and gas exploration and development and production operations is likely to be substantially greater than for any single activity or any activities associated with any individual lease sale. Disturbance of some individuals as a result of both onshore and offshore oil and gas operations is expected to be unavoidable over the long term. Some mortality could result from contact with spilled oil. Exposure of eiders to noise-producing activities in the planning area is not expected to result in lethal effects, but some individuals could experience temporary, nonlethal effects. Although oil spills are likely to be small and primarily confined to drilling pads, some eiders may be adversely affected by spills that reach the surrounding tundra. The Fish and Wildlife Service anticipates that only those individuals or nests within 200 meters of a spill are likely to be affected. Some individuals may also be adversely affected by loss of habitat for drill pads and roads, although the amount of habitat lost is not a significant proportion of the total amount of habitat available. Improper containment or disposal of refuse at support camps could attract potential bird predators. It is possible that an increase in predators could result in the loss of eggs, chicks, or even adult eiders. Cumulative effects are likely to be greater on the Arctic Slope spectacled eider population than on the Arctic Slope Steller's eider population. The overall contribution of proposed activities in the planning area to the cumulative effects on spectacled and Steller's eiders is expected to be limited primarily to occasional disturbance from aircraft activities resulting in temporary, nonlethal effects. Disturbance may last less than an hour but could continue all summer in the case of summer drilling operations. Some mortality could result from contact with spilled oil, road construction, or attraction of predators to facilities, although mortality is not expected to affect the species at the population level. The overall contribution to the cumulative effects on species along transportation routes from tankering oil produced in the planning area to ports along the U.S. West Coast is expected to be minimal.	The cumulative effects to bowhead whales, spectacled, and Steller's eiders should be essentially the same as under Alternative E. Proposed activities in the planning area under Alternative A, as well as the Central NPR-A Scenario, the Kuukpik/ASRC Lands Scenario, and the interconnecting road, should not contribute to the cumulative effects on bowhead whales since there would be no project related vessel and aircraft activities or drilling operations in marine waters. Some whales could also be affected by an oil spill. The scenario provides no information pertaining to the size of the spill or the likelihood of the spill to contact bowhead habitat. Proposed activities in the planning area under Alternative A are not expected to contribute to the cumulative effects on spectacled and Steller's eiders since most of the activities under this alternative, including aircraft activities, are already occurring in the planning area. However, activities associated with the Offshore Scenario, the Central NPR-A Scenario, the Kuukpik/ASRC Lands Scenario, and the interconnecting road are likely to contribute to the cumulative effects on spectacled eiders, and to a lesser extent, Steller's eiders.	The cumulative effects to bowhead whales, spectacled, and Steller's eiders should be essentially the same as under Alternative E. The overall contribution of proposed activities in the planning area under Alternative B, as well as the Central NPR-A Scenario, the Kuukpik/ASRC Lands Scenario, and the interconnecting road, to the cumulative effects on bowhead whales is expected to be slightly less than expected under Alternative E since there would likely be minimal project related vessel and aircraft activities in marine waters. The Offshore Scenario, which includes drilling operations and vessel and aircraft traffic, would likely affect some whales as a result of noise and disturbance. Some whales could also be affected by an oil spill. Proposed activities in the planning area under Alternative B are expected to contribute only slightly to the cumulative effects on spectacled and Steller's eiders since most of the activities under this alternative, including aircraft activities, are already occurring in the planning area. Oil and gas activities in the area available for leasing could affect some eiders as a result of aircraft traffic, noise disturbance or displacement, an increase in predation, and possible exposure to spilled oil. In addition, activities associated with the Offshore Scenario, the Central NPR-A Scenario, the Kuukpik/ASRC Lands Scenario, and the interconnecting road are likely to contribute to the cumulative effects on spectacled eiders, and to a lesser extent, Steller's eiders.

ENDANGERED AND THREATENED SPECIES		
Alternative C	**Alternative D**	**Preferred Alternative**
The cumulative effects to bowhead whales, spectacled, and Steller's eiders should be essentially the same as under Alternative E. The overall contribution of proposed activities in the planning area under Alternative C, as well as the Central NPR-A Scenario, the Kuukpik/ASRC Lands Scenario, and the interconnecting road, to the cumulative effects on bowhead whales is expected to be slightly less than expected under Alternative E since there would likely be less project related vessel and aircraft activities over marine waters. The Offshore Scenario, which includes drilling operations and vessel and aircraft traffic, would likely affect some whales as a result of noise and disturbance. Some whales could also be affected by an oil spill. Proposed activities in the planning area under Alternative C are expected to contribute only slightly to the cumulative effects on spectacled and Steller's eiders since most of the activities under this alternative, including aircraft activities, are already occurring in the planning area. Oil and gas activities in the area available for leasing could affect some eiders as a result of aircraft traffic, noise disturbance or displacement, an increase in predation, and possible exposure to spilled oil. In addition, activities associated with the Offshore Scenario, the Central NPR-A Scenario, the Kuukpik/ASRC Lands Scenario, and the interconnecting road are likely to contribute to the cumulative effects on spectacled eiders and, to a lesser extent, Steller's eiders.	The cumulative effects to bowhead whales and Steller's eiders should be essentially the same as under Alternative E. The overall contribution of proposed activities in the planning area under Alternative D, as well as the Central NPR-A Scenario, the Kuukpik/ASRC Lands Scenario, and the interconnecting road, to the cumulative effects on bowhead whales is expected to be slightly less than expected under Alternative E since there would likely be less project related vessel and aircraft activities over marine waters. The Offshore Scenario, which includes drilling operations and vessel and aircraft traffic, would likely affect some whales as a result of noise and disturbance. Some whales could also be affected by an oil spill. The scenario provides no information pertaining to the size of the spill or the likelihood of the spill to contact bowhead habitat. Proposed activities in the planning area under Alternative D are expected to contribute only slightly to the cumulative effects on spectacled and Steller's eiders since most of the activities under this alternative, including aircraft activities, are already occurring in the planning area. Oil and gas activities in the area available for leasing could affect some eiders as a result of aircraft traffic, noise disturbance or displacement, an increase in predation, and possible exposure to spilled oil. Spectacled eiders are more likely to be affected since a portion of the spectacled eider LUEA, which has a higher density of eiders, is available to oil and gas leasing. In addition, activities associated with the Offshore Scenario, the Central NPR-A Scenario, the Kuukpik/ASRC Lands Scenario, and the interconnecting road are likely to contribute to the cumulative effects on spectacled eiders and, to a lesser extent, Steller's eiders.	The cumulative effects to bowhead whales should be essentially the same as under Alternative E. The overall contribution of proposed activities in the planning area under the Preferred Alternative, as well as the Central NPR-A Scenario, the Kuukpik/ASRC Lands Scenario, and the interconnecting road, to the cumulative effects on bowhead whales is expected to be slightly less than expected under Alternative E since there would likely be less project related vessel and aircraft activities over marine waters. The Offshore Scenario, which includes drilling operations and vessel and aircraft traffic, would likely affect some whales as a result of noise and disturbance. Some whales could also be affected by an oil spill. The scenario provides no information pertaining to the size of the spill or the likelihood of the spill to contact bowhead habitat. Proposed activities in the planning area under the Preferred Alternative are expected to contribute only slightly to the cumulative effects on spectacled and Steller's eiders since most of the activities under this alternative, including aircraft activities, are already occurring in the planning area. Oil and gas activities in the area available for leasing could affect some eiders as a result of aircraft traffic, noise disturbance or displacement, an increase in predation, and possible exposure to spilled oil. Spectacled eiders are more likely to be affected since a portion of the spectacled eider LUEA, which has a higher density of eiders, is available to oil and gas leasing. In addition, activities associated with the Offshore Scenario, the Central NPR-A Scenario, the Kuukpik/ASRC Lands Scenario, and the interconnecting road are likely to contribute to the cumulative effects on spectacled eiders and, to a lesser extent, Steller's eiders.

ECONOMY		
Alternative E	**Alternative A**	**Alternative B**
Activity other than oil and gas would have no effect on the economy. The effects of the cumulative-case activities, not including the "replacement effects" described in 11.b above or the TAGS are as follows: NSB property taxes, 6 to 12 percent ($12-$24 million); direct oil-industry employment, 1,400 to 2,800 (five times this in additional jobs) residing in Southcentral Alaska; NSB resident employment, 4 to 10 percent; and annual revenues of $3 to $6 million property tax to the State, $28 to $232 million royalty to the Federal Government, $28 to $232 million royalty to the State and NSB, and $48 to $392 million severance tax to the State. The total cumulative effects—those effects described in the preceding paragraph plus the "replacement effect" described in 11.b above but not including TAGS, approximately in the years 2015 to 2020, are—NSB property tax, $232 to $244 million annually; oil and gas industry employment on the North Slope 3,900 to 5,300; NSB resident employment 1,446 to 1,520; State oil and gas revenue from the North Slope $689 to $1,240 million annually; and Federal revenue $118 to $322 annually. The TAGS during 5 years of construction will peak at 7,200 direct jobs and 3,300 indirect jobs. The TAGS during operations will generate 550 direct jobs and 1,250 indirect jobs. The TAGS during operations will generate annually $188 million in property tax (for all local jurisdictions and the State), $64 million State severance tax, and $125 million royalty revenue.	The difference in effects of the cumulative case (except TAGS) compared to Alternative A equal those effects described in cumulative case conclusion without the "replacement effects."	The differences in effects of the cumulative case (except TAGS) compared to Alternative B are as follows: NSB property taxes, 6 to 10 percent ($12-$21 million); direct oil-industry employment, 1,400 to 2,100 (five times this in additional jobs) residing in Southcentral Alaska; NSB resident employment, 4 to 8 percent; and annual revenues of $3 to $5.25 million property tax to the State, $24 to $225 million royalty to the Federal Government, $24 to $225 million royalty to the State and NSB, and $42 to $330 million severance tax to the State. In addition would be the employment and revenue effect of TAGS described in the cumulative case.
CULTURAL RESOURCES		
Alternative E	**Alternative A**	**Alternative B**
Cultural resources may be impacted by seismic activities and overland moves and similar activities which might disturb the surface. Cultural resources are at greatest risk, however, at material borrow pits, on gravel pads for production facilities, gravel roads, and airstrips. Approximately 8,400 acres east of the planning area have been impacted by pits and pads and future actions may create 2,070 to 3,270 additional acres of pits and pads (240-1,200 of them in the planning area). Thus, approximately 10,470 to 11,670 acres of cultural resources have been or would be at risk. Non-destructive mitigation to protect cultural resources, however, is commonly available.	Cumulative impacts and risk of significant cumulative impacts under Alternative A are reduced from Alternative E since no lease sales would occur in the planning area. Pads and pits would place or have placed 10,230 to 10,470 acres of cultural resources at risk. Non-destructive mitigation to protect cultural resources, however, is commonly available.	Cumulative impacts and risk of significant cumulative impacts under Alternative B are reduced from Alternative E since lease sales would be restricted by non-lease areas within the planning area. Pads and pits would place or have placed 10,230 to 10,710 acres of cultural resources at risk. Non-destructive mitigation to protect cultural resources, however, is commonly available.

ECONOMY		
Alternative C	**Alternative D**	**Preferred Alternative**
The difference in effects of the cumulative case (except TAGS) compared to Alternative C are as follows: NSB property taxes, 5 to 10 percent ($10-$20 million); direct oil-industry employment, 900 to 2,000 (five times this in additional jobs) residing in Southcentral Alaska; NSB resident employment, 3 to 8 percent; and annual revenues of $2.5 to $5 million property tax to the State, $24 to $189 million royalty to the federal government, $24 to $189 million royalty to the State and NSB, and $41 to $319 million severance tax to the State. In addition would be the employment and revenue effect of TAGS described in the cumulative case.	The difference in effects of the cumulative case (except TAGS) compared to Alternative D are as follows: NSB property taxes, 4 to 8 percent ($8-$16 million); direct oil-industry employment, 900 to 1,600 (five times this in additional jobs) residing in Southcentral Alaska; NSB resident employment, 3 to 6 percent; and annual revenues of $2 to $4 million property tax to the State, $18 to $145 million royalty to the Federal Government, $18 to $145 million royalty to the State and NSB, and $31 to $245 million severance tax to the State. In addition would be the employment and revenue effect of TAGS described above.	The differences in effects of the cumulative case (except TAGS) compared to the Preferred Alternative are as follows: NSB property taxes, 5 to 10 percent ($10 to $20 million); direct oil-industry employment, 900 to 1,975 (five times this in additional jobs) residing in Southcentral Alaska; NSB resident employment, 3 to 8 percent; and annual revenues of $2.5 to $5 million property tax to the State, $23 to $187 million royalty to the federal government, $23 to $187 million royalty to the State and NSB, and $39 to $317 million severance tax to the State. In addition would be the employment and revenue effect of TAGS described in the cumulative case.

CULTURAL RESOURCES		
Alternative C	**Alternative D**	**Preferred Alternative**
Cumulative impacts and risk of significant cumulative impacts under Alternative C are reduced from Alternative E since lease sales would be restricted by non-lease areas within the planning area. Pads and pits would place or have placed 10,350 to 10,830 acres of cultural resources at risk. Non-destructive mitigation to protect cultural resources, however, is commonly available.	Cumulative impacts and risk of significant cumulative impacts under Alternative D are reduced from Alternative E since lease sales would be restricted by non-lease areas within the planning area. Pads and pits would place or have placed 10,470 to 11,310 acres of cultural resources at risk. Non-destructive mitigation to protect cultural resources, however, is commonly available.	Cumulative impacts and risk of significant cumulative impacts under the Preferred Alternative are reduced from Alternative E since lease sales would be restricted by non-lease areas within the planning area. Cumulative impacts would be further reduced because no road or offshore pipeline would cross the planning area under this alternative. Pads and pits would place or have placed 9,470 to 9,950 acres of cultural resources at risk. Non-destructive mitigation to protect cultural resources, however, is commonly available.

SUBSISTENCE		
Alternative E	**Alternative A**	**Alternative B**
Subsistence use of the Central Arctic caribou herd may already have been significantly impacted by oil and gas development to the east of the planning area. Of the communities within the scope of this plan, this most directly impacts Nuiqsut residents. In addition, cumulative impacts from oil spills into the Colville River and the Beaufort Sea may significantly restrict subsistence use of fish and marine mammals. In addition, Alternative E may cause population losses among the Teshekpuk Lake caribou herd and access restrictions for subsistence users in the planning area. Outside the North Slope, black brant that molt in NPR-A have a substantial value to subsistence users in the Yukon-Kuskokwim Delta, and Canada geese are used extensively by subsistence hunters in Alaska's Interior region. Cumulative effects to communities farther outside the planning area, including those in the Yukon-Kuskokwim Delta, are expected to be minimally affected.	The cumulative impacts would be the same as for Alternative E, except that there would be low to negligible impacts to subsistence resources from activities in the planning area.	The cumulative impacts would be the same as for Alternative E, except that there would be minimal impacts or short-term, nonlethal impacts on subsistence resources with no resource population significantly impacted from activities in the planning area.

SOCIOCULTURAL SYSTEMS		
Alternative E	**Alternative A**	**Alternative B**
Because of its proximity to most ongoing oil-development activities on the North Slope, cumulative effects on sociocultural systems could cause chronic disruption to the sociocultural systems in the community of Nuiqsut for a period of 2 to 5 years, with a tendency toward the displacement of existing institutions and social organization. Barrow and Atqasuk could experience chronic disruption to sociocultural systems for a period of 1 to 2 years, with no tendency toward displacing existing institutions or social organization. The contribution of the IAP to the cumulative effects would be disturbance effects that could disrupt sociocultural systems for an entire season (1 year) and create disruption to institutions and sociocultural systems, but these disruptions are not expected to displace ongoing sociocultural institutions, community activities, and traditional practices for harvesting, sharing, and processing subsistence resources.	Barrow, Nuiqsut, and Atqasuk could experience disruption of sociocultural systems for a period up to 1 year, with no tendency toward displacing existing institutions or social organization. The contribution of the IAP to the cumulative effects would be periodic disruption of institutions and sociocultural systems, but these disruptions are not expected to displace ongoing sociocultural institutions, community activities, and traditional practices for harvesting, sharing, and processing subsistence resources.	Barrow, Nuiqsut, and Atqasuk could experience disruption of sociocultural systems for a period up to 1 year, with no tendency toward displacing existing institutions or social organization. The contribution of the IAP to the cumulative effects would be periodic disruption of institutions and sociocultural systems, but these disruptions are not expected to displace ongoing sociocultural institutions, community activities, and traditional practices for harvesting, sharing, and processing subsistence resources.

SUBSISTENCE		
Alternative C	**Alternative D**	**Preferred Alternative**
The cumulative impacts would be the same as for Alternative E, except that there would be minimal impacts or short-term, nonlethal impacts on subsistence resources with no resource population significantly impacted from activities in the planning area.	The cumulative impacts would be the same as for Alternative E, except that the impacts on the Teshekpuk Lake caribou herd would be less severe. These impacts, though, may still significantly restrict subsistence uses by reducing productivity and abundance of the Teshekpuk Lake caribou herd	The cumulative impacts would be the same as for Alternative E, except that there would be minimal impacts or short-term, nonlethal impacts on subsistence resources with no resource population significantly impacted from activities in the planning area.

SOCIOCULTURAL SYSTEMS		
Alternative C	**Alternative D**	**Preferred Alternative**
Barrow, Nuiqsut, and Atqasuk could experience chronic disruption to sociocultural systems for a period of 1 to 2 years, with no tendency toward displacing existing institutions or social organization. The contribution of the IAP to the cumulative effects would be disturbance effects that could disrupt sociocultural systems for an entire season (1 year) and create disruption to institutions and sociocultural systems, but these disruptions are not expected to displace ongoing sociocultural institutions, community activities, and traditional practices for harvesting, sharing, and processing subsistence resources.	Barrow, Nuiqsut, and Atqasuk could experience chronic disruption to sociocultural systems for a period of 1 to 2 years, with no tendency toward displacing existing institutions or social organization. The contribution of the IAP to the cumulative effects would be disturbance effects that could disrupt sociocultural systems for an entire season (1 year) and create disruption to institutions and sociocultural systems, but these disruptions are not expected to displace ongoing sociocultural institutions, community activities, and traditional practices for harvesting, sharing, and processing subsistence resources.	Barrow, Nuiqsut, and Atqasuk could experience chronic disruption to sociocultural systems for a period of 1 to 2 years, with no tendency toward displacing existing institutions or social organization. The contribution of the IAP to the cumulative effects would be disturbance effects that could disrupt sociocultural systems for an entire season (1 year) and create disruption to institutions and sociocultural systems, but these disruptions are not expected to displace ongoing sociocultural institutions, community activities, and traditional practices for harvesting, sharing, and processing subsistence resources.

COASTAL ZONE MANAGEMENT		
Alternative E	**Alternative A**	**Alternative B**
In the cumulative case, the contribution of other Federal and State onshore and offshore oil and gas lease sales increases the potential for conflicts with the coastal management policies identified under Alternative E, the maximum resource scenario (user conflicts between development activities and access to subsistence resources, adverse effects on subsistence resources, habitats, and water quality). Additionally, the cumulative case presents the potential for conflict with two more policies: energy-facility siting and transportation and utilities. Overall cumulative effects to subsistence harvests are expected to cause one or more important subsistence resources to become unavailable, undesirable for use, or experience population reductions for a period of 1 to 5 years in Nuiqsut. In Barrow and Atqasuk, overall cumulative effects to subsistence harvests are expected to cause one or more important subsistence resources to become unavailable, undesirable for use, or experience population reductions for a period of 1 to 2 years. The contribution of the NPR-A sale to the cumulative effects in Barrow, Atqasuk, and Nuiqsut would be to affect subsistence resources, especially the subsistence caribou hunt, for up to an entire season (1 year), making pursuit more difficult (with hunters having to travel farther than normal to harvest them). For all three communities, an oil spill affecting any portion of the bowhead whale migration route may well taint this culturally important subsistence resource, or, even if available, the perception of tainting could substantially affect the desirability of bowheads and curtail the subsistence harvest (Section IV.4.G.15). Physical (soil, air, water, paleontological), biological (vegetation, fish, birds, mammals, endangered and threatened species), and socio-cultural resources (economy, cultural, subsistence, sociocultural systems, recreation) are impacted as described elsewhere in this table. Because Alternative E has the greatest impact on these resources, it has the potential to increase conflicts with coastal management policies.	The cumulative impacts of Alternative A would be significantly less than for Alternative E, because no portion of the planning area would be made available for oil and gas leasing.	The cumulative impacts of Alternative B would be significantly less than for Alternative E, because approximately half of the planning area would not be made available for oil and gas leasing and those lands which are not available include those with the greatest sensitivity for wildlife, subsistence, recreation, and other surface values.
RECREATION AND VISUAL RESOURCES		
Alternative E	**Alternative A**	**Alternative B**
There is potential for significant cumulative impacts on recreation/visual resources in certain locations on the North Slope. Within the planning area, the area around Nuiqsut has a high potential for significant cumulative effects. However, the region being considered is so large these "high risk" areas make up only a small percentage of the North Slope. Also, although there may be certain areas and times of concentrated activity and development, generally, expected activity and development will be quite dispersed both in time and space greatly reducing the likelihood of a significant cumulative effect. Prime recreation/visual resources along the Colville River are far removed from most existing development and only moderately threatened by additional development.	Cumulative impacts and the risk of significant cumulative impacts under alternative A are reduced from alternative E to the extent that no single or multiple sales would occur in the planning area. Prime recreation/visual resources along the Colville River are far removed from most existing development and would not be threatened by additional development.	Cumulative impacts and the risk of significant cumulative impacts under alternative B are reduced from alternative E to the extent that single and multiple sales are restricted by non lease areas within the planning area. Prime recreation/visual resources along the Colville River are far removed from most existing development and protected from further development as a "Wild River" under provisions of the Wild and Scenic Rivers Act.

COASTAL ZONE MANAGEMENT		
Alternative C	**Alternative D**	**Preferred Alternative**
The cumulative impacts of Alternative C would be significantly less than for Alternative E because important caribou and waterfowl habitat would not be made available for oil and gas leasing.	The cumulative impacts of the Preferred Alternative would be less than for Alternative E because important waterfowl habitat would not be made available for oil and gas leasing.	The cumulative impacts of the Preferred Alternative would be significantly less than for Alternative E because important waterfowl habitat would not be made available for oil and gas leasing and the majority of the important caribou habitat would either be unavailable for leasing or would not be subject to surface activities by lessees.

RECREATION AND VISUAL RESOURCES		
Alternative C	**Alternative D**	**Preferred Alternative**
Cumulative impacts and the risk of significant cumulative impacts under alternative C are reduced from alternative E to the extent that single and multiple sales are restricted by non lease areas within the planning area. Prime recreation/visual resources along the Colville River are far removed from most existing development and protected from most new development as a "Scenic River" under provisions of the Wild and Scenic Rivers Act.	Cumulative impacts and the risk of significant cumulative impacts under alternative D are reduced from alternative E to the extent that single and multiple sales are restricted by non lease areas within the planning area. Prime recreation/visual resources along the Colville River are far removed from most existing development and protected from most new development as a "Recreational River" under provisions of the Wild and Scenic Rivers Act.	Cumulative impacts and the risk of significant cumulative impacts under the Preferred Alternative are reduced from alternative E to the extent that single or multiple sales are restricted by no lease areas within the planning area. Cumulative impacts would also be reduced beyond that of Alternative C (which has similar no lease areas) because no road or offshore pipeline would cross the planning area under this alternative.

I. UNAVOIDABLE ADVERSE EFFECTS ON:

1. Soils: Development destroys soils; where development is authorized or permitted, there will be an unavoidable loss of soils. Soils buried or truncated during oil development are lost.

2. Paleontological Resources: Unavoidable adverse effects to paleontological resources, should they occur, would result directly from oil and gas exploration and development activities and facilities such as drill pads and pipelines. Future technological advances may reduce the likelihood of such impacts.

3. Water Resources: Uunavoidable adverse effects of oil and gas exploration and development would result from construction activities associated with road and pad construction, culvert and bridge work in streams and lakes that disturbs stream banks or shorelines, blockages of natural channels and floodways that disrupt drainage patterns, increased erosion and sedimentation, and removal of gravel and water from riverine pools and lakes.

The short-term effect of construction activity would be some subsidence of the ice-rich permafrost along the stream banks and lakeshores, especially in areas where the wave action of the water would accelerate the removal of the degrading protective cover. Fine-grained sediments melting out of the ice-rich permafrost would result in increased sediment erosion and changes to stream channel and bed morphology. Water removal from pools and lakes may have short-term effects on aquatic and other resources.

4. Water Quality: Unavoidable adverse effects on water quality would occur from ice-road construction, which could affect water quality over hundreds of acres.

5. Air Quality: An increase in emissions of air pollutants would occur as a result of the proposed action. In all the alternatives and the cumulative case, the additional emissions are not expected to be significant. In the event that any emissions are significant, they may be reduced by existing methods, as necessary. For the proposed action, the limits to air-quality-standards would not be approached.

6. Vegetation: All of the impacts to vegetation described for Alternatives A through E and the Preferred Alternative are unavoidable, given the occurrence of the activities causing them. However, not all of these impacts can definitely be judged as adverse, while some of those that are adverse would have effects for only a short period. Those impacts caused by oil field development, such as burial of vegetation under gravel fill and contamination by oil spills, would have obvious adverse effects. However, those impacts that may cause plant-composition change, such as snow drift and dust accumulation, account for about 65 percent of oil field-development impacts on an acreage basis. These types of impacts would have an adverse effect on the plant community replaced and its associated fauna but a beneficial effect on the plant communities and fauna that colonize those areas.

7. Fish: Unavoidable adverse effects associated with Alternative E may occur from seismic surveys, construction-related activities, and oil and fuel spills. Seismic surveys located above or near overwintering areas may have lethal effects on some juvenile fish overwintering there. However, these events are likely to be infrequent and they are not expected to have a measurable effect on Arctic fish populations. Under-ice withdrawals from areas having water and dissolved-oxygen levels barely to moderately sufficient to support overwintering fish would be likely to kill 50 to 100 percent of the fish overwintering there (an estimated 5-10-year recovery). Withdrawals from freshwater sources that do not support resident fish populations, or from areas having sufficient under-ice reserves of water and dissolved oxygen, are not likely to adversely affect overwintering fish. Gravel pad and road construction in high-density spawning and overwintering areas, or in access corridors used by migratory fish, is expected to result in spawning failure and fish mortality in 50 to 100 percent of the fish affected (estimated 10-year recovery). Construction in low-diversity areas sparsely inhabited by large fish during nonmigratory periods, and where siltation is minimized and fish passage is not impaired, is expected to reduce spawning failure and fish mortality to <5 percent of the fish affected and recovery to 1 year. Oil and fuel spills are expected to have lethal or sublethal effects on <1 percent of the fish in the planning area over the production life of the field. Recovery from each spill affecting fish is expected within 3 years. The probability of the above effects occurring and affecting arctic fish populations is estimated to be roughly five to six times higher for Alternative E than for Alternative B.

8. Birds: Disturbance of some individuals by noise and/or visual presence of aircraft, ground vehicles, or personnel associated with management action activities such as wildlife aerial surveys, resource surveys, camp maintenance, float trips, hunting, and winter transport, as well as routine oil and gas exploration and development activities such as seismic surveys, air and ground traffic, construction, and drilling is considered unavoidable under Alternatives B through E and the Preferred Alternative. Many of these potentially disturbing activities, particularly those associated with oil and gas development, are expected to be mitigated through adoption of the proposed stipulations. However, the BLM Authorized Officer, in consultation with the FWS, may waive stipulations under certain circumstances, which could result in some level of unavoidable disturbance for some species.

9. Mammals:

a. Terrestrial Mammals: Some surface-vehicle disturbance of caribou during the calving season and some habitat alterations from planning-area oil development under Alternatives B through E and the Preferred Alternative probably are unavoidable. This displacement or reduced habitat use by caribou of the Teshekpuk Lake and Central Arctic caribou herds is likely to be local (within 1.86-2.48 mi [3-4 km] of oil field roads and along pipeline corridors) and long term (>1 generation) and perhaps persist over the life of the oil fields. Some noise and disturbance of other terrestrial mammals may be unavoidable but are expected to be short term and local and not significantly affect mammal populations.

b. Marine Mammals: Most oil spills are considered unavoidable, while most human disturbance of marine mammals is considered avoidable through voluntary compliance with the BLM stipulations on air traffic.

If an onshore fuel- or crude-oil spill occurred in the Teshekpuk Lake area and reached the marine environment, such a spill perhaps could result in the unavoidable loss of a small number of seals and polar bears, with recovery likely to occur within 1 year.

10. Endangered and Threatened Species:

Most sale-related marine-vessel traffic and the disturbance of bowhead whales as a result of such traffic is unavoidable. However, any disturbance associated with marine-vessel traffic is likely to be very minimal and very localized. Some bowhead whales may interact with marine-vessel traffic, and some inadvertent conflicts or incidental "taking" situations may occur. These inadvertent conflicts with or incidental "taking" situations of some individual whales as a result of marine-vessel traffic would not constitute a threat of harm to the species.

Spectacled and Steller's eiders are most likely to be disturbed by aircraft traffic. Most disturbance caused by oil and gas activities can be mitigated through the proposed stipulations pertaining to seismic surveys, facility design and construction, ground transportation, air traffic, and oil and gas exploratory drilling. However, some of the activities other than oil and gas exploration and development under the management plan, such as aerial wildlife surveys and other aerial surveys, are exempted from the aircraft-flight-timing restrictions and may cause temporary, nonlethal effects on eiders. Disturbance of some individuals over the life of the project is expected to be unavoidable.

11. Economy: Unavoidable effects on the economy generally are considered positive rather than adverse, but some people consider any one or a combination of them as adverse. Production is projected to generate increases above the levels without Alternative E as follows: NSB property taxes, 3 to 6 percent ($6-$12 million); direct oil-industry employment, 700 to 1,400 (5 times this in additional jobs) residing in Southcentral Alaska; NSB resident employment, 2 to 5 percent; and annual revenues to the State of $1.5 to $3 million, $2.5 to $10 million, and $1.25 to $5 million from property tax, royalty income, and severance tax, respectively.

12. Cultural Resources: Unavoidable adverse effects to cultural resources, should they occur, would result directly from oil and gas exploration and development activities and facilities such as drill pads and pipelines. Future technological advances may reduce the likelihood of such impacts.

13. Subsistence-Harvest Patterns: Noise and traffic disturbance and a potential barge fuel-spill incident that are unavoidable could lead to the localized, direct losses of small numbers of belukha whales, seals, walruses, and polar bears. Noise and traffic disturbance would produce chronic, local, short-term impacts on caribou, other terrestrial mammals, fish, and birds; however, none of these losses would lead to elimination of any subsistence harvest. Only disturbance effects on caribou could lead to a reduction of total annual harvests by making their pursuit more difficult for subsistence hunters. Other effects on other species and harvests due to noise and traffic disturbance and construction activities are expected to be avoidable if mitigated, thus decreasing the overall level of effects from these sources.

14. Sociocultural Systems: Federal, NSB, and community-supported social programs with adequate funding would mitigate many of the sociocultural consequences of oil and gas development in the planning area. One area of unavoidable adverse effects involves the potential repercussions to the sharing of subsistence resources. Unavoidable effects on subsistence harvests, primarily from disturbance to caribou, could disrupt sociocultural systems for an entire season (1 year) and create disruption to institutions and sociocultural systems; but these disruptions are not expected to displace ongoing sociocultural institutions; community activities; and traditional practices for harvesting, sharing, and processing subsistence resources.

15. Coastal Zone Management: Noise and traffic disturbance and a potential barge fuel-spill incident that are unavoidable could lead to the localized, direct losses of small numbers of belukha whales, seals, walruses, and polar bears. Noise and traffic disturbance would produce chronic, local, short-term impacts on caribou, other terrestrial mammals, fish, and birds; however, none of these losses would lead to elimination of any subsistence

harvest. Disturbance typically is considered an unavoidable effect. Other effects on other species and harvests due to noise and traffic disturbance and construction activities are expected to be avoidable if mitigated, thus decreasing the overall level of effects from these sources.

Unavoidable adverse effects from oil and gas leasing in the NPR-A from oil spills, noise and disturbance from construction and transportation. To the extent that facilities are sited to minimize effects of oil spills on the environment and on subsistence harvest patterns, conflicts with the Statewide standards and the NSB policies of the ACMP are avoidable; therefore, it is expected that activities generally will conform with existing policies of Federal, State, and local coastal management programs.

16. Recreation and Visual Resources:

Unavoidable adverse effects to scenic quality, solitude, naturalness, and primitive/unconfined recreation would occur from oil and gas exploration and development. These effects would be a direct result of oil and gas exploration and development activities and facilities such as drill pads and pipelines. Recent and future technological advances may make green trails and pads an avoidable impact.

J. RELATIONSHIP BETWEEN THE LOCAL SHORT-TERM USES AND MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY:

The short-term effects and uses of various components of the environment in and adjacent to the Northeast NPR-A Planning Area are related to long-term effects and the maintenance and enhancement of long-term productivity. Short term refers to the period during which oil and gas production would occur within the planning area. This is roughly 30 years. Long term refers to an indefinite period beyond the termination of oil and gas production. The effects of the activities associated with the IAP would vary in kind, intensity, and duration, beginning with preparatory activities (seismic-data collection and exploration drilling) of oil and gas development, and ending when natural environmental balances might be restored.

Many of the effects discussed in Section IV are considered to be short term (being greatest during the construction, exploration, and early production phases) and could be further reduced by the stipulations noted in the stipulations described in Section II.C.7.

1. Physical Resources: The adverse effects of oil and gas exploration and development would result in both short-term and long-term change to the water resources. Construction activities associated with road and pad construction, culvert and bridge work in streams and lakes that disturb stream banks or shorelines, blockages of natural channels and floodways that disrupt drainage patterns, and removal of gravel would cause short-term increases in erosion and sedimentation. Water removal could cause short-term changes in aquatic habitat. Permanent gravel roads and pads, airstrips, pipelines, and facilities constructed adjacent to or crossing streams and lakes would have long-terms effects on water resources. Magnitude and duration of effects would vary with the type and extent of the activities.

Degradation of onshore water quality from construction and operation of oil field(s) and from connecting winter ice roads, would be a long-term effect. Onshore and offshore spills would be short-term effects on water quality.

2. Paleontological Resources: Paleontological resources are nonrenewable. Once a paleontological resource locale is physically impacted, it cannot be reclaimed. Therefore, impacts would be permanent, and there would be no rehabilitation.

3. Biological Resources: Most effects on vegetation of management actions other than oil development would be short term. The construction of well collars for exploration wells and the most severe impacts of vehicles during overland moves and seismic exploration would affect vegetation for the long term. All effects on vegetation of oil field construction would be long term. Oil spills and dust and gravel spray from vehicular traffic on the gravel pads would not occur after field abandonment. The recovery time for vegetation from prior spills would extend only briefly into the long term (Jorgenson, 1997), but it is not known how long plant-community changes from dust effects would persist. Although research indicates that natural plant communities can be restored to gravel pads (McKendrick, 1997), especially if some silt-loam soil is added to the substrate, the time until recovery of a natural canopy cover would be so long that the impacts may be considered permanent from a human perspective. As a result, the long-term productivity of these localized areas would be reduced, but these areas represent <0.1 percent of the planning area.

Noise disturbance as a result of ground impacting management actions, including oil and gas activities could have potential short-term effects on the biological populations and their habitats and might have long-term effects. Effects would vary with the type and magnitude of the various activities.

Short-term, localized, adverse effects on biological populations and habitats could occur in the event of an oil spill, although oil spills associated with the planning area are expected to be small and not likely to affect a large area. Oil spills in the marine environment are not likely to occur. Potential effects include mortality of individuals, physiological stresses in surviving individuals, reduction in the number of species or species populations in the affected area, changes in the distribution of species or individuals, and changes in behavior or migration patterns. Long-term, cumulative effects might occur if recovery from the short-term effects extended beyond the estimated useful life of the proposed action. Some species might have difficulty repopulating physically altered habitats and could be permanently displaced.

The potential effects of noise disturbance and terrestrial habitat alteration may also include short-term, localized effects such as mortality, stress, population or species decreases or redistribution, and changes in survival patterns. Long-term effects might occur if recovery from the short-term effects extended beyond the estimated useful life of the proposed action. Also, long-term biological productivity could be lost from those areas that have been assumed as facility sites in support activities of the proposed action.

4. Socioeconomic Systems: Increased employment, population, industrial activity, revenues, and oil spills that might occur as a result of the plans developed through IAP all contain the potential for disrupting Native communities in the NSB and communities in Southcentral

Alaska in the short term and could contribute to long-term consequences.

The production of oil and gas from the NPR-A would provide short-term energy and, perhaps, provide time either for the development of long-term alternative-energy sources or substitutes for petroleum feedstocks. Economic, political, and social benefits would accrue from the availability of oil and gas. Most benefits would be short term and would decrease the Nation's dependency on oil imports. Regional planning would aid in controlling changing economics and populations and, thus, in moderating any adverse effects. If additional supplies were discovered and developed, the proposed production system would enhance extraction. However, consumption of this oil and gas would be a long-term use of nonrenewable resources.

The redistribution or reduction of species populations in the short term could affect regional subsistence-harvest patterns. Such short-term effects on subsistence-harvest patterns from the proposed action would not be expected to have long-term consequences except as a source of social disruptions or unless chronically imposed on the resource base of the region. Habitat destruction also might cause a local reduction in subsistence species, which could threaten the regional economy.

Increased population and industrial activity, and minor gains in revenues and employment that might occur as a result of the proposed action all contain the potential for disrupting Native communities in the short term. In addition, changes brought about by leasing in the planning area could be a participating factor in long-term consequences for Native social and cultural systems.

There is a negative relationship between short-term uses and long-term productivity of recreation and visual resources. Rehabilitation and removal of pads and facilities can, at best, achieve (a perception of) the original condition. If airstrips are not removed and/or rehabilitated, then recreation opportunities in that area could be enhanced by providing access. Scenic quality, naturalness, and primitive/unconfined recreation still would be negatively impacted.

5. Cultural Resources: Cultural resources are nonrenewable. Once a cultural resource locale is physically impacted, it cannot be reclaimed. Therefore, impacts would be permanent, and there would be no rehabilitation.

K. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES: Estimates of undiscovered, economically recoverable resources are based on the areas proposed for leasing and the price of produced crude oil, which is assumed to range from $18 to $30 per barrel (Appendix A). For the Northeast NPR-A Planning Area, five alternatives have been proposed (Sec. II.D.1) that would allow oil and gas leasing. These alternatives and associated resource estimates are shown in Table IV.K-1. Should these resources be recovered, they would be irretrievably consumed. Following are discussions of the assumed effects of this commitment of resources on:

1. Effects on Soils: Soil formation is a very slow process; development of definitive soils in dynamic equilibrium with their environment may take centuries. This process of soils formation is especially slow in the planning area, where there are low temperatures and short growing seasons. Thus from a historical perspective, destruction through burial or truncation may be considered an irretrievable commitment of soils.

2. Paleontological Resources: Paleontological resources are nonrenewable. Once a paleontological resource locale is physically impacted, it cannot be reclaimed.

3. Water Resources: The adverse effects of oil and gas exploration and development would result in both short-term and long-term change to the water resources. Construction activities that disturb stream banks or lake shorelines, temporary blockages of natural channels, and removal of gravel would cause short-term increases in erosion and sedimentation. Water removal could cause short-term changes in aquatic habitat. Permanent gravel roads and pads, airstrips, pipelines, and facilities constructed adjacent to or crossing streams and lakes would have long-term effects on water resources. Removal of these structures from streams and lakes after production ceases would restore drainage patterns and natural sedimentation processes. Irretrievable changes could occur where thermokarst has caused major changes in stream banks or lake shorelines or altered natural drainage patterns.

Table IV.K-1
Resource Estimates by Alternative: First and Multiple Sales

	First Sale		Multiple Sales	
	Estimated Range (MMbbl)		Estimated Range (MMbbl)	
Alternative	price/barrel $18	price/barrel $30	price/barrel $18	price/barrel $30
B	65	350	90	500
C	75	410	110	580
D	185	825	370	1,650
E	250	1,100	500	2,200
Preferred	90	420	130	600

4. Water Quality: Thermokarst erosion along gravel roads and pads could result in degraded water quality that would last long after the life of the field(s). There would be no irreversible or irretrievable effect on water quality.

5. Air Quality: Air quality would be affected by well drilling, construction activities, and production. These effects would occur only during the life of the field(s). There would be no irreversible or irretrievable effects on air quality.

6. Vegetation: The vegetation communities of Alaska's North Slope evolve through several phases over periods of decades or centuries. This is especially true for the Arctic Coastal Plain, where ice and thaw lakes cause a constantly changing landscape (Bergman et al., 1977). Therefore, plant-community changes resulting from dust or snow drift accumulations would not be considered irreversible. The burial of vegetation under gravel fill is a different situation. The potential recovery of vegetation on these pads would take such a long time that, from a human perspective, this may be considered an irretrievable commitment of vegetation resources.

7. Fish: Arctic fish in the planning area would be exposed to overland seismic surveys, construction-related activities, and oil and fuel spills associated with Alternative E. A relatively small number of fish are likely to be adversely affected by these activities and the agents associated with them. Fish populations in the planning area are not expected to experience any irreversible and irretrievable effects associated with Alternative E.

8. Birds: Loss or degradation of an insignificant proportion of available habitat as a result of pad, road, and pipeline construction and gravel extraction during development may be irreversible. Although some proportion of habitat alteration is expected to be permanent, such areas may be partially reclaimed at the conclusion of activities using techniques developed in recent years. Any placement of facilities in the Goose Molting Habitat LUEA that causes long-term abandonment (life of the field) may be irreversible.

9. Mammals:

a. Terrestrial Mammals: It is possible that caribou and other terrestrial mammals could be

subjected to direct and indirect effects of disturbance caused by noise and movement of motor vehicles, aircraft, other human activities, oil spills, or losses and/or deterioration of habitat due to facility developments. It is likely that such effects would lead to some permanent (irreversible) losses of these resources (Sec. IV.C.9.a).

b. Marine Mammals: It is possible that seals, walruses, polar bears, and belukha whales could be subjected to direct and indirect effects of oil spills, disturbance caused by noise and movement of aircraft and vessels, and other human activities. It is unlikely that such effects would lead to permanent (irreversible) losses of these resources (Sec. IV.C.9.b).

10. Endangered and Threatened Species: It is possible that bowhead whales could be subjected to direct and indirect effects of disturbance due to noise from vessel traffic. It is unlikely that such effects would lead to permanent (irreversible) losses of these resources for bowhead whales.

It also is possible that spectacled eiders and Steller's eiders could be subjected to direct and indirect effects of disturbance due to noise and movement of aircraft and vessels and other human activities, or loss and/or deterioration of habitat due to facility siting. Facility siting could result in permanent (irreversible) loss of an insignificant proportion of available eider-nesting habitat. Although it is unlikely that the other effects would result in irretrievable loss of these resources, recovery of the eider populations from any substantial mortality is not expected to occur while they are declining.

11. Economy: The commitment of human resources would be irreversible and irretrievable. That is, routine activity would generate employment at an enclave near the Prudhoe Bay complex for workers who would reside permanently in Southcentral Alaska. Also, there would be an increase in resident employment and population in the NSB.

12. Cultural Resources: Cultural resources are nonrenewable. Once a cultural resource locale is physically impacted, it cannot be reclaimed.

13. Subsistence-Harvest Patterns: Many important aspects of Inupiat society and culture are centered around subsistence activities (Sec. III.C.2). Virtually every family on the North Slope participates in the hunting of the bowhead whale and the sharing of its meat. The activities associated with the taking of caribou, seals, fish, and birds are somewhat less important to the integration of the region as a whole (but certainly not in the inland village of Atqasuk), but they are of equal importance to the social organization of each community as well as to the domestic economies of most households. As with the bowhead whale, the inability to harvest sufficient quantities of these resources would be an irreversible and irretrievable loss to the Inupiat diet, to Inupiat traditional practices of sharing and reciprocity, and to fundamental aspects of Inupiat identity.

14. Sociocultural Systems: Disruption to the traditional harvest of caribou, especially in Nuiqsut, could be an irreversible and irretrievable loss to Inupiat social and cultural values. The contribution of oil and gas development in the planning area to the cumulative consequences of offshore and onshore energy development could, in conjunction with other processes of social change in the long term, lead to the irretrievable loss of Inupiat cultural behaviors and traditional practices.

15. Recreation and Visual Resources: Given time, there would be no irreversible and irretrievable commitment of resources. Conducting proper rehabilitation and removal of development pads, etc. should restore the perception of a natural environment.

L. EFFECTS OF NATURAL GAS DEVELOPMENT AND PRODUCTION: Natural gas may be discovered in the Northeast NPR-A Planning Area during exploration drilling. Although gas resources are not considered economic to exploit at this time or in the foreseeable future (Sec. IV.A.1.b(1)(b)), they could be developed and produced at some undetermined future time. Under such circumstances, natural gas production probably would not occur until after oil production had begun. Thus, leases containing nonassociated natural gas that could be recoverable in the future probably would be retained by the leaseholder. (Associated and dissolved gases that are recovered along with the crude oil are expected to be reinjected or used as fuel, depending on the amount recovered.) The effects of potential gas development and production on the environment of the planning and adjacent areas that would be additional to the effects associated with oil development and production are described in this section.

Additional facilities and infrastructure would be needed if and when the nonassociated natural gas is developed and produced. The gas could be produced through wells drilled from gas-production platforms.

A large-diameter pipeline would be installed to transport the produced gas from the production pad(s) to a gas-processing facility located in the Prudhoe Bay area; the gas pipeline would be separated from any oil pipelines to the extent necessary to minimize the risks that would arise during installation and operation; however, the main trunk gas pipeline would be constructed parallel to the trunk oil pipeline. No booster-pump stations would be required between the production pad(s) and the gas facility.

After processing, the gas would be piped to Valdez for liquefaction. The required gas pipeline would parallel the TAPS. The liquefied gas would be shipped to market, most likely in Asia. However, should a regassification plant be constructed on the U.S. West Coast, a market also could develop there.

Effects of natural gas development and production on the biological resources, social systems, and physical regimes of the planning area and adjacent areas could be caused by gas blowouts; drilling gas-production wells; installing onshore pipelines and a gas-processing facility; surface- and air-traffic noise and disturbance; construction activities; and growth in the economy, population, and employment.

Accidental emissions of natural gas could result from a gas-well blowout or a pipeline rupture. In the unlikely case that such an event occurred, a gas-well blowout probably would not persist for >1 day and would release perhaps 20 metric tons of gaseous hydrocarbons; 60 percent of all blowouts since 1974 have lasted ≤1 day. From such a blowout, a hazardous plume of gas could extend downwind for about a kilometer but quickly would dissipate once the blowout ceased. The amount of volatile organic compounds released by such a blowout would be less than that evaporated from an oil spill ≥1,000 bbl.

The rupture of a gas pipeline would result in a short-term release of gas. A sudden decrease in gas pressure automatically would initiate procedures to close those valves that would isolate the ruptured section of the pipeline and thus prevent a further escape of gas.

Following are analyses of the effects of natural gas development on:

1. Soils: The types of impacts on soils that natural gas development and production would cause would be the same as those caused by oil development and described in Alternatives B through E, except that there would be no crude-oil spills. Spills of refined oil still would occur. Thus, additional development of material sites, burial under gravel fill for production and facilities pads, roads and airstrips, and construction of pipelines would cause the destruction of additional soils in the planning area.

2. Paleontological Resources: Natural gas development is similar to the production of oil, and they generally occur together. The infrastructure necessary to produce oil basically is the same to produce gas. Therefore, the impacts accountable for the production of gas would be the same as those discussed for oil.

3. Water Resources: The adverse effects of gas exploration and development on water resources would be similar to the effect of oil exploration and development. The main difference would be the lack of spills and cleanup, because a natural gas blowout would be released to the air and not to streams or lakes.

4. Water Quality: The risk to water quality from gas accidents during natural gas development, production, and transportation would be less than the risk from oil spills from oil development, production, and transportation. Degradation of water quality related to seismic and gas exploration and to construction, placement, and operation of gas-production facilities would be the same as those for exploration and oil production. Tanker oil spills would not occur.

5. Air Quality: The risk to air quality from natural gas development, production, and transportation would be similar to the risk from oil development, production, and transportation. Degradation of air quality related to construction, placement, and operation of gas exploration

and production facilities would be the same as those for oil exploration and production facilities.

6. Vegetation: The types of effects on vegetation that natural gas development and production would cause would be the same as those caused by oil development and described in Alternatives B through E and the Preferred Alternative, except that there would be no crude-oil spill. Spills of refined oil still would occur. Thus, development of material sites, burial under gravel fill for production and facilities pads, roads and airstrips, and construction of pipelines would cause the destruction of additional vegetation in the planning area, given that pads additional to those constructed for oil development would be needed. Plant-species-composition change also would occur in areas adjacent to pads and pipeline VSM's.

7. Fish: Natural gas exploration and development could adversely affect arctic fish from either a natural gas blowout or the construction of overland gas pipelines. If a natural gas blowout occurred, some fish in the immediate vicinity might be killed. Natural gas and condensates that did not burn in the blowout would be hazardous to any organisms exposed to high concentrations. A plume of natural gas vapors and condensates would be dispersed very rapidly from the blowout site, but it is not expected to be hazardous for >1 km downwind or for >1 day. The construction of overland gas pipelines through waters supporting fish populations is expected to have short-term effects on fish and would displace those affected a short distance. However, those affected are expected to reuse their habitat upon completion of activities.

8. Birds: Any effects of natural gas development and production on birds, such as noise and visual disturbance from vehicles or construction activity, are expected to be temporary, nonlethal, and local, affecting a few individuals. However, a natural gas blowout occurring from May to October could affect birds that are nesting, rearing young, staging, or migrating. Some mortality could result from such an incident, although it is likely that a small number of individuals would be affected.

9. Mammals:

a. Terrestrial Mammals: The most likely effects of natural gas development and production on caribou and other terrestrial mammals would come from motor-vehicle traffic and construction activities associated with installing the onshore pipeline system that connects the production pads with the onshore processing facilities. Onshore, the gas pipelines would run parallel to the oil pipeline and would be serviced by the same within-field roads. Some displacement of calving caribou would be expected within 3 to 4 km of roads between oil field facilities, when they are located within caribou calving habitat. Caribou are likely to successfully cross the pipeline corridor within a short period of time (perhaps within a few hours or no more than a few days) during breaks in the traffic, with little or no restrictions in general movements and no effect on overall caribou distribution and abundance. As with construction of the oil pipeline, the construction of the gas pipeline would alter only a small fraction of caribou and other terrestrial mammal range.

If a gas blowout occurred, the toxic plume likely would extend downwind about 1 mi, dissipate quickly, and last for not much more than 1 day. If there were an explosion and fire, the wet tundra habitat of most of the Arctic Slope likely would not catch fire. However, if a gas blowout occurred in the Umiat area, a tundra fire could occur and may spread to other areas, but the gas plume itself is likely to persist for no more than 1 day. The effect on terrestrial mammals and their habitats likely would be local and short term.

b. Marine Mammals: The most likely effect of natural gas development and production in the planning area on seals, walruses, polar bears, and belukha whales would come from air traffic that may occur along the coast to and from the exploration and development facilities in the planning area and support facilities at Prudhoe Bay and Camp Lonely. The air traffic associated with gas production would be an additive source of noise and disturbance of marine mammals. However, the effect of this noise and disturbance likely would be very brief and result in only a temporary displacement of some marine mammals along the flight paths (a short-term effect).

10. Endangered and Threatened Species: Should natural gas development and production occur in the planning area, it is unlikely that bowhead whales would be affected. If materials and supplies are transported to the planning area by marine vessels during the fall bowhead whale migration, some whales could experience temporary, nonlethal effects as described under Alternative B.

Any effects of natural gas development and production on spectacled and Steller's eiders also are expected to be limited to temporary, nonlethal effects, perhaps resulting in disturbance to a few birds. However, a natural gas blowout occurring from June to September could affect eiders that are nesting, rearing young, staging, or migrating. Some mortality could result from such an incident, although it is likely that a small number of individuals would be affected.

11. Economy: Natural gas development and production from the NPR-A, especially construction of a gas pipeline from the NPR-A through Prudhoe Bay to Valdez, would generate additional employment. The employment would be in the workers' enclave in the Prudhoe Bay complex and temporary work camps along the

gas pipeline. Most workers would reside in Southcentral Alaska. A small number of workers would reside in the NSB. Development would generate additional property-tax revenues for the NSB and property tax, royalties, and severance tax for the State.

12. Cultural Resources: Natural gas development is similar to the production of oil, and they generally occur together. The infrastructure necessary to produce oil basically is the same to produce gas.

13. Subsistence-Harvest Patterns: Effects on subsistence-harvest patterns from natural gas development and production could occur from natural gas blowouts, noise and traffic disturbance, and construction activities. If a natural gas blowout occurred, the subsistence harvest of any species in the vicinity could be affected. Additionally, if a natural gas blowout occurred, with possible explosion and fire, subsistence resources in the immediate vicinity probably would be killed. Natural gas and condensates that did not burn in the blowout would be hazardous to any organisms exposed to high concentrations. However, natural gas vapors and condensates would be dispersed very rapidly from the blowout site (1 km downwind for about 1 day) and would affect only those species in the immediate vicinity of the accident. While such an effect would be relatively short term and localized and likely would not measurably affect the regional population of any species, it could cause disruption to subsistence harvests in the area of the blowout. Noise and disturbance activities due to the development of a gas field, especially to caribou, would be local (within 3-4 km of the pipeline corridor) but would persist for the life of the field.

14. Sociocultural Systems: Effects on sociocultural systems would be due to changes in employment and population and effects on subsistence-harvest patterns. In the event of natural gas development and production in the planning area, there would be a slight increase in employment and population in the region adjacent to the planning area.

15. Coastal Zone Management: Natural gas development and production are assumed to occur in the NPR-A. Conflicts with specific Statewide standards and NSB CMP policies are related to potential user conflicts between natural gas development and production activities and effects from contruction and transportation on the natural resources and subsistence -harvest patterns and activities if a natural gas blowout occurred. Potential effects to biological resources and habitats are analyzed in Sections IV.4.K.1-14. Although effects from these activities is expected to be local and short-term, potential effects from pipeline construction is possible. Therefore, some level of conflict from natural gas development with coastal management programs is anticipated.

16. Recreation and Visual Resources: Natural gas development is similar to the production of oil, and they generally occur together. The infrastructure necessary to produce oil basically is the same to produce gas. Therefore, the impacts accountable for the production of gas would be the same as those discussed for oil.

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